The Bay Institute
Natural Resources Defense Council

By email and hardcopy

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Charles Hoppin, Chair
c/o commentletters@waterboards.ca.gov
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

RE: DRAFT TECHNICAL REPORT ON SAN JOAQUIN RIVER FLOW AND SOUTHERN DELTA SALINITY OBJECTIVES

Dear Chairman Hoppin,

This letter is submitted as the comments of the Bay Institute and the Natural Resources Defense Council regarding the October 29, 2010, "Draft Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives." Our comments here are focused exclusively on issues relating to the San Joaquin River flow objectives.

Overall, Chapters 2 and 3 of the draft report present a relatively thorough and accurate analysis of the hydrologic and biological bases for developing alternative San Joaquin River flow objectives that will more fully protect fish and wildlife beneficial uses. There are a number of places, however, where the draft should be revised to more completely describe historic and/or existing conditions or fish and wildlife needs relating to San Joaquin River flows, in order to ensure that these beneficial uses receive the fullest protection. In contrast, the water supply impact analysis in Chapter 5 is overly and unnecessarily simplistic and should be substantially improved before being used as a basis for estimating potential impacts.

In summary, we recommend the following changes:

Chapter 3 should be revised to:

- Expand the suite of fish species under consideration;
- Consider all aspects of viability affecting these species; and,
- Evaluate flow needs of these species throughout the entire year.

Chapter 2 should be revised to:

- More fully address hydrologic and water quality alterations outside the spring period;

- Include a description of hydrologic and water quality alterations resulting from groundwater pumping, return flows from imported Delta waters, changes in Tulare Basin inflows, and other factors

Chapter 5 should be revised to:

- Include all sources of flow within the San Joaquin Basin, rather than a subset of San Joaquin River tributaries;

- Treat compliance with the current salinity objectives as part of the baseline, rather than as an additional water supply impact.

- Factor in the effect of achieving salt load reductions on water supply impacts.

Chapter 3

In general, Chapter 3 provides a comprehensive review and synthesis of the best available information – scientific literature, "grey" literature (i.e., state and federal agency reports), and monitoring data – to describe the life histories, population trends and environmental needs for fall-run Chinook salmon and, to a lesser extent, Central Valley steelhead. It also describes the ecological functions of flows in San Joaquin Basin tributary rivers, the lower San Joaquin River and the upper Delta, and reviews and evaluates the relationships between flow, survival and population abundance (primarily for Chinook salmon). Finally, the chapter provides a useful discussion of the ecological value of natural seasonal and inter-annual variations in flow (i.e., the "natural flow regime") for hydrologic and geomorphic processes, environmental conditions, food webs, connectivity and the fish communities those ecological processes and ecosystems support.

The draft documents the recent and long-term declines in anadromous fish populations in San Joaquin Basin rivers and correctly concludes that: a) current flow conditions are harmful to San Joaquin Basin Chinook salmon and other native fishes and are not therefore adequate to support fish and wildlife beneficial uses; b) improved flow conditions are key to restoring and protecting those (and other) fish resources in the region; and c) both increases in flow levels and restoration of natural seasonal variations in flow will be necessary support fish and wildlife beneficial uses and protect these public trust resources. The report correctly recognizes that other stressors (many of which are also related to and exacerbated by the current impaired flow conditions) have contributed to the poor habitat conditions and declining fish population, but does not minimize the importance of flow in protecting beneficial uses. The draft may, however, somewhat underestimate the extent to which salmon populations have declined. For instance, data from CVPIA / Grandtab show natural production of fall-run salmon averaging ~375,000 for the 1967-1991 period, and Mesick 2009 (cited in the draft, p. 54) states that fall run populations were ~130,000 in the Tuolumne River alone in the 1940s.

The analyses and methodological approaches described in the chapter and proposed for developing and establishing flow objectives are well-documented and scientifically based, although consideration of species other than Chinook salmon and of additional biological response variables is necessary to strengthen this analytical and objective-setting approach (see below). The studies and quantitative analyses of relationships between flow and survival, abundance and migration timing provide a strong basis for identifying the timing and flow levels needed to provide specified levels of protection of fish and wildlife beneficial uses, at least as pertains to Chinook salmon. The chapter's recognition of the importance of natural seasonal and inter-annual variations in flow, which have been largely eliminated in most years by water management activities in this basin, is particularly valuable: developing flow objectives that reflect and are based on this variation is well-supported by a growing body of scientific literature and management practice in other watersheds and aquatic systems.[1] This approach also provides the greatest likelihood for developing flow objectives that address the needs of fish species other than Chinook salmon, as well the physical and ecological processes that support food webs and ecosystems. In addition, flow objectives that restore natural variation should be less favorable for the many undesirable non-native species that constitute one of the several "other stressors" in this lowland river and upper estuary ecosystem.

However, there are three areas in which Chapter 3 is incomplete and should be revised to ensure that fish and wildlife beneficial uses are fully identified and protected.

