Public Comment
Bay Delta Plan Workshop 3
Deadline: 10/26/12 by 12:00 noon

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10-26-12
SWRCB Clerk

CLOSING COMMENTS RELATING TO THE 2012 WORKSHOPS ON THE COMPREHENSIVE (PHASE 2) REVIEW AND UPDATE TO THE BAY-DELTA PLAN

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AND

RECOMMENDATIONS RELATING TO WORKSHOP 3 (ANALYTICAL TOOLS FOR EVALUATING WATER SUPPLY, HYDRODYNAMIC AND HYDROPOWER EFFECTS)

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Submitted to:

STATE WATER RESOURCES CONTROL BOARD

On behalf of:

NATURAL RESOURCES DEFENSE COUNCIL
THE BAY INSTITUTE

October 26, 2012

I. Closing Comments, Part One: Public Trust, Balancing, and Program of Implementation Issues That Must Be Addressed in Amending the Bay-Delta Plan

During the current review by the State Water Resources Control Board (Board) of the Bay-Delta Water Quality Control Plan ("Plan" or "Bay-Delta Plan"), questions have been raised regarding the Board's obligations under the public trust doctrine and other statutory requirements. In the first section of these closing comments for the 2012 Phase 2 workshops, we attempt to address these questions. In summary, the Board must ensure that the Bay-Delta Plan:

- Protects public trust resources to the extent feasible.
- Complies with the Board's obligation to conserve listed fisheries under the California Endangered Species Act.
- Discharges the Board's obligation to achieve the salmon doubling narrative objective.
- Considers alternative water supplies and the economic benefits of fishery protection in determining how to balance between competing beneficial uses and what water quality objectives are feasible and reasonable.

1. <u>The State Water Resources Control Board Must Ensure that the Bay-Delta Plan Protects Public Trust Resources to the Extent Feasible</u>

The promulgation of water quality standards for the Bay-Delta requires the Board to "establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance." Cal. Water Code § 13241. In addition, in establishing water quality standards for the Bay-Delta the Board must also protect public trust resources "whenever feasible." *See National Audubon Society v. Superior Court*, 33 Cal.3d 419, 446 (1983); *State Water Resources Control Board Cases*, 136 Cal.App.4th 674, 777-78 (2006). As the Board has recognized in prior decisions,

> The State Water Resources Control Board has broad authority to establish minimum flows and take other measures needed for protection of fisheries and other public trust resources. That authority is provided by article X, section 2 of the California Constitution, Water Code sections 100 and 275, the public trust doctrine as articulated by the California Supreme Court in *National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419 [189 Cal. Rptr. 346], and Water Code sections 1243 and 1253**.**

SWRCB Decision 1644 at p. 29. As the Board further recognized in that decision,

> The purpose of the public trust is to protect navigation, fishing, recreation, fish and wildlife habitat, and aesthetics. (*National Audubon Society v. State Water Resources Control Board, supra,* 33 Cal.3d at 434-435, 437 [189 Cal. Rptr. at 356, 358]; cert. denied, 464 U.S. 977.) Fish and Game Code section 5937 is a legislative expression concerning the public trust doctrine that should be taken into account when the SWRCB acts under its public trust authority. (See

> C*alifornia Trout, Inc. v. State Water Resources Control Board* (1989) 207 Cal.App.3d 585, 626, 631 [255 Cal. Rptr. 209, 212].)
>
> In applying the public trust doctrine, the State has the power to reconsider past water allocations even if the State considered public trust impacts in its original water allocation decision… **The State has the duty of continuing supervision over the taking and use of appropriated water and an affirmative duty to protect public trust uses whenever feasible**. (*National Audubon Society v. Superior Court*, *supra,* 33 Cal.3d at 445-448).

Id. at 30-31, emphasis added; *see* SWRCB, Decision1631, at 11 ("The *Audubon* decision establishes that the SWRCB has the additional responsibility to consider the effect of water diversions upon interests protected by the public trust and to avoid or minimize harm to public trust uses to the extent feasible.").

In exercising its duties, the Board must respect the rule of priority and other statutory protections for water rights, but even those rules must yield if they conflict with the public trust or reasonable use doctrines. *El Dorado Irr. Dist. v. State Water Res. Control Bd*., 142 Cal.App.4th 937, 944 (2006) ("Although the rule of priority is not absolute, the Board is obligated to protect water right priorities unless doing so will result in the unreasonable use of water, harm to values protected by the public trust doctrine, or the violation of some other equally important principle or interest."); *see id*. at 966 ("Thus, like the rule against unreasonable use, when the public trust doctrine clashes with the rule of priority, the rule of priority must yield. Again, however, every effort must be made to preserve water right priorities to the extent those priorities do not lead to violation of the public trust doctrine.").

2. <u>The Board Must Consider Water Conservation, Water Recycling, and Other Alternative Water Supplies Which are Available to Municipal, Industrial, and Agricultural Water Users in Determining the Feasibility of Protecting Public Trust Resources and the Reasonability of Water Quality Objectives that Protect Instream Beneficial Uses</u>

As the Board considers economic factors and competing beneficial uses of water in determining the reasonable protection of beneficial uses and the extent to which protection of public trust resources is feasible, the Board must also consider the ability and need to develop alternative water supplies, including recycled water[1], to meet other beneficial uses, such as municipal and agricultural uses. *See* Cal. Water Code § 13241(f).

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[1] *See, e.g.,* Water Code § 13511 ("The Legislature finds and declares that a substantial portion of the future water requirements of this state may be economically met by beneficial use of recycled water."); Water Code §§ 13510-13512, 13550 *et seq*. (legislative policy encouraging water recycling, directing the state to take "all possible steps" to encourage development of water recycling facilities, and finding certain uses of potable water unreasonable if recycled water is available that meets certain criteria).

Aquatic life is the least flexible use of the Bay-Delta's waters. The establishment and maintenance of sustainable fish and wildlife populations, habitats and ecological processes is highly dependent on maintaining adequate flow, temperature, and water quality conditions in the estuary. The populations and ecosystems of the Bay-Delta are naturally resilient, of course. The formal listing of numerous fish species as endangered, the unprecedented closure of the commercial salmon fishery, and the systemic decline in both ecosystem values and public recreational uses of the Bay-Delta's waters demonstrate, however, that this natural resilience has been exceeded as a result of large-scale hydrologic alteration in recent decades. Fish and wildlife beneficial uses entrusted to the Board's care are in danger of disappearing forever.

Native fisheries and other public trust resources in the Bay-Delta must rely exclusively on the waters of the estuary for their existence. In contrast, there are cost-effective, environmentally superior alternative water supplies available for municipal, industrial, and agricultural beneficial users of water from the Delta (as discussed in detail in the recommendations relating to Workshop 3 contained in Section II.1 below). These important beneficial uses of water have greater flexibility as a result of water users, water managers, and regulatory agencies such as the Board being able to implement a broad suite of management actions to more efficiently divert, store, and apply water supplies; secure water supplies from alternative sources; and/or switch to different activities to maintain economic viability. The Board must take these potential alternative water supplies into account when balancing competing beneficial uses and determining what level of public trust protection is feasible.

The Board has considered the availability of alternative water supplies in past Bay-Delta plans and in other proceedings. In 1978, the Board waived salinity protections in Antioch based on a determination that adequate substitute water supplies were available for municipal and industrial customers. SWRCB Decision 1485 at pp. 16-17.[2] In addition, in D-1485 the Board cautioned that future requests by the SWP and CVP to increase diversions or transfer water would be subject to careful scrutiny of the conservation and wastewater recycling programs in the service areas:

> "However, in its review of applications for additional appropriations by the CVP and SWP or of proposed transfer of water utilizing CVP and SW facilities, the Board will review conservation and wastewater reclamation programs in the proposed service areas to ensure that these additional water resources will be used in the most efficient manner possible consistent with the general public interest. Unappropriated water in California is an increasingly short, precious resource. As greater demands are made on a more limited unclaimed supply, the Board must scrutinize proposed uses more intensely than ever before to ensure that vested water rights and the public interest are protected."

[2] Because Antioch's water rights were protected under the Delta Protection Act (Water Code section 12202), the Department of Water Resources was obligated to pay for these substitute rights and ensure that they were of like quality and quantity. *Id*.

SWRCB Decision1485 at pp. 18-19. Similarly, in Decision 1631, in considering the impacts of reduced water supply from protection of public trust resources, the Board explicitly acknowledged that, "[a] number of alternatives are available to LADWP to help offset water losses from the reduction of Mono Basin exports," including local groundwater, water conservation, water recycling, other surface supplies, and transfers. SWRCB Decision1631 at 165-168. The Board determined that the focus of the economic analysis is whether the economic costs make adoption of the decision feasible, and concluded that neither the water supply nor power supply costs made the protections infeasible and that there would be sufficient water to meet municipal needs of Los Angeles when diversions are restricted. *Id*. at 176-177.

