

## **Old and Middle River Diversions Sensitivity Analysis**

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## Appendix 4M

# Old and Middle River Diversions Sensitivity Analysis

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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.

## 4M.1 Introduction

CalSim 3 has been developed and refined in a collaborative manner between the California Department of Water Resources (DWR), the US Bureau of Reclamation (Reclamation), and other agencies. In some cases, individual agencies develop components of the CalSim model to better represent operations within a given system. In response to comments received on the DEIR, it was discovered that Contra Costa Water District (CCWD) operations, as modeled, were allowing the fill of Los Vaqueros Reservoir using diversions from CCWD's Old River intake during Old and Middle River (OMR) management periods between December and June. In reality, CCWD's water right for filling Los Vaqueros is junior to the State Water Project (SWP) and Central Valley Project (CVP) water rights, which could preclude CCWD diversions at their Old River intake during OMR management periods. As such, additional CalSim 3 model runs were prepared that limit CCWD diversions for filling Los Vaqueros Reservoir when OMR is controlling, consistent with water right priorities and past practice.

In CalSim 3, as with CalSim II, DWR and Reclamation have relied on CCWD for the latest modeling related to Los Vaqueros operations, including code, switches, inputs, and other model components. Additionally, CCWD serves as a water service contractor for the CVP and attends meetings related to the consultation of the long-term operation of the CVP and SWP. Through this coordination with Reclamation, an iterative process has been developed between CalSim 3 and DSM2 to inform operations pertaining to water quality objectives affecting CCWD diversions at the Rock Slough intake, Old River intake, and the Victoria Canal intake. For this sensitivity analysis, however, this iterative process was not implemented and therefore does not reflect revised water quality conditions that may be present at intake locations with this adjustment to CCWD diversions from the Old River. As such, water quality conditions, as they relate to CCWD, are not discussed. Flow and storage parameters related to CCWD are included for informational purposes only and are intended to display the potential relative changes in magnitude with constraining diversions to Los Vaqueros Reservoir during the OMR management period. It is assumed that the relative influence of this adjustment outweighs the influence of water quality conditions at each intake.

This document summarizes key findings from a sensitivity analysis of operational changes to the Baseline Conditions and Proposed Project with an adjustment to the modeled representation of CCWD diversions from the Old River that are used to fill Los Vaqueros Reservoir. For this sensitivity analysis, the Baseline Conditions (Study 1) and Proposed Project (Study 9bv2) were simulated using CalSim 3 and modified to reflect these conditions (generating Study 1 CCWD Fix and Study 9bv2 CCWD Fix). Additional detail on assumptions pertaining to these elements are included in the subsections below.

Operations results from these simulations were analyzed to understand if the incremental changes between the Baseline Conditions and Proposed Project remain similar with this adjustment to CCWD diversions. The following sections summarize key CalSim 3 results for the Baseline Conditions and Proposed Project under these conditions.

### 4M.1.1 CCWD Diversions

CCWD operates several diversions to provide water to its customers. The Contra Costa Canal originates at Rock Slough, about four miles southeast of Oakley, and terminates after 47.7 miles at Martinez Reservoir. Historically, diversions at the unscreened Rock Slough facility (Contra Costa Canal Pumping Plant No. 1) have ranged from about 50 to 250 cubic feet per second (cfs). The canal and associated facilities are part of the CVP; but are operated and maintained by CCWD. CCWD also operates a diversion on the Old River and the Alternative Intake Project, the new drinking water intake at Victoria Canal, about 2.5 miles east of CCWD's intake on the Old River. CCWD is able to divert water to the Los Vaqueros Reservoir to store good quality water when available and supply to its customers.

