Master Response 5.2
Incorporation of Non-Flow Measures

Overview

This master response addresses comments regarding non-flow measures; their role in the overall ecosystem health of the tributaries; and how they relate to the plan amendments described in Chapter 3, *Alternatives Description*, Appendix K, *Revised Water Quality Control Plan*, and Master Response 2.1, *Amendments to the Water Quality Control Plan*. The State Water Board recognizes the importance of implementing non-flow measures to support and maintain the different habitat needs of fish and wildlife. For this reason, the State Water Board incorporates and recommends a range of non-flow actions complementary to the flow objectives for the reasonable protection of fish and wildlife in Appendix K. Description of these actions and their associated cost and potential environmental impacts are provided in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, Section 16.3, *Lower San Joaquin River Alternatives—Non-Flow Measures*.

The State Water Board recognizes the recommended non-flow actions should be part of the overall effort to comprehensively address Delta aquatic ecosystem and tributary ecosystem needs, and results from implementation of non-flow actions can be used to inform adaptive implementation decisions under the plan amendments (see Chapter 3, Appendix K, and Master Response 2.1). However, as stated in Appendix C, *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*, "non-flow measures alone will not be sufficient to "support and maintain the natural production of viable native San Joaquin River Watershed fish populations migrating through the Delta;" therefore, water quality objectives based on flow are needed (Appendix C, Sections 3.1, *Introduction* and 3.7, *Importance of Flow Regime*). Non-flow measures, which in most cases depend on sufficient flow for successful implementation, cannot substitute or be prioritized over the need for flow requirements and, therefore, cannot be considered alternatives to the plan amendments (please see Master Response 2.4, *Alternatives to the Water Quality Control Plan Amendments*, for more information regarding the range of alternatives considered).

Hydrological health is the key driver of the overall ecological health of a watershed. Construction of storage infrastructure (dams) and diversions have vastly altered the natural flow regime of the San Joaquin River and its major tributaries (Appendix C; McBain and Trush 2000; Kondolf et al. 2001; Cain et. al 2003, Brown and Bauer 2009). Flow is generally considered as a "master variable" that limits the distribution and abundance of riverine species and regulates the ecological integrity of rivers (Poff et al. 1997; Resh et al. 1988; Power et al. 1995). This master variable influences many critical physicochemical variables of rivers, such as habitat, geomorphic processes, temperature, and water quality. Creating habitat features and other engineered solutions is insufficient to restore a healthy ecosystem if the key driver of functional habitat remains unrestored (Beechie et al. 2010). In general, variable flow regimes provide the conditions needed to support the biological and ecosystem processes that are imperative to the reasonable protection of fish and wildlife beneficial uses. Although changes to other ecosystem attributes (such as floodplain habitat restoration, gravel augmentation, and invasive species control), in addition to flows, are needed in order to fully restore biological and ecosystem processes in the three eastside tributaries and on the Lower San Joaquin River (LSJR), flow remains a critical element of that restoration. On the other hand, many of the

problems identified by the commenters as the cause of the decline of salmon populations, such as predation, invasive species, and loss of floodplain habitat, are all related to the effects of hydrologic alteration. If flow is not maintained, then any measures to tackle those problems will not be effective (Beechie et al. 2010).

Please see Master Response 3.1, *Fish Protection*, for more information regarding the scientific justification for the plan amendments and the incorporation and use of flow in the water quality objective. Recognizing the importance of non-flow measures, the State Water Board recommends non-flow measures in the plan amendments, in addition to establishing a framework that allows resource agencies or regulated entities to implement non-flow measures to inform adaptive adjustments to the required percentage of unimpaired flows, within a prescribed range. As described in Appendix K, "the non-flow measures may support a change in the required percent of unimpaired flow, within the range prescribed by the flow objectives, or other adaptive adjustments otherwise allowed in this program of implementation." As such, those resource agencies or entities with the authority to do so could choose to undertake one or more of these actions to inform adaptive implementation.

The State Water Board reviewed all comments related to non-flow measures and developed this master response to address recurring comments and common comment themes. This master response references related master responses, as appropriate, where recurring comments and common comment themes overlap with other subject matter areas. This master response addresses concerns related to the role of non-flow measures in the overall health of the tributaries' ecosystem and their relationship to the plan amendments and program of implementation and includes, for ease of reference, a table of contents on the following page to help guide readers to specific subject areas. In particular, this master response addresses the following topics.

- Importance of flow measures and the role of non-flow measures.
- Incorporation of non-flow measures into the plan amendments program of implementation as recommendations to other agencies and to inform adaptive implementation.
- State Water Board's authority regarding non-flow measures.
- Non-flow measures are not alternatives to the plan amendments or feasible mitigation measures.
- Cost of non-flow measures.

Please see Master Response 3.1, *Fish Protection*, for responses to comments regarding the need for flow in protecting fish and wildlife. For objectives of plan amendments and alternatives evaluated, please see Master Response 2.1, *Amendments to the Water Quality Control Plan*, and for a discussion of the range of alternatives, please see Master Response 2.4, *Alternatives to the Water Quality Control Plan Amendment*s. For more discussion of the State Water Board's authorities in general and mitigation measures, please refer to Master Response 1.1 *General Comments*, and for more discussion about the State Water Board's authorities as they relate to the water quality control planning process, please see Master Response 1.2, *Water Quality Control Planning Process*.