<u>1. The suite of fish species used for the review, analysis and proposed approach for developing flow objectives is too limited.</u>

San Joaquin Basin rivers and the southern Delta are important habitat for a variety of native and desirable fish species, including Chinook salmon, steelhead, delta smelt, longfin smelt, green and white sturgeon, Sacramento splittail, striped bass and American

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[1] For a recent regional evaluation of the effects of stream flow alterations, see: Carlisle, D. M., D. M. Wolock and M. R. Meador (2010) Alteration of streamflow magnitudes and potential ecological consequences: a multiregional assessment. Frontiers in Ecology and the Environment. Available at: http://water.usgs.gov/nawqa/pubs/Carlisleetal_FLowAlterationUS.pdf. The authors found that "biological assessments conducted on a subset of these streams showed that, relative to eight chemical and physical covariates, diminished flow magnitudes were the primary predictors of biological integrity for fish and macroinvertebrate communities. In addition, the likelihood of biological impairment doubled with increasing severity of diminished streamflows."

shad.[2] While Chapter 3 provides detailed reviews of the life histories, environmental needs and population trends for fall-run Chinook salmon and, to a lesser extent, Central Valley steelhead, it does not provide similar information for any of these other species. For many of these species (as well as for the two salmonid species), San Joaquin Basin rivers and southern Delta habitats are the southernmost extent of their geographic range and thus these regions represent an important component of the species' spatial structure, one of four recognized characteristics of species and population viability (see comment #2 below).

Chapter 3 should be revised to include similar reviews for these species and, as supported by the available scientific and monitoring data, identification of the relevant timing of flow needs and quantitative and/or qualitative analyses of the relationships between flow and species response. While improved flow objectives to protect juvenile fall-run outmigration may also provide significant benefit to juvenile spring-run outmigration, for instance, the analysis should specifically address the similarities and differences between the life history requirements of fall-run and of other salmon runs and between fall-run and other species.

<u>2. All aspects of species viability should be considered in the analysis and proposed approach for developing flow objectives.</u>

Protection of fish and wildlife beneficial uses in San Joaquin Basin rivers and the upper Delta requires providing flow conditions that support restoring and maintaining the viability of the fish populations that rely on these habitats. As we explained in our submissions to the Board for the Delta Flow Criteria proceedings,[3] "viability" means the maintenance of acceptable levels or conditions of four different biological characteristics that relate to the persistence of populations: abundance, spatial extent (or distribution), diversity (both genetic and life history) and productivity.[4] The analyses presented in Chapter 3 are limited to the relationships between springtime San Joaquin River flow and the abundance and productivity viability criteria for fall-run Chinook salmon. In addition

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[2] These species use or historically used San Joaquin Basin rivers and southern Delta habitats for migration, spawning, and/or rearing. For example, longfin smelt have been detected as far up the San Joaquin River drainage as the Tuolumne River (i.e., in a sample from 1999, B. May, UC Davis, *unpublished data*) suggesting that the San Joaquin River may also provide spawning habitat in some years.

[3] TBI *et al.*, Exhibit 1: General Analytical Framework for Developing Public Trust Flow Criteria, submitted to the SWRCB February 16, 2010.

[4] The characteristics of viability we used are based on those defined by the National Marine Fisheries Service for "viable salmonid populations" (see: McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt (2000) Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum NMFS-NWFSC-42; and Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams (2007) Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin basin. San Francisco Estuary and Watershed Science 5(1): [Article 4]. Available at: http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4)

to the overly narrow focus on a single species during a single season, this approach ignores the important relationships between adequate flows in the lower San Joaquin River and into the southern Delta and the spatial structure and diversity of Chinook salmon and most of the other fish species that use (or could use) these habitats.[5] The importance and relevance of the spatial extent and diversity viability criteria are summarized below.[6]

Spatial Extent (or Distribution): More widely distributed populations are less vulnerable to catastrophic events and have a lower risk of extinction. Flows affect spatial distribution by facilitating the movement of organisms and allowing them move into and occupy habitats, and by creating and increasing the amounts of habitat available. Inadequate flow conditions can prevent fish passage (e.g., as a result of impassable water depth or intolerable temperature or dissolved oxygen conditions), degrade habitat quality, and/or create conditions that favor harmful non-native species. The current inadequate flow conditions in San Joaquin Basin rivers and the southern Delta, by preventing passage and/or by causing habitat conditions to be degraded, unsuitable or intolerable, have reduced the spatial extent of many native species that, as recently as a few decades ago, utilized these habitats. For many of these species, the San Joaquin Basin was the southernmost extent of their geographic range, and thus also an important component of their distribution and, potentially a contributor to environmentally based genetic and life history diversity. Restoration of adequate flows at appropriate times relative to life history patterns will allow fish species to re-occupy and re-establish populations in these habitats.

Diversity: Species and populations that are more genetically diverse and more diverse in life history patterns are more resilient to environmental change and less at risk of extinction. Natural diversity (e.g. life history patterns[7]) allows organisms to adapt to and benefit from environmental variability. This is an especially important characteristic in highly variable ecosystems such as the San Joaquin Basin watershed and the Delta. Inadequate flow conditions that restrict specific life history stages such as spawning or migration to either limited geographic areas or limited time periods functionally impose artificial selection on populations for a narrowly expressed life history pattern. For example, the current inadequate flow conditions in San Joaquin Basin rivers and the southern Delta during the spring effectively limit survival of outmigrating juvenile salmonids to those individuals that complete their migration through the Delta within a

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[5] One of the mechanisms that drives variations in abundance and productivity is survival, thus the analyses of the relationships between flow and survival reviewed by Chapter 3 are essentially analyses of the effects of flow on the abundance and productivity criteria.

