Common Response 7.6.2
Aquatic Biological Resources and Cold Water Habitat

Introduction

This introduction provides important context to this common response. A similar introduction is provided in each common response to ensure that the reader has the appropriate context when reviewing common responses. For ease of reference, a table of contents is included after this introduction to guide readers to specific subject areas.

Protecting the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) watershed and its many beneficial uses of water is one of the State Water Resources Control Board's (State Water Board) primary responsibilities and top priorities. In response to declines of several native aquatic species since the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Watershed (Bay-Delta Plan or Plan) was last comprehensively updated, the State Water Board commenced a process to update the Bay-Delta Plan for the Sacramento River and its tributaries, Delta eastside tributaries (including the Calaveras, Cosumnes, and Mokelumne Rivers), and Delta for the reasonable protection of fish and wildlife beneficial uses, referred to as the Sacramento/Delta Update to the Bay-Delta Plan. The Bay-Delta Plan identifies beneficial uses of water to be protected in the Bay-Delta watershed, water quality objectives and program of implementation to achieve the reasonable protection of those beneficial uses, monitoring, evaluation, and special study provisions. The State Water Board's proposed action to update the Bay-Delta Plan is supported by a Staff Report/Substitute Environmental Document (Staff Report), which provides an evaluation of the environmental impacts and economic effects in support of consideration of different alternatives to update the Bay-Delta Plan to achieve reasonable protection of fish and wildlife beneficial uses in the Sacramento/Delta. The Staff Report is functionally equivalent to an Environmental Impact Report under the California Environmental Quality Act (CEQA) but also provides the additional analyses that support the State Water Board's consideration of the action under the Clean Water Act and Porter-Cologne Water Quality Control Act (Porter-Cologne Act).

Development of the final Staff Report and final draft Bay-Delta Plan were informed by several opportunities for public comment over multiple years. This common response may address issues that were raised during any of those public comment periods. In September 2023, the State Water Board released the 2023 draft Staff Report evaluating different alternatives for the Sacramento/Delta Update to the Bay-Delta Plan for public review and comment. Following release of the 2023 draft Staff Report, the State Water Board released draft amendments to the Bay-Delta Plan in October 2024 (2024 draft Plan) for public review and comment that incorporated alternatives identified in the 2023 draft Staff Report with revisions based on public comments. The State Water Board released revised draft Plan updates in July 2025 (July 2025 revised draft Plan), but delayed public comment on that version of the Plan pending further updates, though some parties did submit public comments on the July 2025 draft that are part of the State Water Board's response to comments. In December 2025, the State Water Board released Chapter 13, *Revised Proposed Plan Amendments*, as a limited recirculation of the 2023 draft Staff Report (2025 partially recirculated draft Staff Report) together with the December 2025 revised draft Plan for public review and comment. These documents reflect the updated proposed project, referred to as the revised proposed Plan amendments, which brings together in the Bay-Delta Plan program of implementation a voluntary agreement (VA) pathway that incorporates commitments identified in the Healthy Rivers and Landscapes (HRL) proposal and would apply to specified HRL water rights, and a regulatory pathway based on the proposed Plan amendments that would apply to other water rights and to any HRL water rights no longer covered under the VA pathway. In August 2026, the State Water Board released a final draft Bay-Delta Plan that included refinements to the revised proposed Plan amendments based on public comments received on the December 2025 revised draft Plan. At the same time, the State Water Board released this final Staff Report, including responses to comments previously received on the draft Staff Report. The final Staff Report informs the State Water Board's consideration of adoption of the Sacramento/Delta updates to the Bay-Delta Plan.

With respect to the CEQA impact conclusions, it is important that they be understood in the context of the overall nature of the proposed project, which is intended to be an environmental restoration action. CEQA only considers changes that could negatively impact the existing environment and does not recognize or offset negative changes with improvements that could result from an environmentally beneficial project. Here, the impacts that could potentially result from implementation of the restoration action occur in a system that has been highly altered, and the project would be expected to improve conditions for native fish and wildlife in the Sacramento/Delta watershed over time. However, the project will also result in changes in hydrology and changes in water supply that could result in some potentially significant adverse environmental impacts at certain times and locations that must be analyzed under CEQA. These potentially significant environmental impacts should be viewed in light of the overall purpose and goals of the Sacramento/Delta update to the Bay-Delta Plan.

The State Water Board reviewed and considered all comments and developed common responses to address recurring comments and common themes.

This common response addresses recurring comments and common themes with respect to the cold water habitat objective and water temperature analyses. Because comments on the proposed Plan amendments described in Chapter 7, *Environmental Analysis*, of the 2023 draft Staff Report are also applicable to the regulatory pathway of the revised proposed Plan amendments, this common response uses the "revised proposed Plan amendments" terminology (or more simply "Plan amendments") in response to all comments.

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Background

As described in Chapter 3, *Scientific Knowledge to Inform Fish and Wildlife Flow Recommendations*, salmonids require adequate cold water and flow conditions throughout their freshwater lifecycle, and particularly during the spawning and rearing period. Before construction of reservoirs and other habitat alterations, salmonids generally had year-round access to cold water habitat in higher elevations. Since construction of dams and other habitat alterations, this access has been eliminated or substantially reduced to the detriment of salmonid populations. Remaining populations that would otherwise migrate to upstream habitat are now dependent on maintenance of suitable conditions in the downstream reaches below dams. During summer and fall, when air temperatures exert a strong influence on river temperatures, the release of cold water from reservoirs is critical for maintaining suitable cold water habitat. Under current conditions, temperature management is frequently a concern below reservoirs on many tributaries throughout summer and fall for the protection of salmon, especially during droughts and critically dry periods. Some reservoirs currently have cold water management requirements. However, comprehensive requirements do not exist for all tributaries where reservoirs are present or for tributaries without reservoirs, and the Bay-Delta Plan does not currently include any such requirements.

Changes in flow and reservoir storage under the Plan amendments could affect stream temperatures and the availability of cold water downstream. The numeric inflow requirements under the regulatory pathway would generally result in higher spring flows on regulated tributaries compared with baseline conditions. While higher spring flows that more closely resemble the natural hydrologic regime would benefit native anadromous salmonids and other native species, higher spring flows also could result in a reduction in reservoir storage at the end of spring and reductions in stream flow and/or a smaller cold water pool volume in summer and fall months. In streams with reservoirs with limited cold water supplies, providing greater volumes of cold water early in the year could reduce the cold water supply available later in the year.

As a complementary measure to the inflow requirements, the revised proposed Plan amendments include a new cold water habitat objective for the Sacramento/Delta tributaries. The proposed objective is intended to address existing and potential future temperature management concerns on the tributaries for salmonids and other native species, but will also minimize potential temperature-related impacts of the new inflow and Delta outflow requirements. Because temperature needs depend on the species of salmonid, the life stage, and other factors, and because temperature management actions depend on the specific circumstances of each tributary, a narrative objective is proposed. The objective would require that measures be implemented to provide cold water habitat for salmonids and other native cold water fish species in the Sacramento/Delta tributaries, including management of cold water storage and releases or alternate protective measures (including measures to install and operate temperature control devices (TCDs), measures to provide for passage above dams, and other measures) to ensure that fish below dams are kept in good condition. To the extent that existing measures are in place for temperature control, those requirements would be reviewed to determine whether additional or updated measures are necessary to ensure that they are protective and that measures are integrated with the inflow and outflow objectives and implementation measures.

Under the regulatory pathway, water right holders that own or operate specific reservoirs would be responsible for undertaking actions to comply with the cold water habitat objective. Those reservoir owners/operators would be required to develop temperature management strategies for approval by the Executive Director of the State Water Board describing how the inflow and cold water habitat provisions would be implemented together, including meeting carryover storage levels and alternate proposed measures that would provide an equivalent level of protection. In addition to the long-term temperature management strategy, the reservoir owners/operators identified in the program of implementation would be required to submit annual temperature management plans consistent with the approved long-term strategy to the Board's Executive Director for approval each year.

The implementation of the narrative cold water habitat objective in tandem with the flexibility provided in the inflow requirements would be expected to improve water temperature conditions for native cold water fish over time as long-term temperature management strategies and annual plans are developed and implemented. However, it is possible that there would be some instances on some streams where temperatures could increase. In particular, while the specific long-term temperature management strategies are refined, there may be some challenges in preventing temperature increases compared to baseline at all times on all tributaries while meeting the flow requirements and providing water deliveries, particularly on those tributaries with significant water diversions and smaller storage capacity.