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The Relationship between Flow and Non-Flow Measures

Multiple commenters made claims regarding non-flow measures. Included were claims that non-flow measures are the only solution to the population declines of fish species in the tributaries and the Delta ecosystem and that flow is not needed if non-flow measures are implemented. This section discusses the relationship between flow and non-flow measures, including the importance of flow and the role non-flow measures play in complementing flows.

Importance of Flow

As described in Master Response 3.1, *Fish Protection*, and in Appendix C, *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives*, substantial scientific evidence indicates that reductions in flow and alteration of the natural flow regime resulting from water development has been a major driver of historic declines of native fish populations and a major impediment to the restoration of salmon populations in the San Joaquin River (SJR) and other Central Valley watersheds. While aquatic resources in the SJR Basin have been adversely impacted by numerous factors, including physical habitat alteration and passage barriers, flow during the spring time period remains a limiting factor (NMFS 2014). The hydrologic characteristics of the LSJR and its three major tributaries (plan area) have been so dramatically altered that current habitat conditions favor nonnative fish species, while native fish species are struggling to survive. The native species are adapted to high interannual and seasonal variability in flow, water temperatures, and other environmental parameters that characterize the natural climatic conditions of this region but that no longer prevail within the project area. The nonnative species are more successful within in the plan area which is now dominated by slower, warmer, and less variable environments, which are similar to their native habitats (typically in the Eastern United States). The plan amendments for the LSJR flow objectives are intended to restore more natural habitat conditions for native fish species to address key factors that have contributed to historic declines and that currently act to limit the success of these species.

Using a river's unaltered hydrographic conditions as a foundation for determining ecosystem flow requirements is well supported by the scientific literature, and extensive evidence supports the restoration of a more natural flow regime (e.g., higher and more variable flows at biologically important times) as a key restoration need for SJR salmon populations. In highly-modified rivers such as the SJR and its tributaries, it is impossible to restore a full natural flow regime, although restoration of key components of the natural flow regime can be effective in restoring a number of important ecological functions (Yarnell et al. 2015). Because constraints imposed by flow regulation and various physical, chemical, and biological stressors can limit the effectiveness of a more natural hydrograph in restoring these functions, an integrated approach that utilizes a combination of flow and non-flow improvements may be the most effective approach for addressing these constraints (Beechie and Bolton 1999; Beechie et al. 2010; Yarnell et al. 2015). However, non-flow measures alone are not sufficient to support and maintain viable populations of native fish populations. Many non-flow measures are typically reach-level solutions aimed at addressing symptoms of ecosystem degradation within specific reach(s) of river(s). Actions like creating habitat, modifying structures, or enhancing channel forms are often relatively short-term solutions, requiring repeated application and/or maintenance in order to continue to provide benefits, and do not address restoration of key watershed- or river-scale regulating processes (Beechie et al. 2010).

Role of Non-Flow Measures

Non-flow measures have a complementary role to flow-based measures in river restoration. As described in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, non-flow measures may include floodplain and riparian habitat restoration, reduction of vegetation-disturbing activities in floodplains and floodways, gravel augmentation, enhancement of in-channel complexity, improvement of temperature conditions, fish passage improvements, predatory fish controls, and invasive aquatic vegetation control (i.e., engineered solutions). Most of these types of non-flow actions depend on a more natural flow regime to be successful, and conversely, address constraints to ecosystem function that flow measures alone cannot resolve alone. For example, loss of floodplain habitat in the SJR basin cannot be adequately addressed by increased flows alone because of existing levees and channelization that prevent floodplain inundation. This constraint can be addressed by levee setback, floodplain restoration, and riparian restoration projects. However, without sufficient flow to activate restored floodplains, the benefits of such projects are limited. When floodplains are activated by the appropriate flow regime, a positive feedback loop can be initiated by which restored floodplains recruit riparian vegetation and retain sediment during high flows, expanding floodplain habitat and riparian growth, which in turn can eventually provide a sustained source of woody debris, contributing to in-channel complexity.

Similarly, while nonnative predator populations are a major stressor for salmon and steelhead populations in the SJR and its tributaries, predator control actions alone would require an ongoing intensive implementation program and would not address the habitat conditions that allow predator populations to thrive. Higher and more variable flows will create habitat conditions that are less suited for predator populations and provide conditions that reduce exposure of salmonids and other native fishes to predators, increasing the overall effectiveness of the predator control measures.

Thus, while non-flow measures serve an important role in restoring ecosystem functions supporting salmonid populations of the SJR Basin, implementation of a long-term, sustainable strategy for restoring these populations requires a process-based approach (i.e., focused on addressing the causes of habitat change) based on restoration of key components of the natural flow regime.

Incorporation of Non-Flow Measures in the Plan Amendments

Multiple commenters identified their support for non-flow measures and the need for the State Water Board to require non-flow measures as part of the plan amendments and implement non-flow measures on the tributaries. This section discusses the State Water Board's authority with respect to non-flow measures and how non-flow measures were considered within the SED.

