Common Response 7.4
Agricultural Resources

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.

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. Both of 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 comments regarding Staff Report Sections 7.4, 9.7.4, and 13.7.4, each titled *Agriculture and Forest Resources*, which describe the environmental setting, potential agricultural impacts that may result from changes in hydrology and changes in water supply, and mitigation measures for such impacts. The impact analysis presented in these sections considers how and to what extent changes in hydrology and water supply could lead to reductions in irrigated acreage that could result in conversion of important farmland to nonagricultural uses or could affect parcels under existing contracts protecting agricultural land. Importantly, the impact analysis is conservative (i.e., worst case). Irrigated agriculture is used as a proxy for important farmland and any reduction in irrigated crop acreage that is important farmland is assumed to be converted to nonagricultural use. In reality, the decision as to whether to convert land to nonagricultural use, pause production temporarily, or keep it in agricultural production involves many personal and business decisions by the individual grower or rancher.

In addition to a grower's personal decision-making, water suppliers' programs and policies can also influence a grower's decision. A water supplier's physical capacities, distribution policies, and legal requirements affect the availability and quantity of water. Growers might consider questions such as the following.

- Could irrigation efficiencies or water conservation measures stretch less water further?
- Could crop shifting, finding alternate water supplies, deficit irrigation, or instituting other adaptations be used?
- What are the market prospects for a grower or rancher's product?

- Is the land in proximity to development pressure, such as infrastructure and other services, such that conversion is an option, or would it likely be fallowed more often but still remain in agricultural production?

These are a few, but not all, of the questions ultimately determining whether conversion from agricultural use to nonagricultural uses would result. Because the answer to these questions in any particular place is speculative, the Staff Report makes a conservative assumption that any reduction in irrigated crop acreage that is important farmland is assumed to be converted to nonagricultural use.

Most of the irrigated agriculture in the study area is located on the valley floor portion of the Sacramento/Delta and the San Joaquin Valley. For these areas, growers' responses to changes in water supply were estimated using the Statewide Agricultural Production (SWAP) model. The SWAP model is a regional agricultural and economic optimization model, originally developed at the University of California, Davis, that estimates growers' responses to changes in water supply by determining the cropping pattern that maximizes the net returns to agricultural production.

Changes in crop acreage in other parts of the study area that are not modeled in SWAP (i.e., areas outside of the Central Valley) are estimated using an analytical approach, the California Sub-Regional Agricultural Analysis (CASRAA) model, that emulates the same optimization process that is used in the SWAP model. The details of the analyses are described in Chapter 8, *Economic Analysis and Other Considerations*, as part of the methodology for estimating the potential economic effects of the proposed Plan amendments on agriculture. Estimated changes in crop acreage derived in Chapter 8 for these regions are summarized in Section 7.4, *Agriculture and Forest Resources*, with qualified descriptions of the potential effects on example growers in those areas. Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*, provides more details on the SWAP model, including the modeling methodology, model inputs, adjusted modeling parameters, and detailed model results. Additional details about the CASRAA model and methods can be found in Appendix A1a, Attachment A1a1, *California Subregional Agricultural Analysis (CASRAA)*.

This common response addresses topics related to the Staff Report's analysis of impacts to agriculture, including:

- SWAP model baseline and assumptions about baseline cropping patterns
- Level and scope of the SWAP analysis
- SWAP model assumptions about groundwater pumping
- SWAP model assumptions about deficit irrigation
- SWAP modeling for critically dry water years and water year 1977, which is intended to represent the last year of a multi-year drought
- Sacramento/Delta surface water supply for rice straw decomposition
- Fallowing and agricultural land conversion

This common response references related sections of the Staff Report and other common responses as appropriate where recurring comments and common comment themes overlap with other subject matter areas. For responses to comments concerning agricultural economic effects, please see Common Response 8.1, *Economic Analysis and Other Considerations*. For responses to comments concerning the groundwater impact analysis and consideration of the Sustainable Groundwater Management Act (SGMA), please see Common Response 7.12.2, *Groundwater and Sustainable Groundwater Management Act*.

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SWAP Model and Impacts to Agricultural Production

This section provides information on the SWAP model and potential impacts to agriculture resulting from changes in water supply. As discussed in Sections 7.4, 9.7.4, and 13.7.4, each titled *Agriculture and Forest Resources*, the Sacramento/Delta update to the Bay-Delta Plan could result in surface water and groundwater supply reductions to agricultural users in the study area. Such reductions could lead to changes in distribution of crop types and acreage and conversion of important farmland to nonagricultural use, which is an adverse environmental impact under CEQA.

In Sections 7.4 and 9.7.4, each titled *Agriculture and Forest Resources*, changes in crop acreage in the Sacramento/Delta and San Joaquin Valley are estimated using the SWAP model for average and dry hydrologic conditions. The SWAP model is an economic decision model that estimates growers' responses to changes in water supply by determining the cropping pattern that maximizes the net returns to agricultural production. It estimates the cropping pattern that maximizes the net returns to agricultural production for 27 production regions: 10 in the Sacramento/Delta (the Sacramento River valley floor, Delta eastside tributaries, and Delta regions), and 17 in the San Joaquin Valley. The model generates outputs for each production region, including cropping acreage by category of crops, total revenue, net revenue (profit), and amount of irrigation water used by source of supply. Additional details about the SWAP model and methods can be found in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*. For the analysis presented in the Staff Report, SWAP version 6.1 was used.

The evaluation of impacts on agriculture involves using surface water delivery estimates from SacWAM as inputs. Estimates of surface water deliveries to growers within the Sacramento/Delta are provided by SacWAM in sufficient detail that the output can be directly mapped into the SWAP production regions. SacWAM also provides estimates of the amounts of Sacramento/Delta water exported to the other regions in larger aggregations based on conveyance facilities. Information from water contracts and water management plans were used to disaggregate these estimates to individual State Water Project (SWP) and Central Valley Project (CVP) contractor levels and smaller subareas for analysis purposes. Further details are provided in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*. In this way, changes in agricultural water deliveries, the use of water, and the crop acreage and crop mix in the other regions can be analyzed.

Figure 7.4-5 in the Staff Report depicts the SWAP model production region boundaries. The SWAP model incorporates information on the availability of water supplies within a SWAP region, such as SWP and CVP deliveries, local surface water supplies, and groundwater, into its analysis. As inputs representing conditions change within a SWAP-modeled region (e.g., the quantity of available SWP and CVP water supply decreases or the cost of groundwater pumping increases), the model optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs. The model assumes land will be taken out of production when that is the most cost-effective response to resource conditions.

In Section 7.4, *Agriculture and Forest Resources*, changes in crop acreage in the Bay Area, Central Coast, and Southern California regions are estimated using the California Sub-Regional Agricultural Analysis (CASRAA) model. The CASRAA model uses an approach similar to that used by the SWAP model to determine cropping patterns and water use for average and dry hydrologic conditions. Additional details about the CASRAA model and methods can be found in Appendix A1a, Attachment A1a1, *California Subregional Agricultural Analysis (CASRAA)*.

Commenters raised various concerns regarding the SWAP model and the approach used to evaluate agricultural impacts. This common response addresses these comments and provides additional information regarding the use of the SWAP model. It also presents supplemental SWAP modeling results for critically dry water years and for water year 1977, which is used to represent multi-year drought conditions. These supplemental SWAP results are provided for transparency and in response to commenters' requests for additional information regarding impacts to agriculture during critically dry water years and during multi-year droughts. The supplemental results do not change the Staff Report's conclusions.

Given the inherent uncertainties involved in modeling agricultural impacts, the Staff Report uses a reasonable and conservative approach to evaluating the potential agricultural impacts of the flow scenarios. SWAP is currently the best available tool for modeling agricultural economic responses to water supply shortage. It has been peer-reviewed and applied to numerous policy analyses and impact assessments over the last two decades (Reclamation 2012; Medellin-Azuara et al. 2016). SWAP is frequently used to estimate changes in California agricultural production due to changes in water resource availability.

The SWAP model is designed to simulate decisions that Central Valley growers would make regarding crops to grow, the use of water supplies, and other inputs that would maximize profit—subject to resources constraints, agronomic production relationships, cropping opportunities, and market conditions. However, like other modeling tools, the SWAP model cannot predict the behavior of every individual grower. The Staff Report acknowledges that actual grower responses may vary from the SWAP model results.