Under the VA pathway, the HRL commitments would be required to be implemented in a manner to improve temperatures to the extent possible and avoid redirected impacts to water temperatures. As part of the annual and periodic review processes, the HRL participants would be required to report on measures they have undertaken to address temperature impairments in their stream systems in coordination with HRL implementation measures.

Cold Water Habitat as Part of the Project

Several commenters argue that the modeling used to analyze potential temperature impacts from the proposed Plan amendments improperly includes carryover storage targets for reservoirs. Citing *Lotus v. Dept. of Transportation* (2014) 223 Cal.App.4th 645, 657-658 (Lotus), these commenters argue that the analyses fail to disclose the full scope of effects in the absence of mitigation, in violation of CEQA, by not modeling flow requirements without maintaining reservoir storage at levels that are generally protective of cold water habitat below the dam. The analyses and subsequent drafts of the Plan provisions demonstrate the full disclosure and public discourse around issues of adequate reservoir storage.

The proposed cold water habitat objective and implementation, however, are fundamental project components and the project need not be modeled without them. The Plan amendments include a new cold water habitat objective for the Sacramento/Delta tributaries. The proposed objective is intended to address existing and potential future temperature management concerns on the tributaries for salmonids and other native species, and to minimize potential temperature-related impacts of the new inflow and Delta outflow requirements. The proposed cold water habitat objective is narrative to allow for tailored solutions, given the structural, operational, and hydrological characteristics of each individual tributary. To meet the objective, the Plan will require implementation by water right holders and reservoir owners and operators through long-term management strategies that include meeting carryover storage target ranges.

The proposed cold water habitat objective and its implementation are consistent with the fundamental purposes and goals of the project, which include providing flows and improving both habitat and temperature conditions for native fishes. Thus, the proposed cold water habitat objective and its implementation are essential project components necessary to achieve the project's fundamental purposes and goals. A necessary consideration of the project is how best to balance the benefits to fish and wildlife from providing more Delta inflow during much of the year against the potential associated effects on temperature management in the tributaries.

The Staff Report clearly identifies increases in temperature as a potentially significant impact. Elevated water temperatures are an existing concern in California, particularly in rivers where rim reservoirs prevent access to upper watershed habitat for native cold water anadromous fish. Carryover storage is important for maintaining a supply of cool water deep in a reservoir and it could be affected by early release of water that may reduce the initial volume of cold water captured in a reservoir. There are trade-offs between managing for Delta inflows and outflows, reservoir storage, and water supply. The inclusion of the cold water habitat objective in the Bay-Delta Plan is an acknowledgment that management of reservoir storage and releases is an integral part of protecting native migratory fish. Management of reservoir storage and releases is also critical for supplying water for health and safety and salinity control.

The Staff Report contains meaningful analysis of all the potential impacts of the project. The temperature impact is identified as potentially significant, both with and without the implementation of the cold water habitat objective. To clarify its inclusion as part of the project, implementation of the cold water habitat objective has been removed from the listed mitigation measures in Appendix H3, *Mitigation Measures for the Revised Proposed Plan Amendments*, because it is part of the proposed project. Cold water habitat implementation measures are no longer identified as mitigation for potential temperature impacts on aquatic biological resources.

Integration with Existing Temperature-Related Requirements

Several commenters argue that implementation of flow and cold water requirements would be inconsistent with already existing environmental requirements such as specific Endangered Species Act (ESA) constraints and Federal Energy Regulatory Commission (FERC) hydropower conditions and therefore would be legally infeasible. Commenters such as East Bay Municipal Utility District (EBMUD) argue that the new requirements would interfere with existing and successful efforts to protect fisheries on a given tributary.

The State Water Board acknowledges existing efforts on some tributaries to improve conditions for fish. As discussed in Section 4.3.5, *Temperature*, Section 7.6.2, *Aquatic Biological Resources*, and elsewhere, under current conditions, temperature management is frequently a concern below reservoirs on many tributaries throughout summer and fall for the protection of salmon, especially during droughts and critically dry periods. Some reservoirs currently have cold water management requirements that are being implemented with varying degrees of success. However, comprehensive requirements do not exist for all tributaries where reservoirs are present or for tributaries without reservoirs, and the Bay-Delta Plan does not include any such requirements.

As described in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta*, and elsewhere, the Plan amendments are intended to be complementary to other existing environmental requirements, and to provide sufficient flow for instream beneficial uses within the tributary watershed and also downstream and through the Delta. Generally, if requirements contained in the Bay-Delta Plan differ from those contained in any water right order or water quality certification, the more stringent requirement would control. In cases where Bay-Delta Plan requirements call for increased flows at different times of the year from other flow requirements, the optimal use of the water for fish habitat would be determined through the adaptive implementation or local cooperative solution provisions in the Plan. Instream flow requirements are included in the Sacramento Water Allocation Model (SacWAM) modeling and are, therefore, already integrated with the evaluation of the revised proposed Plan amendments.

Provisions for adaptive implementation of the numeric inflow requirements are provided to optimize flows to benefit native fish and wildlife while also minimizing water supply impacts, and for the numeric inflow requirements to be implemented in a coordinated fashion with the cold water habitat and inflow-based Delta outflow requirements. Adaptive implementation may be allowed on a seasonal, annual, or long-term basis as part of local cooperative solutions or may be required by the Executive Director or State Water Board. Adaptive implementation may also be used to integrate, as appropriate, Bay-Delta Plan requirements with water quality certification requirements, water right orders, or other existing environmental requirements.

The cold water habitat objective is narrative in order to provide sufficient flexibility for implementation options. This includes the integration of existing environmental requirements to the extent possible. To the extent that existing measures are in place for temperature control, those requirements would be reviewed to determine whether additional or updated measures are necessary to ensure that they are protective and that measures are integrated with the inflow and outflow objectives and implementation measures.

Any alleged conflicts with various endangered species act requirements do not render the flow scenarios as legally infeasible. The flow scenarios are fully feasible to implement. The fact that National Marine Fisheries Service (NMFS) exercises jurisdiction over a project pursuant to the ESA does not prevent the State from exercising its independent jurisdiction to regulate diversions of water for the reasonable protection of beneficial uses in the Bay-Delta watershed. Alleged consistency with the federal ESA or even the California Endangered Species Act (CESA) is not a determination, legal or otherwise, of what species need for their reasonable protection. See Common Response 1.1, *General Comments*, regarding consistency with other laws, policies, and agreements, including a general discussion of federal and state ESAs.

Scope of the Water Temperature Analysis

Several commenters argued that there was insufficient information to evaluate water-temperature related impacts. Some stated that the temperature modeling does not reveal all potential effects or properly characterize the effects of the revised proposed Plan amendments. These comments were mostly regarding tributaries without water temperature modeling results. While the water temperature analysis cannot identify exact effects in all water bodies, it does consider possible effects in all types of waterbodies that could be affected by the revised proposed Plan amendments. The analysis that was performed was complete and sufficient despite an inability to model all waterbodies and predict the precise future actions that will be taken to protect cold water habitat on a given tributary. For additional general information regarding approach, scope of analysis, and the sufficiency of the CEQA analysis, please see Common Response 7.1, *General CEQA and Approach to the Analysis*.

The 2025 partially recirculated draft Staff Report includes water temperature modeling for the Sacramento, Feather, and American Rivers, similar to the 2023 draft Staff Report, and adds the Yuba River. Water temperatures were not simulated for other tributaries because models were not available. However, potential water temperature effects on non-modeled tributaries, including those outside of the Plan area, are included in the evaluation of effects on aquatic biological resources (please see Sections 7.6.2 and 13.7.6.2, each titled *Aquatic Biological Resources*). Effects on non-modeled tributaries were inferred from changes in hydrology and the results from the water temperature modeling performed for other tributaries. It is possible that temperatures in some streams could increase at times, particularly before tributary-specific cold water habitat implementation measures become more fully implemented.

Precise changes in temperature and their effects on fish are uncertain because the changes will depend on multiple factors, including decisions that will be made by reservoir operators and water users in real-time in an effort to comply with the cold water habitat objective and changes based on information gathered through the development of the annual temperature management plans and long-term temperature management strategies. Additionally, identifying and taking the appropriate actions to meet the cold water habitat objective in some locations may not result in immediate improvements, and temperature concerns could occur until all cold water habitat measures are implemented in the tributary.

