STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY

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Public Comment
Bay-Delta Phase II Working Draft Report
Deadline: 12/16/16 12:00 noon

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SENT VIA E-MAIL: commentletters@waterboards.ca.gov

December 16, 2016

Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
P.O. Box 100
Sacramento, California 95812-2000

Subject: Working Draft Scientific Basis Report for New and Revised Flow Requirements on the Sacramento River and Tributaries, Eastside Tributaries to the Delta, Delta Outflow, and Interior Delta Operations

Dear Ms. Townsend:

The Department of Water Resources (DWR) appreciates the opportunity to submit the attached comments on the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Water Quality Control Plan (WQCP) Update Phase 2 Working Draft Scientific Basis Report for New and Revised Flow Requirements on the Sacramento River and Tributaries, Eastside Tributaries to the Delta, Delta Outflow, and Interior Delta Operations (SBR). DWR believes it is essential to complete the update of the WQCP and recognizes that the completion of the SBR is an important step in this process. We find that the SBR, in general, appropriately identifies the issues associated with updating the WCQP. We have provided detailed, technical comments suggesting ways to improve the SBR in the attachment to this letter. We would like to emphasize four main comments.

Determination of Unimpaired Flows

The SBR proposes the use of “unimpaired flows” (UF) at specific river/stream reaches as a basis for establishing new or revised flow requirements in the modeling. The unimpaired flow estimates are theoretical and conceptually available water supplies assuming existing river channel conditions in the absence of: (1) storage regulation for water supply and hydropower purposes; and (2) stream diversions for agricultural and municipal uses. But these flow estimates do not include the analysis of critical factors such as depletions by riparian and native vegetation and the overtopping of river banks and the subsequent impoundment, depletions, and deep percolation of these flows.

Additionally, the proposed instream flow requirement locations must be properly assigned as to proportionately share in the responsibility of meeting the requirements. Of particular note is how the unimpaired flows were estimated in the Feather River as compared to estimates for the Sacramento River.

Impact of Groundwater Extractions on Surface Flow

The interaction of groundwater and surface water is also significant. The SBR does not fully consider the impacts of groundwater extractions on streamflow and thus does not fully take advantage of current modeling tools available. We believe the modeling should take into account depletions due to riparian vegetation and stream bank overtopping during high flow events.

Proposed Use of Current Month's Eight River Index

The State Water Resources Control Board (SWRCB) has requested input on the proposed use of the current month's Eight River Index (ERI) instead of the previous month's ERI (currently used in Decision 1641) for calculating the Delta Outflow requirements of water project operations on a daily basis. DWR believes that the use of the current month's ERI would create significant operational difficulties for the State Water Project and the Central Valley Project. At the beginning of a month, water project operators would not know what Delta Outflow standards must be met for that month since the final ERI for the month is unknown. The final monthly Delta Outflow criteria would not be known until the end of the month, at which time, the ERI for the month would be known. If a month starts dry but becomes increasingly wet, the monthly Delta Outflow criteria could not be met since at the start of the month, project operators would not know what would be required. We recommend that the previous month's ERI be used instead, because it allows for project operations to make adjustments to meet changing standards and to anticipate the standards that will be controlling that month.

Environmental Analysis

Although the report summarizes the effects of flow on aquatic species in the Bay-Delta and its watershed relatively well, DWR believes that several changes should be made to the scientific objectives and their bases. We recommend that the report include a conceptual model that explicitly defines the mechanisms that connect flow to expected ecosystem and fish species responses. We also recommend that the SWRCB consider the interaction of the various environmental influences and existing landscape conditions that are affecting fish species populations.

DWR recognizes that refined population models are not yet available to assist with evaluation and identification of specific targets for flow and species responses, and SWRCB therefore relied on known relationships between species abundances and flows and presumably on historical abundance levels. Unfortunately, species' current responses to flow may be substantially different from past responses due to recent changes in the ecosystem. It is also difficult to separate the effects of flow on species responses from other effects. DWR believes it would be better for the SWRCB to consider that target abundance levels formulated on the basis of historical data are inherently subjective, and that provisions should be made for adjustments in response to new information.

The report should consider ongoing, planned, and potential future management actions that will improve conditions for target native fish species and that may require flow magnitude and timing that are inconsistent with patterns based on unimpaired flow. As examples, floodplain and off-channel restoration for reintroduced spring-run Chinook salmon in the San Joaquin River, managed Yolo and Sutter Bypass flooding for Sacramento River salmonids, and July/September food web enhancement flows for Delta Smelt, may all require "unnaturally" timed flow pulses to maximize benefits for targeted fish species.

Balancing beneficial uses and implementation of new standards

The SWRCB advised readers in its 2010 Flow Report that it "must consider and balance all competing uses of water in its decision-making," the 2010 report "only presents a technical assessment of flow and operational requirements to provide fishery protection under existing conditions" and "there are many other important beneficial uses that these waters support such as municipal and agricultural water supply and recreational uses."[1] SWRCB must develop a water quality control plan that is "implementable" in the water rights administration phase of developing revised standards for the estuary.[2] In this regard, the proposed instream flow requirement locations must be properly assigned so as to proportionately share the responsibility of meeting the requirements.

Moreover, DWR appreciates the statement that flow needs could be reduced by addressing habitat and other ecosystem stressors.[3] One concern, however, is that the discussion of other stressors seemed inconsistent. At times these stressors were identified as key contributors to species declines, but other parts of the document focus solely on flow. A more consistent treatment of flow as an interacting variable would improve the report.

[1] Available at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf.
[2] *State Water Resources Control Bd. Cases* (2006) 136 Cal.App.4th 674, 734 (referred to herein as "*Robie*").
[3] SBR, at page 5-2.

DWR appreciates the opportunity to comment on the SBR. As the SWRCB moves further along in the adoption of a final water quality control plan and water rights implementation to replace Decision 1641 for the Bay-Delta estuary, DWR will continue to work with the SWRCB to develop appropriate new standards and water rights obligations. If there are any questions, please contact Ms. Robin McGinnis at (916) 657-5400.

Sincerely,

Mark W. Cowin
Director

Attachment

Attachment A

California Department of Water Resources
Table of Comments

Document: San Francisco Bay/Sacramento-San Joaquin Delta Estuary Water Quality Control Plan (WQCP) Update Phase 2 Working Draft Scientific Basis Report for New and Revised Flow Requirements on the Sacramento River and Tributaries, Eastside Tributaries to the Delta, Delta Outflow, and Interior Delta Operations (SBR)

Date: December 16, 2016

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Main Areas			
M:1	General		**<u>Determination of Flows</u>** The SBR proposes the use of "unimpaired flows" (UF) at specific river/stream reaches as a basis for establishing new or revised flow requirements. However, there is an important distinction between unimpaired runoff and the concept of "unimpaired flows" at a stream location. Unimpaired runoff that is estimated in upper watersheds that are relatively pristine and have little land-use development can provide a reasonable estimate or index of water supply availability at the furthest upstream locations and relatively equal in magnitude to the stream outflows from those watersheds. But the unimpaired flow estimates described in the report are different because they attempt to estimate water supply availability at specific stream or river reaches. The unimpaired flow estimates are theoretical and conceptually available water supplies assuming existing river channel conditions in the absence of: (1) storage regulation for water supply and hydropower purposes; and (2) stream diversions for agricultural and municipal uses. These flow estimates ignore critical factors that affect flow such as depletions by riparian and native vegetation and the overtopping of river banks and the subsequent impoundment, depletions, and deep percolation of these flows. Unimpaired flow estimates at locations downstream of the most upstream points in the river are theoretical in that they attempt to represent conditions that have

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			never occurred historically. Yet the SBR contends that unimpaired flows are generally reflective of natural flow conditions to which fish and wildlife have adapted. DWR's March 2016 draft report entitled, Estimates of Natural and Unimpaired Flows for the Central Valley of California: Water Years 1922-2014,[1] demonstrates the significant difference in frequency, timing, magnitude, and duration of Delta outflow when using natural flow estimates versus "unimpaired flow" estimates, a distinction that should not be lost in the SBR analysis. The proposed instream flow requirement locations must be properly assigned so as to proportionately share the responsibility of meeting the requirements. The estimated unimpaired flows in the Sacramento River include weir operations while the estimated unimpaired flows in the Feather River ignore flooding effects. This inconsistent treatment reduces the responsibility of parties in the Upper Sacramento River for meeting the requirement of a percentage of total unimpaired flows and may burden parties in the Feather River basin with meeting a larger percent of the unimpaired flow requirement than other users. The total flow contribution from a tributary to Delta Inflow should be taken into consideration in the implementation of an instream flow requirement based on a percent of unimpaired flow. Otherwise, a single party in the tributary may be burdened unfairly in meeting the flow requirement. The total flow contribution includes the tributary mouth flow, the cross-tributary diversion that exports water to other Sacramento River tributaries, and all return flows that return to the Sacramento River. The interaction of groundwater and surface water may also influence flows. But the SBR covers groundwater only in a cursory way using limited supporting data and modeling approaches that are hard to follow. It is noteworthy, also, that the SBR does not mention the 2014 Sustainable Groundwater Management Act (SGMA). The groundwater model C2VSIM was incorrectly applied in the SBR in conjunction with another model to estimate unimpaired flows, which led to deficiencies in the estimates of unimpaired flows resulting in an overestimation of

[1] Available here: https://msb.water.ca.gov/documents/86728/a702a57f-ae7a-41a3-8bff-722e144059d6.

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			available water for streamflows. The following is a list of improper assumptions and implementations of C2VSIM: 1. In estimating “unimpaired flows” using C2VSIM in the valley floor, the methodology ignores two key hydrological components that can have significant impacts on how much water actually reaches the Delta: a. There is no accounting of depletions in the valley floor due to riparian vegetation and/or native vegetation. While native vegetation demands may be limited by precipitation, riparian vegetation can access stream flows, including those generated from upstream areas. b. There is no allowance for streams to overtop banks, especially during high flows which exceed stream capacities. The resulting flood flows would be subject to storage (attenuation), evaporation, and deep percolation, all of which decrease flows reaching the Delta. Given that the simulations are a monthly time step further does not reflect a real-time occurrence since flood events are on a much shorter time step. The methodology estimates stream depletions that would occur under “current groundwater storage conditions.” The report uses “an ensemble” approach with C2VSIM to account for hydrological variations. The warm-up period used for each run is two years which is insufficient. C2VSIM requires at least a 5 to 10 year warm up period to attain stable groundwater conditions. Also, the “ensemble” approach is inherently improper because it does not maintain year to year groundwater storage continuity in the constructed data sets that feed into the unimpaired flow estimates. Thus, year-to-year mass balance is not maintained. For these reasons the “ensemble” approach is also unrealistic for estimating stream-aquifer interactions. A more realistic and accurate approach would be to run the entire simulation period at once maintaining a constant head boundary condition at all nodes. The SWRCB also requested input on the proposed use of the current month’s Eight River Index (ERI) instead of the previous month’s ERI (currently used in Decision 1641) for calculating the Delta Outflow requirements of water project operations on a daily basis. The previous months’ ERI makes more sense because it accounts for: a) antecedent conditions of the following month which