CalSim 3 accounts for CCWD operations in its OMR index calculations. However, in modeling the Baseline Conditions and Proposed Project for this EIR, CCWD diversions to fill Los Vaqueros Reservoir were not constrained to this OMR index, allowing times where diversions could be made during OMR management periods. For this sensitivity analysis, this assumption in the Baseline Conditions and Proposed Project has been modified to constrain CCWD diversions for the purpose of filling Los Vaqueros when the OMR index is limiting SWP and CVP exports, consistent with and better reflecting operations in reality.

## 4M.2 Study Objectives

The CalSim 3 model was applied to evaluate the sensitivity of the Baseline Conditions and Proposed Project with this adjustment to CCWD diversions used to fill Los Vaqueros Reservoir. The CalSim 3 model was used for quantifying the changes in river flows, delta channel flows, exports, and water deliveries. Key output parameters from this analysis are shown in Figure 4M-1 through Figure 4M-28. The effects of this adjustment are summarized below.

## 4M.3 Operations Sensitivity

For this sensitivity analysis, the Baseline Conditions and Proposed Project scenarios were generated using modified logic to limit CCWD diversions used to fill Los Vaqueros Reservoir during periods when OMR is constraining SWP and CVP exports. CalSim 3 simulations for the Baseline Conditions and Proposed Project in this sensitivity analysis only differ with respect to this adjustment. None of the other system parameters or inputs have been changed.

The purpose of conducting these simulations is to help describe the sensitivity in projected SWP system operations under the Baseline Conditions and Proposed Project to this adjustment to CCWD diversions. The incremental changes between the Baseline Conditions and Proposed Project were compared to the incremental changes of these scenarios with the CCWD diversion adjustment incorporated.

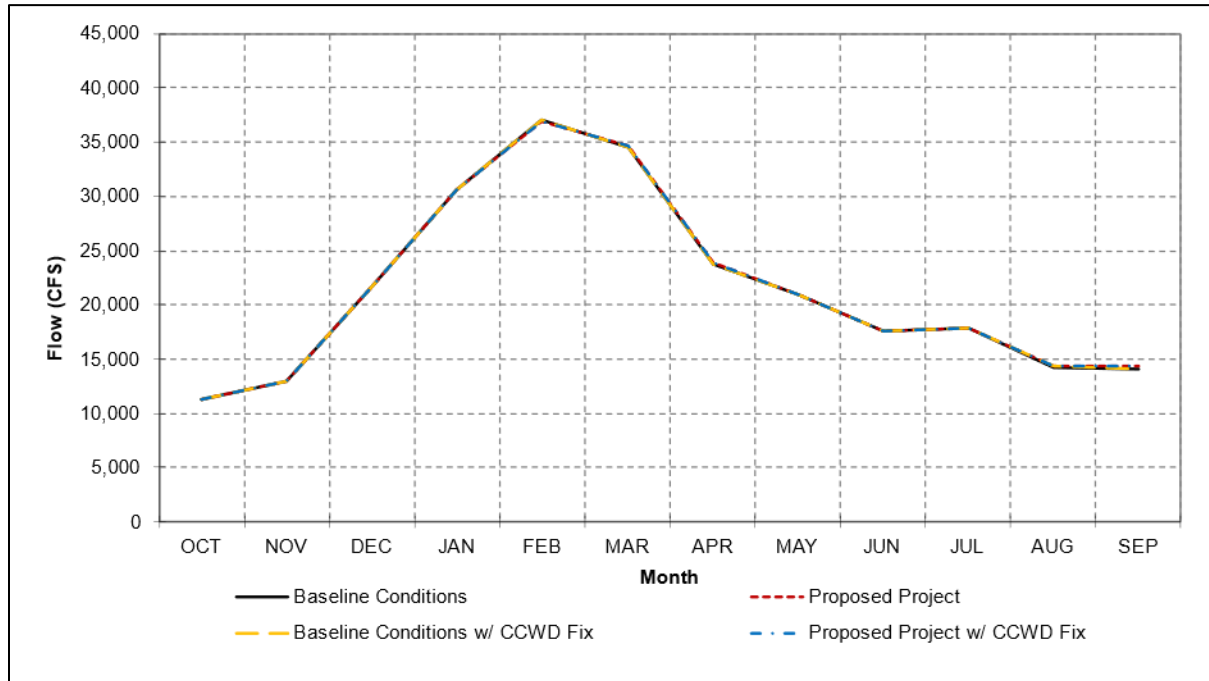
Figure 4M-1 through Figure 4M-28 show CalSim 3 simulation results for the Baseline Conditions (black lines); Proposed Project (red lines); Baseline Conditions with CCWD Fix (orange lines); and Proposed Project with CCWD Fix (blue lines). The plots presented in this document are relevant to assessing whether the conclusions in the hydrology, water quality and aquatic biological resources analyzed in the EIR hold under the adjusted operational changes described above. For transparency in modeled operations with this adjustment, certain CCWD and CVP-specific parameters are also included in this analysis. Several key observations can be made based on these simulations:

- Incremental changes in long-term average flow show no change for the Sacramento River at Freeport, Yolo Bypass, Georgiana Slough, Delta Cross Channel, Qwest, and Delta Outflow between the Proposed Project and Baseline Conditions with this adjustment to CCWD diversions.
- Long-term average OMR flow shows slight decreases (less negative flow; less pumping) in April and May and a slight increase (more negative flow; more pumping) in August with the incorporation of this adjustment. However, incremental changes between the Proposed Project and Baseline Conditions remain similar under these considerations.
- With the adjustment to CCWD Old River diversions, Los Vaqueros water right diversions decrease relative to the Baseline Conditions in January, February, April, and May. A slight relative increase is also noted in November. Incremental changes between the Baseline Conditions and Proposed Project with and without this fix are largely similar with the exception of April and December, where the Proposed Project appears to decrease slightly more than the Baseline Conditions with this adjustment. To compensate for these decreases, slight increases to CCWD CVP diversions in July through December are noted.
- Long-term average CCWD Old River diversions show a relative increase in flow in both the Baseline Conditions and Proposed Project with this adjustment in July through November and a relative decrease in flow between December and February as well as April and May (i.e., months where OMR has to greatest potential to be controlling). Increases in summer and fall months likely occur to compensate for the decreases in flow in other months. Incremental changes remain largely consistent between the Baseline Conditions and Proposed Project scenarios, although there is some slight variability in April and May for scenarios including the CCWD fix. These changes are likely due to revisions in the Spring Outflow Requirement and additional protective actions under the Proposed Project.
- CCWD Victoria Canal diversions show similar long-term average monthly patterns as those presented for CCWD Old River diversions, with a lesser magnitude of relative change. Relative increases from the Baseline Conditions and Proposed Project occur in July through December and decreases are present in April and May. These changes likely further compensate for decreases in December, January, February, April, and May for the Old River to meet overall demands for CCWD. Incremental changes between the Baseline Conditions and Proposed Project remain similar across all months with this adjustment.
- CCWD diversions through Rock Slough cannot be used to fill Los Vaqueros Reservoir and are largely unaffected by this change as the intake location is downstream of the OMR criteria. However, relative decreases in August occur with this adjustment to CCWD Old River diversions due to the increase in flows at other CCWD diversion points.

