Appendix 4L

Proposed Project Hydrology with Early Spring Outflow Implementation

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This appendix is entirely new for the Final Environmental Impact Report and was not included as part of the Draft Environmental Impact Report. Therefore, it is not provided in strikethrough or underline format.

4L.1 Introduction

The Proposed Project Incidental Take Permit (ITP) Spring Outflow scenario was modeled to represent conditions during the transition to the Proposed Project and prior to the approval of the Voluntary Agreements (VAs) flows by the California State Water Resources Control Board. This scenario replaces the VAs for Spring Outflow, as reflected in the Proposed Project, with the existing Spring Outflow requirement as described in 2020 ITP Condition of Approval 8.17. This appendix provides a comparison of the Proposed Project ITP Spring Outflow scenario with the Baseline Conditions to describe changes in surface water hydrology related to Sacramento River flow into the Sacramento–San Joaquin Delta (Delta), Delta outflow, Old and Middle River (OMR) flow, and Banks Pumping Plant State Water Project (SWP) exports.

The results of model simulations are also provided for informational purposes. Please do not use any information contained in these products for any purpose other than this environmental impact report process. If there are any questions regarding the results of these model simulations, please contact the California Department of Water Resources (DWR).

Any use of results of model simulations should observe limitations of the models used as well as the limitations to the modeled alternatives. These results should only be used for comparative purposes. More information regarding limitations of the models used as well as the limitations to the modeled alternatives is included Appendix 4A, "Model Assumptions," Attachment 8, "Model Limitations."

4L.2 Modeled Alternatives

The following scenarios were prepared:

- Baseline Conditions (Study 1)
- Proposed Project ITP Spring Outflow (Study 9b ITPSPRING)

The following model simulations were prepared for each alternative:

- CalSim 3
- DSM2

Documentation of CalSim 3 model assumptions for each alternative listed above are provided in Attachment 1, "CalSim 3 Model Assumptions Callouts." DSM2 model assumptions are consistent with those highlighted in Appendix 4A, Attachment 3, "DSM2 Model Assumptions Callouts."

4L.3 Model Results

Location-specific results for the alternatives and models listed above are included in the following attachments:

- Attachment 2, "CalSim 3 Storage and Elevation Results"
- Attachment 3, "CalSim 3 Flow Results"
- Attachment 4, "CalSim 3 Diversion Results"
- Attachment 5, "CalSim 3 X2 Results"
- Attachment 6, "DSM2 Stage Results"
- Attachment 7, "DSM2 Electrical Conductivity Results"
- Attachment 8, "DSM2 Chloride Results"

4L.4 Comparison of the Proposed Project ITP Spring Outflow with the Baseline Conditions

This section describes the changes to hydrology associated with the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions.

The Proposed Project ITP Spring Outflow scenario would modify baseline operations, downstream surface water flows, and diversions at selected SWP facilities and related waterways. Descriptions of estimated changes in hydrology are presented to provide a basis for understanding potential impacts on designated beneficial uses.

Discussions of the potential impacts on designated beneficial uses and other environmental resources are presented in separate sections, as appropriate. For example, estimated changes to Delta outflow could affect surface water quality or aquatic resources, which are further discussed in Appendix 5C, "Proposed Project Surface Water Quality Effects with Early Spring Outflow Implementation," and Appendix 6D, "Biological Results for Sensitivity Scenarios," respectively. Therefore, the changes in Delta outflow are discussed in this section as part of the analysis of hydrology, while the potential influence of the change to Delta outflow on surface water quality or aquatic resources and associated habitat is presented in Appendices 5C and 6D, respectively.

4L.4.1 Method of Analysis

Changes to surface water hydrology were modeled with CalSim 3. Additional details regarding the CalSim 3 model are provided in Attachment 1 as well as Appendix 4A. Detailed modeling results using the CalSim 3 computer model for all water year types and long-term averages are provided in the attachments.