State Water Board's Authority to Impose Non-Flow Measures

Multiple commenters state that the State Water Board has authority to require non-flow measures, such as restoring, enhancing, and protecting floodplain and riparian habitat, and that these actions should be required in the plan amendments. In most cases, commenters' desires for non-flow actions are in-lieu of providing additional flow. The State Water Board's exercise of its water quality authority in this water quality control proceeding, however, focuses on the activities and factors that

may affect the quality of the waters of the state. (Wat. Code, § 13000.) By their very definition, water quality objectives address the "water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or prevention of nuisance within a specific area." (Id., § 13050, subd. (h).) Thus, the plan amendments' focus on flow objectives and measures is in keeping with the State Water Board's authority and responsibility to protect the quality of the waters of the state and the beneficial uses of those waters. (Wat. Code, §§ 13240, 13241, 13000-13002, 13050, subd. (g), (h), (i) and (j).) As a physical attribute related to the quality of water, flow and the functions it provides are critical in protecting fish and wildlife beneficial uses. The State Water Board, however, recognizes the importance of non-flow measures in complementing flow to protect these uses. Accordingly, the proposed plan amendments include recommendations for non-flow measures, which, along with the coordinated and adaptive implementation of the LSJR flow objectives, are expected to improve habitat conditions that benefit native fish and wildlife or improve related science and management within the LSJR Watershed.

The State Water Board's authority to require and enforce the implementation of non-flow actions depends on the proposed non-flow action and whether the facts and circumstances support requiring them. For example, as one commenter pointed out, in the State Water Board's Water Right Decision (D)-1631, the Board required restoration activities in connection with a water diversion; however, the factual record in the water right proceeding supported the allocation of responsibility to the water diverter and the need for, and benefit of, the particular restoration actions under consideration in light of the physical solution doctrine. Under the physical solution doctrine, "a water diverter can be compelled to employ a physical solution through which competing water demands can be met and the constitutional goal of promoting maximum beneficial use of the State's waters will be served." (State Water Board 1994, p. 118.) Based on the reasonable use of water doctrine, California courts have frequently considered whether there is a physical solution available by which competing needs can be served more efficiently. (*Peabody v. Vallejo* (1935) 2 Cal.2d 351, 383–384; *City of Lodi v. East Bay Municipal Utility District* (1936) 7 Cal.2d 316, 339–340; Cal. Const., art. X, § 2; Wat. Code, § 100.) In D-1631, which resolved the major controversies relating to the Los Angeles Department of Water and Power's (LADWP) diversion of water from the Mono Basin, the State Water Board required restoration actions to expedite the recovery of resources that LADWP's prior diversions degraded. The State Water Board looked at the connection between the diversion and the loss of waterfowl habitat and concluded that in light of competing uses of water, it would not require restoration of the maximum amount of habitat through higher Mono Lake elevation levels than the State Water Board ultimately required. Rather, it held that a physical solution could restore additional habitat to restore public trust uses while requiring a smaller commitment of water. Thus, the imposition of non-flow requirements turned on the facts of the case and specific considerations of whether the habitat restoration under review could protect public trust issues while allowing diversion of water for other uses.

In the case of the plan amendments to the 2006 Bay-Delta Plan, the State Water Board recommends, but does not require, non-flow actions in the plan amendments because, in part, there is no evidence in this proceeding that supports a physical solution that imposes a requirement on a particular party in this proceeding. For example, there is no evidence of the efficacy of non-flow measures to protect fish and wildlife beneficial uses, the amount of water that would be saved through the non-flow measures, or how the non-flow measures would achieve the plan amendments' goals and objectives described in Chapter 3, *Alternatives Description*. Moreover, most non-flow measures require flow in order to be effective. That is not to say, however, that non-flow measures cannot in the future be implemented as a physical solution to reduce the required flow within the allowed range as the

revised Bay-Delta Plan is implemented in specific watersheds. There may be the specific facts and circumstances in a future water right or water quality proceeding to implement the revised Bay-Delta Plan that support the imposition of non-flow measures as a physical solution on a particular party and waterbody. Currently, however, the record supporting the imposition of specific non-flow actions, and the allocation of responsibility for undertaking them, is lacking. In this respect, as stated in the SED, the State Water Board's authority to impose non-flow measures is limited.

More importantly, as noted earlier in this master response, the plan amendments require the regulation of activities or factors that affect water quality. In the case of the plan amendments, this includes flow-related objectives and measures, and not non-flow actions, because flow is the water quality parameter within the State Water Board's authority and responsibility that can be regulated to protect fish and wildlife beneficial uses under the Porter-Cologne Water Quality Control Act. Complementary non-flow actions can address the stressors that contribute to the degradation of fish and wildlife beneficial uses. Non-flow actions may support a change in the required percent of unimpaired flow within the range prescribed in the water quality objective through the adaptive adjustment framework provided in the program of implementation in Appendix K, *Revised Water Quality Control Plan*. Thus, while non-flow actions have a complementary role, the plan amendments are fundamentally about addressing water quality by providing more needed flows to protect fish and wildlife beneficial uses.

Consideration of Non-Flow Measures

The State Water Board received a number of comments in support of implementing non-flow measures, such as floodplain habitat restoration and predator removal. The State Water Board received general comments from a wide variety of commenters noting that multiple restoration efforts were underway or in planning stages within the watersheds of the three eastside tributaries. Some commenters noted that a certain number of miles had been restored on a certain river. However, in most cases, it was unclear if the restoration projects commenters were speaking of were actually funded or implemented or if commenters were simply endorsing such efforts by various entities.