[6] More detailed review of the viability criteria is provided in TBI *et al.*, Exhibit 1, General Analytical Framework for Developing Public Trust Flow Criteria, submitted to the SWRCB February 16, 2010.

[7] Although only genetically based traits are subject to evolution and not all diversity is genetically-based, it is a trait itself (genetically based or not) that confers the ability to survive and reproduce in different environments. Thus, in a conservation sense, flow criteria that protect natural diversity are protective of the public trust values whether or not the diversity is genetically based.

rigidly fixed 31-day period. Restoration of both adequate and seasonally appropriate temporally variable flows that characterize natural flow patterns in the San Joaquin Basin watershed will allow recovery and expression of life history and (over time) genetic diversity of fish populations in the region.

Table 1[8] relates each of the four viability criteria for a variety of species to San Joaquin River Delta inflows (as well as to the other three flow parameters considered in the Delta Flow Criteria proceedings). In TBI *et al.*, Exhibit 3 (Delta Inflows, submitted to the SWRCB February 16, 2010), we presented detailed discussion and analyses of the relationships between San Joaquin River Delta inflow and all four viability criteria for fall-run Chinook salmon, as well as identification and/or discussions of the relationships for spatial extent and/or diversity for several other species.

Lack of quantitative data on genetic diversity or even abundance does not preclude consideration of the spatial extent and diversity viability criteria in the development of flow objectives. Useful analyses and credible, scientifically based approaches for development of flow objectives can be made using information on environmental tolerances and preferences (e.g., for temperature) and life history patterns (e.g., timing and duration of migration or spawning periods).

Chapter 3 should be revised to include reviews and analyses of the relationships between flow levels, timing and durations and the environmental requirements and life history patterns of multiple species, and flow objectives should be developed that promote improved spatial extent (or distributions) and diversity as well as increased abundance and productivity.

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[8] This table was presented as Figure 8 in TBI et al., Exhibit 1, General Analytical Framework for Developing Public Trust Flow Criteria, submitted to the SWRCB on February 16, 2010, and again as Figure 1 in our closing comments, submitted to the SWRCB on April 14, 2010.

Table 1. Identification of relationships between flow criteria, including San Joaquin River Delta inflows, and each of the four viability criteria (from TBI *et al.*, Exhibit 1, Delta Flow Criteria Proceedings, submitted to the SWRCB February 16, 2009).

Viability Attribute		Flow Criteria			
		Delta outflows	San Joaquin River Delta Inflows	Sacramento River Delta Inflows	Delta Hydrodynamics
	Abundance	**longfin smelt** **bay shrimp** **delta smelt** starry founder Sacramento splittail striped bass American shad Eurytemora affinis (spring) *habitat abundance for estuarine species*	**fall run Chinook salmon** spring run Chinook salmon *Abundance of and transport to accessible cold-water riverine habitats and communities*		**SJR Chinook salmon** **Sacramento River Chinook salmon** **Delta smelt** *abundance of habitat for smelt species in the south Delta*
	Spatial Extent	**longfin smelt** **Delta smelt** **striped bass** YOY starry founder bay shrimp *transport both seaward and landward (e.g. gravitational circulation)*	**fall run Chinook salmon** **spring run Chinook salmon** steelhead white sturgeon green sturgeon Sacramento splittail longfin smelt Delta smelt *Distribution of productive cold-water riverine habitats and communities*	**fall run Chinook salmon** **Sacramento splittail** **spring run Chinook salmon** **winter run Chinook salmon** **late-fall run Chinook salmon** white sturgeon green sturgeon American Shad striped bass *increased distribution of floodplain*	longfin smelt Delta smelt fall run Chinook salmon (SJR) spring run Chinook salmon (SJR) *Spatial distribution of spawning and rearing habitats in the South Delta*
	Diversity	*increased occurrence of juveniles seaward for freshwater spawners and landwards for marine spawners*	**fall run Chinook salmon** spring run Chinook salmon white sturgeon steelhead *Diversity of riverine hydrographs and habitats in the Central Valley*	fall run Chinook salmon spring run Chinook salmon winter run Chinook salmon late fall run Chinook salmon *increased availability of floodplain habitats*	**Delta smelt**
	Productivity/ Stability	**longfin smelt** **bay shrimp**	**fall run Chinook salmon**	**fall run Chinook salmon** **Sacramento splittail** spring run Chinook salmon winter run Chinook salmon late-fall run Chinook salmon white sturgeon green sturgeon American Shad striped bass *increased production and transport of materials off of floodplains to river and tidal habitats*	**longfin smelt** **Delta smelt** **SJR Chinook salmon**

Figure 8: Public trust resources (species and ecosystem attributes) protected by flow recommendations in this submission. Bold text indicates that analysis of a species' catch, distribution, and life history data contributed directly to formulation of the flow recommendation. Research studies and or life history similarities indicate that other species (plain text) and ecosystem attributes (italics) will benefit from the recommended flows. The list is not exhaustive; absence of species names indicates absence of research that we are aware of, not absence of a mechanistic relationship (e.g., all species native to the lower Sacramento River are expected to benefit from a restoration of higher magnitude flows during the appropriate season).