4L.4.2 Comparison of Sacramento River Flows into Delta, Delta Outflow, and OMR Flow

This section provides an overview of changes to surface water hydrology under the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions for Sacramento River at Freeport, Delta outflow, and OMR flow. As described in Chapter 4, "Surface Water Hydrology," flows in the Delta are a result of coordinated SWP and Central Valley Project (CVP) operations. While this discussion focuses on assessing potential changes in surface water hydrology under the Proposed Project ITP Spring Outflow (i.e., due to SWP operations) scenario, existing CVP operations must also be modeled with CalSim 3 to appropriately represent conditions in the Delta. Plots comparing changes to long-term average flow and descriptions for noteworthy monthly changes under various water year types at each of these locations are presented in the following subsections.

4L.4.2.1 Sacramento River at Freeport

As shown in Figure 4L-1, CalSim 3 model results indicate that over the 100-year simulation period, Sacramento River inflow to the Delta under the Proposed Project ITP Spring Outflow scenario would generally resemble inflow under the Baseline Conditions in all months, with a slight increase in September of Wet and Above Normal years.

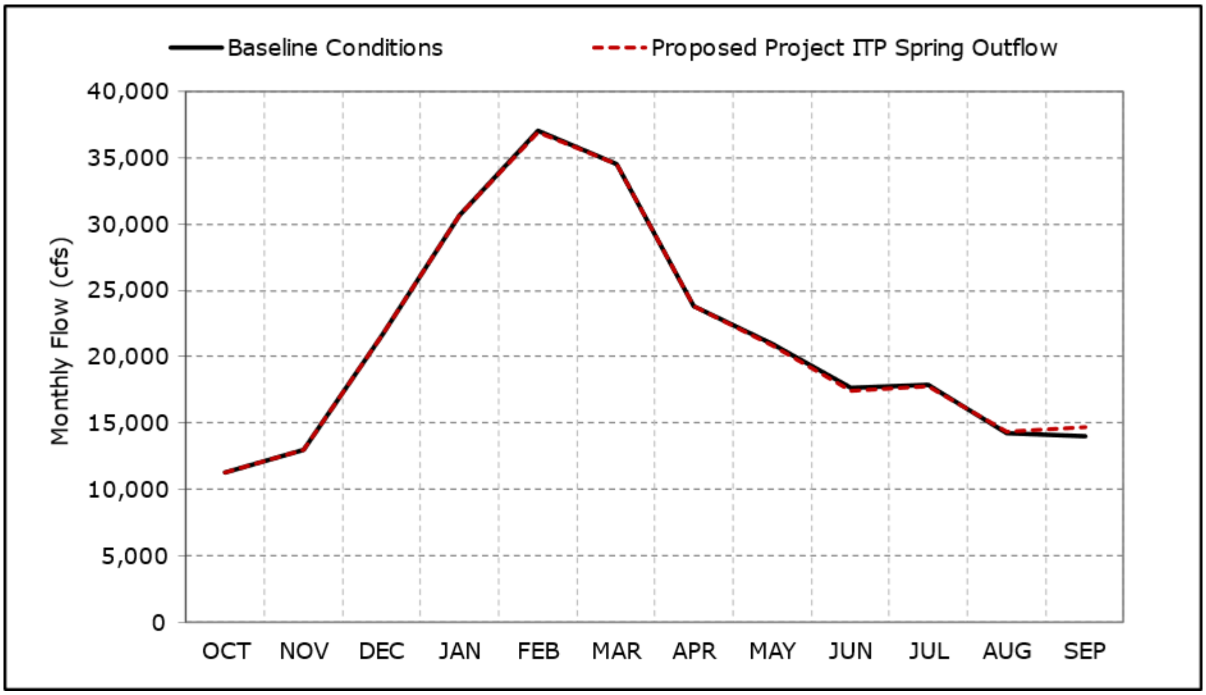

Figure 4L-1. Sacramento River at Freeport, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project ITP Spring Outflow Operations

Figure 4L-1 shows the flow, from 0 to 40,000 cubic feet per second (cfs), for Sacramento River inflow to the Delta under the Proposed Project ITP Spring Outflow scenario compared to Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project ITP Spring Outflow scenario generally resembles inflow under the Baseline Conditions in all months apart from September.

Proposed operations would increase Sacramento River flow in September in Wet and Above Normal water years by roughly 1,225 (6 percent) and 2,307 cfs (13 percent), respectively. This increase in flow is due to the replacement of the 100-thousand-acre-foot (TAF) block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions, including updates to the Summer-Fall Habitat Actions and revised Suisun Marsh Salinity Control Gate (SMSCG) operations under the Proposed Project ITP Spring Outflow scenario.