In recent years the Board has mandated improved water use efficiency and other measures as conditions for approving changes to water rights. *See, e.g.,* Order WR 2009-0034-EXEC (Order approving temporary urgency change for Sonoma County Water Agency, which includes conditions limiting irrigation of commercial turf grass (condition #13), establishing water efficiency goals (condition #15), and development of development of water conservation plans (condition #16-17)). The Board has substantial constitutional and statutory authority to establish conditions on the water rights of the CVP, SWP, and other diverters that mandate improved water use efficiency, investments in water recycling and other alternative water supplies, and avoid waste and unreasonable use of water in their service areas. This authority stems from the public trust doctrine, from federal and state statute, from the express conditions on existing water rights, and from the constitutional requirement prohibiting waste and unreasonable use of water. The mandatory terms and conditions included in every water rights license or permit explicitly preserves the Board's authority to require the permittee or licensee to implement a water conservation plan, which may include water recycling or efficiency measures.[3] *See* SWRCB, Mandatory License Terms, available at: http://www.swrcb.ca.gov/waterrights/water_issues/programs/permits/terms/license/mandatory.pdf, last accessed October 11, 2012. While the Board may determine it is unnecessary to include mandatory terms imposing specific conservation, recycling, and

[3] "The continuing authority of the State Water Board may be exercised by imposing specific requirements over and above those contained in this license with a view to eliminating waste of water and to meeting the reasonable water requirements of licensee without unreasonable draft on the source. Licensee may be required to implement a water conservation plan, features of which may include but not necessarily be limited to: (1) reusing or reclaiming the water allocated; (2) using water reclaimed by another entity instead of all or part of the water allocated; (3) restricting diversions so as to eliminate agricultural tailwater or to reduce return flow; (4) suppressing evaporation losses from water surfaces; (5) controlling phreatophytic growth; and (6) installing, maintaining, and operating efficient water measuring devices to assure compliance with the quantity limitations of this license and to determine accurately water use as against reasonable water requirement for the authorized project. No action will be taken pursuant to this paragraph unless the State Water Board determines, after notice to affected parties and opportunity for hearing, that such specific requirements are physically and financially feasible and are appropriate to the particular situation."

other investments in water rights and/or the program of implementation, the Board has authority to do so and has done so in recent years.

This approach also is consistent with the requirements of the 2009 Delta Reform Act. That Act reiterated that, "[t]he longstanding constitutional principal of reasonable use and the public trust doctrine shall be the foundation of state water management policy and are particularly important and applicable to the Delta." Water Code § 85023. Likewise, that Act established co-equal goals of "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem" in a manner that protects and enhances the unique values of the Delta and its communities. Water Code § 85054. And in order to provide a more reliable water supply, the Legislature mandated that,

> The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

Cal. Water Code § 85021.

Finally, the physical solution doctrine also compels the Board to consider alternative water supplies in promoting maximum beneficial use of the State's water resources:

> "In resolving disputes involving competing uses of water, California courts have frequently considered whether there is a "physical solution" available by which competing needs can best be served. (*Peabody v. Vallejo*, 2 Cal.2d 351, 383-384 [40 P.2d 4861 (1935); *City of Lodi v. East Bay Municipal Util. Dist.*, 7 Cal.2d 316 [60 P.2d 4391 (1936).) Adoption of a physical solution is consistent with the constitutional goal of promoting maximum beneficial use of the State's water resources."

SWRCB Decision 1631 at p.10. Under the physical solution doctrine, the Board can require habitat restoration or similar measures to protect public trust resources. *Id*. at 118 ("Thus, as part of a physical solution allowing for diversion of water for municipal use, LADWP can be required to undertake waterfowl habitat restoration measures. Waterfowl habitat restoration can serve to restore public trust uses while requiring a smaller commitment of water.").[4] Equally important, the physical solution doctrine must also include consideration of the development of alternative water supplies, such as conservation and recycling, where such a physical solution can be used to reasonably and feasibly advance protection of public trust resources and the consumptive

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[4] Such measures can be included in the program of implementation, and the obligations can be made enforceable through the water rights proceeding to implement the Plan.

demand for water. The Board has broad authority to require the development of alternative water supplies as a physical solution to reduce conflicts between such uses of water.

Thus, state law requires the Board to consider these alternative supplies in balancing between competing beneficial uses, in determining what measures are "feasible" to protect public trust resources, and in considering a physical solution to protect public trust resources and other beneficial uses of water.

3. The Board's Discretion in Balancing Protections for Public Trust Fishery Resources Has Been Constrained by CESA and other Legislative Enactments

The courts have previously determined that the SWRCB's balancing of competing beneficial uses is constrained by legislative enactments such as sections 5937 and 5946 of the Fish and Game Code, which are specific legislature rules concerning the public trust. *California Trout, Inc. v. State Water Resources Control Bd.*, 207 Cal.App.3d 585, 622-625, 631 (1989); *California Trout, Inc. v. State Water Resources Control Bd*., 218 Cal.App.3d 187, 195 (1990). According to the Court of Appeal, in its 1989 decision, "[w]e concluded that, by the enactment of section 5946, the Legislature had resolved the competing claims for the beneficial use of water in these streams in favor of preservation of their fisheries." *California Trout, Inc.*, 218 Cal.App.3d at 195; *see also* SWRCB Decision 1631 at 12. While the court recognized that the legislature's authority was not unlimited and was subject to the constitutional limitations of reasonable use, the court recognized that the legislature has substantial authority to define the balance between competing beneficial uses. *California Trout, Inc.*, 207 Cal.App.3d at 625. Subsequently, the Board explicitly found that compliance with section 5937 and 5946 of the Fish and Game Code is not subject to balancing, concluding that these protections are mandatory and that, "[f]lows needed to reestablish and maintain the fishery are not subject to reduction due to economic cost." SWRCB Decision1631 at 172.

The Legislature has similarly resolved the question of balancing in favor of protecting threatened and endangered species under the California Endangered Species Act ("CESA").[5] Among competing beneficial uses, the legislature has afforded priority for protecting species listed under CESA, and the legislature has required state agencies to act to conserve listed species and to prevent their extinction. Fish and Game Code §§ 2050 et seq; *see esp. id*. §§ 2052, 2053, 2055. In past water rights decisions, the Board has recognized that CESA requires the Board to act to conserve listed species: "Thus, in exercising authority over water rights in the lower Yuba River, the California Endangered Species Act **requires** the SWRCB to seek to conserve spring-run Chinook salmon." SWRCB Decision 1644 at p. 27 (emphasis added).[6] As with section 5937, in

[5] As discussed infra, the Legislature has also expressed the primacy of protecting salmon in enacting the salmon doubling requirement in 1989 as part of the Salmon, Steelhead Trout, and Anadromous Fisheries Program Act. Cal. Fish and Game Code §§ 6900 *et seq*.
[6] In addition, applicants for water rights and for permits to change the point of diversion, purpose of use, or place of use must demonstrate compliance with the federal endangered species Act and the requirements of the Fish and Game Code. Cal. Water Code §§ 1275(b), 1701.3(b)(2).

enacting CESA the legislature has "resolved the competing claims for the beneficial use of water in these streams in favor of preservation of their fisheries." *See California Trout, Inc.*, 218 Cal.App.3d at 195. The Board lacks authority to disregard that rule. *California Trout, Inc.*, 207 Cal.App.3d at 631 ("We agree with the Water Board that the mandate of section 5946 is a specific legislative rule concerning the public trust. Since the Water Board has no authority to disregard that rule, a judicial remedy exists to require it to carry out its ministerial functions with respect to that rule. The Legislature, not the Water Board, is the superior voice in the articulation of public policy concerning the reasonableness of water allocation.").

While some may argue that Water Code section 106 establishes an absolute priority for municipal uses of water, the Supreme Court has acknowledged that "these policy declarations must be read in conjunction with later enactments requiring consideration of in-stream uses (Wat. Code, §§ 1243, 1257, quoted ante at pp. 443-444) and judicial decisions explaining the policy embodied in the public trust doctrine. Thus, neither domestic and municipal uses nor in-stream uses can claim an absolute priority." *National Audubon Society*, 33 Cal. 3d at 448 n. 30. The Supreme Court did not address the priority afforded to resource protection under CESA in *National Audubon Society*, but has elsewhere acknowledged CESA's priority:

> Bay–Delta ecosystem restoration to protect endangered species is mandated by both state and federal endangered species laws, and for this reason water exports from the Bay–Delta ultimately must be subordinated to environmental considerations. The CALFED Program is premised on the theory, as yet unproven, that it is possible to restore the Bay–Delta's ecological health while maintaining and perhaps increasing Bay–Delta water exports through the CVP and SWP. If practical experience demonstrates that the theory is unsound, Bay–Delta water exports may need to be capped or reduced.

In Re Bay-Delta Programmatic Environmental Impact Report Coordinated Proceedings, 43 Cal.4th 1143, 1168 (2008). Unfortunately, the past decade has made clear that this theory was unsound, existing CESA and ESA permits require substantial additional protections for listed species, and the Board has already determined that, "The best available science suggests that current flows are insufficient to protect public trust resources." SWRCB 2010 at 2.