The State Water Board agrees with the commenters that implementing non-flow measures on the Stanislaus, Tuolumne, and Merced Rivers is important to restore the ecosystem for the health of special status species and maybe non-special status species. The State Water Board also recognizes and appreciates the past and ongoing efforts by various agencies to address non-flow stressors on these three rivers. The following list of non-flow measures were recommended in Appendix K, *Revised Water Quality Control Plan*, and a description of those non-flow measures and their associated potential environmental impacts are provided in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, Section 16.3, *Lower San Joaquin River Alternatives—Non-Flow Measures*.

- Floodplain and riparian habitat restoration (Section 16.3.1)
- Reduce vegetation-disturbing activities in floodplains and floodways (Section 16.3.2)
- Gravel augmentation (Section 16.3.3)
- Enhance in-channel complexity (Section 16.3.4)
- Improve temperature conditions (Section 16.3.5)
- Fish passage improvements—fish screens (screen unscreened diversions in tributaries and LSJR) (Section 16.3.6)

- Fish passage improvements—physical barriers in the southern delta (Section 16.3.7)
- Fish passage improvements—removal or modification to human-made barriers to fish migration (Section 16.3.8)
- Predatory fish control (Section 16.3.9)
- Invasive aquatic vegetation control (i.e., plant control) (Section 16.3.10)

In practice, a combination of the non-flow measures can be carried out simultaneously or in a sequence. Many are implemented along with flow-based measures, as part of a comprehensive restoration program, to address multiple stressors and protect anadromous fish population on a long-term, sustainable basis. Table 5.2-1 shows some examples of such restoration project recently carried out, or planned for, in the Stanislaus, Tuolumne, and Merced Rivers. Most of projects are funded and implemented in partnership involving multiple public agencies and non-profit organizations, including some of the commenting agencies and organizations that expressed support for non-flow measures.

Table 5.2-1. Example of Restoration Programs in the Three Eastside Tributaries

Example Project	Description
Merced River	
Merced River Ranch Floodplain Enhancement Project	Completed in 2013, the project restored 4.23 acres of riparian floodplain and 1.23 miles of spawning habitat, and included adding over 91,000 cubic yards of spawning gravel. Project partners included the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and Cramer Fish Science (Cramer Fish Sciences 2016a; The Nature Conservancy 2016a).
Henderson Park Habitat Restoration Project	Completed in 2015, the project enhanced oak-grassland upland habitat, reclaimed 15 acres of historic riparian floodplain, and returned almost 72,000 cubic yards of gravel to 4,100 linear feet of the Merced River, rehabilitating 7.2 acres of Chinook and steelhead spawning and rearing habitat. Project partners included the USFWS, Anadromous Fish Restoration Program, Merced County, and CDFW (The Nature Conservancy 2016a; USFWS 2016).
S.A.F.E Plan	Merced Irrigation District has a plan to restore 5.5 miles of riparian and riverine habitat on the Mercer River and to develop an anadromous salmonid predator management plan; however, the details of the plan as they relate to non-flow measures are unclear (Merced River S.A.F.E Plan 2016; see Master Response 2.4*, Alternatives to the Water Quality Control Plan*, for more information regarding the S.A.F.E Plan).
Stanislaus River	
Lover's Leap Restoration Project	In 2007, over 18,000 tons of spawning gravel was added to create over 33 riffles for spawning habitat in the reach, due to loss of a natural sediment supply downstream of Goodwin Dam. Floodplain and side-channel rearing habitat was also created. Partners include the California Department of Water Resources (DWR), CDFW, KDH Biological Consultants, and the USFWSs (The Nature Conservancy 2016b; KDH Environmental Services 2008).
Honolulu Bar	Two and a half acres of shallow water floodplain habitat were restored to provide habitat for young fish to rear and grow. Nonnative invasive vegetation was removed along the river, and native riparian species planted. Project partners included Oakdale Irrigation District, USFWS, Cbec, River Partners, and FISHBIO. The project was funded by Oakdale Irrigation District and the USFWS (FISHBIO 2017; River Partners 2017a).
Lancaster Road Floodplain and Side-channel Restoration Project.	Completed in 2012, the project restored over 2 acres of floodplain habitat and approximately 640 feet of side-channel habitat. Over 2,800 cubic yards of fine sediment were removed, the understory was cleared, and 180 cubic yards of gravel were augmented. After restoration, the side channel begins to inundate at 600 cubic feet per second and occurs at a more frequent return interval. Project partners included private landowners, Cramer Fish Sciences, and the USFWS (The Nature Conservancy 2016b; Cramer Fish Sciences 2016b).
Tuolumne River	
Grayson River Ranch	Riparian floodplain along 1.2 miles of the lower Tuolumne River at the ranch was restored to maintain riparian habitat and improve floodplain habitat. Partners included the East Stanislaus Resource Conservation District, Friends of the Tuolumne River, Tuolumne River Preservation Trust. Funding was provided by CALFED Bay-Delta Authority; USFWS