For SMSCG operation, the Baseline Conditions assume a continuous 60- or 30-day operation of the SMSCG that is initiated in either June or July depending on salinity conditions the previous month. The purpose of the SMSCG operation is to pump fresher water from the Sacramento/San Joaquin confluence into Suisun Marsh, which tends to make the confluence incrementally more saline. The CalSim 3 model compensates for this increase in salinity at the confluence by increasing the outflow through increased releases or reduced exports and results in a water cost associated with the operation. The Proposed Project ITP Spring Outflow scenario has a similar initiation of SMSCG.

The 100-TAF block of water that would be managed adaptively in the 2020 SWP ITP required generalized assumptions for the CalSim modeling (i.e., the Baseline Conditions). As such, the CalSim modeling assumed that at least 20 TAF would be added to outflow in August of Wet and Above Normal years, with the remainder, 80 TAF, backed into Oroville for actions in the following year, unless storage conditions indicated an increased risk of spill, in which case that remainder water was added to outflow as well. Like the Proposed Project, this block of water is not included in the Proposed Project ITP Spring Outflow scenario, allowing greater end-of-August storage at Oroville to be followed by increased releases from Oroville in September of Wet and Above Normal years. As part of the transition from the Baseline Conditions to the Proposed Project, DWR has committed to a one-time release of a block of water during the summer–fall period for Delta Smelt (*Hypomesus transpacificus*) habitat in 2025 if 2025 is not a Critical water year. The modeling does not include this action because it would only occur once. As a result, Sacramento River flow at Freeport under the Proposed Project (or Proposed Project ITP Spring Outflow scenario) may be slightly higher than the modeled values during the summer–fall of 2025.

In Wet, Below Normal, Dry, and Critical water years, Sacramento River flow under the Proposed Project ITP Spring Outflow scenario will remain similar to the flow under the Baseline Conditions. Based on the changes described above, the Proposed Project ITP Spring Outflow scenario would not result in an increase to the frequency of reverse flow conditions on the Sacramento River near Freeport compared to the Baseline Conditions.

Based on these modeled differences in surface water flow for the Sacramento River at Freeport, the Proposed Project ITP Spring Outflow scenario would not substantially affect surface water resources at this location relative to the Baseline Conditions.

4L.4.2.2 Delta Outflow

Under the Proposed Project ITP Spring Outflow scenario, long-term average Delta outflow would remain similar to the Baseline Conditions in all months. Delta outflow long-term average monthly flow patterns under the Baseline Conditions and the Proposed Project ITP Spring Outflow scenario over the 100-year simulation period are shown in Figure 4L-2.