An optimization model, such as SWAP, can over-adjust and minimize costs associated with detrimental changes or, similarly, maximize benefits associated with positive changes. To account for this possibility, two bookends related to reduced Sacramento/Delta surface water supplies are included: *maximum replacement groundwater pumping*, and *no replacement groundwater pumping*. Under maximum replacement groundwater pumping, it was assumed that growers could use groundwater in addition to local water supplies to offset some or all Sacramento/Delta supply reductions. Importantly, this is not a directive that farmers and ranchers should or would replace Sacramento/Delta reductions with groundwater pumping, especially in light of requirements to achieve sustainability in basins subject to the Sustainable Groundwater Management Act (SGMA). It is rather, a good faith attempt to capture the potential maximum impacts on the groundwater basin from replacement pumping. For no replacement groundwater pumping, it was assumed that groundwater would not be available to replace reductions in surface water availability beyond the existing use under the baseline condition. Similarly, this is not an assumption about groundwater demand management in any particular basin, for example under SGMA, but a good faith attempt to model the potential lower limit of potential groundwater pumping. In this way, the analysis captures the breadth of likely responses, which would be somewhere in between the bookend scenarios, meaning that water users likely would increase groundwater pumping to replace some amount of the reduced surface water supplies, but not at volumes sufficient to replace all of the reduced surface water supplies. Additional discussion regarding the two SWAP bookends is provided below.

SWAP does not explicitly account for the dynamic nature of agricultural production. It is an annual model that provides a point-in-time comparison between two conditions, which is consistent with conducting environmental impact analyses. The base SWAP model can be modified for specialized studies to incorporate or specify additional production regions, or to apply assumptions regarding deficit irrigation or groundwater supply, as discussed further below.

Please see Chapter 8, *Economic Analysis and Other Considerations*, and Appendix A3, *Agricultural Economic Effects: SWAP Methodology and Modeling Results,* of the Staff Report for a more detailed description of the SWAP model and methods. For discussion regarding the use of SWAP to estimate agricultural economic effects (changes in crop revenue), see Common Response 8.1, *Economic Analyses and Other Considerations*.

Assumptions about Baseline Cropping Patterns

Some commenters asserted that the SWAP model relies on outdated baseline land use data from 2010, which does not reflect current cropping patterns or recent agricultural trends in the Central Valley, like a decline in alfalfa acreage and an increase in the acreage of tree crops such as almonds. These commenters suggested using more recent cropping pattern data to provide a more accurate baseline.

For the Staff Report, SWAP version 6.1 was used, which is the most recent peer-reviewed and publicly available model version. The SWAP model uses the California Department of Water Resources (DWR) 2010 land use survey data as the baseline cropping patterns. The Staff Report acknowledges that cropping patterns have changed over time when compared to 2010; however, the DWR 2010 survey is the best publicly available and validated dataset for cropping patterns, and the 2010 survey is the most recent available data at the geographic scale required for the SWAP model. In addition, hydrologic conditions in 2010 were relatively moderate, with water year 2010 classified as Below Normal based on the Sacramento Valley Index and Above Normal based on the San Joaquin Valley Index. This provides for a suitable selection for calibration purposes and to represent long-term average conditions because SWAP constrains the crop acres within each production region to the total acres observed during the baseline year.

Although cropping patterns have changed somewhat in California's Central Valley since 2010, SWAP remains the best available tool for evaluating potential changes in agricultural production and crop revenues in the Sacramento/Delta watershed and San Joaquin Valley.

Level and Scope of the SWAP Analysis

The SWAP model results presented in the Staff Report are generally provided for the Sacramento/Delta watershed and the San Joaquin Valley, with detailed results for the 27 SWAP production regions listed in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*. Multiple commenters asserted that the analysis is flawed because the presentation of SWAP results at the regional level and for the 27 production regions does not analyze agricultural impacts to individual water agencies or users or smaller geographic areas.

The analysis provided in the Staff Report of impacts to agriculture is appropriately detailed for the scope of the project. As described in Section 7.1.5, *Environmental Analysis,* of the Staff Report, due to the size and complexity of Sacramento/Delta water supply and use, the impact analyses are necessarily broad to cover the wide range of foreseeable compliance measures and responses that may result. The Staff Report adequately identifies the significant effects of the planning approval at hand. Future project-specific review may develop detailed site-specific information as needed. The Staff Report has been prepared with a sufficient degree of analysis to provide decision-makers with information that enables them to make a decision that intelligently takes into account environmental consequences (Cal. Code Regs., tit. 14, § 15151). Exact project-specific impacts cannot yet be identified, as they will depend in part on how water users respond to changes in hydrology and reduced surface water supplies. For more information on the approach to the analyses, please see Common Response 7.1, *General CEQA and Approach to the Analysis.*

SWAP contains 27 production regions- 10 in the Sacramento/Delta and 17 in the San Joaquin Valley. These production regions represent the smallest spatial units of analysis within the model. These production regions correspond to one or more of the Detailed Analysis Units (DAUs) developed by the Department of Water Resources, grouped based on similar climate and water supply characteristics, such as depth to groundwater. The boundaries of these production regions were defined using a combination of SWAP model default boundaries and SacWAM Water Budget Areas (WBAs). In the Delta and San Joaquin Valley, default SWAP boundaries were retained. In the Sacramento Valley, several boundaries were modified to align more closely with SacWAM WBAs, which delineate the spatial extent of agricultural demand units. In many cases, WBAs correspond closely with DAUs, resulting in only minor adjustments to the original SWAP boundaries. Where modifications were necessary, WBAs were aggregated in a manner that preserved the integrity of the original SWAP regions.

Most SWAP production regions include multiple agricultural water users. The SWAP model inputs, such as water supply, are provided at the SWAP production region level, and all SWAP model outputs are similarly reported for the SWAP production regions. It is not possible to isolate estimated agricultural impacts for individual water users or public agencies within the SWAP production regions. Commenters have suggested that the Staff Report should use an alternative model to evaluate agricultural impacts to each individual water user, but no commenter has identified such a model. Even if this proposed model were available, projecting the specific ways that all agricultural users may respond to reduced surface water supply would require undue speculation.

However, information is available in the Staff Report to estimate agricultural impacts within each SWAP production region, which are easily located by readers. Figure A3-2 in Staff Report Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results,* is a map that shows the geographic location of each SWAP production region. Section A3.2.1.2, *SWAP Agricultural Production Regions,* in Staff Report Appendix A3 provides a summary table that lists the SWAP production regions and the corresponding SacWAM WBAs in Table A3-2. In addition, Table A3-3 in Staff Report Appendix A3 provides examples of water users within each SWAP production region.

Assumptions about Groundwater Pumping in SWAP

Some commenters stated that the groundwater bookends used in the SWAP analysis do not appropriately capture the maximum potential impacts to agriculture that could occur as a result of the flow scenarios. Some commenters asserted that the *no replacement groundwater pumping* bookend does not appropriately capture the lowest end of groundwater pumping conditions, and that actual agricultural impacts would likely be larger than modeled. This scenario assumes that groundwater pumping continues as at existing baseline levels, but these commenters stated that groundwater pumping cannot be maintained at such levels in perpetuity because groundwater basins are in overdraft in some locations, particularly in portions of the San Joaquin Valley> they further argue that SGMA and groundwater basin management efforts will prevent pumping from continuing at baseline levels. Thus the commenters argue, the Staff Report's analysis should have assumed less groundwater use as the lower bound.

The groundwater bookends used in the SWAP analysis are a reasonable representation of potential outcomes that could occur as a result of the flow scenarios. As discussed above, these bookends are not directives or recommendations for groundwater management; nor are they proposals for an ongoing regulatory regime. It would be highly speculative to use a different pumping level for the no replacement bookend other than the level under the baseline condition, as methods for implementation of SGMA and regional decisions or actions are highly variable and subject to change.

In addition, as discussed in Staff Report Section 7.12.2, *Hydrology and Water Quality- Groundwater*, it is uncertain how all water users may respond to reduced Sacramento/Delta water supply regarding groundwater pumping. The dynamic between potential groundwater resources impacts and potential agricultural impacts creates a challenge for the impact analyses, because the majority of groundwater pumping in many areas is for agricultural irrigation. In other words, modeling lower groundwater replacement pumping by farmers and ranchers in response to decreased surface water supplies will result in lower impact conclusions for groundwater resources but will increase the severity of impact conclusions for agricultural resources: with less groundwater use input, the model and analysis will find more acres converted to nonagricultural uses. Conversely, modeling higher groundwater replacement pumping by farmers and ranchers increases the severity of impact conclusions for groundwater resources but assumes that more water is available for agriculture, which reduces the severity of impact conclusions for agricultural resources. Importantly, the analysis cannot assume both “worst-case” scenarios simultaneously: there cannot be both maximum potential impacts on groundwater resources from replacement pumping and maximum potential impacts on agricultural resources.

Please see Section A3.2.1, *SWAP Model Structure*, in Staff Report Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results,* for more discussion of assumptions about groundwater pumping in SWAP. Please see Common Response 7.12.2, *Groundwater and Sustainable Groundwater Management Act*, for additional discussion regarding the groundwater bookends, SGMA, and the potential effects on regional groundwater conditions.