Example Project	Description
	and U.S. Department of Agriculture Natural Resources Conservation Service (The Nature Conservancy 2016c; Friends of the Tuolumne River, Inc. n.d. (a)).
Bobcat Flat Restoration Project	Bobcat Flat is 303 acres of riparian habitat owned by Friends of the Tuolumne, Inc., a land trust. Completed in 2011, the project restored 8 acres of highly disturbed floodplain and 1.6 miles of spawning and rearing habitat in the lower Tuolumne River. The west section was restored instream for salmon and steelhead and the floodplain elevation was lowered and planted for riparian habitat. Project partners include Friends of the Tuolumne, CALFED Bay-Delta Program, USFWS, the City and County of San Francisco, and the Stanislaus Fly Fishermen (The Nature Conservancy 2016c; Friends of the Tuolumne River n.d. (b)).
Gravel Mining Reach Project	The Gravel Mining Reach goes from river mile (RM) 40.3 to RM 34.4 of the Tuolumne River. The primary goal of the project is to establish a river channel and riparian floodway that will improve flood conveyance, geomorphic processes, and riparian and aquatic habitat throughout the reach. Due to its length, the project is being implemented in four phase: the 7-11 Reach (RM 37.7 to RM 40.3), M. J. Ruddy Reach (RM 36.6 to RM 37.7), Warner-Deardorff Reach (RM 35.2 to RM 36.6) and Reed Reach (RM 34.3 to RM 35.2). Phase I (7-11 Reach) was completed in 2003. The other phases are either in land acquisition, planning or pre-design stages. Project partners include CALFED Bay-Delta Program, USFWS, Tuolumne River Technical Advisory Committee, and several consulting companies, including McBain & Trush, HDR Engineering, HART Restoration, and Stillwater Sciences (Fryer 2004; Vick and Keith 2006).
Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	River Partners owns the fee title for 2,100 acres of flood-prone farmlands at the confluence of the San Joaquin and Tuolumne Rivers in Stanislaus County. The project will restore the properties to multi-benefit wildlife habitat and transient floodwater storage areas through the re-establishment of native vegetation, grading, levee breaching, and other local improvements (such as fish screening surface diversions, permanently retiring riparian water rights, weed management, recreational development, and removing bank revetment). Currently, 600 acres are being restored, and planning is underway for the remaining acreage. Project partners include American Rivers, California Conservation Corps, DWR, California River Parkways Program, Central Valley Flood Protection Board, Ducks Unlimited, National Resources Defense Council, Natural Heritage Institute, The River Islands Fund, River Partners, San Francisco Public Utilities Commission, San Joaquin Regional Conservation Corps, Tuolumne River Trust, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Department of Agriculture Natural Resource Conservation Service, and the USFWS (Mid San Joaquin River Regional Flood Management Plan 2015; River Partners 2017b; River Partners 2017c).

Multiple commenters asserted non-flow measures should be considered as either alternatives to the plan amendments or as mitigation measures to avoid or minimize the impacts associated with reduced water supplies and their indirect, secondary effects. As discussed previously in this master response, non-flow measures are included in the program of implementation as recommendations and, if parties choose to implement them, may inform adaptive implementation of the flow objectives. Non-flow measures are not alternatives or mitigation measures to the plan amendments. As stated in Appendix K, the recommended non-flow measures are complementary to the LSJR flow objectives for the protection of fish and wildlife. Non-flow measures are actions parties could conceivably take under adaptive implementation framework described in the plan amendments to adjust the percentage of unimpaired flow (within the range) needed to protect fish and wildlife upon approval from the State Water Board.

As discussed in Master Response 2.4, *Alternatives to the Water Quality Control Plan Amendments*, implementation of non-flow measures is not a feasible alternative to the plan amendments. For example, among the factors that may be used to eliminate an alternative from detailed consideration in an environmental impact report are: (1) failure to meet most of the basic project objectives; (2) infeasibility; or (3) inability to avoid significant environmental impacts. (Cal. Code Regs., tit. 14, § 15126.6, subd. (c).) The non-flow measures meet all of these factors and, as such, are not considered feasible alternatives to the plan amendments.

The non-flow measures fail to meet the fundamental project purpose and goal to establish flow objectives for the reasonable protection of fish and wildlife beneficial uses in the LSJR watershed, consistent with the Water Board's authority and responsibilities under the Porter-Cologne Water Quality Control Act. The State Water Board is engaged in a water quality control planning process to adopt water quality objectives to protect beneficial uses and flow is a necessary water quality parameter to protect fish and wildlife beneficial uses. The purposes and goals specifically related to the LSJR flow objectives, which are described in Chapter 3, *Alternatives Description*, Section 3.2, *Purposes and Goals*, include maintaining inflow conditions to support and maintain the natural production of viable migratory native fish populations and providing flows to achieve hydrological conditions and functions essential to native fishes. Non-flow measures do not meet most of these project purposes and goals.

In addition, as discussed in this master response, flow is a key driver of hydrologic health for fish and wildlife. There is no evidence that non-flow measures in lieu of, or as a partial substitution for, providing the requisite flows would protect fish and wildlife beneficial uses in the LSJR. Nor is there evidence on the efficacy of non-flow measures to protect fish and wildlife beneficial uses while reducing the required flows and to what extent significant impacts could be avoided. Under these circumstances, and as discussed throughout this master response and in the SED, the State Water Board's authority to impose non-flow measures is limited. Accordingly, non-flow measures are not a feasible alternative to the proposed plan amendments to reasonably protect fish and wildlife beneficial uses. Furthermore, as explained earlier, the record does not support the imposition of non-flow measures and allocation of responsibility to any particular party to undertake them now. Finally, non-flow measures do not avoid significant impacts. Chapter 16, *Evaluation of Other Indirect and Additional Actions*, discloses that there may be unavoidable significant impacts related to the take of protected species in connection with the construction of certain non-flow actions. Please refer to Master Response 2.4, *Alternative to the Water Quality Control Plan Amendment*, for provisions of CEQA as they relate to the development and range of alternatives.