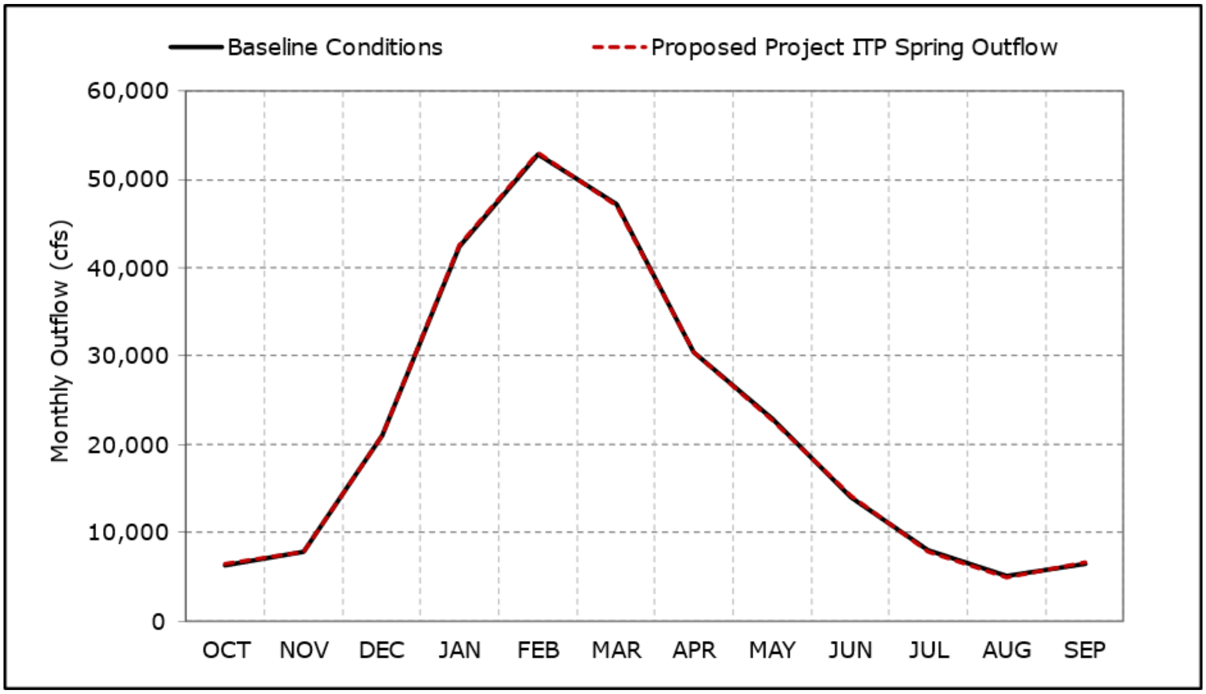

Figure 4L-2. Delta Outflow, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project ITP Spring Outflow Operations

Figure 4L-2 shows the flow, from 0 to 60,000 cfs, for Delta outflow under the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project ITP Spring Outflow scenario would remain similar to outflow under the Baseline Conditions in all months.

With the Proposed Project ITP Spring Outflow scenario, Delta outflow would be reduced in August for Above Normal and Dry water years when compared to the Baseline Conditions. Delta outflow would be reduced in this month during these water year types because export patterns and reservoir releases would change under the Proposed Project ITP Spring Outflow scenario. This change is due to the replacement of the 100-TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions referenced in Section 4L.4.2.1, "Sacramento River at Freeport." As noted in the prior section, the CalSim 3 model assumes this action occurs in August. As such, in Above Normal and Dry years, Delta outflow decreases by up to 732 cfs (12 percent) in August under the Proposed Project ITP Spring Outflow scenario with the replacement of this action. The large relative change in August is primarily due to the low flow conditions in the Baseline Conditions. Delta outflow may be slightly higher than modeled values under the Proposed Project (or Proposed Project ITP Spring Outflow scenario) during some portion of the summer–fall of 2025 (during the transition from the Baseline Conditions to the Proposed Project) if 2025 is not a Critical water year. In Above Normal water years, Delta outflow increases by 931 cfs (9 percent) in September due to additional storage being available in this month.

Based on these modeled differences in Delta outflow, the Proposed Project ITP Spring Outflow scenario would not substantially affect surface water resources relative to the Baseline Conditions.

4L.4.2.3 Old and Middle River Flow

Long-term average monthly OMR flow would be negative in all months because of south Delta CVP and SWP pumping operations over the 100-year simulation period, as shown in Figure 4L-3. For the descriptions of changes in OMR flow under the Proposed Project ITP Spring Outflow scenario, increases and decreases are highlighted with respect to absolute changes in magnitude. For example, a change to a more negative OMR flow is described as a relative increase in the magnitude of the flow. As OMR flow in certain water years may be near zero, switch from positive to negative, or vice-versa, relative changes to this action may be misleading. Therefore, all changes to OMR flow are described as absolute changes between the Proposed Project ITP Spring Outflow scenario and the Baseline Conditions.

The Longfin Smelt (*Spirinchus thaleichthys*) entrainment protections described in the 2020 SWP ITP are not explicitly modeled in the Baseline Conditions. These entrainment protections are assumed to be covered by the OMR actions for winter-run Chinook Salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*Oncorhynchus mykiss*) because they share the same OMR flow requirement during the same season under the Baseline Conditions. Additional protections, specific to the Longfin Smelt, are based on coordination between DWR and the California Department of Fish and Wildlife. They do not have explicit triggers and flow requirements that could be incorporated into an operational model. Therefore, OMR flow may be lower (i.e., less negative) and Delta exports may be lower in the Baseline Conditions than the modeled values during the winter and spring months. However, the Longfin Smelt entrainment protections only apply to SWP exports. As such, it is uncertain if and how much OMR flow and Delta exports may decrease under the Baseline Conditions.