The cold water habitat objective would not apply outside the Sacramento/Delta watershed. However, existing regulatory requirements such as California Fish and Game Code section 5937, FERC license conditions and water quality certifications, and NMFS biological opinion (BiOp) requirements would apply.

Implementation of the Cold Water Habitat Objective

Several commenters identified that there could be water temperature impacts to special-status fish species as indicated in the water temperature evaluation in Section 7.6.2, *Aquatic Biological Resources*, suggesting that this indicates the flow requirements could be incompatible with the cold water habitat objective. Commenters also stated the Staff Report lacked description of how the cold water habitat objective could be implemented along with the flow requirements. This section describes how the cold water habitat objective can be implemented to reduce the temperature impacts described in the Staff Report.

These comments appear to miss the fundamental purpose of the narrative cold water habitat objective and its role in the overall context of the revised proposed Plan amendments. The State Water Board recognizes that providing instream flows for the environment necessarily results in less water available for other uses. Providing balanced protection of all beneficial uses of water is incredibly important and requires careful consideration, and the State Water Board is sensitive to water supply impacts. The revised proposed Plan amendments were developed to improve flow and water quality conditions over a large geographic area, and particularly for fish and wildlife beneficial uses in the Sacramento/Delta. The impacts that could potentially result from implementation occur in a system that has been highly altered, and the project would be expected to improve conditions for native fish and wildlife in the Sacramento/Delta watershed over time.

The Staff Report acknowledges that while higher spring flows that more closely resemble the natural hydrologic regime would benefit native anadromous salmonids and other native species in the spring, higher spring flows also could result in a reduction in reservoir storage at the end of spring and a smaller cold water pool volume in summer and fall months. The Staff Report acknowledges potential temperature increases could occur in some streams under some circumstances and managing these factors to protect cold water habitat for fish is complex and challenging. It is also important to note that water supply deliveries are also a major factor in determining reservoir operations. Even with optimized reservoir operations and cold water management, some reductions in water supply deliveries would be necessary. Without reductions in water supply deliveries, reservoir storage would be lower and it would be more difficult to attain the inflow requirements without further impairments to temperatures. In recognition of these inherent tensions, the cold water habitat objective serves as a complementary measure to the inflow requirements to bolster existing legal protections to ensure comprehensive temperature protection over time.

The cold water habitat objective is narrative by design in order to provide sufficient flexibility for successful implementation. Flexibility in the form of adaptive implementation is provided in part to mitigate water supply impacts if tailored solutions are available that are equally or more protective for fish. CEQA impact determinations are conservative but in many instances can be reduced or avoided with tailored operations. The State Water Board provides these flexibilities so that water diverters and reservoir owner/operators, who are in a good position to understand their unique circumstances on a specific tributary, can tailor long-term strategies and adaptive implementation to their tributary.

The narrative cold water habitat objective provides flexibility for implementation options that are tailored to the unique circumstances of each tributary. Reservoir owners and operators may need to meet the proposed cold water habitat requirements by implementing some combination of cold water releases, flow shaping, TCDs including reservoir outlet shutters and thermal curtains, fish passage improvements, and reductions in deliveries to meet instream flow requirements and/or maintain reservoir storage. Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, discusses and evaluates the potential environmental impacts, including construction impacts, of habitat restoration and other ecosystem projects (e.g., use of TCDs and fish passage improvement projects) that entities may undertake toward achieving the overall goal of improving conditions for fish and wildlife in the Sacramento/Delta. While it is expected that many parties would take advantage of the provided flexibility to optimize operations and avoid environmental impacts, the analysis considers and incorporates the most conservative assumptions to ensure comprehensive impact conclusions.

The environmental analysis discloses impacts that would occur if cold water habitat is managed solely with carryover storage target ranges included in the SacWAM modeling. This includes identifying impacts due to reductions in deliveries that may be necessary to meet the inflow and cold water habitat requirements. Provisions for adaptive implementation of the numeric inflow requirements are provided to optimize flows to benefit native fish and wildlife while also possibly reducing water supply impacts, and for the numeric inflow requirements to be implemented in a coordinated fashion with the cold water habitat and inflow-based Delta outflow requirements. The environmental analyses evaluate a complete range of impacts in the event that water users do not utilize adaptive implementation, as well as the potential impacts from implementation of adaptive implementation. A full range of flow scenarios with cold water storage targets are analyzed in Chapter 7 and Section 13.7, each titled *Environmental Analysis,* and physical habitat restoration and other ecosystem projects that may be pursued are analyzed in Section 7.21, *Habitat Restoration and Other Ecosystem Projects.*

The Plan amendments specify that any decision to approve or direct adaptive implementation must be informed by best available scientific information, including monitoring and evaluation of the effectiveness of the measures in meeting the narrative objectives, and biological goals when available.

Common Response 1.3, *Revised Proposed Plan Amendments*, provides a description of the components of the revised proposed Plan amendments including the components of the regulatory pathway that will need to be utilized to fully implement the measures for meeting the cold water habitat requirements. Key components for meeting the cold water habitat requirements include adaptive implementation provisions, long-term temperature management strategies, annual temperature management plans, and local cooperative solutions.

The potential water temperature impacts described in Section 7.6.2, *Aquatic Biological Resources*, for Sacramento/Delta tributaries would be reduced after implementation of the cold water habitat objective can be optimized. Identifying and taking the appropriate actions to meet the cold water habitat objective may not result in immediate improvements in some tributaries, and temperature concerns could occur until the tributary is in compliance with the objective.

Some commenters thought that the impacts of the cold water habitat objective could not be fully determined because implementation of the objective had not been fully described or that implementation of the cold water habitat objective would incur new impacts over time. On the contrary, effects associated with implementation of cold water habitat actions would not go beyond the scope of the environmental and economic analysis in the Staff Report. The water temperature simulations performed for Chapter 7, *Environmental Analysis* (proposed Plan amendments), and Chapter 13, *Revised Proposed Plan Amendments* (revised proposed Plan amendments), do not include all measures that may be included in the long-term temperature management strategies and annual temperature management plans that may be needed to implement the cold water habitat objective and thus, conservatively estimate greater effects to river temperature. Additionally, the SacWAM and HEC-5Q modeling discussed in Chapter 7 and Chapter 13 only include carryover storage targets as included in the Plan. Although water temperature modeling does not include all aspects of long-term temperature management strategies, the environmental impacts and economic effects of these measures are fully analyzed in the Staff Report, for example in Section 7.21*, Habitat Restoration and Other Ecosystem Projects*, and Section 8.8, *Costs Associated with Habitat Restoration and Other Ecosystem Projects*. With implementation of the cold water habitat objective including refinements through other actions developed through the long-term temperature management strategies and annual plans, the temperature effects are likely to be less than what is modeled in Chapter 13.

In the revised proposed Plan amendments*,* the State Water Board will require the water right holders and reservoir owners/operators identified in Table 7 of the draft Bay-Delta Plan that are not part of the VA pathway to develop long-term temperature management strategies for operations of the rim reservoirs and associated facilities identifying how the reservoirs and related facilities will be operated to meet the cold water habitat requirements based on the best available scientific and technical information. Long-term temperature management strategies may consider times of year that various life stages of anadromous fish are present, locations in the river that are utilized by anadromous fish, and the flow and storage required to maintain suitable water temperatures far enough downstream to protect sensitive life stages from adverse temperature effects. Long-term temperature management strategies may set priorities and temperature goals for protection of particular life stages and river locations and include additional modeling of water temperature effects to better explore the effects of different actions that could be taken. The actual carryover storage levels for a given reservoir may need to be higher or could be lower than modeled for the Staff Report and identified as a range of carryover storage targets in the revised Plan to protect cold water habitat. The strategies are also required to evaluate other available measures to improve temperature management, including passage, temperature control device measures, riparian habitat improvements, and other measures that will be implemented to contribute to meeting the narrative cold water habitat objective.