Similarly, non-flow measures are not mitigation measures for the plan amendments. Non-flow measures are part of the plan amendments. As previously stated, the State Water Board recognizes that non-flow measures have an important complementary role to play along with flow to protect fish and wildlife beneficial uses and should be part of the overall effort to comprehensively address Delta and tributary aquatic ecosystem needs. Accordingly, they are included in the plan amendments as recommended actions and the framework for adaptive implementation of the flow objectives is structured such that non-flow measures can inform adjustments to the percentage of unimpaired flows within the prescribed range. For example, if parties wanted to undertake a certain suite of non-flow actions and lower percentage of unimpaired flow to 35 percent, then the State Water Board would need to evaluate if the 35 percent unimpaired flow would meet the narrative objective and any biological goals. It would evaluate this question considering the specific suite of non-flow actions intended to reasonably protect fish and wildlife.

The plan amendments also allow for non-flow measures in voluntary agreements. As stated in the program of implementation in Appendix K, the State Water Board encourages voluntary agreements to assist in implementing the plan amendments. If the voluntary agreements include non-flow measures, the non-flow measures may support a change in the required percent of unimpaired flow, within the range prescribed by the flow objectives, or other adaptive adjustments otherwise allowed in the program of implementation. The State Board or its Executive Director, upon request from the Stanislaus, Tuolumne, and Merced (STM) Working Group, would approve adjustments to the percentage of unimpaired flow for a proposal that includes non-flow measures if the flow proposal meets the two criteria for adjusting: (1) it meets the narrative objective, and (2) it meets any biological goals.

Recommended non-flow measures are included in the proposed plan amendments for the reasons given above—not because they are mitigation measures. Under CEQA, mitigation measures must be proposed to minimize a project's significant environmental impact and be feasible. (Pub. Res. Code, §§ 21002.1, subd. (a), 21100, subd. (b)(3), Cal Code Regs., tit. 14, § 15126.4, subd. (a)(1).) Feasible means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." (Pub. Resources Code, § 21061.1) The effectiveness of a mitigation measure may be considered in determining the feasibility, in addition to desirability of a mitigation measure to the extent it is based a reasonable balancing of the relevant economic, environmental and technological factors. (*Living Rivers Council v. State Water Resources Control Board* (Sep. 28, 2017, A148400) Cal.App.4th [2017 WL 4296959].)

Commenters fault the SED for not considering the feasibility of non-flow measures as mitigation measures, asserting certain non-flow measures, such as predator suppression and habitat restoration, must be considered as mitigation measures. Commenters raise non-flow measures as a means to minimize surface water supply reductions and their secondary effects on the environment. Reduced surface water supply is not a physical environmental impact requiring mitigation, as described in Master Response 1.1, *General Comments*. Even if it were, the effectiveness of non-flow measures, including predator suppression and habitat restoration, in reducing the need for flows and by how much has not been scientifically established. Also, as discussed earlier in this master response, there are legal limitations for the State Water Board to impose non-flow measures now. Non-flow actions also take time to develop, to be approved and funded, and to be implemented. For example, many of the projects identified in Table 5.2-1 took several years to plan and execute, and are still in the monitoring phase to determine effectiveness. As set forth in the *Executive Summary*,

the Bay-Delta is in ecological crisis. Timely action is needed. Given all the foregoing, non-flow measures as a mitigation measure to minimize surface water supply reductions and their effects is not feasible. The State Water Board satisfied its duties under CEQA by describing feasible mitigation measures—not infeasible ones—that could minimize significant environmental impacts. (Cal. Code Regs., tit. 14, § 1526.4, subd. (a)(1).)

Non-Flow Measure Costs

Multiple commenters assert non-flow measures are less "costly" than the percent of unimpaired flow requirement, and they point to, or compare, economic calculations based on a potential reduction in water supply for other beneficial uses (e.g., irrigation) under the suggested premise that non-flow measures would fully *substitute for* flow measures and a reduction in water supply. As discussed in Chapter 16, *Evaluation of Other Indirect and Additional Actions*, Section 16.3, *Lower San Joaquin River Alternatives- Non-Flow Measures*, and Chapter 20, *Economic Analyses*, Section 20.3.7, *Non-Flow Measures*, non-flow measures do have costs associated with them. However, comparing the costs associated with a potential reduction in surface water for other beneficial uses under a specified percent of unimpaired flow requirement (i.e., the plan amendments) with those costs of non-flow measures is invalid and misleading. This is because non-flow actions are very different in terms of nature and scale of benefits generated and full range of costs incurred, which includes construction, operation and maintenance, and monitoring.

The first difference between the costs associated with the plan amendments and costs associated with non-flow measures is that costs associated with the plan amendments are *opportunity costs.* The water either remains instream to protect salmon and its riverine habitat, or the water is diverted for irrigation purposes or for urban water use. In other words, the "cost" of increasing the percentage of unimpaired flow represents a "loss" of opportunity to certain sectors of the economy that would divert water as an input to producing goods for consumption. However, the costs associated with non-flow measures include outlays of funds for materials and devices, equipment, construction services, transportation, labor, and professional services needed to plan, place, construct, and implement the non-flow measures. Once in place, the non-flow measures may require operation and periodic maintenance, with associated material costs over time. In nearly every case, non-flow measures will require monitoring or adjustments to ensure that the measures are meeting appropriate standards and goals. Non-flow measures have both implementation and ongoing costs that must be acknowledged, in consideration with the biological benefits such non-flow measures would provide.