Commenters raised several other concerns related to assumptions about groundwater pumping in SWAP that are relevant to the agricultural economic analysis presented in Staff Report Chapter 8, *Economic Analysis and Other Considerations*. Please see Common Response 8.1, *Economic Analyses and Other Considerations*, for discussion and response to these comments on the Staff Report’s economic analysis.

Assumptions about Deficit Irrigation

SWAP can apply assumptions regarding deficit irrigation, which is an important setting to model farming operation in dry conditions. As discussed in Section 7.4.2*, Environmental Setting,* deficit irrigation is a short-term irrigation management measure that involves reducing application of irrigation water at strategic times in the growth cycle to reduce consumptive use of water. Deficit irrigation will stress the crop but allow its survival, at the expense of production yield. Typically, it is performed when water supplies are low, particularly during droughts. It can minimize impacts of reduced water supply on crop yield by carefully timing irrigation at certain growth stages to ensure that a crop receives water when it is most important (Goldhamer et al. 2005).

For the 2023 draft Staff Report analysis and supplemental SWAP analysis results presented below, deficit irrigation is disabled in the average year model run but enabled in the dry year model runs. SWAP will select the use of deficit irrigation for crop acres only if it represents a profit-maximizing response to a water supply shortage or to high water costs. Allowable deficit irrigation levels were specified in SWAP for certain crops based on a literature review of crop tolerance for deficit irrigation, as shown in Table A3-13, *Ability of Crop Groups Used in SWAP to Accommodate Deficit Irrigation and Literature Reviewed* and A3-14, *Maximum Allowed Irrigation Deficit by Crop,* in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*.

Supplemental SWAP Modeling for Critically Dry Water Years and Multi-Year Drought

Several commenters asserted that the SWAP analysis presented in the Staff Report underestimates or misrepresents the potential agricultural impacts associated with the flow scenarios because the SWAP analysis presented in Section 7.4, *Agriculture and Forest Resources*, and Chapter 8, *Economic Analysis and Other Considerations*, does not model specifically for critically dry water year types or multi-year drought conditions. Commenters asserted that Sacramento/Delta water supplies to agriculture would be more limited during critically dry water years and multi-year droughts than those assumed for the SWAP average and dry year model results presented in the Staff Report, and that the Staff Report therefore underestimates impacts to agriculture.

The Staff Report acknowledges that changes in Sacramento/Delta supply could result in potentially significant impacts to agriculture. The Staff Report also notes that impacts to agriculture and associated agricultural economic effects in any particular year may be greater or less than the SWAP average year or dry year model results. However, because several commenters requested additional information regarding effects during critically dry water years and multi-year drought conditions, this section presents the results of supplemental SWAP model analyses for: (1) critically dry water years; and (2) the driest water year (1977), intended to represent the last year of a multi-year drought. Results for changes in crop acreage are presented below, and results for the corresponding changes in crop revenues are presented in Common Response 8.1, *Economic Analyses and Other Considerations*. The modeling approach for these supplemental runs is the same as the approach used for the SWAP dry year model runs as described in detail in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*, except that Sacramento/Delta surface water deliveries were less, reflecting that Sacramento/Delta water supplies were more limited than those available under the SWAP dry year model run. Consistent with the SWAP analyses presented in the 2023 draft Staff Report, SacWAM version 2023.06.12 was used to obtain water deliveries for the supplemental model runs, ensuring comparability with other SWAP analyses for average and dry conditions. SWAP model version 6.1 was used for these supplemental model runs.

Both supplemental SWAP model analyses were completed for the *no groundwater replacement pumping* condition to capture the worst-case scenario for agricultural impacts and agricultural economic effects. For no replacement groundwater pumping, it was assumed that groundwater would not be available to replace reductions in surface water availability beyond the level under the baseline condition. This approach is appropriate given commenters' assertions that the SWAP model may underestimate reductions in crop acreage and crop revenue under the flow scenarios. However, it is uncertain how all water users may respond to reduced Sacramento/Delta supply regarding groundwater pumping. If groundwater replacement pumping by farmers and ranchers is assumed, more water would be available for agricultural uses which would reduce the associated effects on crop acreage and crop revenues. Therefore, reductions in crop acreage and crop revenues would be less than those presented below if it is assumed that growers could use groundwater in addition to local water supplies to offset some or all Sacramento/Delta supply reductions.

Both supplemental SWAP model analyses allow for deficit irrigation. By allowing deficit irrigation in those model runs, SWAP implicitly accounts for agricultural responses to very dry conditions such as critically dry years and multi-year drought. Under reduced surface water availability, farmers may choose to deficit-irrigate, shift to lower water-using crops, or fallow lower-profitability land. In some cases, deficit irrigation is more economical than increased groundwater pumping or additional land fallowing.

Overall, these supplemental SWAP results are provided for transparency and in response to commenters' requests for additional information regarding impacts to agriculture that could occur as a result of the flow scenarios during critically dry water years and during multi-year droughts. However, the Staff Report already identifies potentially significant impacts to agriculture and identifies adverse agricultural economic effects. These additional analyses are consistent with the analyses already presented in the Staff Report, and do not change the Staff Report's conclusions that reductions in Sacramento/Delta supply to agriculture could result in conversion of farmland to nonagricultural use. A conservative threshold of significance for conversion is used that captures the importance of agriculture as a resource in California. All irrigated agriculture is used as a proxy for important farmland. In addition, the analysis assumes that any reduction in irrigated crop acreage is important farmland converted to nonagricultural use and that any conversion to nonagricultural use is a significant impact. This conclusion is unchanged by the supplemental analyses.

Supplemental SWAP Modeling for Critically Dry Water Year Type

This section presents the results of the supplemental SWAP analysis for critically dry water years. For these SWAP model runs, critically dry water year deliveries were estimated as the average deliveries for critically dry water years only. Results are first presented for the Sacramento/Delta watershed, followed by results for the San Joaquin Valley.

Table CR 7.4-1 shows the total surface water supply inputs used in the critically dry year SWAP model runs for baseline and flow scenarios for the Sacramento/Delta watershed. As shown below, the total surface water supply for agriculture in the Sacramento/Delta watershed would be less under the flow scenarios compared to baseline.

Table CR 7.4-1. Total Surface Water Supply for Agriculture in the SWAP Production Regions of the Sacramento River Watershed, Delta Eastside Tributaries, and Delta Regions, Critically Dry Water Year Type, SWAP Model Inputs for Baseline and Flow Scenario Runs (thousand acre-feet per year)

Water Year Type	Baseline	35	45	55	65	75
Critically dry year	4,382	3,713	3,562	3,317	3,026	2,573

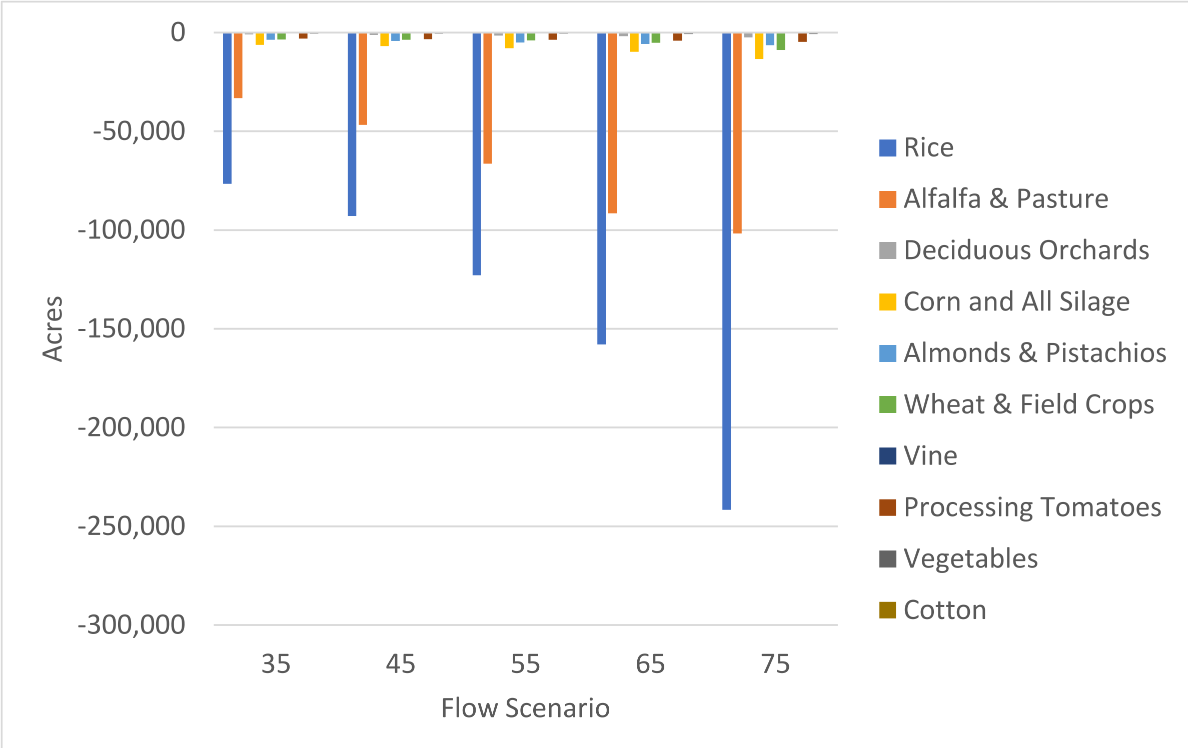
Source: SacWAM output and SWAP model files.