3. Flow objectives should be developed for all months of the year in order to protect fish and wildlife beneficial uses.

Native and other desirable fish species are present in or migrating through the lower San Joaquin River and southern Delta throughout the year (Table 2[9]). While the draft is correct in identifying that the greatest alteration in San Joaquin River inflows to the Delta occurs during the spring snowmelt period (roughly February through June), inadequate flow conditions that are lethal or block passage, degrade habitat quality, or provide insufficient migratory cues occur throughout the year. Adult and juvenile migrations of migratory species, including Sacramento splittail, green and white sturgeon, Chinook salmon, steelhead, striped bass, and American shad, are timed to correspond with flows that, among other things, provide:

- migratory cues (e.g. salmon find their natal streams by the "scent" of their natal river as transported by flows from that river),
- transport upstream (e.g. providing suitable water quality, depth and continuity of flows needed to cross barriers),
- transport downstream (e.g. providing the suitable water quality, depth and continuity of flows needed to cross barriers,
- beneficial rearing habitats (through the wetting of streambank and overbank habitats and by mobilizing sediments that contribute to turbidity in the Delta), and
- adequate temperature and dissolved oxygen conditions on the lower San Joaquin River.

Existing flows in the lower San Joaquin River and southern Delta during the summer, fall and winter regularly result in unsuitable or lethal water quality conditions and thus are not adequate to protect fish and wildlife beneficial uses. However, using the ecologically sound approach behind the protective winter – spring San Joaquin river inflow criteria contained in the SWRCB Delta Flow Criteria report and briefly described in Chapter 3, based on a 14-day running percentage of the unimpaired flows (an approach that, importantly, addresses both flow levels and variability), may not be suitable for these other seasons because unimpaired flows during the summer, fall and some winters are typically low. Instead, flow objectives for these periods should be developed using information on life history patterns for the affected species, their predicted presence and/or movement through the lower San Joaquin River and southern Delta, their environmental tolerances and preferences, and quantitative analyses of the relationships between flow levels and the relevant environmental conditions. For instance, the report should directly address the relationship between flows and adequate temperature conditions to protect beneficial uses and evaluate whether minimum temperature

[9] This table was presented as Figure 7 in TBI et al., Exhibit 1, General Analytical Framework for Developing Public Trust Flow Criteria, submitted to the SWRCB on February 16, 2010.

requirements for salmonids would be met by a given percentage of unimpaired flows, and identify periods when additional flow objectives might be necessary to ensure adequate temperatures.

Chapter 3 should be expanded and revised to describe approaches for development of flow objectives for the summer, fall and winter months.

Table 2. Life history timing for native species that reside in or migrate through the Delta including through the southern Delta and into the lower San Joaquin River (from TBI *et al.*, Exhibit 1, Delta Flow Criteria Proceedings, submitted to the SWRCB February 16, 2009).