In addition, the Bay-Delta Plan must also meet the requirements of the federal Clean Water Act. Federal regulations under the Clean Water Act require that states must adopt water quality criteria which protect designated uses, and "[f]or waters with multiple use designations, the criteria shall support the most sensitive use." 40 CFR § 131.11(a).[7] This federal regulation also precludes the Board from failing to provide adequate protections for listed native fish species in

[7] In addition, in reviewing the Bay-Delta Plan EPA must consult with the U.S. Fish and Wildlife Service and National Marine Fisheries Service under section 7 of the Endangered Species Act. As a result, the Plan must avoid jeopardy to federally listed species and be consistent with protections afforded to federally listed species

the Delta (the Preservation of Rare, Threatened, or Endangered Species (RARE) beneficial use in the 2006 Bay-Delta Plan), which is typically the most sensitive use.

As a result, the Board must at a minimum adopt flow and other objectives in the Bay-Delta Plan that are consistent with the conservation of listed species under CESA. But the Board should achieve more than minimal compliance with CESA, both with respect to listed species as well as to provide adequate protection for species, such as fall run Chinook salmon, that are not listed under CESA but support major commercial and recreational fisheries and/or are species of concern whose populations have declined over time. This is consistent with the co-equal goals of the Delta Reform Act, the public trust doctrine, and salmon doubling requirements; the co-equal goals do not preempt, override, or affect CESA, the Fish and Game Code, the Porter-Cologne Water Quality Control Act, section 1702 of the Water Code, the public trust doctrine, CEQA, water rights, or several other enumerated laws. Cal. Water Code § 85032.[8] Instead, the co-equal goals make restoration of fish and wildlife beneficial uses in the Delta of equal concern to improving water supply reliability.

4. <u>The Board Must Consider Economic Benefits of Protecting Public Trust Fishery Resources in Determining the Reasonableness of Water Quality Objectives</u>

As the Board considers economic factors and other beneficial uses in determining what objectives to protect fish and wildlife beneficial uses in the Bay-Delta are reasonable, Cal. Water Code § 13241, and what protections for public trust resources are feasible, *National Audubon Society,* 33 Cal.3d at 446, the Board cannot limit its analysis to economic costs, but must also consider the economic benefits of improved flows for public trust resources. These economic benefits include:

- The economic value of sustaining and restoring commercial and recreational fisheries for salmon, crab, starry flounder, sturgeon, and numerous other native species that depend upon the Delta. Together, these fisheries contribute at least hundreds of millions of dollars each year to local and state economies and support thousands of jobs.
- The economic value of recreational activities in the Delta, such as bird watching or duck hunting, which depend upon a healthy Delta ecosystem. In 2011, the U.S. Fish and Wildlife Service estimated that 26% of Californians participated in hunting, fishing, or wildlife dependent recreation (such as birdwatching), and that statewide, these activities resulted in more than $7 billion in total expenditures. The Board should invite the Delta Protection Commission, other local and state agencies, and other economists to provide detailed information and estimates of the economic value of wildlife dependent recreation in the Delta.
- The monetary value of a healthy Delta ecosystem, including recovery of listed fish species. David Sunding has presented preliminary results of a contingent valuation methodology for the Bay Delta Conservation Plan, which showed that the non-use value of restoring the Delta ecosystem ranges from a present value of $12 billion to $53

[8] The Delta Reform Act also explicitly preserves area of origin, watershed of origin, water rights priorities, and several other provisions of the water Code. Cal. Water Code § 85031.

billion.[9] His analysis shows that the present non-use value of restoring the Delta is greater than the present value of a 20% reduction in water exports from the Delta, and may be worth three times as much as a 20% reduction in water exports from the Delta. Given the importance of adequate flows to restoring the health of the Delta ecosystem, these estimates should apply equally to the Board's weighing of economic benefits of improving flow conditions in the Bay-Delta.

- The economic value of agriculture in the Delta, to the extent that protections for fishery resources are consistent with and help protect agricultural uses in the Delta.
- Improved reliability of water supplies over the longer term in terms of reduced conflicts with species protections and avoiding future endangered species act listings.
- Other economic values that are consistent with ecosystem protection of the Delta, such as the value of protecting export water quality (reduced water quality treatment costs).

Of course, economic considerations do not trump the responsibility to protect public trust resources or meet other legal requirements. *See* Brian Gray, *Ensuring the Public Trust*, 45 U.C. Davis L. Rev. 973, 990 ("if the consumptive use threatens significant harm to public trust uses, the public trust may take precedence — even at substantial cost to the consumptive water user." (citations omitted)); SWRCB Decision 1631 at 176-180 (increased costs of developing alternative water supplies was feasible and did not prevent implementation of protection of public trust resources). As the Board concluded in 1994, the focus is in determining "whether the economic costs of this decision [to protect public trust resources] make its adoption infeasible." SWRCB Decision1631 at 176-77. And where the legislature has acted to constrain the Board's discretion, the Board has recognized in past decisions that economic considerations cannot outweigh meeting those statutory mandates. SWRCB Decision 1631 at 172; *see* pages 7 through 9, *infra*. This is particularly true when a physical solution, such as the development of water recycling facilities or improved water use efficiency, is feasible and minimizes conflicts between protection of public trust resources and other beneficial uses of water.

5. <u>The Water Quality Control Plan and Program of Implementation Must Demonstrate How Salmon Doubling and Other Objectives Will be Achieved</u>

Under state law, the Board must determine what flows and other actions are necessary to achieve salmon doubling and other water quality objectives that are adopted in the Bay-Delta Plan. Water Code §§ 13050(j)(3), 13242(a); *In re State Water Resources Control Board Cases*, 136 Cal.App.4th 674, 775 (2006) ("Determining what actions were required to achieve the narrative salmon protection objective was part of the Board's obligation in formulating the 1995 Bay–Delta Plan in the first place.").

For more than two decades, both state and federal law have required the State and Federal governments to take action to double natural production of native salmon populations. Cal. Fish

[9] Sunding's analysis is available online at: http://baydeltaconservationplan.com/Files/June%202012%20Public%20Meeting%20Presentation%206-20-12.pdf (*see* slides # 51-54).

and Game Code §§ 6900 *et seq*; Central Valley Project Improvement Act, § 3406(b)(1) of P.L. 102-575. Consistent with these statutory requirements, the 1995 Bay-Delta Plan included a narrative objective of salmon doubling, which reads: "Water quality conditions shall be maintained, together with other measures in the watershed, sufficient to achieve a doubling of natural production of Chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law." In the 1995 Plan, and again in the 2006 Plan, the State Board recognized that non-flow measures could contribute to meeting the salmon doubling objective, and in the 2006 Plan the Board identified several such measures.

In the 1995 Plan, the Board acknowledged uncertainty as to whether the measures would be sufficient to achieve the objective, and in the 2006 Plan the Board found that "D-1641 did not require separate actions to implement the narrative objective for salmon because the State Water Board expects that implementation of the numeric flow-dependent objectives and other non-flow measures will implement this objective." 2006 Plan at 33. In both plans, the Board stated that monitoring results and studies would be used to evaluate achievement of this objective and to develop additional or revised numeric objectives. 1995 Bay-Delta Plan at 29; 2006 Plan at 33.

Unfortunately, it is clear that the specific flow objectives in the plan and those other measures were not sufficient to achieve the salmon doubling objective, as salmon populations have continued to decline and are further from achieving the doubling goal than when the CVPIA was enacted twenty years ago. While salmon doubling will not be achieved solely by improving flow conditions, there is substantial evidence that the existing flow requirements in the 2006 Plan are not sufficient to achieve salmon doubling. As a result, the Board must ensure that the updated plan and program of implementation include flow and other measures that will achieve salmon doubling. As the Court of Appeal noted in 2006,

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

In re State Water Resources Control Board Cases, 136 Cal.App.4th at 777. There is sufficient scientific evidence showing that greater flows and other protections are needed to achieve the narrative salmon doubling objective, in terms of Vernalis inflow as well as Sacramento River inflow, outflow, and cross-delta flows / export restrictions.

6. <u>Conclusion</u>

The Board faces substantial challenges in meeting its responsibility to preserve fish and wildlife beneficial uses, protect the public trust, conserve endangered fish species and commercial and recreational fisheries, double salmon populations, and contribute to more reliable water supplies by investments in water recycling, conservation, and other regional tools. But the Board also has a significant opportunity before it, to place California on a path to restoring one of the largest and most unique estuarine ecosystems in the world to some measure of health and resilience and on a path to creating a more sustainable water supply that can support a growing population and economy. Finally, the Board has substantial authority to realize these goals, and a legal and ethical mandate to wield that authority. We look forward to working with the Board to ensure that the Bay-Delta Plan achieves these legal requirements and protects public trust resources, and the jobs, economies, and quality of life that depend on them.

II. Recommendations Relating to Workshop 3: Analytical Tools for Evaluating the Water Supply, Hydrodynamic, and Hydropower Effects of the Bay-Delta Plan

This section directly addresses the two major questions posed as topics for discussion in Workshop 3:

- What types of analysis should be completed to estimate the water supply, hydrodynamic, and hydropower effects of potential changes to the Bay-Delta Plan? and
- What analytical tools should be used to evaluate those effects?