With the Proposed Project ITP Spring Outflow scenario, the long-term average monthly OMR flow, as modeled, would increase in September and decrease in February and June. Mean monthly long-term average flow increases of up to 522 cfs are modeled in September, with decreases of up to 444 cfs in June.

In Wet water years, OMR flow would increase by 418 cfs in March and 1,350 cfs in September when compared to OMR flow under the Baseline Conditions. In March of Wet water years, increases in flow under the Proposed Project ITP Spring Outflow scenario are the result of high flow offramps in the Delta Smelt OMR actions, revisions to the protective fish actions, as well as the addition of winter-run Chinook Salmon and steelhead weekly loss thresholds under the Proposed Project ITP Spring Outflow scenario. September increases in OMR flow may be attributed to the replacement of the 100-TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions under the Proposed Project ITP Spring Outflow scenario. OMR flow would also decrease by 546 cfs in June under the Proposed Project ITP Spring Outflow scenario. The extension of existing and additional species-specific protections under the Proposed Project ITP Spring Outflow scenario can be attributed to this decrease in OMR flow.

In Above Normal and Below Normal water years, OMR flow would increase by 565 cfs in August and 62 cfs in May, respectively. In Above Normal water years, OMR flow would also increase by 1,268 cfs in September under the Proposed Project ITP Spring Outflow scenario. Increases in OMR flow in August and September in Above Normal water years occur for the same reason described for September of Wet water years. For May of Below Normal water years, OMR changes under the Proposed Project ITP Spring Outflow scenario are primarily the result of the revisions and additions to the OMR management protective fish actions. Furthermore, minor changes to OMR flows during

May of Below Normal water years are more apparent due to the lower magnitude of flows during this month.

OMR flow decreases of up to 559 cfs in February and 701 cfs in June would occur in Above Normal, Below Normal, and Dry water years under the Proposed Project ITP Spring Outflow scenario. In March of Dry water years, OMR flow also decreases by 215 cfs under the Proposed Project ITP Spring Outflow scenario. For these months, decreases in OMR flow occur as a result of the revisions and additions to the OMR management protective fish actions. The additional triggering of actions under these changes results in an overall decrease in OMR flow during these months for these water year types.

In Critical water years, OMR flow would decrease by 415 cfs in February with the Proposed Project ITP Spring Outflow scenario. Changes that occur during this month can be attributed to the revisions and additions to the OMR management protective fish actions under the Proposed Project ITP Spring Outflow scenario, with the decrease in flow resulting from an increase in actions being triggered.

Based on these modeled differences in surface water flow for the Old and Middle rivers, the Proposed Project ITP Spring Outflow scenario would not substantially affect surface water resources at this location relative to the Baseline Conditions.