Additional actions to meet the cold water habitat objective could also be part of local cooperative solutions. The revised proposed Plan amendments allow for and encourage local cooperative solutions that would facilitate a combination of flow and non-flow actions to promote habitat restoration to amplify the ecological benefit of new and existing flows. Local cooperative solutions may utilize adaptive implementation provisions or other measures that provide cold water habitat benefits. Water right holders may also propose local cooperative solutions that share responsibilities between water right holders in different manners than would occur by implementing the objectives in strict water right priority, provided that doing so provides the same level of inflow and does not impact other legal users of water or have reduced benefits or impacts to fish and wildlife. Water right holders may propose local cooperative solutions for individual tributaries, two or more tributaries, or for regions, including the Delta.

Other implementation actions that will likely be necessary to implement the cold water habitat objective include actions described in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta*, the revised proposed Plan amendments, and Section 13.7.6.2, *Aquatic Biological Resources*, and could be part of local cooperative solutions or long-term temperature management strategies. Additionally, the cold water habitat objective is a narrative objective and other actions could be taken to meet the objective. Possible actions are:

1. **Optimize reservoir release temperatures and modify carryover storage requirements** in accordance with Section 4.4.2.3 of the revised proposed Plan amendments. This could help provide cold water habitat for fish. For example, if reservoir releases are reduced during certain times of the year as a result of the revised proposed Plan amendments, colder water could be released from the reservoir. Cold water management could be better optimized and targeted to specific times of year and species when it is most beneficial. Depending on circumstances such as cold water benefits in summer versus fall, either higher or lower carryover storage could also be beneficial.
2. **Adaptive implementation including flow shaping and adjusting in the range of unimpaired flow -** as part of adaptive implementation in accordance with Section 4.4.2.2 of the revised proposed Plan amendments. This could improve cold water habitat under certain circumstances. Flow shaping could shift some of the winter/spring flow requirements to later in the year if deemed necessary to protect cold water habitat. Under a lower flow requirement, the potential impacts associated with reductions in storage and/or lower flows in summer and fall would be reduced.
3. **Local Cooperative Solutions that could use items 1) and 2) in this list, as well as habitat restoration. -** in accordance with Section 4.4.2.4 of the revised proposed Plan amendments for two or more tributaries, local cooperative solutions could be used to improve water temperatures by allowing increases in flow where it would be most beneficial. For example, moving and combining compliance points on two tributaries to a location downstream of the confluence of two tributaries could allow water to be managed in a way that would be more

beneficial for cold water habitat. Habitat restoration could improve fish access to cold water by either bringing colder water to the fish (e.g., through channel reconfiguration, construction of temperature control devices, or increasing riparian shade), increasing fish habitat in colder stream sections higher in the watershed (e.g., through gravel augmentation), or providing fish passage to colder water (e.g., through construction of fish ladders or other fish passage projects).

4. **Increasing hydropower bypass**, which could be investigated as part of long-term temperature management strategies, could allow access to colder water that is deep in reservoirs below powerplant penstocks or allow water to stay in rivers instead of being diverted to hydropower facilities.

Water Temperature and Fish Evaluation

Some commenters stated that the cold water habitat requirements are too restrictive or not possible to attain with the flow requirements, while others stated the requirements were not protective enough or that any temperature impact is unacceptable and not consistent with the Project purpose. As described in Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1.3, *Reservoir Carryover Storage Targets,* of the Staff Report, specific end-of-September carryover storage targets were modeled together with the inflow requirements by adjusting carryover storage targets and allocations with the goal that the resulting end-of-September storage levels in the scenarios were above the carryover target as frequently as or more frequently than the baseline scenario. In some reservoirs and in some scenarios, this goal was not possible to achieve. For locations not represented with water temperature modeling, SacWAM simulations were used to evaluate where challenges with meeting suitable temperatures while meeting the proposed flow requirements and water supply deliveries may exist due to reduced reservoir storage levels and reduced flows in summer and fall in some tributaries. Because the cold water habitat objective is narrative and is intended to be implemented based on the specific circumstances of each watershed, the modeling did not include specific prescriptive requirements. Instead, it included assumptions that generally reflect reservoir management actions that could be taken to provide cold water habitat protection with a focus on the rim reservoirs.

Reservoir operations modeling must include, by necessity, assumptions that constrain the reservoirs (e.g., do not allow them to be drained dry) to provide a reasonable set of water operations. However, numeric constraints that are used for modeling are not regulatory requirements and these assumptions are not the only methods of actual operation under the Plan amendments. Rather, fall carryover targets are intended to represent system responses to regulatory conditions for the purpose of comparing plan alternatives.

The October 2024 draft Bay-Delta Plan included specific initial carryover storage requirements the owners/operators of these reservoirs would be required to meet in the absence of an approved temperature management strategy. In response to comments that the initial carryover storage requirements were too restrictive, subsequent drafts allowed reservoir owner/operators to propose their own carryover storage levels for State Water Board approval as part of their development of a long-term temperature management strategy. The Plan amendments now identify ranges that carryover storage levels should fall within, with a lower range identified for drought years for most reservoirs. The Plan amendments now also identify that if reservoir owners do not develop carryover storage levels, the State Water Board would do so through a public process.

Section 7.6.2, *Aquatic Biological Resources*, and Appendix A6, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers*, of the Staff Report provided water temperature model results for the Sacramento, Feather, and American Rivers for the 35 – 75 flow scenarios, but focused on the 45 – 65 flow scenarios, particularly the 55 flow scenario as being representative of the proposed Plan amendments. Due to changes in SacWAM modeling described in Appendix H1a, *Sacramento Water Allocation Model Methods*, new water temperature modeling of the 35 – 65 flow scenarios and VAs was performed as described in Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American, and Yuba Rivers*. The results of this new water temperature modeling are affected by changes in SacWAM output and by changes in the water temperature modeling methodology, including the addition of Yuba River water temperature modeling. In addition, the 2025 partially recirculated draft Staff Report includes water temperature simulations for the 55 w/WSAs scenario, which generally has reduced water temperature effects as compared to the 55 scenario as described in Section 13.7.6.2, *Aquatic Biological Resources*, of the Staff Report.

A new analysis for the Yuba River has been added to Chapter 13, *Revised Proposed Plan Amendments*. A temperature model was developed for the Yuba River. The new temperature model results for the Yuba River were used to assess temperature effects on all fish life stages of concern as described in Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American, and Yuba Rivers*, and Section 13.7.6.2, *Aquatic Biological Resources*. Please refer to Appendix H1b for more information about the Yuba temperature model and results.

End-of-September reservoir storage was targeted to maintain cold water throughout the year. Reservoir operations that result in low storage in late summer and fall months (i.e., August through November) can cause release temperatures to become too warm for cold water fish, such as Chinook salmon and steelhead. Each reservoir has a slightly different elevation-volume relationship, and the elevation of the outlet and the maximum surface elevation influences the minimum carryover (end-of-September) storage that provides a cold water release. For reservoirs with documented or historical storage-temperature relationships, storage thresholds sufficient to maintain cool release temperatures were incorporated into the modeling. For example, for Folsom Reservoir, historical operations show that, when end-of-September storage is above 400 thousand acre-feet (TAF), cooler downstream temperatures are more often achieved. In the modeling scenarios, CVP allocations were adjusted to maintain end-of-September storage above 400 TAF as frequently as baseline storage.

Comments that suggest any temperature impacts are unacceptable and inconsistent with the project purpose are missing the overall context of the Plan and purpose of the cold water habitat objective. Changes in temperatures are not the only factor affecting aquatic habitat and must be viewed in context of the overall Plan. The impact assessment in the Staff Report focusses on changes in water temperature conditions for fish relative to baseline conditions. As discussed in Section 7.6.2, *Aquatic Biological Resources*, most tributaries with reservoirs have existing temperature management concerns at certain times under baseline conditions. These existing temperature issues do not represent a temperature impact, although the cold water habitat objective is intended to remedy that over time.

Fish Assessment

While many comments point out the potential negative effects to river temperatures, there are also positive effects to river temperatures discussed in the Staff Report and appendices. Modeling results in Appendix H1b, *Temperature Modeling for the Sacramento, Feather, American, and Yuba Rivers* indicate that the regulatory pathway could result in cooler temperatures in some months, with the effect varying by locations on each river. The most prevalent effect is a reduction in spring temperatures. In the spring, increased releases from rim dams could reduce downstream temperatures and improve cold water habitat. Another notable effect is a reduction in the warmest (90th percentile) temperatures released from Shasta Reservoir during August through October due to higher carryover storage. Reductions in temperature could produce favorable effects for some life stages of fish. As described in Section 13.7.6.2, *Aquatic Biological Resources*, the results for the 55 w/WSAs scenario often show more favorable effects than unfavorable effects, depending on river and life stage. In addition, while all tributaries are not modeled, the regulatory pathway would be expected to improve flow and temperature conditions on other tributaries during critical migration periods for adult and juvenile Chinook salmon and steelhead, which would benefit these species.