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			are carrying over into the current month; b) the ability to accrue and use carryover days from previous months to help "smooth out" differences in project operations that must be made to meet changing standards; and c) a reasonable anticipation of what standards will be governing water project operations for the current month. The use of the current month's ERI is- problematic to the point of making it infeasible. At the beginning of the month, water project operators would not know what Delta Outflow standards must be met for that month since the current ERI for the month is unknown. The final monthly Delta Outflow criteria would not be known until the end of the month, at which time, the ERI for the month would be known. If conditions for the month start dry but become increasingly wet, the monthly Delta Outflow criteria could not be met since at the start of the month, project operators could not possibly know what would be required. Thus, the use of the current month's ERI for Delta Outflow requirements is infeasible and the SWRCB should remove this proposal from further consideration.
M:2	General		**Environmental Analysis** Although the report summarizes the effects of flow on aquatic species in the Bay-Delta and its watershed relatively well, DWR is concerned about the scientific objectives and their basis as outlined in the report. Among the most significant issues is that the report does not include a conceptual model clearly describing: i) the specific mechanisms by which a natural flow regime will exert effects on habitat and species; ii) the dependency of such mechanisms on other interacting drivers; and iii) explicit measurable predictions of ecosystem and species responses. Many of the expected beneficial outcomes of a natural flow regime operate through mechanisms that depend on interactions with other environmental drivers (e.g. sediment supply) and landscape conditions (e.g. dynamic river corridors with accessible flood plains). However, for many locations in Central Valley rivers and the Delta, these interacting drivers and landscape conditions are constrained or non-existent. Perhaps because of this, the report shifts from describing the natural flow regime as a driver of habitat conditions to flow as a means to push salmon to the ocean as quickly as possible. This approach is a shift in focus away from managing flow for improvement of several important salmonid response measures (survival, growth, and life history

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			variability) to managing flow mainly for through-Delta salmonid survival. DWR recommends adding to the report a conceptual model that explicitly defines the hypothesized mechanisms that connect flow to expected ecosystem and fish species responses, which should include consideration of interacting environmental drivers and landscape conditions in the Sacramento River and the Delta. Fish species responses should include those identified by interagency science teams (e.g. SAIL, CAMT, CVPIA-SIT) as essential for recovery and resilience of targeted native fish populations: survival, growth, and life history diversity. The conceptual model can be used to describe specific expected ecosystem and species responses to flow and will highlight logical inconsistencies in the current report, help to formulate realistic expectations of a restored natural flow regime, suggest monitoring strategies relevant to hypothesized responses and mechanisms, and improve the ability to provide management-oriented interpretation of monitoring results. Specific response targets could also provide incentives for actions such as habitat improvement that could help meet response targets at lower-than-expected flow levels. DWR recognizes that refined population models are not yet available to assist with evaluation and identification of specific targets for flow and species responses, so SWRCB relied on known relationships between species abundances and flows and presumably on historical abundance levels. Unfortunately, species' current responses to flow may be substantially different from the past due to recent ecosystem regime shifts, and it is also difficult to separate the effects of flow on species responses from other anthropogenic drivers (e.g., eutrophication, urbanization, pollution). The SWRCB should consider that target abundance levels formulated on the basis of historical data are inherently subjective, and that provisions should be made for adjustments in response to new information. The SWRCB should also consider that the Central Valley river network and the Delta are widely recognized as a "novel ecosystem" that needs novel management to achieve the mixed-use objectives proposed as government

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			policy. The report does not adequately consider ongoing, planned, and potential future management actions that will improve conditions for target native fish species, and which may require flow magnitude and timing that are inconsistent with patterns based on unimpaired flow. As examples, floodplain and off-channel restoration for reintroduced spring-run Chinook salmon in the San Joaquin River, managed Yolo and Sutter Bypass flooding for Sacramento River salmonids, and July/September food web enhancement flows for Delta Smelt, may all require "unnaturally" timed flow pulses to maximize benefits for targeted fish species. -DWR found that the science review in several sections of the report were based on out-of-date references or incomplete review of references, particularly the absence of consideration of recent drought conditions and increased likelihood of future drought conditions, which have major implications for fisheries management. There are also some substantial internal inconsistencies and apparent errors within the document, which undermine the basis for some conclusions.
General Comments			
G:1	Chapter 5		DWR notes and supports the commitment to adaptive management throughout the report. Consider more clearly emphasizing the need to maintain existing monitoring and science programs as necessary and required to fully implement adaptive management.
G:2	General		**Importance of Flow:** The report captured some of the key literature and provides a relatively good summary of the effects of flow on aquatic species in the Bay-Delta and its watershed. Some of the science in the report is out of date. As DWR presented in its testimony at the 2012 SWRCB workshops, there is indeed good evidence that flow is a major factor affecting many aquatic organisms. This point was highlighted during the recent drought, where extreme low flows contributed to declining abundance of many native fishes. Similarly, there is widespread recognition that very cool wet years like 2011 tend to improve conditions. The challenge, however, is that there is substantial variability in responses, and mechanisms are poorly understood. This makes it harder to predict species responses within more moderate "middle range" flow levels.
G:3	General		**Inconsistent Treatment of the Importance of Other Effects:** DWR concurs with the approach taken in the report to not isolate flow from the multitude of other stressors that affect aquatic species in the Bay-Delta and its tributaries. In particular, it was helpful that the report recognized the extreme changes in habitat relative to the pre-development

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			period. Moreover, we appreciated the statement that flow needs could be reduced by addressing habitat and other ecosystem stressors (P. 5-2). One concern, however, it that the discussion of other stressors seemed inconsistent. At times these stressors were identified as key contributors to species declines, but in other parts of the document it seemed as if almost everything was attributed to flow. A more consistent treatment of flow as an interacting variable would improve the report.
G:4	General		**Selecting Flow Targets:** The SWRCB has the unenviable task of trying to balance species and economic needs in California. While it is reasonably straightforward to quantify the economic benefits of flow, quantifying species uses is problematic. Setting flow targets for aquatic species is easier if detailed population models are available, which allow managers to evaluate whether flow targets are likely to result in population increases, decreases, or stability. Although such models are in progress (e.g. Delta smelt, Chinook Salmon), they are not currently available for the Bay-Delta and its watershed. In the absence of these types of refined models, SWRCB staff relied on the ecological premise that more "natural" flows will be most suitable for native species. In support of this argument, SWRCB staff highlighted some of the best-known scientific literature supporting the idea of natural hydrographs. Since the concept of "natural" is difficult to define in the current landscape, SWRCB recommended that "unimpaired" flows be used as a management tool. However, it is a challenge to define what portion of unimpaired flows is needed to balance the needs of aquatic species. It is questionable if the Rozengurt et al. (1987) report provides a robust basis to set flow levels for the Bay-Delta estuary. Although it is true that many estuaries with massive water diversions have ecological problems, it is difficult to separate the effects of flow versus other anthropogenic effects (e.g. eutrophication, urbanization, pollution). In evaluating the effects of different levels of unimpaired flows, the SWRCB also relied on established abundance-flow relationships, which has been a relatively common approach to evaluating the relative effects of different scenarios in this region. However, the ecosystem has experienced regime shifts, so species responses to flow may be substantially compromised (e.g. see Chapter 3 Longfin Smelt discussion). A related issue is that this approach does not indicate what the species targets should be. It is unclear how the SWRCB identified these targets, but it appears the SWRCB used historical abundance levels identified by expert panels. Although this is not unusual in impact analysis, it is important to recognize that picking target abundance levels based on

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			historical data is inherently subjective.
G:5	General	5.2.3, 5.3.4.1 and others	**Implementation:** The report provides a reasonable assessment for why flow is important, but it is unclear how implementation would occur. DWR supports the recommendation that adaptive management should be used to maximize the effectiveness of different flows. Note, however, that this will require sufficient resources and appropriate adaptive management plans to make sure that the process is effective. In considering an adaptive approach it would be helpful to understand how unimpaired flows would be operated. Since flows vary substantially, it is unclear how inflows to reservoirs would be translated into downstream flow requirements. Although the authors tried to provide an example in Table 5.3.4, it is unclear how quickly reservoir inflow information would be translated into Delta requirements, and how the obligations would be allocated among various Sacramento Valley water users. Similarly, how would these criteria take into account tradeoffs such as flood safety (e.g. reservoirs are often used to buffer the effects of floods) and ecosystem needs (e.g. temperature management)? As noted on Page 5-29, the specific approach has not yet been determined and would require sophisticated water accounting procedures.
G:6			The report's underlying theory is sound and consistent with current theory regarding river ecosystems and advanced systems of river regulation (i.e. "natural" flow regime) to support habitat conditions favorable to native species. Given the quality and quantity of best available science, the method for estimating relative flow-benefit relationships for target species at different levels of unimpaired flows is reasonable if used as suggested for establishing an initial management baseline. The report correctly recognizes that the realized benefits to target species (e.g. salmon, smelt) are likely to deviate widely from the modeled flow-benefit relationships for numerous reasons, including that the mechanisms underlying the flow-benefit relationship are poorly understood in many cases, and are dependent on many other variables, such as land area available for overbank flooding at higher flows.
G:7			Although a more natural flow regime is crucial driver of habitat formation in a river system through processes such as natural channel migration, it should be recognized that under the current river corridor conditions (levees, low width-to-depth ratio, agricultural and urban development of floodplains), many or most of the habitat-forming processes driven by natural flow regimes will not function. Suggest adding analysis of this issue. Since most of the habitat-forming processes will not function along most of the

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			Sacramento River network, it appears that one of the primary functions expected from the more natural flow pulses is to increase through-Delta survival by: i) pushing juveniles toward the ocean as quickly as possible; and ii) reducing juvenile entrainment into the south Delta by reducing the flow proportion from the Sacramento River into Georgiana Slough. The report concludes that reducing juvenile residence time in the Delta is beneficial because residence time correlates negatively with survival. However, survival is only one of three vital responses that should be considered for assessing management actions, the other responses being individual juvenile growth prior to ocean entry, and the variance of migration rate and migration timing (see SAIL report, Johnson, R., et al. *In Review*). Fast migration may benefit larger stream-rearing juveniles, but not smaller juveniles. Also it should be noted that fish migration speed can decline at high flows, presumably because juveniles migrate closer to river banks under such conditions.
G:8			Report should specify how in-Delta consumption will be managed, regulated, and monitored to achieve Delta outflow objectives.
G:9			Specific objectives are needed to evaluate and adaptively manage flow actions and regulations. More detail is needed on how a scientific and/or management team would be assembled to develop the specific objectives of a more natural flow regime and to evaluate and suggest adaptive changes to management based on early monitoring. Flow management must be considered within the context of current habitat locations, with the aim of using flow to overlap fish with good habitat in both space and time. Consider habitat quality, area, and accessibility as key metrics to determine effectiveness of adaptive flow management. Flexibility (i.e. adaptive management) should be built into the specific management of flows to adaptively manage interaction of flow with more fixed habitat conditions with the clearly stated objectives of maximizing: i) habitat rearing capacity (space and quality); ii) habitat accessibility and actual use (fish number X residence time); and iii) survival during both rearing and migration. Creating incentives to encourage management or restoration actions that improve habitat quality, area, and/or accessibility without requiring additional flow should be considered.
G:10	1-16, 2-9, 2-44, 5-	SacWAM	The current comparison study of SacWAM and CalSim II does not consist of a collaborative study, which is needed to adequately validate SacWAM. In a collaborative study, the SacWAM simulation is configured as closely as possible to the CalSim II

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	5, 5-14		configuration. Such a study would determine how well SacWAM matches CalSim II. The Box Plots and Exceedance Plots in the “Draft Hydrological and Operations Modeling Consideration for the Phase II Update of the 2006 Bay-Delta Plan,” show huge differences between the results of the two models. SacWAM’s documentation states that “SacWAM should not be used in an absolute, stand-alone analysis in which model results are used to predict an outcome.” Therefore it is not appropriate to compare SacWAM results with those of other models when taking them in an absolute sense, because the two models use different channel connectivities, geographic areas, and valley floor hydrology.
G:11		Feather River & Tributary Inflow Requirement	The use of percentage unimpaired flow to develop Sacramento River and Delta tributary inflow requirements should take into account the total contribution of a tributary to the Delta inflows, especially for Feather River. The total contribution of the Feather River to Delta inflows should include not only flow in the main channel, but also the return flows, hydro-power bypass flows and inter-tributary exports which do finally flow back to the Sacramento River. Currently, the average annual return flow to Sutter Bypass and annual export for Bear River to American River together are more than 1 MAF a year. If these flows are not counted as Feather River tributaries’ contribution to the Sacramento River, Oroville Reservoir will be inappropriately burdened. Location is very important when comparing impaired flow and unimpaired flow and dependent on where diversion, return and export points are located. Oroville water releases for two instream flow requirements along the lower Feather River, in terms of percent unimpaired flow values, are very sensitive to the selection of instream flow requirements locations and the definition of Feather River flow. For example, Kelley Ridge Powerhouse water should be considered as a part of the Oroville release, but SacWAM does not include this flow when it imposes the percent unimpaired flow instream flow requirement at the site “Feather River below Oroville” since the instream flow requirement site is located upstream of the Kelley Ridge Powerhouse outlet. All the return flows of Feather River Service Area (FRSA) should be counted as part of the flow of “Feather River above Sacramento River”; they are not all counted in SacWAM.
Specific Comments			
Chapter 1			
C1:1	1-2	1.1	The State Water Board will need to consider all other beneficial uses of water, including groundwater recharge, since groundwater recharge is not currently mentioned.