Table CR 7.4-2 presents the SWAP estimated crop acreages in the Sacramento/Delta for the baseline and each flow scenario for critically dry water years, with no replacement groundwater pumping. Figure CR 7.4-1 presents the corresponding change in crop acreage compared to baseline by crop category. Similar to the SWAP model results presented in Section 7.4, *Agriculture and Forest Resources*, for the average year and dry year model runs, the results indicate that crop acreage would generally decrease with increasing flow scenarios. Based on the SWAP critically dry water year results, the estimated overall crop acreage for the Sacramento/Delta could be about 212,100 acres (9.6 percent) lower than baseline under the 55 scenario. To contrast, the SWAP results presented in Section 7.4 for the 55 scenario estimate that the overall crop acreage for the Sacramento/Delta watershed could be about 88,800 acres (3.9 percent) lower than baseline for the average year model run (see Table 7.4-17 in the Staff Report) or 143,800 acres (6.4 percent) lower than baseline for the dry year model run (see Table 7.4-18 in the Staff Report). The SWAP results also show that, under baseline in the Sacramento/Delta watershed, the crop acreage is lower for the critically dry year model run (2,212,200 acres) compared to the dry year model run (2,247,000 acres) and average year model run (2,258,800 acres), which indicates that water supplies limit crop production during critically dry water years under existing conditions, even absent the Plan amendments. The results presented below in Figure CR 7.4-1 for the critically dry year model runs also show that a large portion of the reduction in Sacramento/Delta crop acreage would be associated with a decline in the production of rice, followed by declines in production of alfalfa and pasture. Other crops could also experience a decrease in acreage, but to a lesser extent.

Table CR 7.4-2. Critically Dry Year: Irrigated Crop Acreage in the Sacramento/Delta, SWAP Model Analysis, No Replacement Groundwater (acres)

Crop Group	Baseline	35	45	55	65	75
Rice	555,200	478,600	462,400	432,300	397,300	313,500
Deciduous Orchards	368,200	367,300	367,100	366,700	366,300	365,800
Alfalfa & Pasture	349,600	316,500	302,900	283,300	258,100	248,000
Corn and All Silage	256,200	250,000	249,300	248,300	246,400	242,800
Wheat & Field Crops	200,300	196,800	196,600	196,300	195,100	191,400
Almonds & Pistachios	165,900	162,200	161,600	160,900	160,100	159,500
Vine	134,200	134,100	134,100	134,100	134,000	134,000
Processing Tomatoes	100,500	97,500	97,300	97,000	96,400	95,800
Vegetables	78,700	78,200	78,200	78,100	78,000	77,900
Cotton	3,300	3,200	3,200	3,200	3,100	3,100
TOTAL	2,212,200	2,084,300	2,052,600	2,000,100	1,935,000	1,832,000
Change from Baseline		-5.8%	-7.2%	-9.6%	-12.5%	-17.2%

Source: SWAP model results.



Source: SWAP model results.

Figure CR 7.4-1. Critically Dry Year: Changes in Crop Acreage, Sacramento/Delta, SWAP Model Analysis, No Replacement Groundwater

Table CR 7.4-3 shows the total surface water supply inputs used in the critically dry year SWAP model runs for baseline and flow scenarios for the San Joaquin Valley. As shown below, the total surface water supply for agriculture in the San Joaquin Valley would be less under the flow scenarios compared to baseline.

Table CR 7.4-3. Total Surface Water Supply for Agriculture in the SWAP Production Regions of the San Joaquin Valley, Critically Dry Year Type, SWAP Model Inputs for Baseline and Flow Scenario Runs (thousand acre-feet per year)

Water Year Type	Baseline	35	45	55	65	75
Critically dry year	6,824	6,823	6,683	6,473	6,218	5,991

Source: SacWAM output and SWAP model files.

Table CR 7.4-4 presents the SWAP estimated crop acreages in the San Joaquin Valley for the baseline and each flow scenario for critically dry water years, with no replacement groundwater pumping. Figure CR 7.4-2 presents the corresponding change in crop acreage compared to baseline by crop category. Similar to the SWAP model results presented in Staff Report Section 7.4, *Agriculture and Forest Resources*, for the average year and dry year model runs, the results indicate that crop acreage would generally decrease with increasing flow scenarios. Based on the SWAP critically dry water year results, the estimated overall crop acreage for the San Joaquin Valley could be about 84,400 acres (1.9 percent) lower than baseline under the 55 scenario. To contrast, the SWAP results presented in Section 7.4 for the 55 scenario estimate that the overall crop acreage for the San Joaquin Valley could be about 107,000 acres (2.3 percent) lower than baseline for the average year model run (see Table 7.4-21 in the Staff Report) or 100,300 acres (2.2 percent) lower than baseline for the dry year model run (see Table 7.4-22 in the Staff Report). The SWAP results also show that, under baseline in the San Joaquin Valley, the crop acreage is lower for the critically dry year model run (4,502,600 acres) compared to the dry year model run (4,611,000 acres) and average year model run (4,685,800 acres), which indicates that water supplies limit crop production during critically dry water years under existing conditions, even absent the Plan amendments. The results presented below in Figure CR 7.4-4 for the critically dry year model runs show that for the flow scenarios, crop acreage reductions occur for multiple crop types and are greater for the higher flow scenarios.

Table CR 7.4-4. Critically Dry Year: Irrigated Crop Acreage in the San Joaquin Valley, SWAP Model Analysis, No Replacement Groundwater (acres)

Crop Group	Baseline	35	45	55	65	75
Corn and All Silage	1,021,000	1,020,800	1,018,900	1,014,700	1,006,900	992,900
Almonds & Pistachios	895,700	895,500	894,300	892,100	888,500	882,800
Alfalfa & Pasture	570,400	570,200	569,100	566,200	559,700	550,400
Deciduous Orchards	536,900	536,900	536,600	536,200	535,400	534,600
Vine	444,500	444,500	444,100	443,200	441,500	439,000
Vegetables	301,900	301,800	300,300	297,700	295,500	293,900
Wheat & Field Crops	263,400	264,800	244,900	233,200	232,800	232,000
Cotton	271,200	271,500	269,300	247,100	209,800	208,600
Processing Tomatoes	187,700	188,000	186,800	177,800	150,600	122,800
Rice	10,000	10,000	10,000	10,000	10,000	9,900
TOTAL	4,502,600	4,503,800	4,474,500	4,418,200	4,330,700	4,266,900
Change from Baseline		0.0%	-0.6%	-1.9%	-3.8%	-5.2%

Source: SWAP model results.

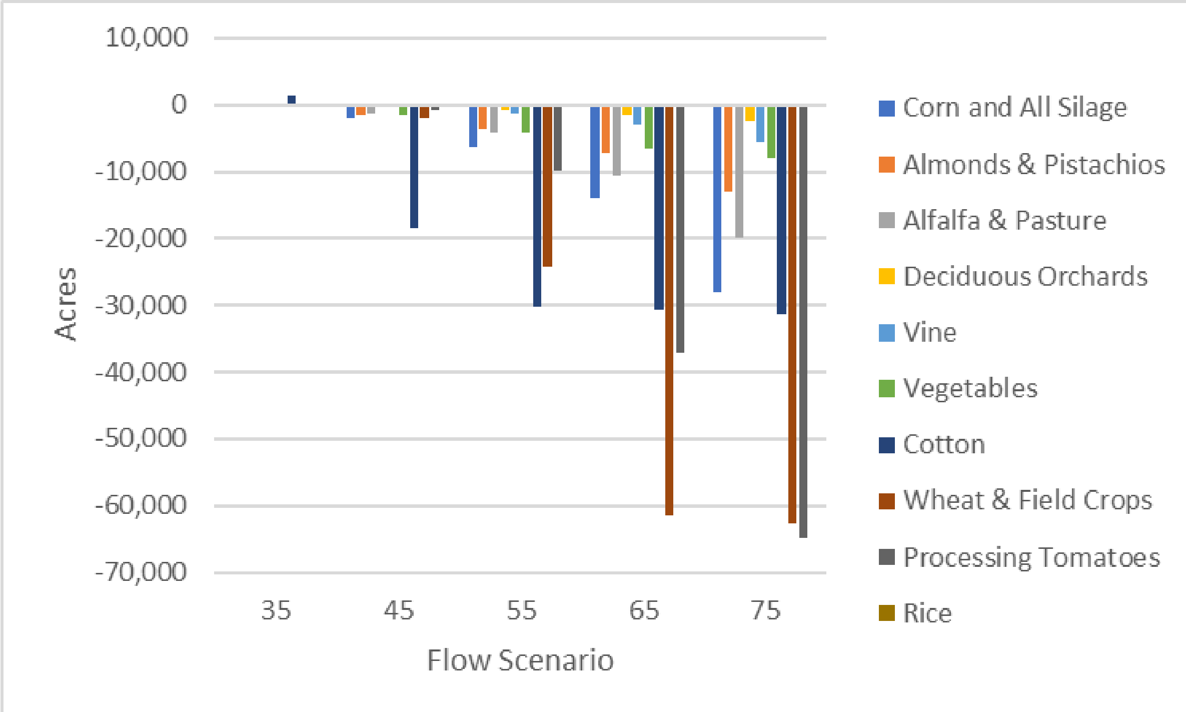


Figure CR 7.4-2. Critically Dry Year: Changes in Crop Acreage, San Joaquin Valley, SWAP Model Analysis, No Replacement Groundwater