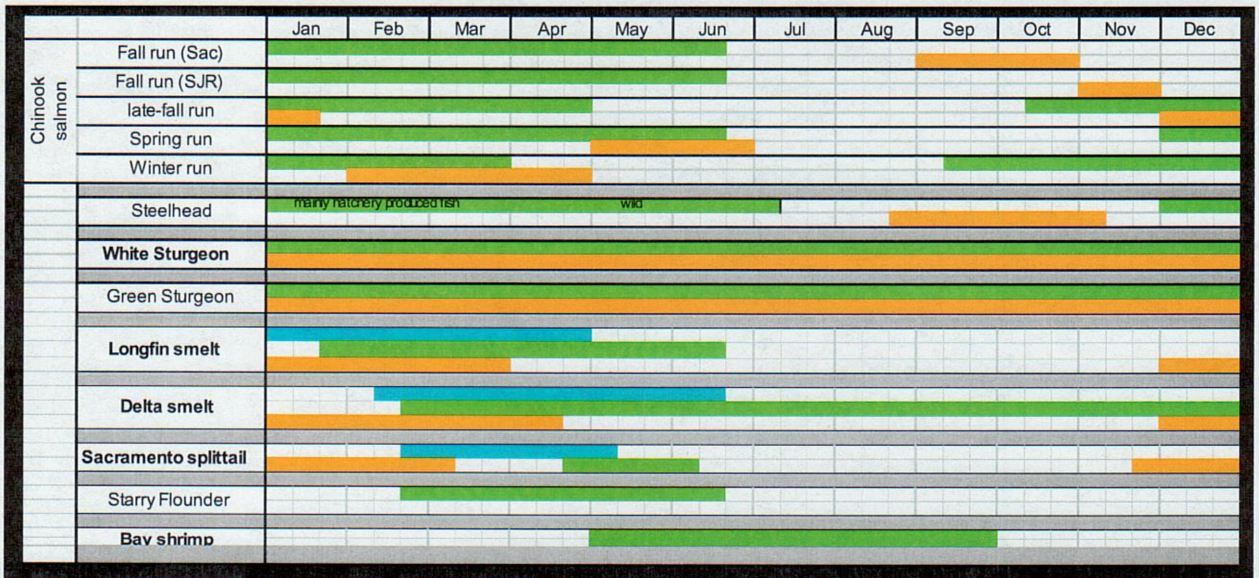

FIGURE 7 : Approximate life history timing of native public trust species described in Exhibits 1-4. Life history timing varies with environmenal conditions in any given year and some individuals will complete their life cycle earlier or later than indicated in every year. Species in boldface are those for whom individuals or the entire population may reside in the Delta + Suisun Bay year-round.

Juvenile migration and rearing
Adult migration
Spawning

Chapter 2

While the draft ably documents the significant alteration of the hydrology of the Basin, particularly in the spring period, it should be revised to more adequately address the following additional aspects of that alteration:

- alteration to hydrology and water quality in the July through January period.
- changes in hydrology and water quality due to land use changes and groundwater pumping.
- changes in hydrology and water quality from the return flow of imported Delta water into the river.
- alteration to hydrology upstream of the confluence with the Merced River, including changes in the inflow on the mainstem and from the tributaries between the Merced and upper mainstem (e.g. Chowchilla and Fresno Rivers), and from the Tulare Lake Basin.

Previous studies

The following studies provide additional hydrologic analysis and information on the historic hydrologic, geomorphic and ecological conditions in the San Joaquin River Basin and their alteration:

a. The Bay Institute. 1998. From the Sierra to the Sea: An Ecological History of the San Francisco Bay-Delta Watershed (TBI 1998). Available at http://bay.org/publications/from-the-sierra-to-the-sea-the-ecological-history-of-the-san-francisco-bay-delta-waters

b. The Bay Institute. 2003. Ecological Scorecard Freshwater Flow Index (TBI 2003). Available at http://bay.org/assets/Freshwater_Inflow.pdf

c. The Bay Institute. 2004. The Year In Water 2003 (TBI 2004). Available at http://bay.org/assets/2003%20The%20Year%20in%20Water.pdf

d. ECORP and The Bay Institute. 2007. The Tulare Lake Basin Hydrology and Hydrography: A Summary of the Movement of Water and Aquatic Species (ECORP and TBI 2007). Prepared for the U.S. Environmental Protection Agency. Available at http://www.epa.gov/region9/water/wetlands/tulare-hydrology/tulare-fullreport.pdf; text, figures, maps, and tables available separately at http://www.epa.gov/region9/water/wetlands/local-wetlands.html

The following Chapter 2 comments are organized by section header.

2.2.1 Selection of flow data and gauges

a. Although this chapter primarily analyzes monthly data (because the Vernalis unimpaired data set is only monthly), it would be useful to include a short description of the gauges and their data quality (USGS rating of gauging records from poor to excellent), location stability, and issues related to side flow, especially during peak runoff.

b. The draft compares the unimpaired flow at the rim dams to the actual flow at the river mouths instead of comparing it to the actual flow below the rim dams. The assumption that the rim station unimpaired flow is a good representation of the unimpaired flow at the river mouths is applicable for an annual analysis of the major East-side tributaries (Stanislaus, Tuolumne, Merced) but we would not recommend it for a daily or monthly analysis or for the tributaries upstream of the Merced. The major tributaries below the rim stations (such as Dry Creek on the Tuolumne River) that can contribute significant runoff in storm events should also be identified.

c. The hydrologic analysis is used mainly for documenting the significant historical alteration of the San Joaquin Basin hydrology. Its use for for predicting future alterations should be caveated, however. In the 1930-2008 historic period there has already been a small decrease in the proportion of the total annual runoff that is derived from snowmelt. This trend is expected to continue in the future as warming will also increase high magnitude winter peak flows and decrease summer and fall base flows originating from the San Joaquin River Basin (in contrast to base return flows derived from imports). It is possible to quantitatively portray that change with the alternative future hydrological scenarios that have been developed for the San Joaquin Basin in studies conducted for and by the Bureau of Reclamation and the Department of Water Resources.

2.2.2 Unimpaired flow sources and calculation procedures

a. The draft uses the terms unimpaired flow and natural flow interchangeably, even though the text describes why the unimpaired flow would be different from the natural flow due to significant changes in land use, channelization and loss of floodplains and other factors (including groundwater hydrology changes which were not noted). See also comment "d" below.

b. Table 2-2 does not include the San Joaquin River at Friant even though that data is used in the hydrologic analysis.

c. The difference between the numbers used for Vernalis unimpaired flows after 2003 in the text and the supporting spreadsheet should be explained. Also, it is not clear why the rim station unimpaired or reservoir inflow data for the tributaries upstream of the Merced

River (available from the USACOE) were not used in extending the Vernalis unimpaired record beyond 2003 given that data is used in the DWR calculation of the unimpaired data. The unimpaired Vernalis flow data record could also be extended by correlating the overlapping Vernalis and rim station unimpaired data for the 1930-2003 period. A similar technique was used to extend the Delta unimpaired outflow record in TBI 2003.