Effects to fish species and life stages based on temperature modeling was conducted for the four largest tributaries in the Sacramento River watershed: the Sacramento, Feather, Yuba, and American Rivers. Simulated water temperatures at multiple river locations were compared with a suite of temperature indices for all upstream life stages of the fish species analyzed. The percentage of time that water temperatures exceed temperature indices for key fish life stages, and the average magnitude of exceedance above the temperature indices, were used to estimate whether there could be favorable or unfavorable effects of changes in water temperature on each life stage of fish relative to baseline conditions. More details on the methodology and results are provided in Appendix A6, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers,* and Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American, and Yuba Rivers.* The fish assessment indicates that the Plan amendments could cause both favorable and unfavorable fish effects that would vary depending on the fish species, life state, temperature index, water year type, and month evaluated. The assessment in the Staff Report necessarily focusses on unfavorable effects and does not combine favorable and unfavorable effects in a way that might obscure unfavorable effects.

Development and Refinement of Carryover Storage Target Ranges

Multiple comments stated that the carryover storage targets used to inform SacWAM modeling and presented in Appendix A1c, *Preliminary Assessment of Effect of Reservoir Storage on Reservoir Release Temperatures*, of the 2023 draft Staff Report were either too onerous and did not allow full use of available water and were higher than needed to fully protect cold water habitat. In contrast, others pointed out that carryover storage in some reservoirs was at least as high as baseline carryover storage for some reservoirs under dry conditions, and commented that unimpaired flow requirements or carryover storage should be higher to better protect fish. In addition, some commented that the carryover storage targets were too simplistic or inaccurate and did not account for all existing and future factors that could affect water temperature. For comments regarding the modeling of carryover storage target ranges in SacWAM, please see Common Response 6.1, *Sacramento Water Allocation Model and Changes in Hydrology and Water Supply*. Otherwise, these concerns are responded to below.

Some commenters suggested that carryover storage target ranges should be higher, or that they are high enough, but the flow requirements could be increased. The Plan amendments include significant flexibility to adjust the flow requirement up to 65 percent of unimpaired flow and adjust implementation of the cold water habitat objective. In addition, the Staff Report indicates that higher flow scenarios would have larger effects on water supply and increase difficulty in meeting the cold water habitat objective without reductions in deliveries. Tables 6.3-6 and 6.3-7 of the 2023 draft Staff Report indicate that higher flow scenarios would generally result in lower end-of-April storage. End-of-April storage is correlated with the volume of cold water available for use through the summer and fall. To conserve cold water into the fall and allow carryover storage to be within the target ranges, reservoir releases must be reduced. Reduction in late spring through early fall reservoir releases can allow carryover storage targets to be met, but can affect water supply and instream flow, and can reduce the longitudinal extent of cold water habitat during the period of lower releases. Carryover storage target ranges described in Appendix H1a1, *Assessment of Effect of Reservoir Storage on Reservoir Release Temperatures,* consider the tradeoff between carryover storage and summer water use. At higher flow requirements, lower spring storage combined with a need to protect fall storage causes increased constraints on summer releases of water for all purposes. For further information on the reasonable protection of fish and wildlife, see Common Response 1.2, *Water Quality Control Planning Process*.

In consideration of commenters' concerns regarding the constraints of carryover storage targets, the evaluation of carryover storage target ranges was updated with new information and considerations, and the ranges were adjusted as described in Appendix H1a1, *Assessment of Effect of Reservoir Storage on Reservoir Release Temperatures*. Inclusion of carryover storage targets in the SacWAM modeling is essential to prevent excessive depletion of reservoir storage under all scenarios, including baseline conditions. The target ranges represent an initial attempt to prevent temperature increases that could result from lower spring reservoir storage associated with flow requirements, while still providing sufficient water for summer releases of water for water supply and instream flow.

Some commenters suggested that the carryover storage target ranges that are based on historical data are too simplistic or inaccurate, do not track the volume of cold water, or do not account for how the Plan amendments would result in deviations from historical conditions, including increased reservoir releases in the winter and spring, and potentially reductions in cold water supply earlier in the year. These comments assume the inflow requirements are a stand-alone requirement and in some cases are based on the commenter's modeling that does not include reductions in deliveries. However, the cold water habitat objective would be implemented together with the inflow requirements. The carryover storage target ranges listed in the draft Bay-Delta Plan are in place to protect river temperatures and water supply in subsequent years. The cold water habitat objective allows for substantial flexibility in implementation and allows individual tributaries to develop an approach that best fits operational capabilities to meet the needs of fish that utilize the tributary, and minimize effects to deliveries. This could include improved tracking of cold water volumes and development of more detailed carryover storage relationships and modeling. With additional actions described above related to implementation of the cold water habitat objective, temperature and cold water could be managed more efficiently, and carryover storage ranges could be adjusted.

Carryover storage requirements have significant flexibility and may be refined as part of long-term temperature management strategies. As described in the revised proposed Plan amendments, the water right holders and reservoir owners/operators of the reservoirs identified within the Plan, not electing to follow or not in compliance with the VA pathway, would be required to develop proposed carryover storage requirements within specified ranges as part of their long-term temperature management strategies, which are intended to provide for maintenance of cold water supplies during the fall months and into the subsequent water year, as well as minimum supplies for health and safety needs and other purposes. Water right holders may develop proposed carryover storage requirements outside of this range based on evidence and documentation that carryover storage requirements outside of these ranges will provide for protection of cold water habitat and other critical purposes, including health and safety supplies. In the event that water right holders do not develop proposed carryover storage levels, the State Water Board will undertake a public process to develop those requirements.

Assessment of Upper Watershed Effects

Several comments stated the Staff Report did not properly assess potential effects within upstream watersheds or that the proposed Plan amendments do not include actions for how upstream watersheds may comply with the cold water habitat objectives.

Section 13.7.6.2, *Aquatic Biological Resources*, discusses the modeling efforts within the upper watersheds. For upper watershed reservoirs and river reaches, specific cold water storage assumptions were not included in the SacWAM modeling because there is not enough available information, and the focus of the analysis is on the anadromous reaches of the tributaries subject to initial cold water habitat implementation actions. As described in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta*, cold water habitat measures could be required for these upper watershed reaches if water temperature concerns exist or become problematic as a result of implementation of the regulatory pathway. In general, the regulatory pathway is not expected to have large effects on hydrology in the upper watersheds but there could be changes in storage and flow at some locations associated with meeting flow requirements of the regulatory pathway, particularly in association with changes in interbasin diversions.

Although Section 13.7.6.2, *Aquatic Biological Resources*, explains why upper watershed carryover storage target ranges were not developed, the effects of re-operating reservoirs and modifying interbasin diversions in the upper watersheds were modeled by SacWAM and incorporated into the water temperature modeling. SacWAM includes estimates of changes in upper watershed hydrology due to the flow scenarios. Changes in upper watershed hydrology are described in Section 13.4, *Changes in Hydrology and Water Supply*, and Appendix H1a2, *Sacramento Water Allocation Model Results for Revised Proposed Plan Amendments*, for the 55 w/WSAs and VA scenarios and Appendix H1a3, *Sacramento Water Allocation Model Results for Updated Unimpaired Flow Scenarios*, for the 35 – 65 scenarios.

Compliance points for the flow scenarios are located at the downstream ends of major tributaries. As indicated in Section 13.4, *Changes in Hydrology and Water Supply*, several upper watershed reservoirs could experience reductions in storge under the flow scenarios in order to meet flow requirements, particularly reservoirs affected by interbasin diversions that move water from one watershed to another. In many tributaries, however, flow requirements can be met without substantially altering storage in upper watershed reservoirs because there is not much consumptive use in the upper watersheds and inflow from unregulated tributaries provide sufficient flow to meet flow requirements. Appendices H1a2 and H1a3 list 53 upper watershed reservoirs included in SacWAM. The SacWAM results indicate that most of these reservoirs do not need to be reoperated to implement the flow scenarios or show no significant change in storage.