Overall, the SWAP critically dry year results show that reductions in crop acreage under the flow scenarios would be similar to or somewhat larger than those indicated by the SWAP dry year model runs, and the types of crops that would be most affected would be similar to those identified in Staff Report Section 7.4, *Agriculture and Forest Resources*. However, SWAP also incorporates a baseline crop acreage that is lower under the critically dry year model runs compared to the dry and average year model runs, which reflects the limited availability of agricultural water supplies during critically dry years under existing conditions. Although Sacramento/Delta surface water supplies would be reduced under the flow scenarios, water users already experience limited agricultural water supplies during critically dry years that are not attributed to the flow scenarios. This analysis assumes that groundwater would not be used to replace Sacramento/Delta water supply reductions to agriculture, and the impacts would be expected to be less if groundwater is used as a substitute supply.

Overall, these additional results are consistent with the analyses already presented in the Staff Report, and do not change the Staff Report's conclusions on impacts to agriculture.

Multi-Year Drought and Supplemental SWAP Modeling for Water Year 1977

Several commenters noted that historical drought sequences (e.g., 2020–2022, 2013–2015, 1987–1992) demonstrate that consecutive critically dry years can lead to extended land fallowing, groundwater depletion, and regional economic disruption. Some commenters contended that the Staff Report should include an assessment of the effects of the flow scenarios and prolonged drought on agricultural production.

SWAP is structured as an annual model that estimates the profit-maximizing response to changes in resource availability, crop market conditions, or other factors. As such, SWAP is not designed to evaluate the effects of multi-year conditions such as prolonged droughts on agricultural production. This is a limitation of available crop modeling tools that is not unique to SWAP. Commenters have not provided suggestions for an alternative model or specific recommendations on how SWAP could be used to assess agricultural impacts under multi-year drought conditions.

While SWAP does not specifically model multi-year droughts, the SWAP analysis in the Staff Report does account for the effect of multi-year drought on surface water supply and delivery through the integrated use of output from SacWAM as input to SWAP. SacWAM simulates continuous hydrology over a 93-year period (1923–2015), which includes numerous multi-year drought sequences in the in the Sacramento/Delta. SacWAM output of water deliveries is used as input to SWAP, meaning that SWAP inherently reflects the effects of multi-year drought conditions through SacWAM's hydrologic sequences.

As discussed in Common Response 4.2, *Drought and Climate Change*, between 1923 and 2021, a "dry" and "critical" year sequence was experienced from 2020 to 2021, three very dry consecutive years were experienced between 2013-2015, and three other drought periods occurred from 1929-1934, 1976-1977, and 1987-1992. By including these periods in SacWAM, the Staff Report considers associated impacts from multi-year droughts within its analysis. This modeling approach allows stress on water supply to build across consecutive dry or critically dry years and revealing impacts that single-year models cannot. By preserving hydrologic sequences, SacWAM also reflects delayed recovery in surface supply after drought, demonstrating that storage and allocations do not immediately rebound even when hydrologic conditions improve. As a result, the framework captures both the severity of individual drought years and the accumulated hydrologic and operational stresses from persistent drought conditions. See Common Response 4.2 for further discussion on SacWAM and multi-year droughts.

To further illustrate that the Staff Report has adequately accounted for the effects of multi-year drought, a supplemental SWAP analysis was conducted using SacWAM output for water year 1977. Water year 1977 was chosen for this supplemental SWAP analysis because it was the driest year in the SacWAM modeling period and part of the severe 1976–1977 drought. In addition, because SacWAM accounts for prior-year hydrologic conditions, water deliveries in water year 1977 reflect cumulative stress on water supply from drought conditions in the preceding water year (1976). Results are first presented for the Sacramento/Delta watershed, followed by results for the San Joaquin Valley.

Table CR 7.4-5 shows the total surface water supply inputs used in the water year 1977 SWAP model runs for baseline and flow scenarios for the Sacramento/Delta watershed. As shown below, the total surface water supply for agriculture in the Sacramento/Delta watershed would be less under the flow scenarios compared to baseline.

Table CR 7.4-5. Total Surface Water Supply for Agriculture in the SWAP Production Regions of the Sacramento River Watershed, Delta Eastside Tributaries, and Delta Regions, Water Year 1977, SWAP Model Inputs for Baseline and Flow Scenario Runs (thousand acre-feet per year)

Water Year Type	Baseline	35	45	55	65	75
Water Year 1977	3,736	2,999	2,967	2,830	2,792	2,744

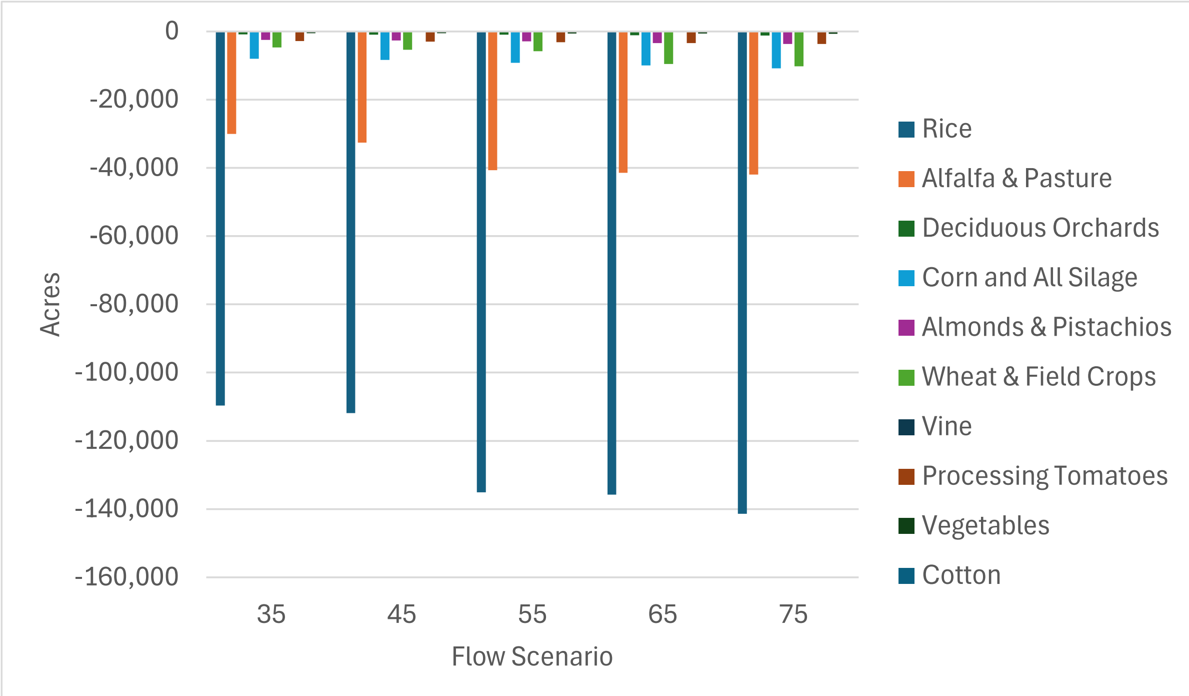
Source: SacWAM output and SWAP model files.