d. This section describes four factors that result in the Vernalis unimpaired flow not representing natural conditions – groundwater accretions, consumptive use of wetland and riparian vegetation, overflow, and Tulare Lake Basin inflow. There is a significant body of additional information and data that can provide a more detailed, "semi-quantitative" picture of the influence of these factors in the San Joaquin River Basin. TBI 1998 describes the historic hydrogeomorphical and ecological conditions of the San Joaquin River Basin and includes references that provide a more detailed description of these four factors. For example, Williamson et al 1998 develops a pre-development groundwater balance for the Central Valley and Mendenhall et al 1916 describes historic groundwater conditions including artesian conditions in the San Joaquin Valley, particularly along the San Joaquin River. Spot stream gauging was conducted on many of the rivers in the Basin in the latter part of the 19th –century including a comprehensive set of gauging by the office of the first State Engineer, William Hammond Hall (e.g. Hall 1886). Historic floodplain wetland and riparian extent in the San Joaquin Basin is mapped and described in TBI 1998 and the annual consumptive use of that vegetation was calculated for a pre-development water balance of the Central Valley for that report. 19th –century government surveys and reports, surveys, maps from early developers of the land along the San Joaquin River also provide a snapshot of hydro-geomorphic and vegetation conditions along the river. Sub-surface inflow from the Tulare Lake Basin is speculated in a 19th century report to have provided up to 1/3 of base flow in the San Joaquin River. An analysis of the Tulare Lake Basin hydrology and hydrography (ECORPS and TBI 2007) indicates that the north fork of the Kings River flowed into the San Joaquin River during higher runoff periods in most years. Tulare Lake is also estimated to have overflowed into the San Joaquin River in 19 out of the 29 years in the 1850-78 period and analysis of hydro-climatic records suggests that it would have overflowed into the San Joaquin River in about 40% of the years in the 20th century under unimpaired conditions. The relevant conclusion that is reached from these analysis and early descriptions for the difference between the unimpaired monthly Vernalis flow and an estimated "natural" Vernalis flow is that there is likely to have been increased surface and sub-subsurface inflow from the Tulare Lake Basin than indicated in the Vernalis unimpaired record (which is not an unimpaired flow but just the measured James Bypass flow), some attenuation of the higher runoff by overflow and consumptive use, and greater base flow particularly in the summer and fall because of the groundwater accretions, which the Vernalis unimpaired record does not capture.

2.3.1 Annual Flow Delivery and Inter-Annual Trends

a. Table 2-3 and the narrative on P. 12 indicate that WY 1995 actual flow was 18% of the unimpaired flow. Data in the table indicates that number should be 54%.

b. The statistics on Table 2-3 and the text on P. 12 do not align. E.g. the P. 12 text describes the median actual flow as 32% of the median unimpaired flow but that percentage is not displayed in the table since it is displaying the median of the annual differences as described in the footnote. Table 2-3 is somewhat confusing because it has both individual years and blocks of years whose percentages are calculated differently. Both are valid but could be presented more clearly.

c. The draft does not address the fact that since the mid-1950s a portion of the flow in the San Joaquin River is return flow from imported Delta water and thus not directly derived from San Joaquin Basin runoff. In non-wet years, much of the flow in the San Joaquin River at the Merced River confluence is imported water return flow (a smaller portion is derived from groundwater). The Delta return flow can potentially represent 20% to 30% of the annual runoff at Vernalis; e.g., in 2003 the flow from upstream of the Merced River represented 24% of the Vernalis runoff (TBI 2004). As noted below, the return flow is a significant part of the Vernalis base flow in the summer and fall months. The spreadsheets used for this analysis already show the difference between the actual Vernalis runoff and the sum of the East-side tributary runoff. That difference is the upper bound for the return flow in periods when there is no upper San Joaquin River or Kings River runoff into Mendota Pool or inflow from the tributaries upstream of the Merced. A large proportion of that difference is return flow from Delta imports.

2.3.2 Annual difference for equal periods and between periods

a. It is not clear why Figure 2-4 is showing the storage in the 3 rim dams excluding Friant and rim storage on the Fresno and Chowchilla Rivers when the comparison is to flow at Vernalis, which includes inflow from the whole Basin including runoff and storage upstream of the Merced.

b. The narrative on p. 16 states that the 1930-1955 period was slightly wetter than the 1984-2008 period. The data in Table 2-4 shows that the 1984-2009 period had slightly higher average runoff, more wet years but many more critical years, so the median runoff is quite a bit less.

c. The portrayal in Figure 2-5 of the alteration in flow with exceedance curves is a bit confusing because so much data is being presented and because the water years are based on the 60-20-20 classification. A simpler way to express the alteration in annual flow is to determine which of the 5 equal exceedance classes of unimpaired runoff in which the actual runoff would occur. In 61% of years in the 1930-2008 period the actual runoff is less than the unimpaired runoff that occurs in the lowest 20% of years. In 91% of the years the actual runoff is less than what occurs in 60% of the unimpaired runoff years. For the 1984-2008 period, in 64% or 16 out of the 25 years the runoff was less than the unimpaired runoff in the lowest 20% of the years. Thus for nearly 2/3 of the past 25 years the San Joaquin River at Vernalis has experienced on an annual basis what would be considered "drought" conditions in terms of unimpaired runoff (the actual runoff would be even less if only San Joaquin Basin runoff is considered and the volume of Delta-derived return flow was removed).