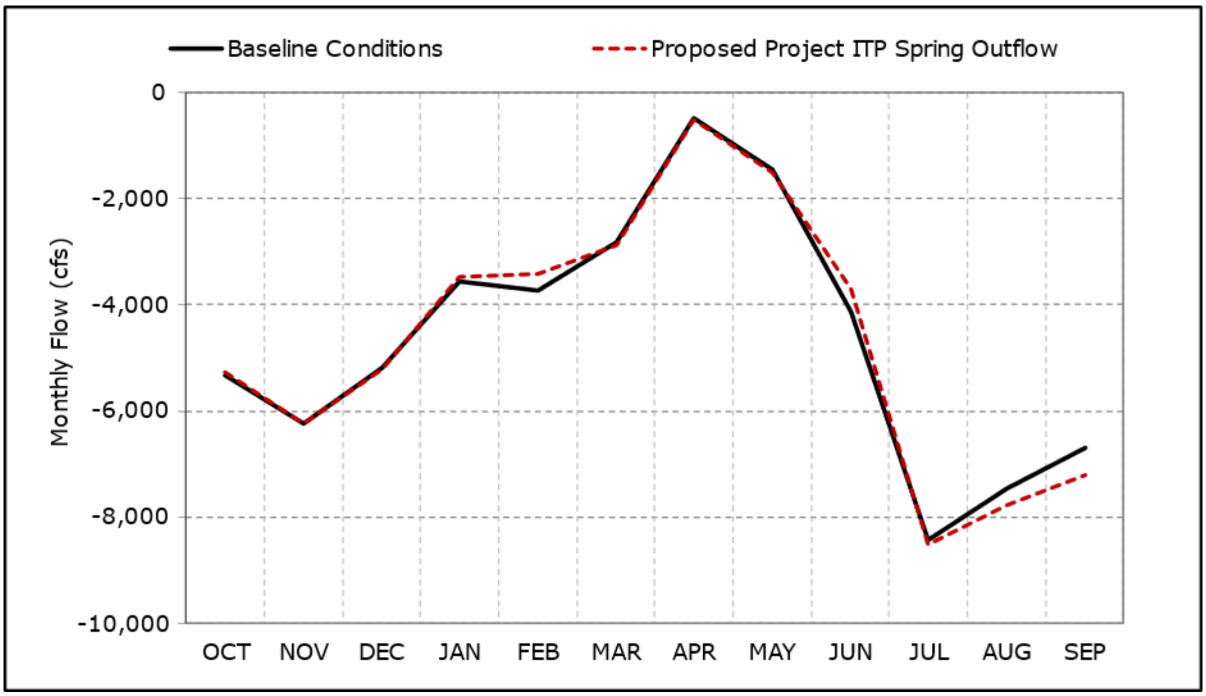

Figure 4L-3. Old and Middle River Flow, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project ITP Spring Outflow Operations

Figure 4L-3 shows the flow, from -10,000 cfs to 0 cfs, for OMR flow under the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project ITP Spring Outflow scenario would generally remain similar to outflow under the Baseline Conditions in all months with slight deviations in February, June, and September.

4L.4.3 Comparison of SWP Banks Pumping Plant Exports

SWP Banks Pumping Plant monthly export patterns under the Baseline Conditions and the Proposed Project ITP Spring Outflow scenario over the 100-year simulation period are shown in Figure 4L-4. Changes to exports between December and June coincide with the changes presented in Section 4L.4.2.3, “Old and Middle River Flow.” Diversions from the Old and Middle River for water rights junior to the SWP were not explicitly constrained during these months in the Baseline Conditions or the Proposed Project ITP Spring Outflow scenario. As such, SWP exports may be slightly higher than those modeled in some cases; this is further explored in Appendix 4M, “OMR Diversions Sensitivity Analysis.” Increases in exports in August and September can be attributed to the replacement of the 100-TAF block of water in the 2020 SWP ITP Condition 8.19 with alternative protective actions. With the Proposed Project ITP Spring Outflow scenario, SWP south Delta long-term average exports at Banks Pumping Plant would potentially increase by 14 TAF (5 percent) in August and 37 TAF (21 percent) in September. A potential pumping decrease of 11 TAF (5 percent) in February and 14 TAF (9 percent) in June would occur with the Proposed Project ITP Spring Outflow scenario.

In Wet water years, the SWP Banks Pumping Plant exports under the Proposed Project ITP Spring Outflow scenario would potentially increase by 25 TAF (8 percent) in March, 24 TAF (6 percent) in August, and 89 TAF (30 percent) in September. SWP Banks Pumping Plant exports would also decrease by 20 TAF (8 percent) in June compared to the Baseline Conditions.

In Above Normal and Below Normal water years, SWP Banks Pumping Plant exports under the Proposed Project ITP Spring Outflow scenario would potentially increase by up to 6 TAF (7 percent) in May and 23 TAF (6 percent) in August. In Above Normal water years, exports would also increase by 95 TAF (49 percent) in September compared to the Baseline Conditions. Additionally, exports would potentially decrease by up to 10 TAF (5 percent) in October, 19 TAF (9 percent) in February, and 20 TAF (13 percent) in June under the Proposed Project ITP Spring Outflow scenario.

In Dry and Critical water years, SWP Banks Pumping Plant exports would potentially decrease by up to 15 TAF (10 percent) in February. In Dry water years, exports would also decrease by 12 TAF (9 percent) in March and 16 TAF (13 percent) in June compared to exports under the Baseline Conditions. In Critical water years, exports would potentially decrease by 4 TAF (11 percent) in July.