Contrary to commenters statements, temperature effects associated with changes in upper watershed flows are incorporated in the water temperature modeling results that are discussed in Section 13.7.6.2, *Aquatic Biological Resources*, for the 55 w/WSAs and VA pathway scenarios and Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American, and Yuba Rivers*, for all other scenarios. Changes in flow in the upper watersheds modeled by SacWAM lead to changes in reservoir inflow volumes. These changes in volume are subsequently accounted for in the HEC-5Q temperature models and associated temperature effects from the upstream flow changes are thus incorporated in the HEC-5Q models because the hydrology inputs are from SacWAM. For example, changes in flow in the upper tributaries of the Yuba River lead to changes in the volume of water entering the North Fork Feather River upstream of New Bullards Bar Reservoir, which result in changes to cold water inflow to the reservoir.

The effect of changes in upper watershed storage on downstream temperatures depends on season, depth of the reservoir, depth of withdrawal, and travel time to the HEC-5Q model domain. However, because the upper watershed reservoirs are generally not expected to experience large changes in storage and because these reservoirs are often far upstream from the rim reservoirs or relatively small in volume compared to reservoirs within the HEC-5Q model domain, the temperature effects of upstream changes in storage would likely be minimal. In cases where the upstream storage capacity is small or nonexistent, stream flows would be unrestricted and close to unimpaired levels and therefore the flow scenarios would not affect flows or temperatures.

In many tributaries, the flow requirements would allow operations in the upper watersheds to continue as they do under existing conditions because there is sufficient flow at the downstream ends of upper watershed tributaries to meet flow requirements at compliance points. However, if reoperation in the upper watersheds were to negatively affect fish of concern, perhaps due to reductions in reservoir storage or reduction in inter-basin diversions, additional actions could be proposed or required to protect cold water habitat, similar to what is described in the section above regarding implementation of the cold water habitat objective. For example, local cooperative solutions might be used to reduce temperature effects in upper watershed tributaries affected by changes in interbasin diversions.

While the revised proposed Plan amendments do not initially require upper watershed reservoir owner/operators to develop long-term temperature management strategies and annual temperature management plans, the State Water Board may require long-term temperature management strategies and annual temperature management plans on additional Sacramento/Delta tributaries or stream segments as part of the periodic review process based on information indicating that water diversion and use practices are causing elevated water temperatures that negatively affect the aquatic ecosystem. In addition, upstream and downstream water right holders may be required to participate in development and implementation of the long-term temperature management strategies and annual temperature management plans, to the extent that their operations affect achievement of the cold water habitat objective.

Sensitivity of American River Temperature Model to Folsom Reservoir Temperature Targets

Some commenters stated that the effects to American River temperatures from the Plan amendments are too great, and therefore that they could not be implemented. Other commenters state that there is not enough flexibility in operations to implement the cold water habitat requirements in combination with the inflow requirements. It is important to note that temperature management is challenging under existing conditions, the Staff Report conservatively presents the impacts of the Plan, and there are additional actions that can be taken to improve conditions and reduce potential impacts. This section presents a sensitivity analysis performed on the American River to evaluate model sensitivity to changes in operations of the Folsom Reservoir for managing cold water and how it would affect water temperatures. It evaluates possible alternative operations that could be developed through additional modeling and optimization of cold water to reduce effects to water temperatures. For more information and documentation of the HEC-5Q model, please refer to Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American and Yuba Rivers.* This analysis demonstrates that changes in operations could reduce water temperature effects of the Plan amendments.

To conservatively evaluate possible impacts to water temperatures, the existing Staff Report approach for modeling water temperatures is not updated with the method used in this sensitivity analysis. Additionally, the approach used in the Staff Report has been used by U.S. Bureau of Reclamation (Reclamation) in the past to evaluate temperatures for annual and long-term planning on the American River. This sensitivity analysis assesses sensitivity of modeled water temperatures to the Folsom temperature target to which the reservoirs temperature control device is operated. This sensitivity analysis uses an adjusted Folsom temperature target, but uses the same SacWAM hydrology as Chapter 13, *Revised Proposed Plan Amendments*, of the 2025 partially recirculated draft Staff Report. Although the sensitivity analysis demonstrates that temperature effects could be lower with different operational assumptions, the impact determinations in the Staff Report are unchanged in order to maintain a conservative impact evaluation.

Background on Staff Report Approach to Defining Folsom Reservoir Target Temperatures

Releases from Folsom Reservoir are actively managed based on current conditions and iterative model runs to determine how to most closely meet objectives of the modified flow management standard (PCWA 2017). This is a complex process and difficult to implement in simulations that span many years for planning purposes. As a result, annual planning analyses have used reservoir release temperature targets that are based on an index that adds end-of-May storage and predicted June–September inflow (see Table H1b-2 reproduced from ^DWR 2016d). The index is used to set a schedule of temperature targets for the year that may be achievable without using power bypass. Thus, every year the index and target changes based on hydrologic conditions, and model scenarios could have different targets. In general, years with a higher index lead to a lower temperature target schedule, and years with lower storage, lead to higher temperature target schedule. Additionally, when comparing two model scenarios, a scenario that results in lower storage in May more frequently than another scenario, will have higher temperature targets and higher resulting river temperatures. These targets were developed for planning purposes based on CalSim results and are described in the Biological Assessment for the California WaterFix (^DWR 2016d). This same table of target temperatures was used for temperature modeling in the Staff Report. Table 5.C-4 was initially developed by Reclamation (Reclamation 2015). The temperature schedules in Table 5.C-4 were set high enough such that temperature bypass is not activated by the model, likely because power bypass is not a planned operation and Reclamation plans operations to avoid requiring use of the power bypass. However, in real-world conditions, power bypass is frequently used to manage temperature in the American River.

While Table 5.C-4 may be used to set temperature targets in annual planning by Reclamation, and is sufficient to use for evaluation of programmatic changes, it does not always result in modeling that matches historical temperatures, and does not always reflect possible operational flexibilities that could further reduce temperature effects of various scenarios. For this reason, the sensitivity analysis modifies the temperature targets to test potential flexibility in operations and potential variations in modeling that could lead to reductions in temperature effects.

Adjusted Folsom Target for Sensitivity Analysis

To present possible alternative operations that could be developed through additional modeling and optimization of cold water and to test the potential for reducing impacts by operating to a different reservoir release target, the temperature targets were adjusted. The adjusted targets more closely represent the historical temperature patterns and allow triggering of power bypass. Actual target temperatures used in daily real-time operations may differ from the target temperatures estimated here for multiple reasons. For example, operational and temperature management protocols have changed through time and real-time targets for Folsom are developed through more detailed modeling and could be informed by real-time hydrologic conditions, downstream temperatures, and presence of fish and spawning activity.

Three primary aspects of the target approach were changed. First, because the flow scenarios in the Staff Report generally lead to lower end-of-May storage, temperature targets produced with the storage-dependent method used in the Staff Report are higher than baseline (see Figure CR 7.6.2-1). Because of this higher temperature target, the modeled temperatures are also generally higher for the flow scenarios than baseline, even if colder water may have been available in the reservoir to reduce temperatures in the flow scenarios. Figure CR 7.6.2-2 compares the Table 5.C-4 planning target schedules to historic observed temperatures below Folsom Dam and to the adjusted target used in the sensitivity analysis. The adjusted target, also presented in Table CR 7.6.2-1, was based on the average daily observed temperatures from 2010 through 2022. By holding the target consistent for each scenario, it is no longer dependent on storage, and thus storage effects on the temperature target no longer affect the resulting temperatures.