2.3.3. Seasonal trends

a. The seasonal alteration of San Joaquin River Basin runoff is greater than the monthly comparison of the actual to unimpaired runoff indicates. A significant portion of the base flow is frequently derived from return flow of imported Delta water, particularly in the summer and fall months. Recommend estimating return flow from Delta imports in order to calculate how much of the Vernalis actual flow is derived from San Joaquin Basin runof. When there is no upstream San Joaquin or Kings River inflow to Mendota Pool, much of the flow in the main-stem above the confluence of the Merced is derived from return flow from Delta imports; that flow is a large part of the difference between the observed Vernalis flow and the sum of the East-side tributary runoff already calculated in the spreadsheet. That difference can be up to 50% of the Vernalis flow in the summer and fall months. If the imported water return flow was removed from the Vernalis measured flow the reduction in San Joaquin Basin unimpaired runoff in the spring would be even greater and the late summer and fall month increase of the observed over the unimpaired flow would be less. Although it is not possible to quantify for this analysis, it is likely that the late summer and fall month unimpaired flow was higher under pre-development conditions because of higher groundwater accretions (and because of greater base flow from the prolonged snowmelt in the 19th century), which would further reduce the difference between the observed and unimpaired flows in those months. The reduction in water quality in those months is also most pronounced because of the high proportion of return flow in the later summer and fall months,

2.3.4. Short-term peak flows

a. The conclusion of this section that the large reservoir capacity in the Basin, especially in the recent period (1984-2009), has reduced the more frequent flood flows (1.5 to 5 year events) is well supported by the data. However, the finding that there may been lower winter peaks under natural conditions relative to the snowmelt peaks is not necessarily supported by the data from the 1930-55 period. The lower winter rainfall peaks relative to the snowmelt peak in the earlier 1930-55 period reflects the hydroclimatic differences in the two periods- the earlier period had less frequent high winter runoff events and a higher proportion of snowmelt runoff relative to the annual runoff. Under natural conditions the higher frequency winter peaks at Vernalis would have been attenuated by upstream floodplains not unlike current reservoirs attenuate the more frequent peak flows but the high snow level storms in more natural conditions would generate much higher winter peak flows than the snowmelt floods. It is generally accepted that global climate change could result in more frequent and higher winter peaks from warmer winter storms that current reservoir storage may not be able to attenuate.

b. The caption in Figure 2-7 indicates the graphs show data from WY 2007 although the graphs show data from WY 2008.

<u>2.4 Hydrology of major tributaries</u>

a. The second sentence in this section incorrectly states that the unimpaired flow at Vernalis is fed by the upper SJR only during wetter years. The upper SJR fed Vernalis flows in unimpaired conditions in all years. It should also be noted that the Vernalis unimpaired flows were fed by Tulare Basin runoff in about half of the years according to DWR data with significant runoff (>100 TAF) in about 1/3 of the years. Historical evidence suggests that under natural conditions the contribution of Tulare Basin surface water and groundwater to the San Joaquin River was a more frequent event.
b. This section should note the contribution of return flow from above the Merced River. Table 2-9 shows that on average 22% of the observed Vernalis flow comes the "remainder" of the Basin, much of which is from return flow.
c. Figure 2-9 should also compare the median unimpaired and observed contribution of the tributary flows to flows at Vernalis since the average reflects the influence of the very wet years.
d. It is not clear why 2009 was included in the tables and statistics for the tributary flows when all previous data analysis stopped at 2008.

<u>2.5 Hydrodynamics downstream of Vernalis</u>

P.32, line 5, should read "Negative OMR flows are now a regular occurrence…"

Chapter 5

This chapter is the most problematic portion of the draft. The simple methodology used to estimate potential water supply impacts leads to an unnecessarily unrealistic set of impact estimates due to a number of shortcomings:

- The draft focuses on sources of make-up water from the Merced, Tuolumne, and Stanislaus watersheds, in contradiction to the statement that the report is not addressing from where "the additional water will be provided within the SJR watershed; instead, the purpose is to demonstrate that water is physically available" If this statement is correct, then the analysis should look at all sources of inflow and diversions from the SJR watershed including inflow and diversions from the Fresno and Chowchilla Rivers, Bear and Mariposa Creeks, and the upper mainstem above the Merced River confluence.

- The draft technical report analyzes unimpaired and observed flows from the upper San Joaquin River in Chapter 2, but does not include flow contributions from the upper San Joaquin River in the water supply impact analysis. The CALSIM run used as a base case in the draft does not include the Friant settlement releases. The Bureau of Reclamation has recently completed CALSIM runs that incorporate the settlement releases along with the USFWS and NMFS RPAs which could be used as a base case run.