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C1:2	1-3	1.1.2 *1st paragraph*	This paragraph attributes declines in fish to the construction and operation of the CVP and SWP. CVP has been operating since the 1950s while the SWP has been operating since the 1960s, and fish decline has largely taken place since 2000.
C1:3	1-3	1.1.2 *3rd paragraph 2nd sentence*	It is unclear whether this is sufficient justification.
C1:4	1-4	1.1.3	Nowhere in this section is it acknowledged that one of the "key" duties of the SWRCB is to balance estuary protection with all other beneficial uses, including exports. .
C1:5	1-6	1.1.4	More amplification on the legal requirement of the SWRCB to "balance" all beneficial uses of Delta waters, including export uses, is needed.
C1:6	1-13	1.3.4	Releasing more water for Delta Outflow in winter, spring, and fall in proportion to unimpaired flows may not leave enough water in reserve storage to meet summer flow obligations or multi-year drought obligations nor water supply obligations to project contractors. .
C1:7	1-16	1.4	Again, protection of beneficial uses of water is mentioned, but there is no mention that Delta export water beneficial uses are included commensurate with in-basin uses. This needs to be acknowledged, to minimize confusion for readers of the document.
C1:8	1-17	1.4	Please describe how the SacWAM model will be used to evaluate impacts to groundwater resources and support the implementation of SGMA.
Chapter 2			
C2:1	2-19	2.2.3.1	The statement that stream/groundwater interactions on Antelope Creek, while not well understood, are most likely very small is not supported by any referenced studies. Please provide scientific references to support this statement.
C2:2	2-50	2.3.5	Discussion of Yolo Bypass benefits does not mention benefits to fish during non-flood and drought periods (e.g. Delta smelt and juvenile salmon). The discussion also does not mention food web subsidy benefits of agricultural drain flows in summer and fall. References for all of three of these can be found in IEP Newsletter Vol 28, #1 (available at: http://www.water.ca.gov/iep/docs/IEP%20Vol28_1.pdf). We recommend including the food web subsidy benefits of Yolo Bypass Toe Drain flows. This is included in the Delta Smelt Resiliency Strategy, and a successful summer flow action in 2016 has indicated that this can be a powerful tool for creating food in the Delta during certain times of the

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			year with relatively little water use.
C2:3	2-56 1st sentence	2.4.2	Changes in inflows also contribute to the altering of flow direction in the Delta.
C2:4	2-56 *Last sentence, 1st paragraph*	2.4.2	This should read "flow contribution combined with high export pumping rates*, greater Delta inflows, and in-Delta diversions* has caused…." Exports are usually balanced by Sacramento River Basin storage releases.
C2:5	2-57 *1st paragraph*	2.4.3	Agricultural barriers installation dates vary from year to year. See http://baydeltaoffice.water.ca.gov/sdb/tbp/web_pg/tempbsch.cfm.
C2:6	2-57 *1st paragraph*	2.4.3	"[A]llowing flow to enter on the flood tide, but restricting it from exiting on the ebb tide." This statement is correct for Old River at Tracy and the Middle River barrier, but not for the Grant Line Canal barrier, which operates in the opposite sense.
C2:7	2-57 *2nd paragraph*	2.4.3	The Head of Old River barrier is not installed every year. See http://baydeltaoffice.water.ca.gov/sdb/tbp/web_pg/tempbsch.cfm
C2:8	2-57 *3rd paragraph*	2.4.3	Installation of barriers is not the only factor altering magnitude and direction of flows.
C2:9	2-57 *4th paragraph*	2.4.3	Areas of null flow occur with or without barriers. Modeling studies indicate that fewer null zones occur when barriers are installed. See http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/AR2012/Chapter%204_2012_Web.pdf

C2:10	2-58	2.4.4 *1st paragraph*	Report states that when DCC gates are open, 40-50% of Sac River water flow enters the interior Delta via DCC and Georgiana Slough. The equation presented in Appendix A, page A-32, would likely compute something different.
C2:11	2-58	2.4.5 *1st paragraph*	Line 7 - Other factors such as in-Delta water diversions and reduced inflows also result in decreased Delta outflow.
C2:12	2-67	2.4.6	These links to the references Bourez (2012) and Mueller-Solger (2012) are broken: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/wrkshop1/ walterbourez.pdf https://www.epa.gov/sites/production/files/documents/notes---on---estimating---x2---with---dayflow.pdf
Chapter 3			
C3:1	3-2	3.2 *2nd paragraph*	*Last sentence:* The discussion here seems to have shifted gears relative to the rest of the paragraph. Here the focus is on the timing of flows rather than quantity. Also, this text gives the impression that flow is the primary driver of invasions, which has not been established for the San Francisco Estuary.
C3:2	3-2	3.2 *3rd paragraph*	The "rule of thumb" in Rozengurt et al. 1987 report should be reexamined, as it may not be very robust given the extreme variability across different types of estuaries and the difficulty in separating flow from other anthropogenic factors.
C3:3	3-3 *3rd paragraph*	3.2.1	The *third paragraph* states that achieving a more natural flow regime would help protect salmonid populations. Other factors such as improving passage would also help protect salmonid populations, allowing the fish to reenter their natal historical watersheds and high elevation reaches which would allow for increased life history diversity. Simply maintaining semi-suitable, limited habitat beneath rim dams is likely less effective and requires water to be impounded and released at times outside the "natural" hydro-graph for those downstream reaches.
C3:4	3-3 *4th paragraph*	3.2.1	*First sentence:* This text undermines the report's argument that flow is the main cause of species declines. Conditions were historically variable, and habitat changes are significant.
C3:5	3-4 *2nd paragraph*	3.2.1	*Last sentence:* The conclusion that more natural flow will reduce the negative effects of hatcheries is questionable.

Comment #	Page #	Section #	Comment
C3:6	3-4 *5th paragraph*	3.2.1	Discussion of dominant role of dam storage of sediments should be included here. Higher flows do enhance turbidities, but dams are a bighuge factor that blocks the turbidity effects of these flows.
C3:7	3-5 *2nd paragraph*	3.2.1	*Last sentence:* Should clarify that this sentence refers to the Sacramento River, not necessarily many other rivers.
C3:8	3-6	3.2.2 *2nd paragraph*	*Last sentence:* Overstates the conclusions in Feyrer et al. 2007, whose key conclusions were that recent lower flows in fall reduced habitat availability, and that there was some evidence that fall salinity changes could affect recruitment in spring. The paper did not attribute the decline of fishes to persistent low outflows, as suggested here.
C3:9	3-7 *1st paragraph*	3.2.2	Whipple and Kelly references: Neither of these references provides very good support for flow changes.
C3:10	3-7 *2nd paragraph*	3.2.2	Moyle reference: Poor reference to make this point. Kimmerer 2002 addresses this issue much more directly.
C3:11	3-7 *Last paragraph*	3.2.2	The updated and peer-reviewed citation for this is: del Rosario, Rosalie B.; Redler, Yvette J.; Newman, Ken; Brandes, Patricia L.; Sommer, Ted; Reece, Kevin; Vincik, Robert. 2013. Migration Patterns of Juvenile Winter-run-sized Chinook Salmon (*Oncorhynchus tshawytscha*) through the Sacramento–San Joaquin Delta. San Francisco Estuary and Watershed Science, 11(1).1-22.
C3:12	3-8 *1st paragraph*	3.2.2	*First sentence:* It would be more accurate to say that upstream movement is associated with turbidity changes during first flush. It is unclear whether turbidity itself is the main trigger, or something else that covaries with turbidity.
C3:13	3-8 *1st*	3.2.2	*Last sentence:* The wording makes it seem like most of the Delta Smelt population is in Grizzly and

Comment #	Page #	Section #	Comment
	paragraph		Honker Bays. This should be reworded to make it clear that this sentence applies to this region, not the San Francisco Estuary as a whole.
C3:14	3-8 *2nd paragraph*	3.2.2	*Second sentence:* The fact that the relationship shifted shows that food also has a major effect on abundance. This wording makes it seem like food has no effect on X2 relationships, which is not true.
C3:15	3-8 *2nd paragraph*	3.2.2	Some Longfin Smelt spawn in Yolo Bypass, but that is unlikely to be a big driver of Longfin Smelt trends.
C3:16	3-9	3.2.3 *1st paragraph*	*First sentence:* There are many other factors including: 1) reclamation activities; 2) channelization; 3) aquatic weeds; 4) operation of non-project facilities (e.g. EBMUD diversions and dams); and 5) levees.
C3:17	3-11	3.3.1	There are a number of other approaches that are not mentioned here. For example, there were several analyses of Old and Middle River (OMR) values.
C3:18		3.4	References should be updated and expanded. There are very few from the last five years, especially in the overview sections (3.4.1 and 3.4.2). In some sections the paucity of references biases the discussion to only one side of a view; there is no single study that can describe all conditions an individual juvenile or adult salmon may encounter, and generally this document needs to incorporate more references and more variability in conditions to fully describe the topics mentioned, especially in the overview sections (3.4.1 and 3.4.2).
C3:19		3.4	The report presents information specific to chinook salmon runs (e.g. winter, spring, etc.) and references to studies, but provides no discussion about length-at-date vs. genetic accuracy of run identification or any indication in any tables, figures or study references of what criteria were used to determine run.
C3:20		3.4	Life history diversity is only vaguely mentioned once each for adults and juveniles and without reference to what it is, how it is maintained, and why it is important.
C3:21		3.4	The juvenile life history varies and how they are distributed over space and time are oversimplified for both Chinook salmon and Steelhead.