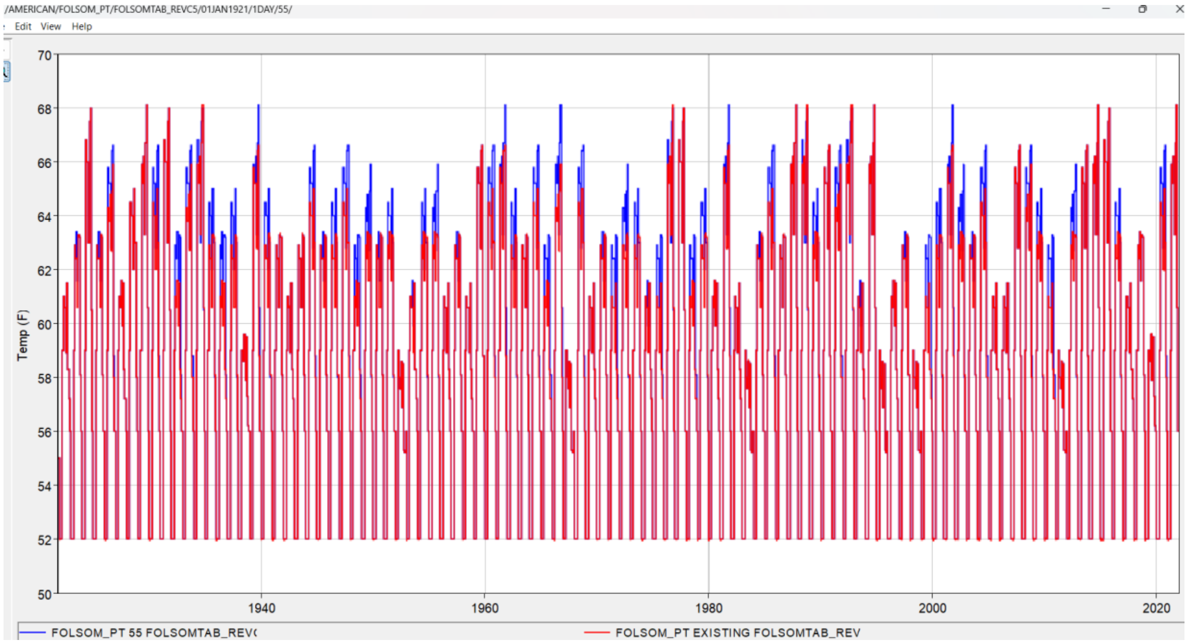
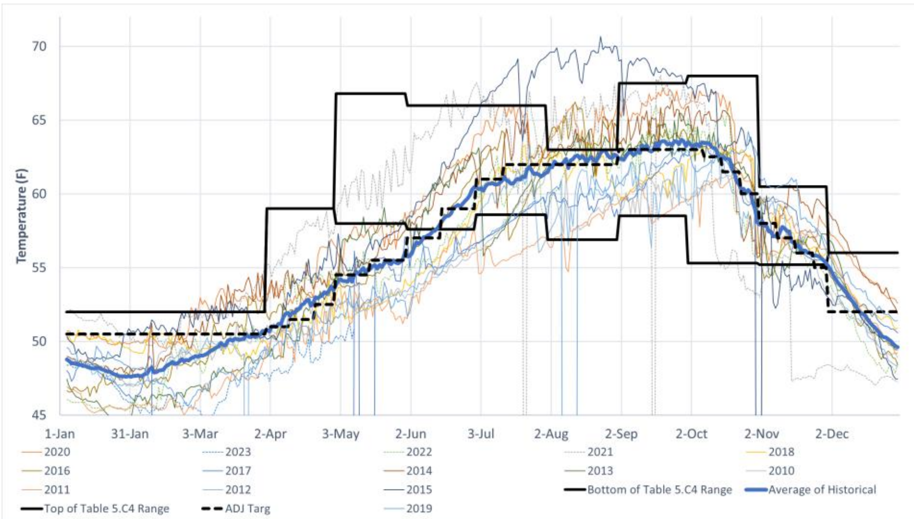


Figure CR 7.6.2-1. Comparison of the Staff Report Baseline (red line) and 55 Flow Scenario (blue line) Folsom Reservoir Target Temperatures from 1920 to 2021. The 55 flow scenario target is frequently higher than baseline.

The second aspect of the temperature target that was adjusted for the sensitivity analysis is related to power bypass. The schedule of temperatures in Table 5.C-4 are set high enough such that power bypass is never triggered in the model. In reality, power bypass has occurred in 15 years between 2000 and 2023, between the middle of October through the end of November, totaling on average 23 TAF in each year with bypass. By lowering the October and November targets, the power bypass functionality can be triggered to meet the temperature target. This was iterated lower until the total bypass from 2000 to 2021 was roughly the same as the observed bypass. Modeled Folsom bypass was also restricted to October 1st through December 15th, based on the historical use of power bypass. The reported total bypass from 2000 to 2021 was roughly 250,000 AF, while the performance evaluation discussed below resulted in 188,000 AF. This allows the HEC-5Q model to engage power bypass when needed, and in a similar manner to historic bypasses. Although this analysis considers different assumptions for power bypass, it would not result in any changes to the analysis of energy impacts since that analysis already considers effects of power bypass on hydropower. See Section 13.7.8, *Energy*, for that analysis.

Lastly, the springtime temperature targets are often set higher by Table 5.C-4 than historical release temperatures for April and May (See Figure CR 7.6.2-2). This is likely because temperature is not generally a concern in these months. However, the HEC-5Q model attempts to release the warmer temperatures, if it can logistically be reached, and frequently releases much warmer temperatures in the HEC-5Q performance evaluation (discussed further below) compared to observed conditions. The observed data shows that the April and May temperatures are frequently much lower than the target. This may be due to penstock intakes being too low in the reservoir to access the warmer water, but may also occur even when warm water may have been accessible. The adjusted targets for the sensitivity analysis use a shorter duration for each step, with the shortest period being seven days, rather than applying a target that is adjusted each calendar month as in Table 5.C-4. This allows the targets to better match natural transitions through seasons and represents the possibility to change the gates controlling release temperatures more frequently than monthly.

The adjusted target temperatures for the sensitivity analysis include cooler spring temperature targets in most years and cooler fall (October, November) targets for years with lower storage, compared to the targets in Table 5.C-4. For the sensitivity analysis, the adjusted temperature target pattern was applied in all years and does not change based on water supply, which is similar to the methodology used for the temperature targets for Oroville Reservoir. The same temperature target is applied to each model scenario, including those based on SacWAM scenarios and the performance evaluation based on observed flows and storages.



Source for Table 5.C-4: ^DWR 2016d
Note: Table 5.C-4 has only one schedule for December 1 through March 31

Figure CR 7.6.2-2. Folsom Reservoir historical daily release temperatures from 2010 through 2022 (thin lines); average daily release temperature (solid blue); the warmest and coolest DWR 2016d Appendix 5.C, Table 5.C-4 schedules (solid black); and the updated target used in the sensitivity analysis (dashed black).

Table CR 7.6.2-1. Adjusted Folsom Reservoir Release Temperature Target (°F) used in the Sensitivity Analysis

Day of Month that Target Changes	Temperature Target (°F)
January 1	50.5
April 1	51
April 15	51.5
April 25	52.5
May 1	54.5
May 15	55.5
June 1	57
June 15	59
July 1	61
July 15	62
September 1	63

Day of Month that Target Changes	Temperature Target (°F)
October 1	62.5
October 8	61.5
October 15	60
November 1	58
November 10	57
November 17	56
November 25	55
December 1	52

°F = degrees Fahrenheit

HEC-5Q Performance Evaluation for the Sensitivity Analysis

The performance evaluation conducted for Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American and Yuba Rivers*, was re-executed for this sensitivity analysis, and presented in this section, using the adjusted targets described above. The performance evaluation models temperatures based on observed flows and storage and compares those results to observed temperatures to determine the accuracy of the model. For more information related to the performance evaluation, please see Appendix H1b. The performance evaluation for this sensitivity analysis demonstrates that the alternative approach for defining temperature targets used in this sensitivity analysis could provide reliable results when the power bypass is activated.

Tables CR 7.6.2-2 through CR 7.6.2-4 summarize model ability to match measured temperatures for the American River. These can be compared to Tables H1b-17, H1b-18, and H1b-21 in Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American and Yuba Rivers*. These tables represent comparisons between measured and modeled temperatures for each 6-hour time increment with corresponding measured data. All observed data stations have from 9 to 19 years of temperature measurements starting after 2001. For these temperatures to match precisely, the model must not only be accurately capturing the daily energy balance but also matching the timing of the temperature fluctuations.

Results for the performance evaluation differ from Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American and Yuba Rivers*, and generally show reduced overall bias, primarily because the model uses historic average temperatures on a shorter increment compared to the Table 5.C-4 targets. Generally, average monthly model bias is less than 2 °F in all months and locations. Temperatures in October and November are much closer to observed temperatures. Temperatures immediately below Folsom Dam may not perform as well as temperatures farther downstream due to fluctuations in flow for hydropower peaking, making it difficult to accurately calculate flow-weighted average temperatures.