Our recommendations are focused on the tools and analytical components the Board should consider in an impact analysis of potential changes to the Plan that can be done in a relatively short period of time (i.e., in order to support adopting Plan amendments by mid-2014) and which best reflect the many adaptations that water users and hydropower producers can and will employ in response to new requirements and a changing climate. While there are a number of models and tools that the Board should consider, the Board should be aware of and work to address the limitations of these models, particularly ones that were developed to address questions very different from the ones being asked by the Board. Even though time constraints may force the Board to employ monthly models that are sub-optimal for the task, no one model should be relied upon for the water supply impact. The Board should consider employing screening models, simulation and optimization models, as well daily or weekly spreadsheet-based models.

1. Evaluate Alternative Water Supplies and Incorporate Them Into the Modeling of Changes to the Bay-Delta Plan

The Board should analyze the full range of water supply management tools including water recycling, improved conservation and efficiency, conjunctive use, transfers, etc., that water users could use to adapt to and mitigate the impacts of changing circumstances, including new Plan requirements. These water supplies and management options should be incorporated into the modeling to fully assess the impacts of changes to the Plan.

a. Increased Investments in Water Efficiency, Recycling, and Other Alternative Water Supply Strategies and Tools Can Yield Significant New Water

Increased water use efficiency, alternative water supplies, and smarter water management offer substantial opportunities to increase California's water supply and decrease demands for water diversions from the Bay-Delta. Based on statistics from the Department of Water Resources' 2009 State Water Plan and supporting documents, documents produced by the State Water Resources Control Board, and research conducted by NRDC and the University of California, Santa Barbara, alternative water supplies and water use efficiency could conservatively result in an additional 6.12 million acre-feet of water per year, state wide, by the year 2030. Based on the conservative estimates outlined below, alternative water supplies could produce significantly more water than current average diversions from the Sacramento-San Joaquin Delta. These alternative water supplies come in the form of agricultural water use efficiency, urban water use efficiency, groundwater, recycled water, and urban stormwater capture (also referred to as low impact development), and in many cases can be more cost effective and more reliable in the long term than Delta supplies. Below we identify additional information and resources for the Board's update of the Bay-Delta Plan.

i. Agricultural Water Use Efficiency

According to CALFED's 2006 Water Use Efficiency Comprehensive Evaluation, on-farm and water supplier recoverable and irrecoverable flow reductions could range from .33 million acre-feet to 3.96 million acre-feet by 2030, depending on investments and funding.[i] In terms irrecoverable flows, CALFED estimates that flow reductions could range from .034 to .888 million acre-feet per year. CALFED estimates that regulated deficit irrigation flow reductions will be 0.142 million acre-feet. In the 2009 State Water Plan Update, DWR chose to use an annual irrecoverable flows water savings of .888 million acre-feet per year for planning purposes. Combined with regulated deficit irrigation flow reductions that yields an annual savings of 1.03 million acre-feet per year. In addition to DWR's estimates, others have estimated significantly higher potential water savings from improved agricultural water use efficiency.

ii. Urban Water Use Efficiency

Urban water use efficiency has the potential to greatly reduce demand for Delta water.[ii] The state estimates that potential reductions in demand from SB 7x7 compliance alone are 1.59 million acre-feet annually by 2020. According to a 2006 CALFED evaluation, the total annual technical potential for 2030 urban water savings is about 3.1 million acre-feet per year. This technical potential does not include advances in water-saving technology, which could lead to even higher levels of efficiency savings.[iii] Los Angeles Department of Water estimates that the unit cost for conservation is in the range of $75-900 per acre-foot, depending on the costs of conservation rebates, hardware installation, and incentive programs and their potential water reductions.[iv] Inland Empire Utilities Agency estimates that their conservation programs cost $69-1094 per acre foot.[v]

iii. Urban Stormwater Capture

A technical analysis conducted by NRDC and UCSB found that implementation of low impact development practices that emphasize rainwater harvesting has the potential to increase local water supplies by up to 405,000 acre-feet of water per year by the year 2030.[vi] Expanding the use of low impact development to industrial, government, public use, and transportation development and redevelopment in southern California has the potential to yield an additional 75,000 acre-feet of savings per year by 2030. Low impact development is a cost-effective alternative water supply – the U.S. Environmental Protection Agency states that "LID practices can reduce project costs and improve environmental performance" of development and that, with few exceptions, low impact development has been "shown to be both fiscally and environmentally beneficial to communities."[vii] According to the State Water Resources Control Board's Recycled Water Policy, the State Board has adopted the goal of increasing the use of stormwater over 2007 use by at least 0.5 million acre-feet per year by 2020, and at least one million acre-feet per year by 2030.[viii] Los Angeles Department of Water and Power has estimated that the unit costs of advanced urban runoff management range from $60 per acre-foot for centralized stormwater capture, to $4,044 per acre-foot for urban runoff plants. LADWP estimates that the cost of rain gardens ranges from $149-1,781 per acre foot, and water from rain barrels and cisterns ranges in cost from $2,326 to $2,788 per acre foot.[ix]

iv. Recycled Water

DWR's 2009 State Water Plan Update estimates that 0.9 million to 1.4 million acre-feet of "new water" could be created by 2030 by recycling municipal wastewater that is discharged into the ocean or saline bays. Statewide, there is an estimated potential supply of about 1.85 to 2.25 million acre-feet of water that could be realized by the year 2030.[x] The State Board has adopted a recycled water use target of at least one million acre-feet per year by 2020, and at least two million acre-feet per year by 2030.[xi] When considering both capital and O&M costs to expand Los Angeles Department of Water and Power's recycled water system to achieve water recycling targets, LADWP estimates that the present value per acre-foot of recycled water over a 50-year life cycle analysis results in a blended cost of $1,100 per acre-foot.[xii] A sampling of the operational costs of the existing recycled water projects in San Diego County show costs ranging from $1,259-1,662 per acre-foot.[xiii] The unit cost of the current Orange County Water District Groundwater Replenishment indirect potable reuse water is $1,299 per acre-foot, including the cost of extraction.[xiv] In addition to municipal wastewater recycling, recycling of a variety of waste streams, including brackish groundwater, agricultural drain water, produced oil water, and municipal greywater, can significantly increase the water supplies in the Central Valley and export regions..

v. Conjunctive Groundwater Management

According to DWR's 2009 State Water Plan Update, conservative estimates of additional implementation of conjunctive management of groundwater resources indicate the potential to increase average annual water deliveries by 0.5 million acre-feet throughout the state. More ambitious estimates indicate the potential to increase average annual water deliveries by two million acre-feet per year.[xv]

b. The Board Should Consider Alternative Water Supply Strategies and Tools in Evaluating Potential Water Supply, Economic and Employment Consequences of Changes to the Plan

The existing CALSIM model is a monthly simulation model to evaluate Federal and State export capabilities, and is designed to meet all demands no matter what the cost, subject to regulatory and physical constraints. It is not the optimal tool for assessing potential water supply impacts in light of alternative water supply strategies such as intra-Basin water transfers, improved water use efficiency, water recycling, and increased groundwater use. The Board should take great care using CALSIM results in estimating water supply impacts, and the use of those results in subsequent modeling of economic and employment effects, such as the Statewide Agricultural Production (SWAP) model or Impact Analysis for Planning (IMPLAN) model. Deficiencies in the water supply modeling will propagate through subsequent economic models.

By ignoring the many alternative and adaptive water management strategies available to water users, modeling can result in significant overestimates of impacts. For instance, initial IMPLAN modeling of employment and economic effects of drought and fishery protection measures in 2009 were dramatically revised downward (employment estimates were revised downward by an order of magnitude), in large part because of increased water transfers which were not anticipated in the modeling. Jeffrey Michael and Richard Howitt et al 2010. *A Retrospective Estimate of the Economic Impacts of Reduced Water Supplies to the San Joaquin Valley in 2009*, at 1.

The Board has acknowledged this conclusion in other analyses; for instance, as the Board has recognized in February 2012, "Input-output analysis approach employed by IMPLAN usually overestimates indirect job and income losses…. For these and other reasons, job and income losses estimated using input-output analysis should often be treated as upper limits on the actual losses expected (SWRCB 1999)." *See* SWRCB, Draft Agricultural Economic Effects of Lower San Joaquin Flow Alternatives, February 2012, at X-29.

Over the longer term, because of availability of alternative supply tools (and greater price elasticity of water in the longer term), estimates of employment and economic consequences of reduced Bay-Delta diversions will likely be overestimated. This is consistent with observed behavior during drought and in prior proceedings, where water users have utilized water transfers, improved efficiency, and other alternative supplies when diversions were reduced.

Therefore, the Board should also consider using water supply models, such as UC Davis' CALVIN model,[10] which can incorporate the response of water users to reduced diversions from the Bay-Delta, including investments in conservation, water recycling, and other alternative water supply tools, as well as increased water transfers. In addition, the Board should explicitly acknowledge in its analysis that estimates of the economic and employment consequences of changes in water supply are likely to be overestimated to the extent that feasible increases in conservation, water transfers, and alternative water supplies are not explicitly modeled.