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C3:22		3.4	Dissolved oxygen (DO) is not mentioned as an important characteristic of water quality (only temperature) for salmon and steelhead. Although temperature and DO are often correlated, spikes in low DO (causing harm) can occur in stagnated water. There also can be a tradeoff where warmer temperatures are tolerable or even provide growth opportunities as long as good DO levels are maintained and food is available, none of which is discussed specific to salmon.
C3:23	3-12	3.4.1 *2nd paragraph*	The last sentence, beginning with "[i]n addition" is confusing. This final overview paragraph lists the three primary reasons for the flow recommendation, and the last sentence seems out of place. If the author wants to introduce hydrodynamic and entrainment studies mentioned on Page 3-39 or velocity recommendations related to pumping and exports it should do so directly, by first mentioning the second recommendation related to connectivity of the Delta during outmigration and reverse flows, and then the justification from the mentioned sentence.
C3:24	3-13 *1st paragraph*	3.4.2.1	The statistic for Native American consumption and trade is both wrong and cited incorrectly. The Gresh et al. 2000 reference is estimating Native American consumption for the Pacific Northwest, not "California waterways" and the number comes from Hewes 1947.
C3:25	3-14 *1st paragraph*	3.4.2.1	This first paragraph needs to start with an introduction of salmon life history that includes: (1) a distinction between adult and juvenile life history characteristics; (2) an explanation of how adult life history characteristics (e.g., run timing) reinforce reproductive isolation and the genetic distinction among chinook salmon runs; (3) followed by an explanation about how juvenile life history characteristics can overlap among run populations and that they are responses to environmental cues and can vary under different environmental conditions (Miller et al. 2010, Sturrock et al. 2015); (4) a final clear statement that wild juvenile Chinook salmon life stage transitions are a continuum of sizes, growth rates, and timing of habitat occupancy and movement (Reimers 1973; Bottom et al. 2005; Anderson 2006) rather than discrete life history types; and (5) mention that life history diversity is important to species resilience (Schindler et al. 2010) and juvenile production (Thorsen et al. 2014).

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C3:26	3-14 *1st paragraph*	3.4.2.1	Healey 1991 and Moyle 2002 are old references and an unsatisfactory way to describe life history characteristics. Juvenile life history characteristics are not static nor are they pre-determined by the run-timing of their parents, as suggested in the first two sentences. "*Life history strategies*" is also an old and disputed term as it suggests active choices, which has not been shown to be true. This first paragraph extremely oversimplifies juvenile life history variation and should be rewritten referencing Williams 2006 and 2012 and Quinn 2005. For example: (a) Winter, Spring and Fall-run juveniles can migrate to the ocean as fry; (b) all four runs will migrate to sea as subyearlings (after a time rearing in river); (c) Winter, Spring and Fall run juveniles can spend a year or more in river before migration; (d) Fall run juveniles have been documented rearing to subyearling size in the Delta (entering as fry) before migrating to sea; and (e) Winter run juveniles can enter the Delta to rear after weeks to months in the mainstem river and then exit as subyearlings. Many of these details are mentioned in later sections, but contradicted in 3.4.2.1.
C3:27	3-14 *2nd paragraph*	3.4.2.1	The statement "adult salmon require adequate flow to provide olfactory cues" has no citation, and no indication of how "adequate flow" is defined.
C3:28	3-14	3.4.2.1	Specific details in the second paragraph would be better represented as a range or specific to run or fish size (see Quinn 2005).
C3:29	3-14 *3rd paragraph*	3.4.2.1	Regarding the statement "end of holding pools," female salmon commonly select redd locations based on stream depth, velocity, and substrate size, which is supported by many available studies. See Quinn 2005 for additional references and a basic review.
C3:30	3-15 *1st paragraph*	3.4.2.1	*First sentence:* Winter-run Chinook Salmon can and do spawn at deeper depths. Spawning typically occurs 1 to 5 feet in depth, with a maximum observed depth of 20 feet.
C3:31	3-15 *3rd paragraph*	3.4.2.1	This should have a reference: Quinn 2005

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C3:32	3-15 *4th paragraph*	3.4.2.1	*First sentence:* Instead of "*micro crustaceans,*" suggest referencing food categories from Sommer et al. 2001: terrestrial invertebrates, zooplankton and aquatic invertebrates. Otherwise mention specific orders or cite a diet study.
C3:33	3-15 *4th paragraph*	3.4.2.1	*Last two sentences:* This is an oversimplification of the life history variation of CCV juvenile salmon and how juvenile salmon respond to environmental cues when migrating and/or rearing in any one habitat. Healey 1991 is not an up-to-date reference; use Williams 2006 and 2012 with reference to recent work like Sturrock et al. 2015 and Miller et al. 2010. There is a much better description in the next paragraph: "*juvenile salmon migration rates vary considerably depending on the physiological stage of the individual and ambient hydrological conditions*."
C3:34	3-15 *5th paragraph*	3.4.2.1	"Fast Migrator" acoustically-tagged hatchery Winter-run Chinook Salmon traveled 350 river kilometers miles in 4 days, so over 87.5rkm (54.4 miles) a day. (Ammann 2016 Bay Delta Science Conference presentation). "Holders" traveled approximately 350rkm in 12 days (~18 miles/day).
C3:35	3-15 *6th paragraph*	3.4.2.1	*Third sentence:* "*[S]moltification usually starts when juveniles are 3 to 4 inches*": this is another oversimplification. The best predictor for the parr-to-smolt transformation is day length (Quinn 2005).
C3:36	3-15 *6th paragraph*	3.4.2.1	*Last sentence:* Regarding the statement "*downstream where ambient salinities are higher,*" suggest including specific location and local reference, e.g., Suisun Bay, the coastal ocean, etc.
C3:37	3-15 *Last paragraph*	3.4.2.1	2016 Knights Landing Rotary Screw Trap data has sampled Winter-run sized juveniles showing up August 29, 2016, which was the first day of trap operations for the season. (DOSS notes October 2016).

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C3:38	3-15, 3-16	3.4.2.1	1 - Table 3.4-2 (and where referenced) does not indicate which years of midwater trawl and rotary screw trap data from Knight's Landing are included. In both of those datasets, juvenile salmon were captured into June (not stopping in May) at Knight's Landing in 2001 to 2005 and 2007 to 2012 and in the Midwater trawl in 1998 to 2014. 2 - In addition, if the Midwater trawl was used, why was the Kodiak trawl not used? Both sample the Sacramento at Sherwood Harbor and the Midwater trawl operates from April-June, while the Kodiak trawl samples from December-March. If this is meant to show timing by month, excluding the Kodiak trawl while including the Midwater trawl would bias your data towards later in the season of juvenile salmon outmigration. 3 – How were runs determined? Is this length-at-date identification or genetically confirmed run-ID?
C3:39	3-16	3.4.2.1	Table is 3.4-2 is out of date. Drought conditions and large early season storms vary Delta entry timing and recent years (2010-2015) should be included to truly reflect current life histories.
C3:40	3-16 *1st paragraph*	3.4.2.1	Why specifically larval dipterans? Sommer et al. 2001 was both adult and larval Diptera and emergent Diptera and are thought to be important prey for juvenile salmon (Grey 2005).
C3:41	3-16 *1st paragraph*	3.4.2.1	Temperature needs to be explained more fully. There are temperature thresholds related to habitat use and refuge, and also life-stage specific physiological temperature thresholds. For example, moderate (decreased growth at around 20°C (Geist et al. 2014, Marine and Cech 2004)) to high (lethal: 25.8°C (Orsi 1971)) water temperatures are thought to be a bioenergetic limitation for juvenile Chinook salmon, and temperatures above 19°C are associated with shallow wetland habitat exclusion (Bottom et al. 2011). To further complicate the establishment of temperature thresholds, thermal tolerances and optimal temperatures for growth shift with increasing body size and daily ration sizes (Beauchamp 2009). This would also be a good place to discuss dissolved oxygen as well.
C3:42	3-16 *2nd paragraph*	3.4.2.1	A "return to main channels when the tide recedes" depends on adequate refuge; see Armstrong et al. 2013 and Hering et al. 2010.

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C3:43	3-17 *1st paragraph*	3.4.2.1	Highlighting only the MacFarlane and Norton 2002 study presents only one side of the estuarine growth argument and contradicts later discussion of del Rosario et al. 2013 and Sturrock et al. 2015 in 3.4.4.2, and Williams 2006 on page 3-19. Estuaries are commonly viewed as a rearing and migratory location for juvenile salmon which contain risks and rewards. Juvenile salmon must navigate the risks and rewards of the river, estuary, and ocean while responding to cues from their environment. There is no single study that can describe all conditions an individual juvenile or adult salmon may encounter, and generally this document needs to incorporate more references and more variability in conditions to fully describe the topics mentioned, especially in these overview sections (3.4.1 and 3.4.2).
C3:44	3-17 1st paragraph	3.4.2.1	Others (del Rosario et al. 2013) have determined a mean residence time for winter-run juveniles of 87 days. Suggest including the full range of residence times found in peer reviewed literature for Sacramento River Winter-run Chinook Salmon.
C3:45	3-17 *1st paragraph*	3.4.2.1	Wrongly interpreted MacFarlane and Norton (2002) statement that fish may benefit from more rapid migration through the estuary because they showed little growth there. MacFarlane and Norton (2002) refer to the “estuary” as waters downstream of Chipps Island to the ocean, but the report wrongly interprets “estuary” to mean waters of the Delta (upstream of Chipps Island). This is important because the report uses this misinterpretation to build a case for a flow management objective of pushing fish through the Delta as quickly as possible. Fast migration may benefit larger stream-rearing juveniles, but not smaller juveniles, which need to rear and grow in the Delta.
C3:46	3-17	3.4.2.2 *1st paragraph*	Clarify that this is a discussion of adult migratory behavior only. Use either “resident” or “rainbow trout” because “resident rainbow trout” is redundant. There are as many as 32 possible life history trajectories for *O. mykiss* (steelhead) (Thorpe 2007). Suggest citing Satterthwaite et al. 2009 throughout 3.4.2.2.
C3:47	3-17	3.4.2.2 *2nd & 3rd paragraphs*	Quinn 2005 is a better review for *O. mykiss* than Moyle 2002. Need to mention iteroparity, which is major difference between steelhead and Chinook salmon life-histories.
C3:48	3-17	3.4.2.2 *3rd paragraph*	*First sentence:* Report mentions confined spawning habitat, and should also mention the genetic consequences of that resource management action (Abadia-Cardoso et al. 2016)

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C3:49	3-17	3.4.2.2	There are as many as 32 possible life history trajectories for *O. mykiss* (Thorpe 2007). Satterthwaite et al. 2009 focuses on coastal *O. mykiss*, but it gives a much more complete view of their life history diversity.
C3:50	3-17	3.4.2.2	*Last paragraph:* Be specific about the “migratory advantages” and the studies that describe them. For example, larger fish may have an advantage in reference to predation, but not temperature tolerance. As in the above comment (C3:49), habitats include risks and rewards that are navigated by fish responses to environmental cues, be sure to be comprehensive when making comparisons.
C3:51	3-17	3.4.2.2 *Last paragraph*	Similar salvage information should also be included in the Chinook overview.
C3:52	3-18	3.4.3.1	Table 3.4-3 is out of date. The natural production time period, 1992-2011, should be updated through 2015 in order to accurately calculate and display the actual change in average natural production.
C3:53	3-19 *2nd paragraph*	3.4.3.1	Regarding winter-run ocean distribution, use updated citation and include more information: Satterthwaite et al. 2015.
C3:54	3-19 *3rd & 4th paragraphs*	3.4.3.2	The high production of hatchery Sacramento River Winter-run Chinook during drought years is not addressed. In year 2014, it was approx. 600,000 and approx. 420,000 in 2015.
C3:55	3-19	3.4.3.2	Percent contribution of hatchery fish, of the total in-river spawners, is out of date. In recent years the percentage was nearly double the value given. (Winter-run Interagency Ecological Program Winter-run Project Work Team notes, October 2016.)
C3:56	3-21 *3rd paragraph*	3.4.3.3	Habitat requirements for Spring-run are not the same as they are for Winter-run Chinook Salmon. Suitable habitat needs to exist year round for Spring-run, versus only half the year for Winter-run.