Table CR 7.4-6 presents the SWAP estimated crop acreage in the Sacramento/Delta for baseline and each flow scenario for water year 1977, with no replacement groundwater pumping. Figure CR 7.4-3 presents the corresponding change in crop acreage compared to baseline by crop category. Similar to the SWAP model results presented in Section 7.4, *Agriculture and Forest Resources*, for the average year and dry year model runs, the results indicate that crop acreage would generally decrease with increasing flow scenarios. For water year 1977, the estimated change in crop acreage for the Sacramento/Delta watershed would be 198,500 acres (9.5 percent) lower than baseline under the 55 scenario. To contrast, the SWAP results presented in Section 7.4 for the 55 scenario show that the overall crop acreage for the Sacramento/Delta watershed would be 88,800 (3.9 percent) lower than baseline for the average year model run (see Table 7.4-17 in the Staff Report), or 143,800 acres (6.4 percent) lower than baseline for the dry year model run (see Table 7.4-18 in the Staff Report). However, the SWAP results also show that the baseline crop acreage in the Sacramento/Delta watershed is lower for the water year 1977 model run (approximately 2,089,900 acres) compared to the dry year model run (approximately 2,247,000 acres) and average year model run (approximately 2,258,800 acres), which indicates that water supplies limit crop production during very dry water years under existing conditions, even absent the Plan amendments. The results presented below in Figure CR 7.4-3 also show that a large portion of the reduction in crop acreage is associated with a decline in the production of rice and alfalfa/pasture. Other crops also show a decrease in acreage, but to a lesser extent.

Table CR 7.4-6. Water Year 1977: Irrigated Crop Acreage in the Sacramento/Delta, SWAP Model Analysis, No Replacement Groundwater (acres)

Crop Group	Baseline	35	45	55	65	75
Rice	500,600	391,000	388,700	365,600	364,900	359,300
Deciduous Orchards	366,800	366,000	365,900	365,800	365,700	249,200
Alfalfa & Pasture	291,200	261,200	258,700	250,500	249,800	365,600
Corn and All Silage	253,200	245,200	244,800	243,900	243,200	242,400
Wheat & Field Crops	200,200	195,600	194,900	194,400	190,700	159,000
Almonds & Pistachios	162,700	160,200	160,100	159,800	159,300	190,000
Vine	134,100	134,000	134,000	134,000	133,900	133,900
Processing Tomatoes	99,300	96,500	96,300	96,200	95,900	95,700
Vegetables	78,500	78,000	78,000	78,000	77,900	77,900
Cotton	3,200	3,100	3,100	3,100	3,100	3,100
TOTAL	2,089,900	1,930,900	1,924,500	1,891,400	1,884,500	1,876,000
Change from Baseline		-7.6%	-7.9%	-9.5%	-9.8%	-10.2%

Source: SWAP model results.



Source: SWAP model results.

Figure CR 7.4-3. Water Year 1977: Changes in Crop Acreage, Sacramento/Delta, SWAP Model Analysis, No Replacement Groundwater

Table CR 7.4-7 shows the total surface water supply inputs used in the water year 1977 SWAP model runs for baseline and flow scenarios for the San Joaquin Valley. Total surface water supply for agriculture in the San Joaquin Valley is essentially unchanged between baseline and the 35 to 55 flow scenarios. However, water supply starts to decrease in the 65 and 75 scenarios.

Table CR 7.4-7. Total Surface Water Supply for Agriculture in the SWAP Production Regions of the San Joaquin Valley, Water Year 1977, SWAP Model Inputs for Baseline and Flow Scenario Runs (thousand acre-feet per year)

Water Year Type	Baseline	35	45	55	65	75
Water Year 1977	5,878	5,873	5,886	5,889	5,756	5,492

Source: SacWAM output and SWAP model files.

Table CR 7.4-8 presents the SWAP estimated crop acreages in the San Joaquin Valley for the baseline and each flow scenario for water year 1977, with no replacement groundwater pumping. Figure CR 7.4-4 presents the corresponding change in crop acreage compared to baseline by crop category. Similar to the SWAP model results presented in Section 7.4, *Agriculture and Forest Resources*, for the average year and dry year model runs, the results indicate that crop acreage would generally decrease with increasing flow scenarios, although results vary somewhat by modeled flow scenario. Difference in total crop acreage between baseline and the 55 scenario is negligible. To contrast, the SWAP results presented in Section 7.4 for the 55 scenario estimate that the overall crop acreage for the San Joaquin Valley could be about 107,000 acres (2.3 percent) lower than baseline for the average year model run (see Table 7.4-21 in the Staff Report) or 100,300 acres (2.2 percent) lower than baseline for the dry year model run (see Table 7.4-22 in the Staff Report). However, the SWAP results also show that the baseline crop acreage in the San Joaquin Valley is lower for the water year

1977 model run (approximately 4,307,700 acres) compared to the dry year model run (approximately 4,611,000 acres) and average year model run (approximately 4,685,800 acres), which indicates that water supplies limit crop production during very dry water years under existing conditions, even absent the Plan amendments. The results presented below in Figure CR 7.4-4 for the SWAP water year 1977 model runs show that for the flow scenarios, crop acreage reductions occur for processing tomatoes, particularly under the 65 and 75 scenarios, although other crop types could also experience a decrease in acreage but to a lesser extent.

Table CR 7.4-8. Water Year 1977: Irrigated Crop Acreage in the San Joaquin Valley, SWAP Model Analysis, No Replacement Groundwater (acres)

Crop Group	Baseline	35	45	55	65	75
Corn and All Silage	990,500	990,000	990,500	990,500	988,600	977,400
Almonds & Pistachios	885,800	883,600	885,500	885,300	883,200	875,700
Alfalfa & Pasture	537,600	543,000	540,300	541,800	532,900	528,700
Deciduous Orchards	534,800	534,600	534,700	534,700	534,500	534,000
Vine	439,600	439,100	439,600	439,500	439,100	437,500
Vegetables	294,900	294,300	294,800	294,700	293,900	291,900
Cotton	232,100	231,900	232,000	232,000	231,700	230,200
Wheat & Field Crops	207,700	207,600	207,700	207,700	207,200	203,400
Processing Tomatoes	175,000	169,800	175,100	174,200	146,800	119,800
Rice	9,800	9,800	9,800	9,800	9,700	6,900
TOTAL	4,307,700	4,303,800	4,309,900	4,310,300	4,267,500	4,205,200
Change from Baseline		-0.1%	0.1%	0.1%	-0.9%	-2.4%

Source: SWAP model results.

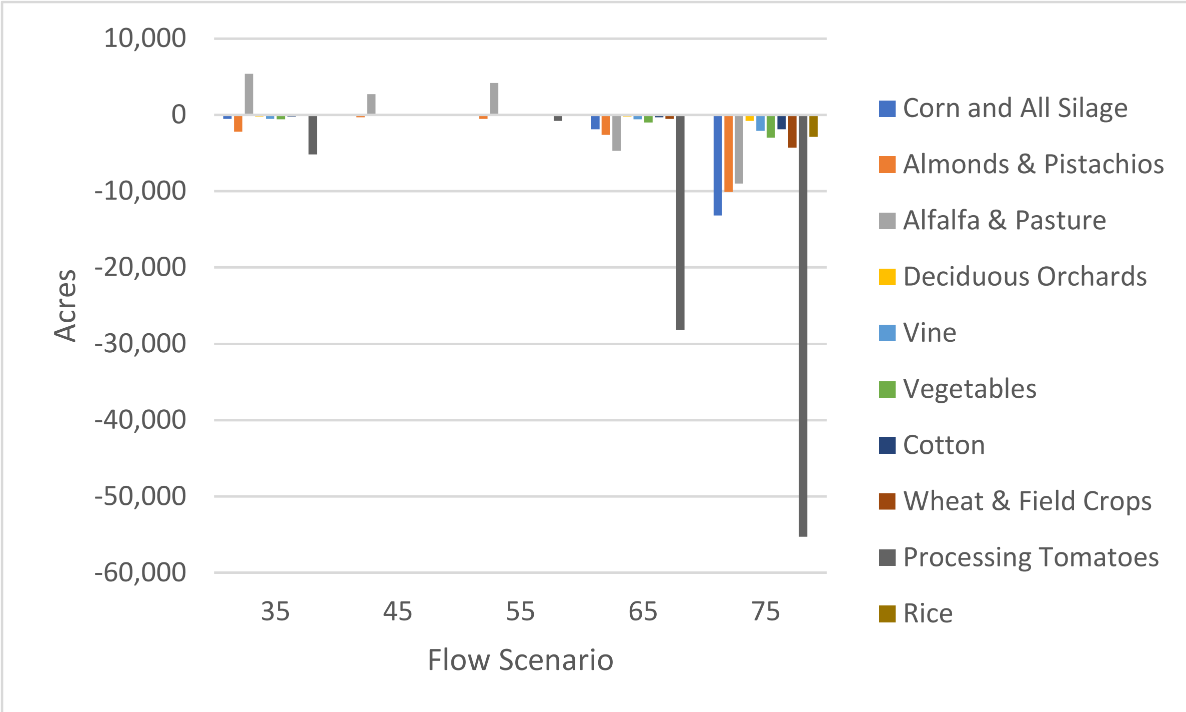


Figure CR 7.4-4. Water Year 1977: Changes in Crop Acreage, San Joaquin Valley, SWAP Model Analysis, No Replacement Groundwater

Overall, for the Sacramento/Delta watershed the SWAP results for water year 1977 show that the percent reduction in crop acreage under the flow scenarios would be similar to or somewhat greater than those for the dry year model run in the Sacramento/Delta watershed. The types of crops that would be most affected would be similar to those identified in Section 7.4, *Agriculture and Forest Resources*. For the San Joaquin Valley, the SWAP results for water year 1977 show that the percent reduction in crop acreage under the flow scenarios could be similar to or somewhat less than those for the dry year model run. Furthermore, the baseline crop acreage is lower under the water year 1977 model run compared to the average and dry year model runs, reflecting the limited availability of agricultural water supplies during drought under existing conditions. Although Sacramento/Delta surface water supplies would be reduced under the flow scenarios, water users already experience limited supplies during drought conditions that are not attributable to the flow scenarios. Extreme drought alone results in reduction in crop acreage, which is not a result of the flow scenarios.