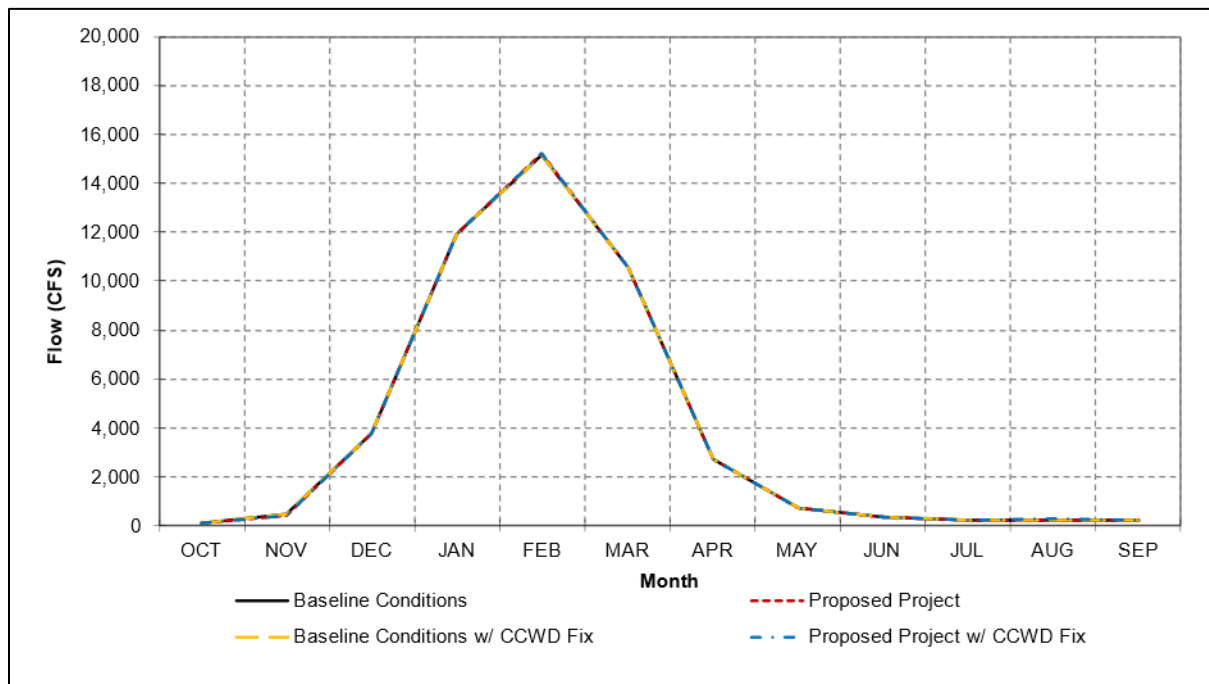
- Diversions to fill Los Vaqueros Reservoir show a decrease relative to the Baseline Conditions and Proposed Project between December and February as well as April and May, consistent with the trends discussed above. Relative increases are observed from July through November to compensate for the decreases in other months. Los Vaqueros Reservoir releases decrease slightly in October through January but remain similar to the Baseline Conditions and Proposed Project during all other months. Monthly storage exceedances show the largest departure from the Baseline Conditions and Proposed Project in May and June. These differences narrow in July through April as additional diversions to fill Los Vaqueros Reservoir are made to compensate for the decreases in other months. Incremental changes between the Baseline Conditions and Proposed Project remain largely consistent across all months, although monthly exceedance trends display some slight variability for some exceedance probabilities.
- Total annual storage for Los Vaqueros Reservoir shows a slight decrease between most exceedance probabilities under the scenarios with adjusted CCWD Old River diversions. Departures from the Baseline Conditions and Proposed Project are most apparent between 90 percent and 80 percent as well as 70 percent and 55 percent. On average, this results in a less than 2% decrease in annual Los Vaqueros Reservoir storage over the entire simulation period. The minimum storage in Los Vaqueros Reservoir appears to be unchanged, and incremental changes between the Baseline Conditions and Proposed Project are largely consistent with these considerations.
- Monthly long-term average deliveries to the CCWD service area appear to be unchanged as a result of the adjustment to CCWD Old River diversions. Incremental changes between the Baseline Conditions and Proposed Project are similar across both sets of scenarios.
- Simulated SWP Banks Pumping Plant, Jones Pumping Plant, and total exports show similar patterns in incremental changes between the Baseline Conditions and Proposed Project with this adjustment to CCWD Old River diversions. In water years where exports are more constrained (e.g., Critically Dry water years), this adjustment may result in a slight increase to exports under the Proposed Project (relative to the CCWD fix scenario) in individual months where OMR is controlling. However, this change does not appear to meaningfully influence any patterns in long-term average SWP Banks Pumping Plant, Jones Pumping Plant, or total exports, nor annual exports for any of these parameters.