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C3:57	3-21 4th *paragraph*	3.4.3.3	When discussing temperature and embryo development, dissolved oxygen should also be discussed (Quinn 2005).
C3:58	3-21	3.4.3.3	As this effort is to justify and outline future flow regimes, absence of any acknowledgment that Spring-run are being reintroduced to the San Joaquin River is a significant omission. It should also be noted that this reintroduction will be done with stock from the Feather River Hatchery that may have traits of both Fall and Spring-run fish. The report should address the potential environmental needs and timing of Delta entry that may be expected once reintroduction is fully in place.
C3:59	3-21	3.4.3.3	The Clear Creek population of Spring-run is not included.
C3:60	3-25	3.4.3.5 *2nd paragraph*	*Last sentence:* Acknowledges juvenile life history diversity is cued by environmental variation ("wet years"). This should be expanded upon. Cite and explain results from Sturrock et al. 2015.
C3:61	3-27	3.4.3.5	*Figure 3.4-10, which states that* outmigration occurs through August, is internally contradicted by Table 3.4-2 (and its many references in the text), which state that outmigration ends in May. Resolve contradiction and make a clear statement about juvenile timing using all data from this document in the overview section.
C3:62	3-29	3.4.4 *1st paragraph*	*Third sentence:* A similar summary of environmentally-cued life history diversity in juvenile salmon should be mentioned much earlier. This topic supports the report's recommendations, but is buried in the last section.
C3:63	3-30	3.4.4.1	Straying rates are also increased by out of river fish releases, especially trucking to the Bay and out of basin releases. This information should be included.
C3:64	3-32	3.4.4.1	Only significant findings should be discussed from Marston et al. 2012.
C3:65	3-32	3.4.4.2 *1st paragraph*	Suggest simply stating that juvenile salmon respond to environmental cues during freshwater rearing and emigration and that connectivity is important for successful habitat transitions.

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C3:68	3-33 *1st paragraph*	3.4.4.2	The statement, "the majority of salmon exhibit an ocean-type life history," needs a reference and percentage associated with the "majority", the location of data collection, and how "ocean-type" was defined. Look to more recent references: Miller et al. 2010 and Sturrock et al. 2015.
C3:69	3-33	3.4.4.2	Riparian habitat also provides food. Terrestrial invertebrates are a common food source for juvenile salmon (Sommer et al. 2001, Winemiller and Jepsen 1998) and the terrestrial environment provides allochthonous inputs to the food web.
C3:70	3-33	3.4.4.2 *2nd paragraph*	Suggest adding more information regarding whether there is sufficient riparian cover on the lower Sacramento River and San Joaquin River.
C3:71	3-35 *1st paragraph*	3.4.4.2	The report states that "studies show," but no studies are referenced. This section is unclear. The first paragraph lacks a clear distinction whether this is an argument for higher flow or about habitat associations in the interior Delta.
C3:72	3-35 *4th & 5th paragraphs*	3.4.4.2	Moving fish through the Delta faster means less time to be eaten, but fish also enter the ocean at a smaller size. Focus of flow management should be geared more toward connecting off-channel habitat, and guiding fish at junctions toward better habitat and away from bad (e.g. Georgiana Slough flow, routing relationship), and not toward pushing fish through the Delta faster.
C3:73	3-35 *2nd paragraph*	3.4.4.2	Table 3.4-2 is referenced exclusively and not Figure 3.4-10, even though they both describe outmigration timing and contradict each other. Table 3.4-2 is likely incorrect, as are the months mentioned here. Spring-run migration timing does not reference any data and needs a citation.
C3:74	3-35 *2nd paragraph*	3.4.4.2	Winter-run juveniles enter the Delta earlier than what is stated in the text. They enter as early as September (per Knights Landing Rotary Screw Trap Data-c CDFW).

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C3:75	3-35 *Last paragraph* *3-36 Figure 3.4-12*	3.4.4.2	Brandes and McLain 2001 was included and replicated despite it being described as flawed (“difficult to ascertain with confidence”). Report unacceptably focuses on only a subset of the data in a study. In addition, Figure 3.4-12 does not incorporate catch efficiency at specific flows or covariates other than flow. At a minimum, temperature and time should be included, since timing and temperature are major topics throughout 3.4. Finally, there is no indication in the text that data diagnostics were done, e.g., determining whether these data are normally distributed and a linear model is appropriate, or whether the three to five high flow points are outliers.
C3:76	3-38	3.4.4.2	The analysis shown in *Figures 3.4-13 and 3.4-14* does not account for post-implementation changes of the Biological Opinions, and thus does not reflect current conditions, operations, entrainment rates, or diverted flow. As such, this analysis is rather dated and less relevant to current conditions and operations.
C3:77	3-38	3.4.4.2	As in Figure 3.4-12, a linear model may not be the most appropriate for Figure 3.4-13 and Figure 3.4-14, and a justification including data diagnostics is missing. See Zuur et al. 2010.
C3:78	3-39 *1st paragraph*	3.4.4.2	Is this a recommendation that tidal reversals at DCC and Georgiana Slough be managed directly or that a flow increase will correct the velocities that cause these hydrodynamic-entrainment issues? A clear and specific message is needed for this section.
C3:79	3-39 - 3-42	3.4.4.2	The discussion of “false attraction flow” and entrainment in this section is similar to the previous section (“Delta Cross Channel Gate Operations”). It would be helpful if these sections were combined with a clear message about hydrology and connectivity in relation to the pumping facilities, be it the gates or the interior Delta. Making this into two sections adds unnecessary redundancy and it does not make sense to partition into parts when it is all one system with interconnected implications for entrainment.
C3:80	3-41 *1st paragraph*	3.4.4.2	Zeug and Cavallo 2014 is cited for salvage and water exports, but the finding that SJR basin salmonid survival is higher if salvaged at the CVP and trucked out of the South Delta is omitted from the discussion of tagging and survival studies.

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C3:81	3-44 *2nd paragraph*	3.4.4.2	Figure 3.4-10: outmigration through August not June, why the inconsistency in the month and the reference?
C3:82	3-44	3.5.1 *1st paragraph*	*Last sentence:* Negative OMR flow would increase smelt salvage, not reduce it. Suggest rephrasing the sentence to better reflect the discussion in section 3.5.4.2
C3:83	3-45	3.5.3 *(various places)*	P-value can mean a lot of things depending on what statistical analysis was applied. Define the test conducted (e.g. Mann-Kendall test, t-test, OLS regression likelihood ratio test, etc.) every time a p-value is presented.
C3:84	3-47	3.5.4.1	*Figure 3.5-2:* It is unclear what the dotted lines on the figures are.
C3:85	3-49	3.5.4.2	*Last sentence on page:* 1250 cfs should be -1250 cfs.
C3:86	3-52	3.5.4.2	There's no inflection point to be found on Figure 3.5-6. Reverse log-transform the figure.
C3:87	3-53	3.5.4.2	*Table 3.5-1:* Indicate that these numbers are the recommended "minimum" Delta outflow and "maximum" OMR reverse flows. Again, negative OMR values are not necessarily protective of Longfin Smelt, but rather less impactful.
C3:88	3-55		Red Bluff rotary screw trap data provides over 20 years' worth of larval sturgeon trends that could be analyzed.
C3:89	3-58	3.7.1 *1st paragraph*	*First sentence:* To our knowledge, there is no monitoring program that tracks total abundance of splittail. Based on the sentence, this number seems to be referring to the Fall Midwater Trawl (FMWT) index for splittail, which captures mainly age-0 splittail and does not do so efficiently (given that there were years where the Fall Midwater Trawl index is zero but juvenile splittail are still captured by the USFWS beach seine survey).
C3:90	3-58	3.7.1 *1st paragraph*	*Sentences 2 – 5:* These statements seem to be generally consistent with the state of knowledge of the species, but they would require citations given that exact numbers are cited.
C3:91	3-58	3.7.1	*Sentence 6:*

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		1st paragraph	The statement that "[*t*]*hese are among the largest flows needed by any Bay-Delta estuarine fish species*" lacks basis. As far as we know, there has been no flow requirement comparison across native fish species. It also contradicts Moyle et al. 2004's population modeling exercise in which they found that splittail can persist through periods of drought due to their high fecundity.
C3:92	3-58	3.7.1 *1st paragraph*	*Sentence 7:* Statement lacks citation.
C3:93	3-58	3.7.2 *1st paragraph*	*Second sentence:* Splittail in the Napa and Petaluma Rivers represent a genetically distinct population that is now listed as a distinct population segment by USFWS in 2010. This report should note that it discusses just the Central Valley population portion of the species. See Baerwald et al. 2007.
C3:94	3-58	3.7.2 *2nd paragraph*	*First sentence:* Moyle 2002 and Daniels and Moyle 1983 suggest that adults typically live 5 to 7 years. Feyrer et al. 2015 also suggests that 8 years or older fish are rare.
C3:95	3-59	3.7.3	See comment C3:89. FMWT survey does not track total population abundance of splittail (mainly targets young-of-year fish). Additionally, the FMWT can be inefficient at sampling juvenile splittail. For example, USFWS beach seine surveys and rotary screw trap at the Yolo Bypass toe drain often catch juvenile splittail even during dry years in which FMWT index for the species is 0. It is unclear as to what test the p-values in this section are referring to (e.g. Mann-Kendall test, likelihood ratio test for OLS regression, etc.). It is also important to note that Moyle et al. 2004's analysis suggests that one or a few dry years with low juvenile splittail production has little impact on the overall robustness of the species population. See comment C3:91. The 2010 report recommendation appears to be based on flawed logic that the FMWT index tracks total population abundance and that continuously high juvenile production is necessary for the species.
C3:96	3-60 *Figure 3.7-1*	3.7.4.1	More details are needed. Specify that it is an ordinary least squares regression if this is what the figure is showing.
C3:97	3-60 -	3.7.4.1	See comment C3:89. FMWT does not track total abundance or even relative abundance

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	3-61		of splittail. It tracks mainly young-of-year splittail.
C3:98	3-63 *1st paragraph*	3.8.2	Discussion of migration into the Sacramento compared to the San Joaquin does not mention the role of flows in determining migration location (i.e. higher flows on the San Joaquin, relative to Sacramento flows, will attract more smelt to migrate there).
C3:99	3-63 *2nd paragraph*	3.8.2	Period for Delta smelt spawning has been gradually getting earlier through the last 15 years and Moyle 2002 may not be the best reference. Spawning now starts end of February/beginning of March, with gravid females seen as early as January in the early warning survey.
C3:100	3-63 *2nd paragraph*	3.8.2	Discussion of larval rearing areas does not include rearing in the north Delta, where freshwater resident fish occur year-round. Citations for this and other recent findings in Moyle 2016 (available at: http://escholarship.org/uc/item/09k9f76s#page-2).
C3:101	3-64 *1st paragraph*	3.8.3	*Second sentence:* It is unclear how the 2% was calculated for 2000 and how that is the same as 1967.
C3:102	3-71 *Figure 3.8-5*	3.8.4.4	Figure does not include most recent 10 years of data. Smelt spawning has been getting earlier over time, and it is possible that salvage timing may also have shifted.
C3:103	3-72 *1st paragraph*	3.8.4.4	Larval smelt distribution over the past decade, as seen in the 20mm survey, is consistently centered around the lower Sacramento River and the Deep Water Ship Channel. The citation of Dege and Brown does not include the most recent and relevant monitoring data.
C3:104	3-73	3.8.4.4	The last paragraph of the smelt section does not include discussion of the importance of turbidity in entrainment and does not reference what we have learned about the entrainment/turbidity relationship since DWR began turbidity transects.
C3:105	3-75	3.9.4	Please clarify if *Figure 3.9-1* illustrates SWRCB's reanalysis of the relationship between lagged Starry Flounder abundance with Delta outflow. If it does not, please include methods and data sources of the reanalysis and a graphic illustrating the results.
C3:106	3.77	3.10.2 *3rd paragraph*	It would be helpful to quantify predation on Bay shrimp if possible; for example, which life stages of fish (juvenile, adult) prey on which life stages of shrimp (larval, juvenile, adult).