Overall, these additional results are consistent with the analyses already presented in the Staff Report, and do not change the Staff Report's conclusions on impacts to agriculture.

Comparison of Supplemental SWAP Results for the 55 Scenario

Tables CR 7.4-9 and CR 7.4-10 show a comparison of irrigated crop acreage for the dry year, critical year and 1977 model runs under the 55 scenario with no replacement groundwater pumping in the Sacramento/Delta watershed and San Joaquin Valley. The results for the critically dry water year and water year 1977 model runs are detailed in the previous sections. The percentage shown in the last three columns is the percentage reduction in crop acreage under the 55 scenario as compared to the baseline values in the respective model runs.

Table CR 7.4-9. Comparing Different Model Runs for the 55 Scenario, No Replacement Groundwater, Sacramento/Delta

	Irrigated Acreage (Acres)			% of Reduction from Baseline		
Crop Group	Dry Year	Critical Year	1977	Dry Year	Critical Year	1977
Rice	489,600	432,300	365,600	-13%	-22%	-27%
Alfalfa & Pasture	322,600	283,300	250,500	-13%	-19%	-14%
Deciduous Orchards	367,400	366,700	365,800	-0.4%	-0.4%	-0.3%
Corn and All Silage	250,600	248,300	243,900	-3%	-3%	-4%
Almonds & Pistachios	162,300	160,900	159,800	-3%	-3%	-2%
Wheat & Field Crops	197,400	196,300	194,400	-1%	-2%	-3%
Vine	134,200	134,100	134,000	-0.2%	-0.1%	-0.1%
Processing Tomatoes	97,700	97,000	96,200	-3%	-4%	-3%
Vegetables	78,300	78,100	78,000	-1%	-1%	-1%
Cotton	3,200	3,200	3,100	-3%	-2%	-4%
TOTAL	2,103,200	2,000,100	1,891,400	-6%	-10%	-9%

Source: Tables 0-1, CR 7.4-2, CR 7.4-6

Table CR 7.4-10. Comparing Different Model Runs for the 55 Scenario, No Replacement Groundwater, San Joaquin Valley

	Irrigated Acreage (Acres)			% of Reduction from Baseline		
Crop Group	Dry Year	Critical Year	1977	Dry Year	Critical Year	1977
Rice	10,000	10,000	9,800	0%	0%	0%
Alfalfa & Pasture	574,600	566,200	541,800	-2%	-1%	1%
Deciduous Orchards	537,600	536,200	534,700	-0.2%	-0.1%	0%
Corn and All Silage	1,036,100	1,014,700	990,500	-1%	-1%	0%
Almonds & Pistachios	896,100	892,100	885,300	-1%	-0.4%	-0.1%
Wheat & Field Crops	271,000	233,200	207,700	-9%	-11%	0%
Vine	445,700	443,200	439,500	-0.4%	-0.3%	0%
Processing Tomatoes	187,000	177,800	174,200	-4%	-5%	-0.5%
Vegetables	302,800	297,700	294,700	-1%	-1%	-0.1%
Cotton	249,700	247,100	232,000	-11%	-9%	0%
TOTAL	4,510,600	4,418,200	4,310,200	-2%	-2%	0.1%

Source: Tables 0-2, CR 7.4-4, CR 7.4-8

Sacramento/Delta Water Supply for Rice Straw Decomposition

Some commenters asserted that the analysis in the Staff Report does not adequately consider impacts associated with changes in water supplies used to flood rice fields after harvest. As discussed in Staff Report Section 7.4, *Agriculture and Forest Resources*, rice fields are commonly flooded in the fall/winter to facilitate decomposition of rice straw. This practice supports field preparation for the subsequent planting season and provides seasonal habitat for wildlife species migrating along the Pacific Flyway. Some commenters noted that the SWAP model analysis does not explicitly model water supplies used for post-harvest rice straw decomposition. These commenters suggested that Sacramento/Delta water supplies available for post-harvest rice straw decomposition could be limited to a greater extent under the flow scenarios than water supplies for rice irrigation during the growing season, and that the SWAP analysis may therefore underestimate impacts to rice agriculture.

The Staff Report acknowledges that reduced water supply to agriculture could affect acreage of post-harvest flooding of rice fields and adequately evaluates these impacts in multiple resource sections. Section 7.5, *Air Quality*, notes that reduced water supply to agriculture could affect acreage of post-harvest flooding of rice fields, which could result in an increased occurrence of post-harvest rice straw burning, but concludes that air quality impacts would be less than significant. Section 7.6.1, *Terrestrial Biological Resources,* acknowledges that changes in water supply could result in decreased acreage of post-harvest flooding of rice fields, which could affect migratory waterfowl and shorebirds, and concludes that these impacts could be potentially significant.

The SWAP model is designed to estimate growers' responses to changes in water supply by determining the cropping pattern that maximizes the net returns to agricultural production in the Central Valley. SWAP is used to model crop acreage during the growing season, and does not explicitly model rice straw decomposition during the fall and winter months. Commenters did not suggest specific methods to modify the SWAP analysis to evaluate the effects of changes in water supply on rice straw decomposition, nor did commenters identify alternative tools or analyses that could be used to evaluate the effects of changes in water supply for fall and winter rice straw decomposition. However, output from SacWAM is used as input to SWAP. SacWAM simulates the entire water balance for the Sacramento watershed and Delta eastside tributaries, including Sacramento/Delta water supplies for agricultural irrigation as well as water supplies for fall and winter rice straw decomposition. The SacWAM results can be broken down by season whereas SWAP is limited to the growing season.

In the interest of transparency and to provide additional information regarding possible effects on water supplies for rice straw decomposition, this section presents additional information regarding the change in water supply for rice straw decomposition in the fall/winter, for the primary rice producing regions in the Sacramento/Delta watershed. This analysis is based on output from SacWAM and from SWAP, as described further below.

Tables CR 7.4-11 and 7.4-12 show the percentage change from baseline for the 45, 55, and 65 scenarios for water supply to rice agriculture during the irrigation season (mid-January through mid-October) and the fall/winter season (mid-October through mid-January) when water is used for rice straw decomposition. The irrigation season results are labeled 45 irrigation season, 55 irrigation season, and 65 irrigation season, and the fall/winter season results are labeled 45 fall/winter, 55 fall/winter, and 65 fall/winter. Results are presented for average and dry conditions. Average years represent the average of the entire SacWAM hydrologic period of record. Dry years represent the average of all dry and critically dry years.

Irrigation season rice water use was obtained from SWAP output. The SWAP results include estimated acres of rice produced within each region for the baseline and flow scenarios. The rice acres within each region were multiplied by the region-specific irrigation season applied water requirements for rice to estimate the total irrigation season rice water needs. Applied water requirements by crop category and by production region for the irrigation season are reported in Table 7.4-12 in of the Staff Report and Table A3-8 in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results.*

Fall/winter season rice water use was obtained from SacWAM output. The annual rice water supply for the 45, 55, and 65 scenarios was filtered to include only the period of October 16 through January 15, and water supplies were aggregated to each of the four regions (3A, 4, 5, and 7).

These results show the change in water supplies only. These results do not show cropping changes leading to potential conversion, which is the adverse environmental impact at issue in this analysis. As noted above, the SWAP results regarding cropping decisions, as reported in the Staff Report including this common response, already account for the water supply changes modeled by SacWAM. Results are provided for SWAP regions 3A, 4, 5 and 7, the major rice producing regions in the Sacramento Valley, as delineated in Figures A3-1 and A3-2 in Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results,* respectively.

In Tables CR 7.4-11 and CR 7.4-12, a negative percentage value (red scale) indicates a Sacramento/Delta surface water supply reduction relative to baseline, and a positive percentage value (blue scale) indicates a Sacramento/Delta surface water supply increase relative to baseline. For each region and flow scenario, a larger percent reduction for the fall/winter compared to the corresponding percent reduction for the irrigation season suggests that water supplies for rice straw decomposition could be reduced to a greater extent compared to water supplies for rice production during the growing season; in these instances, it is possible that Sacramento/Delta water supplies may not be available in the fall and winter to decompose all rice acreage produced during the prior growing season.