A second distinction between the costs of implementing the plan amendments versus non-flow measures is related to the geographic scope of their effects. The scope of the percent of unimpaired flow requirement includes the salmon-bearing tributaries of the LSJR below the rim dams and the mainstream of the LSJR between its confluence with the Merced River and Vernalis. The unimpaired flow requirement will benefit the ecosystems of the entire watersheds of the three tributaries and the LSJR, as well as enhance the commercial and recreational fisheries in the Pacific Ocean (see Chapter 20, Section 20.3.5, *Effects on Fisheries and Associated Regional Economies*). However, the scope of a non-flow measure, such as a habitat restoration project, is limited to a certain reach of a river or a certain portion of the watershed. Many such projects would be necessary in order to benefit an entire river or watershed, and the cumulative cost would be substantial.

For perspective, LSJR Alternative 3 (40 percent unimpaired flow requirement) would result in an estimated reduction of $36 million in annual economic output related to agricultural production, as shown in Appendix G, *Agricultural Economic Effects of the Lower San Joaquin River Flow Alternatives: Methodology and Modeling Results*, Table G-5.4. Additional reductions in economic activity in other sectors occur as a result of changes in agricultural production, for a total of $64 million annually. In contrast, a cost of $5.1 million is estimated for one non-flow measure project in a portion of the SJR drainage is the Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project (the Dos Rios Project) (Mid San Joaquin River Regional Flood Management Plan 2015). But the calculation does not include operation, maintenance, or monitoring costs, nor does it assess other effects on the economy.

A third way that a comparison of flow and non-flow measures can be misleading is that the goals, scope, and complexity of restoration projects can be very different depending on the target species and habitat. Quite often, a restoration project is one component or phase of a restoration program or plan, which covers a much bigger area and spans a longer period, and would require long-term monitoring. For example, the aforementioned Dos Rios Project is part of the Regional Flood Management Plan for the Mid San Joaquin River; Gravel Mining Reach Project is part of the Habitat Restoration Plan for the Lower Tuolumne River Corridor; and several of the projects shown in Table 5.2-1 are part of the Anadromous Fish Restoration Program of the U.S. Fish and Wildlife Service. While the cost of a restoration project that covers a certain reach of a river might be in the order of a few million dollars to construct, plus several tens of thousands to hundred thousand per year to operate, maintain and monitor, the cost of the entire program or plan can be much larger and cannot be fully estimated until the specific component or phrase is to be carried out. For example, the fiscal year 2015, fiscal year 2016 and fiscal year 2017 annual budgets for the Anadromous Fish Restoration Program were $11 million, $6.1 million and $9.9 million, respectively (USBR and USFWS 2014, 2015, and 2016). California EcoRestore, which is a plan to restore 30,000 acres of Sacramento-San Joaquin Delta habitat by 2020, will cost at least $300 million in the first 4 years (California Natural Resources Agency 2017). Therefore, the costs of restoration projects vary greatly depending on the scope, size and location of the project or program under which a project or set of projects is constructed and operated. Thus, the value in discussing the cost of any particular type of non-flow measures is limited.

References Cited

Beechie, T. J., and S. Bolton. 1999. An Approach to Restoring Salmonid Habitat-Forming Processes in Pacific Northwest watersheds. *Fisheries* (24):6–15.

Beechie, T. J., D. A. Sear, J. D. Olden, G. R. Pess, J. M. Buffington, H. Moir, P. Roni, and M. M. Pollock. 2010. Process-Based Principles for Restoring River Ecosystems. BioScience (60):209–222.

Brown, L. R. and M. L. Bauer. 2009. *Effects of Hydrologic Infrastructure on Flow Regimes of California's Central Valley Rivers: Implications for Fish Populations. River Research and Applications*. DOI: 10.1002/rra.1293.

Cain, J. R., R. P. Walkling, S. Beamish, E. Cheng, E. Cutter, and M. Wickland. 2003. *San Joaquin Basin Ecological Flow Analysis*. National Heritage Institute. 247 pages.

California Natural Resources Agency. 2017. *What is California EcoRestore?* Available: http://resources.ca.gov/ecorestore/what-is-california-ecorestore/. Accessed: September 11, 2017.

Cramer Fish Sciences. 2016a. *Project: Merced River Ranch Floodplain Restoration*. Available: http://www.fishsciences.net/projects/merced_river_ranch/. Accessed: August 21, 2017.

———. 2016b. *Project: Lancaster Road Restoration.*

FISHBIO. 2017. *Stanislaus River Restoration*. Available: http://fishbio.com/field-notes/the-fish-report/new-video-highlights-stanislaus-river-restoration. Accessed: August 21, 2017.

Friends of the Tuolumne River Inc. No date (a). *Grayson River Ranch website*. Available: http://www.friendsofthetuolumne.org/grayson.html. Accessed: September 7, 2017.

———. No date (b). *Bobcat Flat website*. Available: http://www.friendsofthetuolumne.org/bobcatflat.html. Accessed: September 7, 2017.

Fryer, W. B. 2004. *Mining Reach—7/11 Segment Tuolumne River Restoration Project Summary Report*. Turlock Irrigation District. 10 September. Available: https://www.fws.gov/lodi/anadromous_fish_restoration/documents/7-11%20MWD%20Sum%20Rpt.pdf. Accessed: September 2017.