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C3:107	3.78 *1st paragraph*	3.10.2	Wahle 1985 is described as a recent reference, but it is over 30 years old and talks about Bay shrimp diets before the introduction of Potamocorbula amurensis. A more recent reference post-clam would be helpful.
C3:108	3.78	3.10.2	Corbula amurensis has been changed back to Potamocorbula amurensis. The old species name will need to be updated throughout the document.
C3:109	3-84 *2nd paragraph*	3.11.4.3	Separate the flow recommendation for E. affinis and N. Mercedis into its own section – it is currently lumped in the “Non-native Zooplankton” section.
C3:110	3-84 *2nd paragraph*	3.11.4.3	Include a summary of the scientific rationale behind the flow recommendation for E. affinis and N. mercedis beyond simply stating that the California Department of Fish and Wildlife recommended it during the 2010 Informational Proceeding.
C3:111	3-89 *2nd paragraph*	3.13	An inflection point was found to be at -6500 (OMR). Zeug and Cavallo 2014.
Chapter 4			
C4:1	4-1	4.2 *1st paragraph*	This statement is incorrect. Flow is a driver of habitat, not habitat itself. The metrics listed in the parentheses are the actual components of habitat. Of those, flow primarily determines depth and velocity.
C4:2	4-2	4.2.1	This section presents a poor review of freshwater tidal marsh. Suisun Marsh is probably better characterized as brackish tidal marsh. See Brown et al. 2003 and some of the excellent recent work by the Interagency Ecological Program (IEP) Tidal Wetlands Project Work Team (PWT) for a more specific discussion of freshwater tidal habitats.
C4:3	4-4	4.2.3	This section presents a weak discussion about floodplain and how this habitat has been altered. Floodplain has been a huge focus of research for 15+ years. Whipple et al. 2012 and more recent SFEI work provide a really good overview of these alterations.
C4:4	4-4	4.3 *1st paragraph*	Contaminants may bioaccumulate in other species beyond fish (i.e. clams, birds) and become a human health concern.
C4:5	4-4	4.3.1	See comment C4:4: contaminants may bioaccumulate in other species besides fish.

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		1st paragraph	
C4:5	4-4	4.3.1	Sediments may also act as a route of exposure and ingestion of organic contaminants to non-target species, not just as a mechanism of transportation.
C4:6	4-5	4.3.1 *1st paragraph*	The statement "(i.e. no kill fish)" should probably be "no fish kills" or "does not kill fish."
C4:7	4-5	4.3.1.1 *1st paragraph*	2011 and 2012 were wet and dry years, respectively, and pesticides/contaminants were widespread throughout the Delta. In the same paragraph, it mentions that pesticide transport is influenced by rainfall, runoff, and streamflow. Include a statement on how changes in the water year types may (or may not) impact the transport of pesticides and contaminants in the Delta.
C4:8	4-5	4.3.1.1 *2nd paragraph*	*Second sentence:* Clarify what species are most impacted by exposure to pesticides in the rainy season. It appears the paragraph is referring to "Delta smelt."
C4:9	4-5	4.3.1.1 *2nd paragraph*	*Last sentence:* State what toxicity endpoint was used to determine that there was no evidence of toxicity to Delta smelt.
C4:10	4-6	4.3.1.1 *2nd & 3rd paragraphs*	The PCB paragraphs are somewhat contradictory. The first paragraph states that PCBs in fish tissues have generally decreased since 2005, typically below concerns for human health. The second paragraph states that PCBs in the sport fish of San Francisco Bay are ten times higher than the threshold for human consumption. Clarify the discrepancies between these two paragraphs.
C4:11	4-6	4.3.1.2	Clarify how the reproductive health of *Menidi* was negatively impacted.
C4:12	4-6	4.3.1.2	State the source of EDCs in the Delta (presumably waste water treatment plant effluent).
C4:13	4-7	4.3.1.3 *1st paragraph*	This paragraph states that mussels were the most sensitive aquatics. Clarify what other organisms this is in comparison to.
C4:14	4-7	4.3.1.3	Include a sentence on the upgrade of Sacramento Regional Sanitation District Waste Water Treatment Plant and its potential impact on ammonia/ammonium levels in the Delta.
C4:15	4-7	4.3.1.4 *1st*	*Sentence 2:* Change "hepatotoxins" to "toxins" as the cyanobacteria listed can produce other toxins

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		paragraph	besides hepatotoxins (i.e. Anabaena and anatoxin, a neurotoxin).
C4:16	4-7	4.3.1.4 *1st paragraph*	*Sentence 3:* Include a citation for this sentence.
C4:17	4-7	4.3.1.4	In addition to Berg and Sutula 2015, include peer-review literature as part of citations.
C4:18	4-8	4.3.1.5	There is no statement or mention of what levels of Selenium are of concern in the Delta. Include a statement regarding concentrations of concern for Selenium in the Delta.
C4:19	4-8	4.3.1.6	There is no statement or mention of what levels of Mercury are of concern in the Delta. Include a statement regarding concentrations of concern for Mercury in the Delta.
C4:20	4-8	4.2 *1st paragraph*	*Sentence 2:* Biological activity (phytoplankton and primary production/decay) are also factors that impact dissolved oxygen (DO) concentrations in the Delta—especially in locations with low flow and long residence times. Include in sentence information regarding factors that impact DO levels.
C4:21	4-9	4.3.3	Average winds have declined in the Delta, and winds may impact waves and ultimately turbidity. Include a sentence on the effects of winds and wave conditions on turbidity in the Delta.
C4:22	4-10	4.3.4	Climate change (i.e., drought) may impact water temperatures in the Delta. Include this factor in the paragraph.
C4:23	4-11	4.4.1.1	Scientific name for Threadfin Shad should be provided in this section.
C4:24	4-11	4.4.1.2	There are several catfish species present in the Delta, each with a different niche and life history. This section should list all the relevant species and clarify that the statements are very broad and not meant to be entirely accurate for all species.
C4:25	4-11	4.4.1.3	The following sentence needs citation: "[a]*pproximately one half to two thirds of the striped bass population spawns in the Sacramento River Basin while the remainder spawns in the lower San Joaquin River.*" The section is also missing the scientific name for Striped Bass.
C4:26	4-11	4.4.1.3 – *Last sentence*	See: Lindley, S. T., and M. S. Mohr. 2003. Modeling the effect of Striped Bass (*Morone saxatilis*) on the population viability of Sacramento River winter run Chinook Salmon (*Oncorhynchus tshawytscha*). U.S. National Marine Fisheries Service Fishery Bulletin 101:321–331.
C4:27	4-12	4.4.1.4	List the species' scientific name.

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C4:28	4-12	4.4.1.4	"*They have many similarities to striped bass* . . . ." Largemouth Bass and Striped Bass have little in common aside from the fact that both can be piscivorous. Largemouth bass are not pelagic, tend to favor areas with aquatic vegetation, and seem to have increased in recent years (see Conrad, et al. 2016).
C4:29	4-12	4.4.1.5	The following primary sources should be cited in place of Moyle 2002: Melinda R. Baerwald, Brian M. Schreier, Gregg Schumer & Bernie May (2012): Detection of Threatened Delta Smelt in the Gut Contents of the Invasive Mississippi Silverside in the San Francisco Estuary Using TaqMan Assays, Transactions of the American Fisheries Society, 141:6, 1600-1607 Mahardja, B., J. L. Conrad, L. Lusher, and B. Schreier. 2016. Abundance trends, distribution, and habitat associations of the invasive Mississippi Silverside (*Menidia audens*) in the Sacramento-San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science. 14(1): Article 1. Brian M. Schreier, Melinda R. Baerwald, J. Louise Conrad, Gregg Schumer & Bernie May (2016) Examination of Predation on Early Life Stage Delta Smelt in the San Francisco Estuary Using DNA Diet Analysis, Transactions of the American Fisheries Society, 145:4, 723-733.
C4:30	4-12	4.4.1.6	Wakasagi was introduced for the purpose of providing forage in reservoirs for rainbow trout and other salmonids (Moyle 2002), not due to recreational aquarium release.
C4:31	4-12	4.4.2 *2nd paragraph*	*First sentence:* Jassby et al. (2002) found a decline from 1975 to 1995 in primary productivity, but Jassby (2008) noted an increase from 1995 to 2005.
C4:32	4-12	4.4.1.5	This section missed the following relevant citations: - Mahardja, B., J. L. Conrad, L. Lusher, and B. Schreier. 2016. Abundance trends, distribution, and habitat associations of the invasive Mississippi Silverside (Menidia audens) in the Sacramento-San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science. 14(1): Article 2. - http://www.tandfonline.com/doi/pdf/10.1080/00028487.2016.1152299
C4:33	4-13	4.4.2	Brown et al. (2016)'s recent review suggests that the different copepod species are roughly equivalent nutrition-wise, citing Kratina and Winder (2015). See: - Brown, L. R., W. Kimmerer, J. L. Conrad, S. Lesmeister, A. Mueller-Solger. 2016.