- The cost of meeting current salinity objectives is considered an impact, whereas meeting those requirements is actually part of the existing baseline condition.

- Load reduction requirements for salt, selenium and other constituents, which will make it easier to achieve salinity objectives, do not appear to be factored into the analysis.

In order to remedy these shortcomings, we recommend the following relatively simple methodological modifications, which provide more reliable conservative estimates:

a. First calculate the water "costs" of meeting the salinity standards (which are existing requirements rather than alternatives for consideration) and then layer the costs of meeting the flow objectives on top of that instead of the other way around as is currently done.
b. Develop a monthly accounting spreadsheet for the San Joaquin River Basin for a few selected recent years with measured and estimated data. Do the same "difference" accounting between unimpaired objectives and existing conditions. This spreadsheet could be used to effect simple shifting of flows (e.g. when CALSIM flows are higher than unimpaired requirement) in combination with simple reservoir reoperaton in order to more efficiently reduce impacts. These selected years could be compared with the same years in the CALSIM analysis to get a sense of how different it is from using CALSIM, which must make numerous simplifying assumptions.
c. Perform a sensitivity analysis on return flow assumptions.
d. Incorporate existing load reduction requirements into analysis to see if it would reduce water supply needs to meet existing salinity objectives.

The following more time-consuming refinements will need to be done eventually to better quantify water supply and economic impacts:

a. CALSIM runs that would optimize existing reservoir and water supply systems to achieve downstream objectives while minimizing water costs.
b. Use of additional other models such as CALVIN in order to optimize system to achieve requirements while minimizing water supply and economic impacts

c. Analysis of agricultural land use to get a more refined estimate of return flows and their effect on salt loading.
d. Analysis of effects of increased groundwater pumping on accretions and depletions.

The following comments and questions refer to specific sections in Chapter 5.

5.2 CALSIM SJR Model
a. Why does the baseline CALSIM not meet salinity objectives? How often are salinity objectives not met?

5.3 Estimating Additional Flow Needed for Alternatives
a. Information on how often the CALSIM flow is higher than the different flow objectives should be included.
b. Why is additional water for meeting the objectives restricted to the Stanislaus, Tuolumne, and Merced Rivers? Why are diversions and return flows from the entire watershed including the portion of the watershed above the Merced not included? In particular why is the west-side of the San Joaquin unaffected in the water supply impact analysis for the salinity objectives even though salinity loading from below Lander Ave is included in CALSIM.
c. There is no discussion of how loading reductions could help meet salinity objectives and reduce the water supply impact.

5.4 Water Supply Impact Analysis
a. It is not clear how salinity objectives in October through January are met.
b. Should explain if there is any on-the ground information from the watershed to support the assumption about the proportional reductions in return flow and the application of an additional 50% reduction of the remainder or is it simply an assumption to achieve the purpose of a very conservative impact analysis.
c. Could the return flow reductions decrease salt loading enough to reduce the water supply needed to achieve the salinity objective?
d. Table 5-4 – It is not clear why the total reductions are not equal to the sum of meeting the flow and salinity objectives.

Contribution of upper San Joaquin River restoration flows

The draft technical report analyzes unimpaired and observed flows from the upper San Joaquin River in Chapter 2, but does not appear to include flow contributions from the upper San Joaquin River in the analysis in Chapter 5. As discussed briefly in the report (see page 40), the San Joaquin River Restoration Program establishes a schedule of releases from Friant Dam to meet instream flow requirements at various points above the Merced River. Restoration Flows that go pass the Merced River are required by the settlement to be protected by the Bureau from illegal diversion. The Water Management Goal's intent to develop a plan to recirculate Restoration Flows downstream of the Merced may at times result in diversion of flows. However, Paragraph 16(a)(1) of the settlement prohibits diversion and recirculation of restoration flows downstream of the Merced if doing so would negatively impact either downstream water quality or fisheries. Given the chronically impaired water quality conditions and the need to significantly improve habitat condition for salmon and other fish it is reasonable to assume that Restoration Flows will largely be ineligible for diversion and recirculation most times of the year until the flows reach the Delta unless and until adequate flows and water quality are achieved downstream. As such the technical report should be updated to include these release schedules. In addition, while the settlement and associated restoration flows resolved the legal claims regarding instream flow needs for salmonids between Friant Dam and the junction with the Merced River, neither the Settlement nor the Settlement Act preempts State law or modifies the obligation of the Bureau of Reclamation to operate the CVP in compliance with state law. See P.L. 111-11, Title X, Subtitle A, Part I, § 10006(b).

In summary, we recommend that the Board augment the draft's generally excellent discussion of hydrologic and biological factors relating to San Joaquin River flow objectivesto include information on additional species, species viability criteria, species life history timing, and sources of hydrologic alteration as described above. We also recommend that the Board substantially revise the water supply impact analysis to include all potential sources of inflow and mitigating factors such as load reductions before using this analysis in the consideration of alternative flow objectives.

We look forward to working with the Board to identify and adopt more fully protective San Joaquin River flow objectives in the Bay-Delta Water Quality Plan. Please contact us if you have any questions regarding our comments.

Sincerely,

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