2. <u>The Board Should Explicitly Model Reservoir Reoperation and Include Changed Assumptions in CALSIM Modeling, Which Has Demonstrated that Increased Spring Outflow Need Not Adversely Affect Upstream Reservoir Storage</u>

[10] University of California, Davis. Statewide Economic-Engineering Water Model – CALVIN. Available online at: http://cee.engr.ucdavis.edu/faculty/lund/CALVIN/ (last visited October 22, 2012).

As the Board recognized in the September 6, 2012 workshop, CALSIM modeling work in BDCP on Alternative 8 shows that increased winter/spring outflow need not adversely affect upstream reservoir storage (cold water pool) and upstream protections necessary for spawning and juvenile salmonids. As the Board is well aware, one of the significant limitations of the CALSIM model is that it typically does not include reservoir carryover requirements in the model and the model is driven to maximize CVP/SWP exports within available constraints. We understand that the state and federal agencies working on BDCP developed additional modeling of reservoir reoperation criteria in 2012 (part of the CS5 modeling), which included revised reservoir storage and release criteria to protect salmonids.

The Board should build on and further refine the approach to modeling Alternative 8 and CS5, in consultation with the fish and wildlife agencies, to explicitly model revised reservoir reoperation criteria and account for minimum reservoir storage and releases needed to meet downstream temperature compliance points in the spring and summer months. This revised modeling analysis should be applied to a broader range of alternative outflow objectives in this proceeding, and should be utilized to ensure that the Plan includes both adequate inflow and outflow requirements, while also ensuring that upstream protections for salmonids are maintained or enhanced, particularly in the face of climate change.

3. <u>The Board Must Incorporate Climate Change in its Modeling and Analysis of Consequences of Potential Changes to the Plan</u>

Because climate change is likely to alter the timing and volume of runoff into the Bay-Delta, the Board must incorporate the effects of climate change into its analysis. Recent modeling work performed for the California Energy Commission has demonstrated that climate change is likely to dramatically change the frequency of water year types as defined in D-1641; as the authors noted, "If current water year type thresholds are maintained, more years will be classified as dry and less water will be allocated for environmental outflows, perhaps failing to provide adequate hydrologic variability to support species, habitats, and ecosystems." Null & Viers 2012 at ii. Their modeling predicts that the effects of climate change will generally result in reduced annual runoff and April-Jul Runoff in both the San Joaquin and Sacramento Basins in the 2001-2050 period as compared to 1951-2000. *Id*. at 8-9. As a result, in the Sacramento Basin their model generally predicts that critical and dry water year types will be more frequent, and above normal and wet years will be less frequent. *Id*. at 15. For the San Joaquin Valley, the results are even more striking, with as much as a 15% increase in critical water year types (to over 41% of years), and reductions in all other water year types. *Id*.

Similarly, DWR's modeling (including sea level rise) also anticipates that water exports from the Bay-Delta will decrease as a result of climate change; for instance, modeling for BDCP anticipates that the effects of climate change will reduce water exports by 200TAF by 2025. The effects are even more dramatic over the longer term, with DWR predicting that water exports from the Bay-Delta may decrease by 10% by 2050 and by 25% by 2100 as a result of climate change. *See* DWR, Possible Impacts of Climate Change to California's Water Supply, California Climate Center, Summary Sheet, April 2009 (Available at: http://www.water.ca.gov/pubs/climate/climate_change_impacts_summary_sheet__june_2009/climate_change_impacts_summary_sheet_6-12-09_lowres.pdf).

We strongly encourage the Board to incorporate climate change effects, including these analyses, into their modeling of the analysis of the consequences of potential changes to the Plan. In particular, because the modeling shows that the frequency of water year types is likely to change significantly, we strongly encourage the Board to move away from objectives and flow measures that are based on water year type, and instead use a percentage of unimpaired flow approach or similar tool. Objectives based on water year type will become less protective of public trust resources as a result of climate change.

4. If the Board uses the CALSIM model for impact assessment, it should use CALSIM 3 as it represents a more transparent and better documented model than CALSIM 2, provides a superior representation of the hydrology and water use, and can more readily evaluate some alternative water management strategies.

Although the use of the CALSIM simulation for impact assessment has the shortcomings noted above (including its inability to economically evaluate investments in alternative water management strategies, its formulation as an export demand driven tool for the State and Federal projects which constrains its use as an impact assessment tool for all water users, and the difficulty in easily incorporating different operational strategies), we recognize that it may be used by the Board because it is the most detailed simulation model of the Bay-Delta water supply system and widely used in many other proceedings. Because the CALSIM 2 model is more than a decade old, aggregates water use over large areas, relies on some very outdated 50-year-old hydrologic representations, and is not dynamically integrated with groundwater, efforts were undertaken in the mid-2000s to develop CALSIM 3. That effort is very close to being completed (possibly by the end of 2012) and should provide a much better model than CALSIM 2 for the Board to use, particularly in its superior representation of the hydrology, water use, surface and groundwater interaction, and ability to more readily evaluate changes in land use and irrigation efficiencies. It is also much more transparent and better documented than CALSIM 2 (Andy Draper, personal communication).

5. <u>The Board's Analysis of Unimpaired Flow Alternatives Must be Compared to Disaggregated Flow Needs of Key Species and Public Trust Resources</u>

Finally, as the Board develops alternatives, including alternatives based on a percentage of unimpaired flows, it is critically important that the Board compare the flows likely to be provided under those alternatives against the flow needs of key species and flow recommendations, including those provided by state and federal fish and wildlife agencies. It is not sufficient that the Board simply show that the flow objectives mimic "natural" flows or provide a more natural hydrograph. Rather, the Board must provide analysis showing the likely flows that would be provided under various alternatives and how those compare to fishery needs (duration, frequency, magnitude, and timing of flows).

In order to provide that needed analysis, we recommend the following approach, which is similar to the Board's analysis in 2010. First, the Board should identify the duration, frequency, magnitude, and timing of flows necessary for key species. During the 2010 Delta public trust flow criteria proceedings, we provided specific, detailed flow recommendations targeted to attributes of viability for key species in the ecosystem that are based on publicly available data from agency sampling programs. Based on additional analysis and refinement of our recommendations since 2010, we intend to provide the Board in the near future with a modestly revised set of flow criteria for consideration and potential adoption as water quality objectives in the Plan, along with recommended actions for inclusion in the program of implementation. For the time being, we provide page references to the specific recommendations in our 2010 Delta flow criteria exhibits and 2012 Phase 2 workshop testimony (Table 1); we note also that CDFG and CSPA offered specific flow recommendations in their 2010 testimony to the Board – those recommendations should also be incorporated into the Board's analysis of alternatives.

Table 1: Specific flow recommendations resulting from TBI et al. Exh. 1-4 (2010) and TBI/NRDC (2012) analyses of the relationship between seasonal freshwater flows and attributes of viability for key public trust resources.

Source	**Flow Category**	**Page #**	**Comment**
TBI et al (2010), Ex. 2	Delta outflows (winter spring)	25	Text at bottom of page
TBI et al (2010), Ex. 2	X2 (Fall)	35	Table 1
TBI et al (2010), Ex. 3	Sacramento River Inflow	36	Table 3 (and associated text)
TBI et al (2010), Ex. 4	Hydrodynamic criteria for Sacramento Basin Chinook salmon & steelhead	10	Text
TBI et al (2010), Ex. 4	Hydrodynamic criteria for San Joaquin Basin Chinook salmon & steelhead	12, 23	Text
TBI et al (2010), Ex. 4	Hydrodynamic criteria for Delta smelt	15, 26	Text
TBI/NRDC (2012)	Hydrodynamic criteria for Longfin smelt	22	Footnote 10 (correcting typographical error in TBI et al 2010, Exh. 4)
TBI et al (2010), Ex. 4	Hydrodynamic criteria for maintenance of protective spatial distribution (multiple species)	29	Text

Note: We summarized our hydrodynamic recommendations in TBI et al., Exh. 4, p. 30 (Table 1). For the Board's convenience, we converted all hydrodynamic flow recommendations into their rough equivalent in terms of Old and Middle River flows (using interpolations described earlier in the exhibit). For the Board's current analysis, we recommend analyzing hydrodynamic criteria in the terms (e.g. Vernalis Flow:Export Ratio, etc.) in which they were originally developed in our testimony. Also, please note that the footnote associated with April and May of critical years has been corrected in our Workshop 2 testimony (page 22, footnote 10).

The Board should aggregate these flow needs into an annual hydrograph and then compare that aggregated analysis with flow alternatives that express actual flows as a continuous function of unimpaired hydrology to determine the extent to which alternatives achieve the duration, frequency, magnitude, and timing of flow recommendations for key species. In its 2010 final report, the Board staff expressed actual recommended flows as a percentage of the 14-day moving average of unimpaired hydrology in the relevant watershed – we support that approach within boundaries established by requirements for maintaining upriver storage described in the NMFS Biological Opinion (NMFS 2009) and minimum exports required to protect human health and safety.

Because many of our flow recommendations fall along a somewhat continuous spectrum of benefits to public trust resources (i.e., they are not binary, full benefit v. no benefit at all), and because all of our recommendations are based on the assumption that *all other significant non-flow related stressors are addressed*[11], we recommend that Board staff evaluate the potential benefits of different levels of freshwater flow using a tabular approach as outlined below in Table 2.