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			Food Webs of the Delta, Suisun Bay, and Suisun Marsh: An Update on Current Understanding and Possibilities for Management. San Francisco Estuary and Watershed Science 14(3). - Kratina P, Winder M. 2015. Biotic invasions can alter nutritional composition of zooplankton communities. Oikos 124(10):1337–1345.
C4:34	4-13	4.4.2	None of the references was a direct study showing that non-native copepods are more energetically costly for fish to capture. It may be better to cite the following article: Lesa Meng & James J. Orsi (1991) Selective Predation by Larval Striped Bass on Native and Introduced Copepods, Transactions of the American Fisheries Society, 120:2, 187-192.
C4:35	4-14	4.4.3	**General comment on Plants section:** it is unclear whether a goal of this section is to make a statement or prediction on how updated flow criteria will affect non-native aquatic vegetation. In general, the section is a very general statement that aquatic plants are present, have negative impacts on the ecosystem, and that there are some control programs in place. Suggest indicating how the Plan update would interact with the permitting process for the Division of Boating and Waterways, which is part of State Parks, not its own department. Also add what are the anticipated aquatic vegetation responses to new flow requirements.
C4:36	4-14	4.4.3	Consider water primrose as another highly problematic invader along with Brazilian Waterweed and Water Hyacinth. The 2015 State of the Estuary report (http://www.sfestuary.org/about-the-estuary/soter/) has a "sidebar" piece regarding the increasing prevalence of water primrose (now equivalent to Water Hyacinth). It is an aggressive invader that affects physical habitat properties and displaces other plant species.
C4:37	4-14	4.4.3	Middle of paragraph 2: a more appropriate reference for the sentence about Brazilian Waterweed's trapping of sediment is Hestir et al. 2015 (in *Estuaries and Coasts*).
C4:38	4-14	4.4.3	Khanna et al. 2012 (in *Biological Invasions*) is an appropriate source for effects of Water Hyacinth on the ecosystem.
C4:39	4-15 – 4-16	4.5.2	Boat strikes can kill or injure sturgeon. Their impact on the population is unknown but has been indicated as a problem worth evaluating for several sturgeon species.
C4:40	4-16	4.5.3	The statement "*[a]nother negative effect of hatcheries is that their discharges, though regulated, can become a problem especially with the introduction of net pens (Brager et*

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			al. 2015) such as in the Yolo Bypass (SJRRP 2015)" is based on faulty reasoning. The source of nutrients in hatchery discharge is hatchery feed, which represents an external input to the river system. Fish in net pens in the Yolo Bypass feed on trophic resources generated within the system, so they do not represent a net input. In fact, fish assimilation and respiration or carbon associated with consumption of in situ trophic resources would cause a net reduction in "discharge" from the Yolo Bypass relative to conditions without fish.
Chapter 5			
C5:1	5-2	5.1	For salmonids, the relationships provided describe outflows and returning adults and/or outflow and juvenile survival, not specific modeling or analysis that provided direct evidence for more "natural" flow regimes. This effort must be coupled with the fact that due to changes in the landscape (loss of wetlands and construction of dams), augmented summer flows are now needed due to this loss, and the resultant and subsequent decreased upwelling and discharge during the summer period.
C5:2	5-3	5.1.1	Water temperatures are not primarily influenced by flow, at least not in all seasons. Summer water temperatures are primarily driven by air temperature.
C5:3	5-3	5.1.1 *2nd paragraph*	*Sentence 3* indicates that flow affects temperature. However, this linkage varies spatially and likely seasonally. For example, Delta water temperatures in summer are driven primarily by air temperature, not flow (Wagner et al. 2012).
C5:4	5-7	5.2.2 *3rd paragraph*	This paragraph claims higher flows increase salmon abundance in the Delta. Keep in mind that the likely mechanism is redistribution of small fish rather than increased production. Put another way, very high flows seem to trigger greater downstream movement of salmon fry to the Delta (see, e.g., Brandes and McClain 2001). Hence, high Delta fry abundance in wet years does not necessarily mean that more fish are produced in the Delta or its tributaries.
C5:5	5-7	5.2.2 *2nd paragraph*	The last sentence describes how a lack of tributary flow can affect connectivity with the main stem Sacramento River. This does not seem to apply to the large tributaries like the Yuba, Feather, or American Rivers, but might to some of the smaller intermittent streams. The text should probably clarify this.
C5:6	5-12	5.3.1	Delta Islands are significantly below the channel systems. The unimpaired study does not account for extensive seepage from channels.
C5:7	5-12	5.3.1 &	Unclear how the Eight River Index could be used in the current month, as contributions for entire month are not yet know. Unclear how this could be implemented.

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		5.3.3	
C5:8	5-15	5.3.3.1	A multiple regression followed by a linear regression is used to estimate Delta outflow as a function of the ERI for the months of January through June. Multiple correlation coefficient (for multiple regression) and R^2 for linear regression should be computed and presented, as well as scatter plots for the relationships that are being modeled. It appears that Figure 5.3-2 is labeled incorrectly (x-axis) or the reference to it in item 3 is incorrect.
C5:9	5-15	5.3.3.1	The period 1922-2003 was used to obtain time series for January to June flows, yet this excludes the most recent drought years, and drought years are predicted to increase in frequency due to Climate Change. This period also excludes flow regimes that have occurred post 2009 NMFS Biological Opinion.
C5:10	5-15	5.3.3.1	*"1. Fit a multiple linear regression independently for each month to predict unimpaired Delta outflow for January to June as a function of unimpaired inflows from the Sacramento River basin, Eastside tributaries to the Delta, and San Joaquin River basin (Table 5.3-1)."* Where does the estimate of unimpaired Delta outflow come from? It would seem from the SVUFM, but it is not specified.
C5:11	5-15	5.3.3.1	*"2. Using the linear model obtained in (1), predict the Delta outflow that would result from unimpaired Sacramento And Eastside Tributary flows and existing conditions for San Joaquin inflows at Vernalis (Figure5.3-1)."* It does not seem appropriate to use existing condition flows on the San Joaquin, along with the unimpaired Sacramento and Eastside streams, as a predictor of unimpaired Delta outflow. Said in another way, replacing unimpaired San Joaquin inflow with impaired, existing condition San Joaquin flows at Vernalis would not produce the appropriate Delta outflow.
C5:12	5-15	5.3.3.1	*"3. Fit a monthly linear regression that predicts the monthly Delta outflows obtained in (2) as functions of monthly ERI (Figure 5.3-2)."* Using the current month's ERI to derive current month Delta outflow may not be possible in real time. The ERI is based on gaged data that needs to be reviewed and interpreted before it is finalized.
C5:13	5-16	5.3.3.1	Unimpaired to existing Delta outflow plots for Vernalis (Figure 5.3-1) are shown with May and June showing effects of impairment. Indicate whether Sacramento and Eastside streams also show this impairment.

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C5:14	5-17	5.3-2	An attempt has been made to linearize monthly Delta outflow as a function of monthly ERI. This only works if there is a good correlation between the 3 watersheds. Figure in 5.3-2 shows a poor linear fit.
C5:15	5-19 *1st paragraph*	5.3.3.2	The message here on Yolo Bypass is somewhat muted and should be expanded in Chapter 5 in general. The Yolo Bypass has been shown to benefit many species beyond splittail. Suggest putting greater emphasis on increasing Yolo inundation as a benefit for many species (salmon should at least be mentioned). Neither are the lower trophic benefits of Yolo Bypass inundation mentioned here. Additionally, though increasing the frequency of Yolo inundation by installing a larger notch in Fremont Weir is required by the NMFS biological opinion, consider specifically stating support for this action. There have been some indirect references, but no explicit support has been noted.
C5:16	5-32	5.4.2	Regarding temperature and egg viability, recent analysis and work presented at the 2016 Bay-Delta Science Conference (Martin-SWFSC) indicates that these laboratory derived estimates are too high, and 12°C (53.6°F) is a more realistic value for protecting in-river, naturally spawned Chinook eggs.
C5:17	5-33	5.4.2.2	The amount of storage required to meet the cold water habitat requirements are not quantified. This would help to determine more precisely the downstream unimpaired flow percentage.
C5:18	5-35 *Last paragraph*	5.4.2.2	Cite which "[s]tudies have shown it is unlikely that adult Chinook salmon can use the Feather River below the Thermalito Afterbay Outlet (High Flow Channel) except as a migration corridor." Salmonids can successfully spawn in the High Flow Channel.
C5:19	5-36 *1st paragraph*	5.4.2.2	DWR is not currently operating under the conditions outlined in the Settlement Agreement and will not implement it until licensed.
C5:20	5-39	5.5.3	Impact of additional closure of DCC in October was not analyzed. Any increase in salinity at Rock Slough and Jersey Point could cause a significant water cost. Indicate whether additional closure requirements can be eliminated using non-physical barriers at Georgiana Slough. Preliminary studies show a reduction of two-thirds of fish movement to the central Delta via Georgiana Slough.
C5:21	5-39	5.5.3	Diurnal operation of the DCC gates is neither realistic nor feasible with the current infrastructure of the DCC gates. The DCC gates, as built, were not intended for this type

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			of operation which would likely lead to more gate failures and longer, unintended outages should it be implemented.
C5:22	5-40	5.5.4 *3rd paragraph*	OMR reverse flows are compared for the periods 1925-2000 and 1986-2005. However, data for the years after the 2009 NMFS Biological Opinion, which set new, reduced negative OMR limits are omitted.
C5:23	5-40	5.5.4 *3rd paragraph*	Figure 4.4-3 is missing.
C5:24	5-41	5.5.4	More OMR limitations could restrict the transfer of Sacramento River water into the central and parts of the southern Delta and degrade water quality in the central and parts of the southern Delta for both agricultural and municipal/industrial water users.
C5:25	5-41	5.5.4	OMR limits are already adaptively managed for fish protection under the cumulative Federal and State Biological Opinions for water project operations. This management is implemented within the framework of certain biological triggers being activated and/or real-time data collection. It is unrealistic and redundant for the SWRCB to propose OMR limits outside of the current framework.
C5:26	5-41	5.5.5	Minimum health and safety exports are recommended to be reduced from 1500 cfs to 800 cfs. Coming to conclusions using a historically severe drought without further studies is not prudent.
C5:27	5-42 *Last paragraph*	5.5.5.1	The expansion of the inflow-export window from April to May (current limit per the NMFS Biological Opinion) to February through June is not realistic for the south of Delta water supply delivery purposes of the CVP or SWP.
C5:28	5-42	5.5.5.1	The proposed minimum of combined CVP/SWP exports of 800 cfs is only achievable for very specific, short-term conditions (very low south Delta water demands and high withdrawals by both projects from San Luis Reservoir) and is neither sustainable nor achievable for human health and safety purposes on a longer term basis.
C5:29	5-43	5.5.5.2	To maximize the benefits from San Joaquin (and its tributaries) pulse flows, the water should reach an area west (downriver) of the Port of Stockton to provide migration cues for returning adults.
Appendix A			

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A:1	A-1	A.1 *3rd paragraph*	This is incorrect. For upper watersheds, DWR's Division of Flood Management (DFM) estimates full natural flow (FNF)/unimpaired flow (UF). DWR's Bay-Delta Office (BDO) reports those values directly as UF and the formulas used by DFM are published in BDO's draft report on Full Natural Flow available on the website (also see DWR 2016a in A.5).
A:2	A-1	A.1 *4th paragraph*	The term "unimpaired flow" is confusing. Chapter 2 (P2-1, S2.1) refers to the "index." However, the entire UF methodology (Appendix A) is about calculating "stream flows" at different locations including Delta inflows and outflows. "Unimpaired Runoff" of different watersheds can provide an index; however, when routing that water through watershed areas to specific locations, the issue is now stream flows. Cumulative runoffs can be an index; runoff from different watersheds does not guarantee the same magnitude stream flows downstream.
A:3	A-1	A.1	DWR's estimate of valley floor runoff is based on rationale that is "subjective [and] that need to be revisited and verified in future updates": the rationale is not about the runoff estimate, but limited to estimated flows in summer/fall months (June-September), see (DWR 2007, in Section A.5).
A:4	A-1	A.1	Since surface water/groundwater interaction is not accounted for, it is unclear what the range of uncertainty in the unimpaired flow estimates will be. Indicate how significant this uncertainty is to the final estimates of unimpaired flow.
A:5	A-2	A.2.1 *1st paragraph*	The second and third sentences describe the geographic extent of the SVUFM model as the Delta, Sacramento River and Delta East Side tributaries, and the valley floor, extending to the foothills, with estimates of unimpaired inflow to the location of the large reservoirs at the edge of the Sacramento Valley, such as Shasta, Oroville, and Folsom. The schematic provided in Attachment A depicts a much greater model domain, extending much further upstream of these reservoirs. The extent of the SVUFM model domain should be clarified.
A:6	A-2	A.2.1 *1st paragraph*	*Last sentence:* Unclear which are the "smaller tributaries" referred to here.
A:7	A-2	A.2.1 *3rd paragraph*	Unclear whether the rim inflows referred to in the first sentence are impaired or unimpaired. The method described would make sense for unimpaired inflows high up on the watershed, where the assumption of not much development might hold and unimpaired flows would closely match observed flows. However, if rim inflow locations are