Over the long-term, average modeled annual SWP Banks Pumping Plant pumping is increasing by about 21 TAF (1 percent) under the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions. Based on the modeled differences for SWP Banks Pumping Plant, the Proposed Project ITP Spring Outflow scenario would not substantially affect surface water resources at this location relative to the Baseline Conditions.

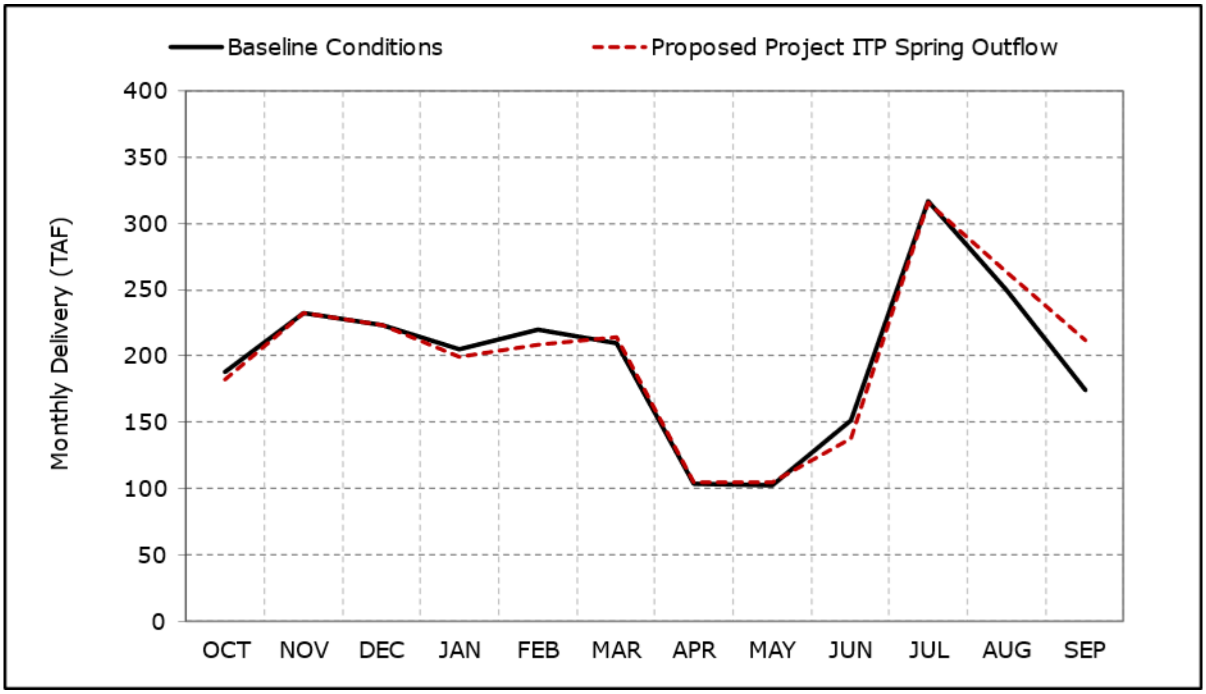

Figure 4L-4. SWP Banks Pumping Plant Exports, Comparison between Long-term Monthly Average Baseline Conditions and Proposed Project ITP Spring Outflow Operations

Figure 4L-4 shows monthly delivery rates, from 0 TAF to 400 TAF, for SWP Banks Pumping Plant under the Proposed Project ITP Spring Outflow scenario compared to the Baseline Conditions. Flows are depicted from October (left) to September (right). The line graph shows that the Proposed Project ITP Spring Outflow scenario would generally remain similar to monthly delivery amounts under the Baseline Conditions in all months with the largest increase from baseline in September.

4L.4.4 Conclusion

Based on the analysis above, surface water hydrology would remain within the range of Baseline Conditions operations under the Proposed Project ITP Spring Scenario. The Proposed Project ITP Spring Outflow scenario would not alter existing drainage or river courses, create additional impervious surfaces that would induce or accelerate erosion or siltation, increase the rate or amount of surface runoff that subsequently would result in flooding, exceed the capacity of existing or planned stormwater systems or substantial sources of polluted runoff, or alter or impede the existing conveyance of flood flows. No impact would occur.