Table 2: Recommended approach to capturing differences among flow alternatives in their ability to provide flows necessary to support viability of public trust benefits. For each specific flow criteria recommendation (e.g. from TBI et al. Ex. 1-4, 2010, CDFG 2010), modeling would determine each flow alternative's ability to provide the recommended flow in terms of its magnitude, timing, duration, and frequency or fraction thereof if other aspects of flow were attained as recommended.

Flow Alternative	**Criteria Based On** (Species -- Attribute)	**Location**	**Max % Magnitude** (*if* timing, duration, & frequency as originally described)	**Max % Timing** (% of critical period *if* mag., dur., freq. as originally recommended)	**Max % Duration** (*if* mag., timing, & freq. as originally recommended)	**Frequency** (*if* mag., timi & duration a originally recommende

[11] As stated in our 2010 testimony: "In developing flow criteria we have recommended the *minimum* flows required to restore the viability of public trust species *if all other stressors are appropriately mitigated*." TBI et al. 2010; Exh. 1, p. 15. Emphasis in original.

This approach will allow the Board to determine which viability attributes of key aquatic species may be impaired under different flow alternatives and where there are tradeoffs between aspects of flow (magnitude, duration, timing, and frequency). This will facilitate efforts the Board's efforts to balance public trust values against other beneficial uses and to identify the extent to which different flow alternatives satisfy (or fail to satisfy) the needs of public trust resources.

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[i] http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2c02_agwtruse_cwp2009.pdf
[ii] 20x202 Water Conservation Plan. February 2010. http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/docs/20x2020plan.pdf
[iii] http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2c03_urbwtruse_cwp2009.pdf
[iv] Los Angeles Department of Water and Power UWMP page 22
[v] IEUA 2010 Water Use Efficiency Business Plan, Page 62
[vi] A Clear Blue Future: How Greening California Cities can Address Water Resources and Climate Challenges in the 21st Century. NRDC Technical Report, August 2009. By Noah Garrison (NRDC) and Robert C. Wilkinson (Donald Bren School of Environmental Science and Management, University of California at Santa Barbara) http://www.nrdc.org/water/lid/files/lid_hi.pdf
[vii] U.S. Environmental Protection Agency, December 2007, Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, fact sheet number 841-F-006, http://www.epa.gov/owow/nps/lid/costs07/factsheet.html
[viii] State Water Resources Control Board Recycled Water Policy Preamble, Page 1 http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf
[ix] Los Angeles Department of Water and Power UWMP Page 22
[x] http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2c11_recycmuniwtr_cwp2009.pdf
[xi] http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf
[xii] Personal communication with Los Angeles Department of Water and Power, Thomas Erb and James Yannotta, by NRDC intern Caitrin Phillips. http://switchboard.nrdc.org/blogs/bnelson/Local%20vs%20Imported_Final%208-4-11.pdf
[xiii] SDCWA Unit Cost of New Local Supply Alternatives, September 15, 2010
[xiv] SDCWA Unit Cost of New Local Supply Alternatives, September 15, 2010
[xv] http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2c08_conjunctmgmt_cwp2009.pdf

III. Closing Comments, Part Two: Discussion of Selected Issues Raised in the Phase 2 Workshops

1. As the Board Appropriately Concluded in 2010, there is Sufficient Scientific Information on Which to Improve Flows to Protect Public Trust Resources

Contrary to the suggestions of some participants at the prior two workshops, the Board has sufficient scientific information on which to base changes to the Bay-Delta Plan in order to adequately protect public trust resources and achieve other statutory requirements. Only two years ago, the Board concluded that there was sufficient scientific information on which to act to increase flows: "There is sufficient scientific information to support the need for increased flows to protect public trust resources; while there is uncertainty regarding specific numeric criteria, scientific certainty is not the standard for agency decision making" (SWRCB, 2010, p. 4). That Board finding is still accurate today, and as documented in our testimony for workshops 1 and 2, the new scientific information developed since 2010 largely confirms and strengthens the conclusions in the Board's 2010 report.

The Bay-Delta is one of the best-studied estuaries in the world, with an incredible set of long term monitoring data and targeted scientific studies. Although there will always be scientific uncertainty and a need for managing adaptively as new information becomes available, the best available scientific information demonstrates that current flows are completely inadequate to protect public trust resources. The situation is urgent: 83% of California's fish species are extinct or at risk of becoming so (TU et al, 2012). Scientific uncertainty does not justify failing to act, as the Delta Environmental Flows Group reminded the Board in 2010 (Delta Environmental Flows Group, 2010). Instead, the Board should:

- Set water quality objectives based on the best scientific information that is currently available.
- Articulate clear and measurable biological and ecological targets that represent the desired outcomes of implementing the objectives.
- Identify specific scientific studies or monitoring programs that are necessary to help reduce scientific uncertainty.
- Use an adaptive management program to modify flow levels (and/or utilize the Board's next review of the Plan to revise objectives in light of new scientific information).

2. The Need to Address Other Stressors Does Not Reduce the Need for Large-Scale Flow Augmentation; Indeed, Improving Flows Is Critical to Addressing Other Stressors

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Some parties have suggested during the Phase 2 workshops that the Board's update to the Plan will necessarily be deficient because it only addresses flow alteration, and that mitigating the impacts of other stressors is more important than improving flow conditions. These assertions are quite simply incorrect.

a. The scientific evidence clearly demonstrates that flow alteration is the single most important, best-documented stressor of fish and wildlife beneficial uses, and that restoring flows is most likely to be effective in protecting those uses.

Following the large-scale conversion of natural habitats that occurred in the late 19th/early 20th century, the alteration of freshwater flow rates and timing caused by water storage, diversions and exports since the mid-20th Century is the single most important stressor on fish and wildlife beneficial uses (e.g. Baxter et al, 2007). Half or more of the water that would normally flow through the Delta is diverted by water users upstream and south of the Delta (e.g. Fleenor et al. 2010; Cloern and Jassby 2012); to serve seasonal water use demands, the timing of freshwater flows has been changed dramatically (e.g. Fleenor et al. 2010) and in ways that do not support the evolved life histories of native fishes. The relationship between abundance and distribution of native fish species and the volume, timing and duration of freshwater flows into, through, and/or out of the Delta are

- Powerful (occur over orders of magnitude),
- Persistent (over 4+ decades of community sampling),
- Widespread (including a wide variety of native and naturalized species),
- Common (evident among a high fraction of species studied), and
- Statistically significant (Stevens and Miller, 1983; Jassby et al., 1995; Kimmerer 2002; Dege and Brown 2004; Rosenfield and Baxter 2007; Kimmerer et al., 2009; Mac Nally et al., 2010; Thomson et al., 2010).

<u>This latter attribute deserves emphasis: statistical significance of a correlation means it is very unlikely to occur at random. The number of significant correlations between attributes of fish viability (abundance, spatial distribution, life history and productivity) is among the strongest patterns observed in any ecosystem in the world. Although "correlation is not causation," the overwhelming number, diversity, strength, and persistence of correlations between freshwater flow and species' viability in the San Francisco Estuary is exceptionally compelling evidence that flows are mechanistically related to the viability of public trust resources</u>. It is widely acknowledged that freshwater flow drives, influences, or affects numerous other variables that may impact the viability of fish species (e.g., Dugdale et al., 2007; Sommer et al. 2001, 2004; Kimmerer 2004; Cloern and Jassby 2012). Conversely, no other single physical or biological variable explains the declines (and periodic increases) in as many species of fish and wildlife as freshwater flow. Simply put, there is overwhelming evidence supporting the need for action to set standards regarding the timing, duration, frequency, and magnitude of Delta freshwater inflows and outflows to support restoration of the Delta's public trust resources and there is absolutely no evidence that would support a plan for restoring these fish and wildlife beneficial

uses that did not include significant improvement in flow conditions. If the Board had to select the single stressor it should prioritize based on the scientific evidence concerning the certainty of large-scale benefits for fish and wildlife resources, that stressor would be flow alteration – a stressor that the Board has the authority and obligation to address.

b. Large-scale flow improvements are needed to protect beneficial uses in conjunction with actions to mitigate other stressors; absent mitigation of other stressors, flow restoration would need to exceed the 75% Sacramento River inflow and Delta outflow levels identified in the Board's 2010 Delta flow criteria report.

In addition to the need for flow improvements, it is both necessary and desirable to address other stressors of public trust beneficial uses in this ecosystem in ways that complement improvements in freshwater flow. As stated in our 2010 testimony: "In developing flow criteria we have recommended the *minimum* flows required to restore the viability of public trust species *if all other stressors are appropriately mitigated*." TBI et al. 2010, Exh. 1, p. 15 (Emphasis in original); *see also* TBI et al. 2010, Exhibit 2, p. 14. Absent the assumption that physical habitats, water quality, and food web productivity can and should be restored through a suite of flow and non-flow measures, the flows required to maintain public trust benefits in this species would be larger than we have recommended to the Board. A multi-pronged approach to restoration is required; without it, flows would have to be provided at a level much closer to unimpaired flows, as indicated by studies of the flows required to maintain similar fish and wildlife benefits in other aquatic ecosystems (which are also impacted by a variety of non-flow related stressors). The best available information from other aquatic ecosystems suggests that protection of public trust resources in the San Francisco Bay-Delta will be inadequate if other stressors are not substantially alleviated and more than ~15% of the unimpaired flow is diverted or delayed from its natural flow pattern (e.g. Richter et al, 2011; Dahm, 2010).

c. Flow improvements are critical to addressing other stressors.