Table CR 7.4-11 Average Year Irrigation Season and Fall/Winter Water Supply for Regions 3A, 4, 5, and 7: Percent Change from Baseline

	SWAP Region			
Scenario	3A	4	5	7
45 Irrigation Season	-2%	-5%	-1%	-4%
45 Fall/Winter	3%	4%	-1%	-3%
55 Irrigation Season	-6%	-12%	-4%	-6%
55 Fall/Winter	4%	7%	-3%	-6%
65 Irrigation Season	-12%	-21%	-7%	-7%
65 Fall/Winter	6%	12%	-7%	-11%

Source: SacWAM and SWAP results

Table CR 7.4-12 Dry Year Irrigation Season and Fall/Winter Water Supply for Regions 3A, 4, 5, and 7: Percent Change from Baseline

	SWAP Region			
Scenario	3A	4	5	7
45 Irrigation Season	-9%	-17%	0%	-6%
45 Fall/Winter	5%	9%	-1%	-3%
55 Irrigation Season	-18%	-36%	-2%	-7%
55 Fall/Winter	7%	12%	-4%	-7%
65 Irrigation Season	-29%	-54%	-7%	-9%
65 Fall/Winter	8%	14%	-9%	-11%

Source: SacWAM and SWAP results

The results presented in Tables CR 7.4-11 and 7.4-12 show that changes in Sacramento/Delta water supplies could be reduced at times within these four regions, during both the irrigation season and in the fall/winter months. As shown in Table CR 7.4-11, in average years, fall and winter water supply available for rice decomposition is not reduced by a greater percentage compared to irrigation season rice water supply in any of the main rice producing regions in the 45 or 55 scenarios, which suggests that Sacramento/Delta water supplies during the fall and winter would remain available to decompose rice fields that were irrigated during the growing season. In the 65 scenario and in average years, fall and winter water supply is reduced by 11% within region 7, which is 4% more than the water supply reduction during the irrigation season (7%). However, fall and winter water supplies are not reduced by a greater percentage compared to irrigation season rice water supply in regions 3A, 4, or 5; within regions 3A and 4, fall and winter water supplies could even increase compared to baseline conditions. These results suggest that under the 65 scenario and for average years, Sacramento/Delta water supplies during the fall and winter would generally remain available to decompose rice fields that were irrigated during the growing season, but there could be some limited instances in which Sacramento/Delta water supplies during the fall and winter may not be available to decompose all rice acreage within region 7.

As shown in Table CR 7.4-12, in dry years, fall and winter water supply is not reduced by a greater percentage compared to irrigation season water supply in regions 3A and 4 for the 45, 55, and 65 scenarios, which suggests that Sacramento/Delta water supplies during the fall and winter would remain available to decompose rice fields that were irrigated within these regions during the growing season. In region 5, fall and winter water supply could be reduced by a greater percentage compared to irrigation season water supply for the 45, 55, and 65 scenarios, and in region 7, fall/winter water supply could be reduced by a greater percentage compared to irrigation season water supply for the 65 scenario. However, all of these dry year reductions are relatively small; in all of these instances, the fall/winter water supply reductions are only 1-2% more than the irrigation season water supply reduction. This suggests that Sacramento/Delta water supplies during the fall and winter would generally remain available to decompose the majority of rice fields that were irrigated during the previous growing season. However, there could be limited occurrences in which fall and winter water supplies may not be available for rice straw decomposition during dry years, particularly within regions 5 and 7 and under the higher flow scenarios.

Overall, these modeling results suggest that Sacramento/Delta water supplies for rice production within regions 3A, 4, 5, and 7 would generally not be reduced to a greater extent during the fall/winter (mid-October through mid-January) rice straw decomposition season compared to the irrigation season (mid-January through mid-October). However, the results shown in Tables CR 7.4-11 and CR 7.4-12 suggest that it is possible that there could be limited occurrences when Sacramento/Delta water supplies for fall/winter rice straw decomposition could be reduced to a greater extent compared to Sacramento/Delta water supply reductions during the growing season, and Sacramento/Delta water supplies may not be available to decompose all rice acreage grown following Plan implementation. The modeling results also suggest that there could be some occurrences when fall/winter water is *more* available than water for the growing season, as indicated by a positive percentage value for the fall and winter in Tables CR 7.4-11 and 7.4-12.

Even if Sacramento/Delta supplies for fall/winter rice straw decomposition are limited in certain circumstances and places to a greater extent than during the growing season, growers would not likely choose to discontinue producing rice as a result of these changes. The availability of fall and winter water supply is not expected to limit rice production and does not change the SWAP analysis or conclusions presented in Staff Report Section 7.4, *Agriculture and Forest Resources*. Under current conditions, growers already face years when winter water is not adequate for rice straw decomposition. Other post-harvest rice straw management activities may be feasible in some cases to reduce and divert rice straw. For instance, some rice growers in the Sacramento Valley implement alternative methods to manage post-harvest rice straw, including incorporating the straw into the soil without winter flooding and harvesting the rice straw for other uses, while others divert rice straw to storage or sell rice straw to other markets (CARB 2013; CalRice 2014; Espino et al. 2021). In addition, some growers rely on mechanical means only, or bale and sell rice straw to remove the straw prior to planting the next year. Therefore, even if there is a reduction in Sacramento/Delta surface water supply for post-harvest rice straw decomposition, these changes would not likely result in an additional reduction in agricultural acreage during the irrigation season beyond the changes that are captured in the SWAP modeling results presented in the Staff Report. Overall, the analysis presented above is consistent with the analyses already presented in the Staff Report, and does not change the Staff Report's conclusions.

In addition, the project has been revised. Please see Staff Report Chapter 13 and Common Response 1.3, each titled *Revised Proposed Plan Amendments*, for a description of the revised proposed Plan amendments. As discussed in Chapter 13 and Common Response 1.3, the regulatory pathway under the revised proposed Plan amendments includes new water supply adjustments that reduce water supply impacts and allow more water to be stored in reservoirs at the outset of Plan implementation. As a result of these changes, water supply reductions under the starting point for the regulatory pathway would be expected to be less than indicated by the results presented above.

Agricultural Land Fallowing/Idling and Land Conversion

This section provides more information about land fallowing, land idling, and permanent conversion of agricultural lands to nonagricultural use that could occur as a result of changes in hydrology and water supply. Permanent conversion is the change of land's use to a practice permanently incompatible with agriculture, such as residential development. Land fallowing and land idling are agricultural practices that temporarily remove land from production: fallowing generally as an agricultural treat to regenerate nutrients or control pests, and idling as a temporary economic measure. These practices, particularly idling, may lead to permanent conversion to nonagricultural use. The temporary nature of idling and fallowing, however, makes them distinct practices from permanent conversion. Despite this distinction, the Staff Report's analysis of impacts to agriculture considers that any agricultural land taken out of production would represent the permanent conversion of agricultural lands to nonagricultural use. This represents a highly conservative assumption because in practice, land fallowing or land idling can be a temporary response to many different factors.

However, as discussed in Section 7.4, *Agriculture and Forest Resources*, equating reductions in irrigated acreage to cropland conversions likely overestimates potential acreage reduction; not all land acreage estimated to be removed from irrigation would be permanently converted to nonagricultural uses. Conversions of land to nonagricultural uses are governed by many factors, including the proximity of land to a developable area and the decision of a landowner whether to remain in agriculture.

Also, the management decisions of individual agricultural producers and more sophisticated and driven by more variables than can be accounted for in modeling. For example, land with less access to irrigation could still remain in agricultural production due to one or more factors, including water conservation efficiency improvements that reduce water demand, crop category, or agricultural use changes to less water intensive-applications, dryland farming, or increased crop rotation.

A series of intermediate decisions lie between imposition of the flow scenarios and conversion of farmland to nonagricultural uses. Individual irrigation districts will make decisions about how to allocate the available surface water in accordance with established rules and regulations. Individual farmers will make cropping decisions, including whether to fallow, idle, or permanently convert land. If a farmer decides to convert the land, others in the market may decide whether to buy it and how it is to be used. Local general plan and zoning patterns make it probable that a new, nonagricultural use would require discretionary decisions by local agencies, such as general plan amendments, rezoning, subdivisions, or conditional use permits. The State Water Board does not control any of these decisions and does not have the authority to place conditions on local agencies to implement measures that would reduce or avoid the potentially significant impacts identified in the Staff Report's analysis.

While the State Water Board can ensure that mitigation is implemented for actions within its authority, other mitigation measures are largely within the jurisdiction and control of other agencies or depend on how water users respond to the proposed Plan amendments. Accordingly, the State Water Board cannot guarantee that measures will always be adopted or applied to fully mitigate potential impacts. Therefore, unless and until the mitigation is fully implemented, the impacts remain potentially significant.

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