Table CR 7.6.2-2. Model Performance for Temperatures in the American River below Folsom Dam (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total number of values	1855	1673	1834	1782	1977	1957	1969	2045	1872	1970	1978	2070
Mean absolute error	2.4	2	1.5	1.2	1.6	1.8	2.3	2.9	2.4	1.8	2	1.7
Root mean square error	2.9	2.4	1.8	1.5	1.9	2.2	3	3.5	3	2.5	2.6	2.1
Average observed	47.9	47.7	49.3	51.9	54.2	57.1	60.1	61.5	62.4	62.4	57.3	52.2
Average modeled	49.8	49.5	50.2	51.7	54.6	57.4	61.3	63	63.9	62.1	57	52.2
Bias (modeled - observed)	1.9	1.8	0.9	-0.2	0.4	0.3	1.2	1.5	1.5	-0.3	-0.3	0

°F = degrees Fahrenheit

Table CR 7.6.2-3. Model Performance for Temperatures in the American River at Hazel Avenue (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total number of values	2232	2032	2232	2160	2232	2163	2356	2356	2280	2356	2280	2353
Mean absolute error	1.6	1.5	1.3	1.2	1.6	2	2.5	2.7	2.8	2.1	1.7	1.6
Root mean square error	1.9	1.8	1.6	1.6	2.2	3	3.9	4.1	4.4	3.5	2.4	1.9
Average observed	48.5	48.5	50.6	53.3	55.8	58.4	61.2	62.6	62.9	62.2	57.4	52.2
Average modeled	49.4	49.5	51.2	53.2	56.1	58.9	62.6	64.4	64.9	62.4	56.8	51.6
Bias (modeled - observed)	0.9	1	0.6	-0.1	0.3	0.5	1.4	1.8	2	0.2	-0.6	-0.6

°F = degrees Fahrenheit

Table CR 7.6.2-4. Model Performance for Temperatures in the American River at Watt Avenue (°F)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total number of values	2235	2139	2356	2280	2356	2280	2356	2356	2280	2356	2280	2356
Mean absolute error	1.9	1.9	1.9	2	2.2	2.5	2.9	2.9	2.5	1.7	1.2	1.3
Root mean square error	2.3	2.3	2.4	2.4	2.7	3	3.5	3.6	3.2	2.1	1.5	1.6
Average observed	48.7	49.5	52.5	56	59.3	61.9	65	66.4	66.1	63.8	57.6	51.8
Average modeled	49.9	51	54	56.8	60.4	63	66.6	68.3	68.1	64.1	57.4	51.6
Bias (modeled - observed)	1.2	1.5	1.5	0.8	1.1	1.1	1.6	1.9	2	0.3	-0.2	-0.2

°F = degrees Fahrenheit

Results of the Sensitivity Analysis

Table CR 7.6.2-5 contains the changes in temperature below Folsom Dam as modeled for the Staff Report and with the sensitivity analysis. Each scenario is compared to its respective baseline. The HEC-5Q model with the adjusted Folsom Reservoir release targets results in scenarios with summer and fall temperatures closer to baseline. In general, the resulting temperatures for all scenarios are lower than those in Appendix H1b, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, American and Yuba Rivers*, Table H1b-53. With the adjusted targets, the model engages power bypass in fall, but the flow scenarios did not increase power bypass volumes above baseline conditions. The 55 and 55 w/WSAs scenarios in the sensitivity analysis increase median June temperatures by roughly 1.2 °F, and all other months by less than 0.5 °F relative to baseline, which is substantially less than the increase simulated with the original target temperatures. This could lead to fewer unfavorable results than in Appendix H1b.

This sensitivity analysis is just one possible scenario for how operations could be different and temperatures could potentially be improved. Both the Staff Report temperature modeling and this sensitivity analysis would result in the same impact conclusion. Because the Staff Report temperature modeling more conservatively estimates potential impacts, that method is retained. However, this sensitivity analysis provides important context for how temperature impacts could be lower depending on how reservoirs are operated in response to the inflow and cold water habitat requirements. With further refinement and optimized management of the cold water in Folsom Reservoir, it is expected the modeled effects in the Staff Report could be reduced. The Folsom target could be further refined, for example by changing the targets by water year type or raising the spring temperature targets, such that the warmest water is released when accessible and when cold water is not needed. Because the model operates perfectly to control temperatures when possible, the model may change gate configurations more frequently than operationally feasible, which may lead to temperature optimization that is not currently feasible. Improving temperature control capabilities by improving operational flexibility could allow improved temperature management. This modeling tool and temperature target approach is used for comparative purposes of potential effects and does not fully optimize cold water for protection of fish. Because flow in July and August is often reduced compared to baseline, it is more difficult to affect temperature further downstream, even if the release temperature is lowered. Shaping of flows could reduce flow-related effects on temperature. Some aspects, such as timing of when the cold water should be released in fall based on real-time information (e.g., October vs November), and decisions made based on presence of fish, are not modeled.

Table CR 7.6.2-5. Comparison of Modeled Baseline and Flow Scenario Monthly Temperature Distributions for the American River below Folsom Dam ("Adjusted" refers to scenarios executed using the adjusted temperature target for the sensitivity analysis)

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Staff Report Baseline (°F)												
10	58.5	57.2	51.4	45.9	46.5	48.7	50.8	53.2	55.0	57.5	59.0	61.6
50	63.2	58.2	54.9	49.8	48.7	50.9	53.0	54.7	56.9	62.3	61.0	63.6
90	67.3	59.7	56.0	52.5	51.3	52.2	58.3	63.0	64.2	65.6	63.7	67.0
Staff Report 55 Minus Staff Report Baseline												
10	0.0	0.2	0.1	-0.1	0.0	0.0	0.0	0.1	0.7	0.2	0.0	0.0
50	0.1	0.1	0.1	0.1	0.0	0.1	1.2	2.5	3.7	1.6	1.3	1.5
90	0.0	0.7	0.0	0.2	0.1	0.0	0.2	0.7	1.2	0.9	0.3	0.0
Staff Report 55 w/WSAs Minus Staff Report Baseline												
10	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.6	-0.1	0.0	0.0
50	0.1	0.0	-0.1	0.0	0.0	0.0	1.1	1.5	3.0	1.0	1.4	0.8
90	0.6	0.8	0.0	0.1	0.0	0.0	0.4	0.9	1.1	-0.1	0.0	0.0
Adjusted Baseline												
10	61.8	56.8	50.9	45.9	46.5	48.7	50.8	53.2	55.1	57.6	61.7	63.1
50	62.0	56.9	52.1	50.4	48.9	50.5	51.9	54.6	57.0	61.8	62.6	63.4
90	62.2	57.2	52.3	53.0	51.5	50.9	52.3	55.7	58.9	63.0	63.9	63.9
Adjusted 55 Minus Adjusted Baseline												
10	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.1	0.7	0.1	0.4	0.0
50	0.0	0.0	0.0	0.6	0.1	0.0	-0.1	0.5	1.2	0.2	0.0	-0.1

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
90	0.0	0.0	0.0	0.8	0.3	-0.1	0.0	0.2	0.1	0.6	0.1	0.0
Adjusted 55 w/WSAs Minus Adjusted Baseline												
10	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.3	0.0
50	0.0	0.0	0.0	0.2	-0.1	-0.1	-0.1	0.4	1.2	0.1	0.1	0.0
90	0.1	-0.1	0.0	0.5	0.1	-0.1	-0.1	0.1	0.0	-0.4	0.0	0.1
Staff Report VA minus Staff Report Baseline												
10	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
50	0.0	0.0	0.1	0.2	0.0	0.0	0.3	0.3	0.4	0.2	0.2	0.0
90	0.0	0.2	0.0	0.2	0.1	0.0	0.3	0.4	0.6	-0.2	0.1	0.1
Adjusted VA Minus Adjusted Baseline												
10	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0
50	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.3	0.1	0.0	-0.1
90	0.1	0.0	0.1	0.3	0.0	0.0	-0.1	0.1	0.1	-0.2	0.0	-0.1

°F = degrees Fahrenheit

Shading is provided only to attract attention to the larger deviations from baseline. Shading does not indicate any impact conclusions.

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