The complementary point to the discussion above is that flow measures are a key part of the solution to other stressors. For instance, higher peak flow events in the Delta can help control the spread of invasive species and reduce predation that increases when turbidity is low, and higher river inflows can reverse habitat loss and reduce predation by increasing the extent and duration of inundated floodplains. The implications for flow management in the restoration of critical habitats are particularly well-documented in the case of Central Valley floodplains; see, for example Sommer et al. (2001), Sommer et al. (2002) and Jeffres et al (2008).

d. The Board can and should address other stressors in updating the Bay-Delta Plan.

It is important to also point out that the Board can address other stressors in both the Plan's water quality objectives and the program of implementation. For instance, the Board has previously identified the adoption of objectives for floodplain inundation as a potential amendment to the Plan, and we and other parties have submitted detailed recommendations for flow regimes that are specifically designed to optimize the benefits provided by floodplain habitats (TBI et al, 2010, Ex. 3; see also more recent Phase 2 testimony of American Rivers.). Furthermore, the Board can include actions it can take to address other stressors using different powers than through its water quality objective setting and water right permitting authorities, and include them in the program of implementation. Finally, in the program of implementation the Board can also identify actions that other entities are taking or should take to address other stressors. We plan to provide the Board in the near future with a list of such actions for potential inclusion in the program of implementation.

3. <u>The scientific basis for amending the Bay-Delta Plan to improve flow conditions continues to be extremely strong, despite assertions to the contrary during the workshops</u>

In this section, we briefly review and rebut a number of assertions regarding the scientific basis for adopting new objectives that improve flow conditions. A summary table of assertions and responses is provided in Appendix 1.

a. <u>Flow correlations are statistically significant and biologically important.</u>

Statistically significant, high order correlations between freshwater flow into, through, and/or out of the Delta and the abundance of native and naturalized aquatic species in the Delta are found among an extremely diverse set of organisms, they are persistent over decades of sampling, and apparent in data sets of numerous long term aquatic community sampling programs (e.g., Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007; Feyrer et al. 2009; Kimmerer et al. 2009; Feyrer et al. 2010). It is highly likely that strong correlations between abundance and flow exist for other organisms that have not been studied or which sampling programs do not measure effectively. Furthermore, statistically significant correlations between one flow attribute (e.g. Delta inflow) and abundance do not justify discounting the existence of similar relationships between other flow attributes (e.g. Delta outflow) and abundance of the same species – for example, the strong relationship between Delta inflow/floodplain inundation and Sacramento splittail abundance (Sommer et al. 2004; Sommer et al. 2007; etc.) does not diminish the potential for a separate (additional) relationship between Delta outflow and Sacramento splittail abundance (e.g. Kimmerer 2002) because flows in these two areas would affect different life stages. Although it is true that "correlation does not equal causation", statistically significant correlations do not generally occur at random (that is the definition of statistical significance) and multiple corresponding, long-term, high-order, significant correlations represent very strong evidence of an (or multiple) underlying mechanistic relationship(s) between freshwater flow and abundance of Public Trust resources.

b. There is no convincing evidence that either abundance estimates or flow correlations are based on misuse of datasets and/or faulty datasets.

We strongly support application of consistent aquatic community sampling methodologies and efforts to correct (where necessary) for unintended trends or changes in employing those methods. However, the suggestion that the strong, persistent, widespread correlations between species' abundance and freshwater flow conditions in the Delta that have been detected by diverse sampling programs (including the Fall Midwater Trawl, Bay Study, and/or Suisun Marsh sampling program) are somehow driven by bias in the sampling program(s) [SJTA 2012a. (p. 2), SJTA 2012b. (p. 62), SVWU 2012 (p. 11-14), SWC 2012 (p. 13-18)] or redistribution of the organisms sampled [SWC 2012 (p. 7-8)] is far-fetched. For example, Rosenfield and Baxter (2007) explicitly studied the value of the Fall Midwater Trawl (FMWT) index as a measure of longfin smelt abundance, comparing it to other survey programs (the Bay Study Midwater Trawl and Suisun Marsh survey) that sample year round and in different areas; their conclusion, based on the apparent spatial and temporal distribution of longfin smelt in the estuary, was that the FMWT was well-suited to provide relative (e.g. year-to-year) measures of longfin smelt abundance and distribution. Rosenfield and Baxter (2007) also created a coarse metric that combined abundance measures from these different sampling programs and that metric (based on simple presence-absence at sampling sites throughout the Bay, Suisun Marsh, and west Delta) showed a significant decline in spawning-age longfin smelt over time that was significantly correlated with flow. Similarly, declines in Delta smelt, Chinook salmon, *Crangon* shrimp and other Delta species have been observed in numerous sampling programs over several decades (IEP, 1999; Baxter et al, 2010; CDFG, 2010a; Mattern et al, 2002). No one claims that any particular current sampling program is ideal for measuring abundance and distribution of all species of pelagic fish; however, the San Francisco Estuary is among the best-studied aquatic ecosystems on Earth – the patterns detected and confirmed by multiple, long-term ecosystem sampling programs in the Delta are real, of major concern, and more than sufficiently robust to justify a rapid and dramatic response by the State Board.

c. Flow is the master variable; there is no evidence that other stressors are more important and/or disconnected from flow alteration

Flow is clearly a dominant variable that controls or moderates other potential stressors on fish populations; most scientists agree that it is the single most important stressor to the ecosystem (e.g., Baxter et al, 2010) because it has such a strong effect on fish populations and various factors that control those populations. There are many different ways for fish to die in the Delta (i.e., there are many different potential "stressors" on their populations), including food limitation, direct entrainment-related mortality, or stress from poor water quality conditions. We do not argue that these "other stressors" may not be important; rather we think that the role of freshwater flows in alleviating or mediating these stressors must be dealt with directly. As described above, our flow recommendations derive from freshwater flows that corresponded to healthier fish populations in the recent past and must be combined with successful efforts to restore productive habitats and water quality in the Delta.

There is simply zero evidence that an "anything but flow" approach will stop the ongoing degradation of the Delta ecosystem, much less reverse that decline, as some have suggested (e.g. SWC, 2012, p. 1, 5, 9-14 [LFS decline not linked to flow, but to introduction of Amur River clam], SJTA 2012b, p. 37-44 [predation is the real problem]). For example, some have argued that ammonium concentrations (or the ratio among nutrients in the Delta's waters) impedes primary production in the Delta (phytoplankton; SWC, 2012, p. 14, 22-23); from this, they have inferred that reduced primary productivity currently impairs production of fish prey items (zooplankton) and further, that the reduction in fish prey limits fish production. Although this argument may sound reasonable, there is actually very little evidence to support this chain of causation on most (if any) fish species of concern; additionally, studies in other ecosystems generally have not detected responses to changes to one level of production (primary, secondary, etc.) in trophic levels more than one level above or below the trophic level that changed. Also, the alleged statistical support for the linkage between ammonium concentrations and fish populations is extremely flawed; Cloern at al. (2012) indicate that the primary publication underpinning this hypothesis is riddled with statistical errors. and they found:

"...no *history for regression (or correlation) analyses on CUSUM-transformed variables prior to its use by Breton et al. (2006), and we have found no theoretical development or justification for the approach. We prove here that the CUSUM transformation, as used by ... Glibert (2010), violates the assumptions underlying regression techniques. As a result, high correlations may appear where none are present in the untransformed data... Regression analysis on CUSUM-transformed variables [the method used by Glibert 2010] is, therefore, not a sound basis for making inferences about the drivers of ecological variability measured in monitoring programs.* [Emphasis added] [p. 665]

Cloern et al (2012) conclude:

"... Glibert (2010) inferred a strong negative association between delta smelt abundance and wastewater ammonium from regression of CUSUM transformed time series. However, the Pearson correlation (r = -0.096) between the time series ... is not significant, even under the naive ... assumptions (p = 0.68). In short, correlations between CUSUM-transformed variables should not be used as a substitute for analysis of the original untransformed variables." [Emphasis added] [p. 668]

Furthermore, the transfer of impairments on primary production to secondary and fish productivity is not supported by analysis of fish abundance data (except, possibly, in the case of longfin smelt; Kimmerer 2002), nor can it explain why those species that live closest to the putative source of ammonium have flourished (e.g., American shad; on a flow corrected-basis) since the late 1980s, while no change has been observed in the flow-abundance correlations (or lack thereof) for Delta resident species (e.g. Sacramento splittail and Delta smelt), as would be predicted by a nutrient-primary-secondary production mechanism. What is acknowledged by all parties is that improved freshwater flows can flush exess ammonium out of the Delta that may concentrate there as a result of severely reduced freshwater flow pulses. Increased flows would tend to moderate negative effects caused by high concentrations (e.g. Dugdale et al, 2007). If the main cause of high ammonium concentrations is not directly related to human activities (some expect that excess ammonium is produced by high densities of the invasive clam, *Corbula amurensis*, which would not be directly controllable), then increased freshwater flows may be the only way to mitigate an effect of ammonium pollution, at least in the short-term.