KDH Environmental Services. 2008. *Lover's Leap Restoration Project: Salmon Habitat Restoration on the Lower Stanislaus River Final Report*. July 16. Available: https://www.fws.gov/lodi/anadromous_fish_restoration/documents/Final_Report_Lovers_Leap.pdf. Accessed: August 21, 2017.

Kondolf, G. M., A. Falzone, and K. S. Schneider. 2001. *Reconnaissance-Level Assessment of Channel Change and Spawning Habitat on the Stanislaus River Below Goodwin Dam*. USFWS, March, 2002.

McBain and Trush, Inc. 2000. *Habitat Restoration Plan for The Lower Tuolumne River Corridor*. Tuolumne River Technical Advisory Committee. March, 2000.

Merced River S.A.F.E Plan. 2016. *What is the S.A.F.E. Plan?* Available: http://www.mercedriversafeplan.org/. Accessed: September 7, 2017.

Mid San Joaquin River Regional Flood Management Plan. 2015. *Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project*. Available: http://www.midsjrfloodplan.org/projects/dos-rios-ranch-floodplain-expansion-and-ecosystem-restoration-project-and-hidden-valley. Accessed: September 2017.

National Marine Fisheries Service (NMFS). 2014. *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead*. July. California Central Valley Area Office.

The Nature Conservancy. 2016a. *California Salmon Snapshots Merced River Restoration Highlights*. Available: http://www.casalmon.org/salmon-snapshots/restoration/merced-river. Accessed: August 21, 2017.

———. 2016b. *California Salmon Snapshots Stanislaus River Restoration Highlights*. Available: http://www.casalmon.org/salmon-snapshots/restoration/stanislaus-river. Accessed: August 21, 2017.

———. 2016c. *California Salmon Snapshots Tuolumne River Restoration Highlights*. Available: http://www.casalmon.org/salmon-snapshots/restoration/tuolumne-river. Accessed: August 21, 2017.

Poff, N. L., J. K. Allan, M. B. Bain, J. R. Karr, K. L Prestegaard, B. D. Richter, R. E. Sparks, and J. C. Stromberg. 1997. *The Natural Flow Regime*. Bioscience 47: 769-784.

Power, M. E., A. Sun, M. Parker, W. E. Dietrich, and J. T. Wootton. 1995. *Hydraulic Food-chain Models: An Approach to the Study of Food-web Dynamics in Large Rivers*. BioScience 45: 159-167.

Resh, V. H., A. V. Brown, A. P.Covich, M. E. Gurtz, H. W. Li, G. W. Minshall, S. R. Reice, A. L. Sheldon, J. B. Wallace, and R. Wissmar. 1988. *The Role of Disturbance in Stream Ecology*. Journal of the North American Benthological Society 7: 433-455.

River Partners. 2017a. *Honolulu Bar Floodplain Restoration Project*. Available: http://www.riverpartners.org/news-and-events/newsletters/201306_HonoluluBar.html. Accessed: August 21, 2017.

———. 2017b. *Dos Rios Ranch Website*. Available: http://www.riverpartners.org/where-we-work/projects-san-joaquin/dosrios/. Accessed: August 2017.

———. 2017c. *Hidden Valley Ranch*. Available: http://www.riverpartners.org/where-we-work/projects-san-joaquin/hiddenvalley/. Accessed: August 2017.

State Water Resources Control Board (State Water Board). 1994. Mono Lake Basin Water Right Decision 1631. September 28. Available: https://www.waterb1631oards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1631.pdf. Accessed: January 22, 2018.

U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service (USBR and USFWS). 2014. *Draft 2015 CVPIA Annual Work Plans–Introduction*. Available: https://www.usbr.gov/mp/cvpia/docs_reports/awp/2015/docs/introduction.pdf. Accessed: September 11, 2017.

———. 2015. *2016 Annual Work Plan Public Draft*. Available: https://www.usbr.gov/mp/cvpia/docs/CVPIA-2016-AWP-Main-Body-20150709-DRAFT.pdf. Accessed: September 11, 2017.

———. 2016. *2017 Annual Work Plan Public Final*. Available: https://www.usbr.gov/mp/cvpia/docs/2017-workplan-cvpia.pdf. Accessed: September 11, 2017.

U.S. Fish and Wildlife Service (USFWS). 2016. *Field Notes Entry*. Available: https://www.fws.gov/fieldnotes/regmap.cfm?arskey=36850. Accessed: August 21, 2017.

Vick, J. and A. J. Keith. 2006. *Lower Tuolumne River Annual Report*. Report 2006-8. Special Run Pool 9 and 7/11 Reach: Post-Project Monitoring Synthesis Report. Prepared by McBain and Trush and Stillwater Ecosystem, Watershed and Riverine Sciences. Prepared for Turlock Irrigation District and Modesto Irrigation District. March. Available:

http://tuolumnerivertac.com/Documents/Project%20Monitoring%20Synthesis%20Rpt1.pdf. Accessed: September 2017.

Yarnell, S. M., G. E. Petts, J. C. Schmidt, A. A. Whipple, E. E. Beller, C. N. Dahm, P. Goodwin, and J. H. Viers. 2015. Functional Flows in Modified Riverscapes: Hydrographs, Habitats and Opportunities. *BioScience* (65):963–972.