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			defined as in paragraph 1 under Section A.2.1, “the location of the large reservoirs at the edges of the Sacramento Valley,” then this assumption is not always valid. Greater clarity is needed in the definitions and descriptions.
A:8	A-5 to A-28	A.2.2.2 and A.2.3	Indicate where one can access the data and the tools (spreadsheets, programs, scripts, etc.) used to compute values presented on Table A-3.
A:9	A-18	A.3	Recent conditions for the purpose of this modeling equal 2009 conditions. Considering that we are in the fall 2016 and in the 6th year of drought conditions, the groundwater conditions in 2009 are likely not representative of recent groundwater level conditions. One test of this assumption would be to compare 2009 groundwater level conditions in the Central Valley to the 2016 conditions.
A:10	A-19	A.3.1	“Land use and urban demands were assumed to be constant throughout the simulation period.” An unimpaired flow simulation should not include agricultural and urban demands or surface water diversions and groundwater pumping to meet these demands. Unimpaired inflows will generally be lower than historical inflows during summer months. These unimpaired inflows will not be sufficient to meet diversion needs, and the diversions would significantly reduce stream flows. Demands would then be satisfied by increased groundwater pumping, which in turn would reduce groundwater discharges to streams. A simulation with surface water diversions and groundwater pumping is not an unimpaired flow simulation.
A:11	A-19	A.3.1	Regarding the “ensemble” approach, past experience with the C2VSim model has shown that the “warm-up period” for these simulations should also be 10 years or longer to reach equilibrium. If tests have already been done and a 3-year period was found to be adequate, then this should be explained clearly.
A:12	A-19	A.3.1	The “ensemble” approach to creating a stream-groundwater interaction time series described in the report is very odd. Under current conditions, historical groundwater pumping has altered groundwater flows, and current groundwater pumping maintains the altered flows. There are several other approaches that would yield more defensible results. The most defensible approach would be to use a constant-head boundary condition at all groundwater nodes, with these heads set to the 2009 head values, and to

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			eliminate all surface water diversions and groundwater pumping.
A:13	A-19	A.3.1	The report states that the land use and urban demands were set to their respective values for water year 2005 from C2VSim, but the groundwater storage was assumed to be at water year 2009 levels. It is not clear in the report why there is a discrepancy between the two. Either 2005 or 2009 level values can be used for all values instead of mixing them up.
A:14	A-19	A.3.1	The C2VSim run was conducted with diversions listed in Table A-5 to calculate the stream-aquifer flow exchange "*under unimpaired flow conditions*." The resulting time series are then used as input to the SVUFM. However, the fact that the diversions were turned on during C2VSim run conflicts with the unimpaired flow concept where it is assumed that there are no diversions. This would decrease stream flows compared to a C2VSim run with no diversions, and effectively increase the groundwater flow into the streams. To be consistent with the unimpaired flow approach, it is recommended that the C2VSim run is carried out with diversions turned off.
A:15	A-24	A.3.2	C2VSim unimpaired simulation results in a total loss of 876 TAF/year of stream water. But if no diversion, exports/imports, and groundwater pumping were assumed for unimpaired flow conditions, the net stream-groundwater interaction should be net stream gain as in natural flow simulation (DWR 2016a, in Section A.5). The regional groundwater system net recharge is balanced by net stream exit of groundwater without groundwater pumping. Without pumping, groundwater storage will eventually recover to natural flow level.
A:16	A-24	A.3.2	SWRCB made significant modifications to the C2VSim model. These modifications included imposing an artificial groundwater head condition, excluding surface water diversions, including groundwater pumping, using constant 2005 land use, and altering stream inflows. These modifications do not produce a coherent scenario. Each scenario development decision directly impacts the modeling outcomes, and they must be logically consistent to produce a reliable outcome. Streamflow gains from (+) and losses to (-) groundwater from the published C2VSim R374 release compared to those presented in the SWRCB's Phase II report are shown below, values in TAF/year:

Comment #	Page #	Section #	Comment
			SWRCB Phase II / **C2VSim R374 (Historical)** • Delta eastside tributaries: -151 / -83 • Sacramento River Valley floor: -582 / 264 • Yolo Bypass and tributaries: -83 / -18 • Delta: -96 / -37 • **Total**: **-876** / **126** As can be seen from these values, the SWRCB Phase 2 model results are significantly different from the published C2VSim model results. These differences could be attributable to one or more of the scenario changes, and it is unclear how each of the multiple changes influences the overall results. Any SWRCB Phase 2 C2VSim run should be based on sound theoretical principles, simulate a realistic scenario, and consider all components of the water budget. In addition, the impacts of each incremental change should be published along with a detailed model sensitivity analysis. A detailed (reach-by-reach) comparison of SWRCB's Phase 2 C2VSim modeling and the C2VSim release version is presented following this table of comments (Figure 1), at the end of this document.
A:17	A-24	A.3.2	The report text states the Delta (reaches 26, 28, 29 and 71-74) experienced an average stream-groundwater loss of 78 TAF/year. The total loss for these reaches in Table A.6 adds up to 57 TAF/year and the total loss value in Table A.10 is 148 TAF/year. Please provide consistent values throughout the report.
A:18	A-26	A.4.2.1	Last bullet item. Because of depletions and levee overtopping during high flows in the San Joaquin valley floor, "unimpaired flow" is not the same as unimpaired stream flow at Vernalis.
A:19	A-27 - A-28	A.4.2.2	This approach is flawed. The approach uses two time series (runoff and stream-aquifer interaction) calculated independently (both obtained with questionable methodology) and neglect any depletions (at the minimum riparian vegetation that rely directly on stream water) altogether. The runoff time series is based on CalSim Hydro which is not calibrated and constitutes a large percentage of the precipitation. The stream-aquifer interaction is computed using a questionable "ensemble" approach that completely ignores the fact that reaching dynamic equilibrium in ground water modeling is a multi-year process and not three as proposed. Also, maintaining the GW elevations at the 2009 levels to initialize

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			every 3-year using "C2VSIM" is questionable. Suggest fixing heads in all nodes in C2VSIM at the 2009 levels for all years. This option is available in C2VSIM. A more realistic approach is to model the entire 98 years dynamically in C2VSIM and compute the stream-aquifer interaction accordingly. Finally, because the model time step is monthly, high event unimpaired inflows are "diffused" over a month, whereas in reality there would be many levee over toppings and loss to stream water subject to ponding, evaporation, and deep percolation and attenuated returns, preventing water from reaching the Delta. Better to use C2VSIM on a daily time step (as DWR's Bay-Delta Office (BDO) did using C2VSIM in the Natural Flows report).
A:20	A-31	A.4.2.5	Delta Accretions – Under current conditions, many, if not most, Delta Islands are under mean sea level. Water commonly seeps from the channels onto the islands and has to be pumped out. The assumption that positive net Delta depletion means consumptive use may not be correct.
A:21	A-32	A.4.2.4	Units for Q1 and Q2 in Table A-8 are not specified.
A:22	A-33	A.4.2.5	DWR would like to obtain data and models/tools used to compute surface rainfall-runoff.
A:23	A-37	A.4.2.5 *1st paragraph*	As modeled in CalSim II, if precipitation exceeds total consumptive use then it is assumed that the positive difference is runoff, which is an acceptable assumption. However, to zero out negative differences is very questionable, as vegetation would draw water either directly from stream channels, or from groundwater (again mostly sourced from stream channels).
A:24	A-37	A.4.2.5	In Section of San Joaquin Inflow. Discussed previously under Comment A:19.
A:25	A-53 - A56	A.4.3 *Table A-10*	Based on our previous comments (A:12 and A:20) and C2VSim modeling performed by DWR's BDO (A:16), if the suggested approaches are followed, the inflows to the Delta would very likely be much less, as would Delta accretions and consequently Delta outflows. These in turn would directly impact the exceedance curves discussed in Chapter 5 (e.g. Section 5.2.2 as shown in Figures 5.2-1 through 5.2-3).
Draft Hydrological and Operations Modeling Consideration for the Phase II Update of the 2006 Bay-Delta Plan			
HOM:1	2 *2nd paragraph*	Overview	*Last sentence.* Time frame required to implement is irrelevant to this discussion. All models of this level of complexity require considerable time to implement, as do significant modifications to complex models.
HOM:2	3	1.1	CalSim II can be run with the free LP solver Coin-or Branch and Cut (CBC).

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HOM:3	4	1.2	CalSim II and SacWAM model run times should be compared. CalSim II takes 20 minutes for 82-year period simulation with the CBC LP solver while the SacWAM takes about 2 days for 88-year period simulation with its free LP solver under the default configuration. There was no instruction on how to configure SacWAM to use XA solver in the SacWAM Model Documentation Draft Version 001.
HOM:4	10	2.4.1	Last sentence is not clear: indicate what is the "additional water required," what it is for, and where it comes from.

Figure 1. Comparison of Results presented in Table A-6 and BDO C2VSim R374 Historical Run

Stream Gain (+) from and Loss (-) to Groundwater (TAF/year)			
Reach	Stream	SWRCB	C2VSim
25	CALAVERAS RIVER	-53	-47
26	SAN JOAQUIN RIVER (part of Delta)	-33	-28
27	MOKELUMNE RIVER	-91	-86
28	DRY CREEK	-3	5
29	COSUMNES RIVER	-3	0
30	MOKELUMNE (SOUTH) (part of	-23	-12
31	SAN JOAQUIN RIVER (part of Delta)	-5	-2
32	SACRAMENTO RIVER	1	42
33	COW CREEK	-11	-1
34	SACRAMENTO RIVER	18	26
35	COTTONWOOD CREEK	-7	-6
36	BATTLE CREEK	10	13
37	SACRAMENTO RIVER	25	32
38	PAYNES CREEK	12	14
39	SACRAMENTO RIVER	43	59
40	ANTELOPE CREEK	14	13
41	SACRAMENTO RIVER	9	11
42	ELDER CREEK	2	18
43	MILL CREEK	2	3
44	SACRAMENTO RIVER	8	11
45	THOMES CREEK	-18	-9
46	SACRAMENTO RIVER	4	8
47	DEER CREEK	-1	-2
48	SACRAMENTO RIVER	0	26
49	STONY CREEK	-69	-38
50	BIG CHICO CREEK	0	0
51	SACRAMENTO RIVER	-22	82
52	BUTTE CREEK	-122	-33
53	SACRAMENTO RIVER	-24	40
54	GLENN COLUSA CANAL	0	0
55	COLUSA BASIN DRAINAGE CANAL	80	104
56	COLUSA BASIN DRAINAGE CANAL	63	122
57	SACRAMENTO RIVER	-14	-12
58	SUTTER BYPASS	-44	0
59	FEATHER RIVER	6	94
60	YUBA RIVER	-22	-10
61	FEATHER RIVER	-67	-27
62	BEAR RIVER	-40	-23
63	FEATHER RIVER	31	54
64	FEATHER RIVER	-26	-8
65	SACRAMENTO RIVER	-175	-150
66	AMERICAN RIVER	-56	3
67	SACRAMENTO RIVER	-104	-76
68	CACHE CREEK	-87	-73
69	PUTAH CREEK	-54	-22
70	YOLO BYPASS - CACHE SLOUGH	-12	13
71	SACRAMENTO RIVER	-17	-9
72	SACRAMENTO-SAN JOAQUIN	-2	0
73	SUISUN MARSH	80	82
74	EXTEND SJR TO CARQUINEZ	-79	-73
	Average	**-18**	3
	Total	-876	126

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