Predation has also been offered as a source of problems for native Delta species (SJTA, 2012a, p. 15; SJTA., 2012b, p. 37-44; SWC 2012, p. 23-24); this despite the fact that one of the major flow-dependent predator species in this ecosystem, striped bass, has also declined significantly (e.g., Kimmerer 2002). Another suite of predators has taken root in the Delta over recent decades and these shallow water predators benefit from introduction of aquatic weeds such as *Egeria*. One thing the new invasive predators (Centrarchid bass/sunfish and Mississippi silversides) and the submerged aquatic vegetation share in common is a preference for shallow habitats with slow moving currents. Thus, flow modifications in the Delta have favored the invasive predators (and the SAV from which they also benefit) by creating ecological conditions that resemble those of lakes in the southeastern United States and South America. These invaders will not thrive (or will at least be put at a disadvantage) if flow patterns in the Delta are restored to more naturalpatterns of seasonal and interannual variability. In the meantime, focusing on reducing predation by direct predator removal or targeted engineering to eliminate predator "hotspots" will likely be exceptionally expensive and ineffective here as it has proved to be in other regions of the country, such as the Columbia-Snake River ecosystem. Again, increased flow rates into, through, and out of the Delta are expected to reduce this "other stressor" on native fishes by (1) reducing exposure to high predator populations, (2) reducing predator efficiency, and (3) (occasionally) increasing turbidity – evidence of such an effect is apparent in CDFG's San Joaquin salmon survival model (2010a) and Bowen (2010).

d. There is convincing evidence that entrainment has population level effects and that Old and Middle River criteria or other measures to limit entrainment and reverse flows is justified and appropriate.

Since the Board issued its 2010 flow criteria report (SWRCB 2010), evidence that entrainment-related mortality is periodically an important stressor on certain fish populations has increased, as has evidence that south-Delta exports alter ecosystem food web productivity. Kimmerer (2011) reaffirmed the findings of his 2008 paper, which found that, in some years, a large fraction of the total Delta smelt population and Chinook salmon juvenile year-class may be entrained at the export facilities. In addition, Kimmerer (2011) demonstrated that because of the nature of the salvage impact and population index data, significant levels of entrainment could drive a population towards extinction while remaining undetected by common statistical techniques**.** In addition, Rosenfield (2010) documented a strong correlation between spring

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Delta freshwater outflows and entrainment of longfin smelt juveniles; entrainment was inversely proportional to the previous FMWT index, thus the effect of entrainment is disproportionately high when the longfin smelt population is low. While USFWS (2012) concluded (without analysis) that longfin smelt entrainment was not a continual problem for this population, it also suggested that entrainment rates in certain years could have had a significant impact on the population – thus, entrainment may have an episodic negative impact on the critically imperiled longfin smelt population. Furthermore, Maunder and Deriso (2010) found a strong effect of entrainment of adult Delta smelt on population dynamics in this imperiled species, though they inexplicably removed that variable from their conclusion because the strength of the effect was "too strong". Despite restrictions on Old and Middle River reverse flows implemented as part of the Biological Opinions' RPAs, there have been record or near-record entrainment events for Sacramento splittail, sturgeon, Sacramento sucker, longfin smelt and other fishes in recent years (TBI, 2011); this result suggests that OMR flow criteria contained in the RPAs are not adequate to protect other species in the Delta.

Some argue that it is a good sign when fish salvage rates are high (because it suggests that fish populations are high), but also argue that low salvage years prove that high exports and reverse flows are not a problem (e.g. SWC, 2012, p. 25-27: reverse flows and entrainment do not equate to population effects per Maunder and Deriso). While the exact scope of the salvage problem remains to be completely described, a few things are certain (see TBI, 2011):

(i) most fish salvaged at the South Delta export facilities (and the much larger amount of fish food, eggs, and larvae that are exported without enumeration) are lost to the ecosystem .
(ii) salvage numbers vastly underestimate the impact of entrainment as pre-screen mortality (within the export facility canals) is one or more orders of magnitude greater than salvage.
(iii) entrainment-related loss is indiscriminant and continuous.
(iv) fish and food web resources can be protected by imposing restrictions on exports in the form of minimum OMR flows, export:inflow ratios, and bypass flows (i.e. Delta outflows).

4. The concept of "regime shift" is neither consistent with scientific understanding of ecosystem dynamics nor an appropriate basis for determining that a healthy native ecosystem cannot be restored.

Despite the diversity and magnitude of changes that have been wrought on the Bay-Delta ecosystem, there is every reason to believe that restoration of freshwater flows will contribute to improved viability and persistence of fish and wildlife beneficial uses and public trust resources. When flow improvements are combined with proposed habitat and water quality restoration actions (a strategy we have helped develop and have consistently advocated for), there is a strong scientific basis for the expectation that these beneficial use and resources in the Bay-Delta estuary can be restored to levels that are sufficient and sustainable – there is even reason to hope that some resources can be restored to levels that exceed those seen during the onset of the modern period of community sampling (e.g. the late 1960s). The argument that there has been a "regime change" and so it is not possible to "go back" to an ecosystem that supports thriving fish and wildlife populations is deceptive and fundamentally unscientific. The "regimes" (current and past) referred to by this line of reasoning are completely undefined and there is no way to test scientifically whether it is possible to revert to a previous regime or what would be required to do so. The notion of static "regimes" where the abundance and distribution of fish and wildlife populations remain relatively stable in a climax state harkens back to the discredited arguments of community ecologists from the early 1900s (e.g. Clements 1936). In the decades since these ideas held sway, ecologists have learned that ecosystems are in a near constant state of change where productivity is governed largely by temperature, elevation, and latitude while diversity is regulated by productivity, barriers to immigration, and the disturbance (physical variability) regime. In the San Francisco Bay-Delta, humans have clearly changed the rates of species immigration, and global climate change will likely further alter system energetics. However, by restoring freshwater flow rates, as well as the seasonal and inter-annual variability of that flow to levels seen in the not-too-distant past *and* restoring habitats that have been unavailable for >50 years, we can expect to counter the decline of native fish and wildlife species and may (in certain cases) establish populations that are more abundant, diverse, and widespread than those we have measured since sampling began in the late 1960's.

5. There is no scientific basis for implementing actions to restore physical habitat as a substitute for improving flow conditions.

For many years we have been involved in helping advocate for, design, and implement programs and projects to create, restore and expand the extent of a diversity of physical aquatic habitats when there is a relatively high degree of certainty that such projects will primarily benefit native species, either directly (e.g. as spawning or rearing habitat) or indirectly (e.g. via exports of food to native species' habitats). However, as discussed in our workshop 1 submission (pp. 19-22), it is far from certain that all of the aquatic habitat restoration projects proposed by various parties will benefit desirable native species more than they will benefit invasive predator and competitor species. For example, during a preliminary, incomplete review of habitat restoration projects considered under the Bay Delta Conservation Plan (DRERIP, 2009), many of the shallow habitat restoration projects (particularly those in the eastern, central and southern Delta) scored low on the magnitude of potential benefits and the likelihood that those benefits would be achieved. On the contrary, experts engaged in the review felt that many of these projects could pose a risk to native species if they became habitat for invasive predators, competitors, or submerged aquatic vegetation. Similarly, the National Research Council was dubious of plans to restore food supplies for Delta smelt by restoring wetlands (NRC, 2010). While restoring historical habitats continues to be an attractive and worthwhile endeavor, expected changes in the regional climate (e.g. warming) and the introduction of non-native species may prevent certain in-Delta restored habitats from performing their historic function, especially if freshwater flows remain drastically reduced by diversions and exports.

Furthermore, it is not at all clear that all the feasible restoration projects taken together will produce and export sufficient volumes of prey to pelagic habitats where many of the key public trust resources live. Use of large scale habitat restorations to supplement the Bay-Delta food web is a compelling idea, and one that should be refined and improved (e.g. through a series of pilot projects); but there are no guarantees that restored habitats will function like historical habitats (see above) or that the area that could be potentially restored will be sufficient (especially without restored freshwater flows) to make a dent in the productivity gap in this ecosystem. Even with adequate flows, achieving the necessary food web subsidy believed to be required to support viable populations of public trust-related fish species will probably only be successful if restoration occurs on a massive scale (e.g. tens to hundreds of thousands of acres) – under any scenario, restoration of this magnitude will take decades to achieve.

The inescapable fact is that in the complex and changing environment of the Bay-Delta, ensuring adequate flow conditions is the action with the highest degree of scientific justification, certainty of successful result, and magnitude of benefit. It is not likely to be sufficient in and of itself to solve every problem plaguing this system. But every other action is likely to be ineffective absent the critical element of flow restoration.

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