Overall, the relative incremental changes due to the Proposed Project as compared to the Baseline Conditions with adjustments to CCWD Old River diversions are similar to those described in the EIR. Furthermore, changes in magnitude to CCWD diversions are likely closer to those observed in reality, and incremental changes for selected parameters remain largely consistent between the Baseline Conditions and Proposed Project under these varying assumptions. This sensitivity analysis demonstrates that by not allowing CCWD diversions for filling Los Vaqueros Reservoir when OMR is controlling, consistent with water right priority and past practice, there are minimal differences in Delta flows and south Delta exports as a result of the different assumptions. This indicates that the quantitative and qualitative results described in the EIR hold, even without this adjustment.

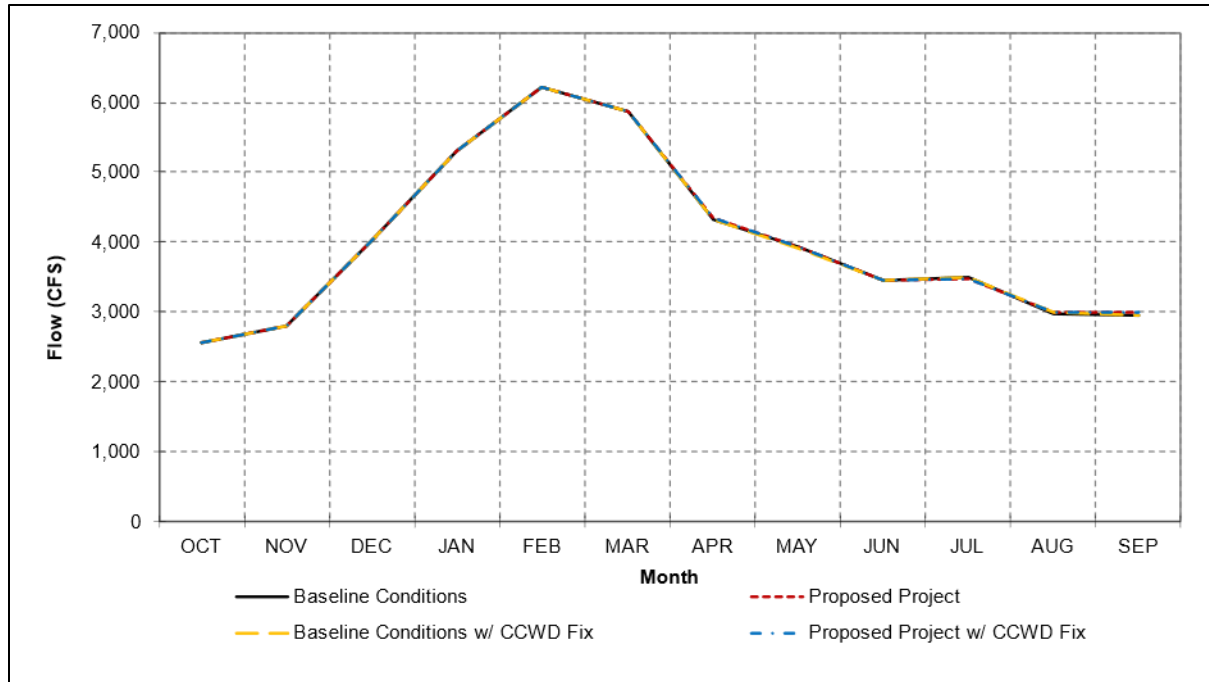
### 4M.3.1 Sacramento River and Delta Flow Figures



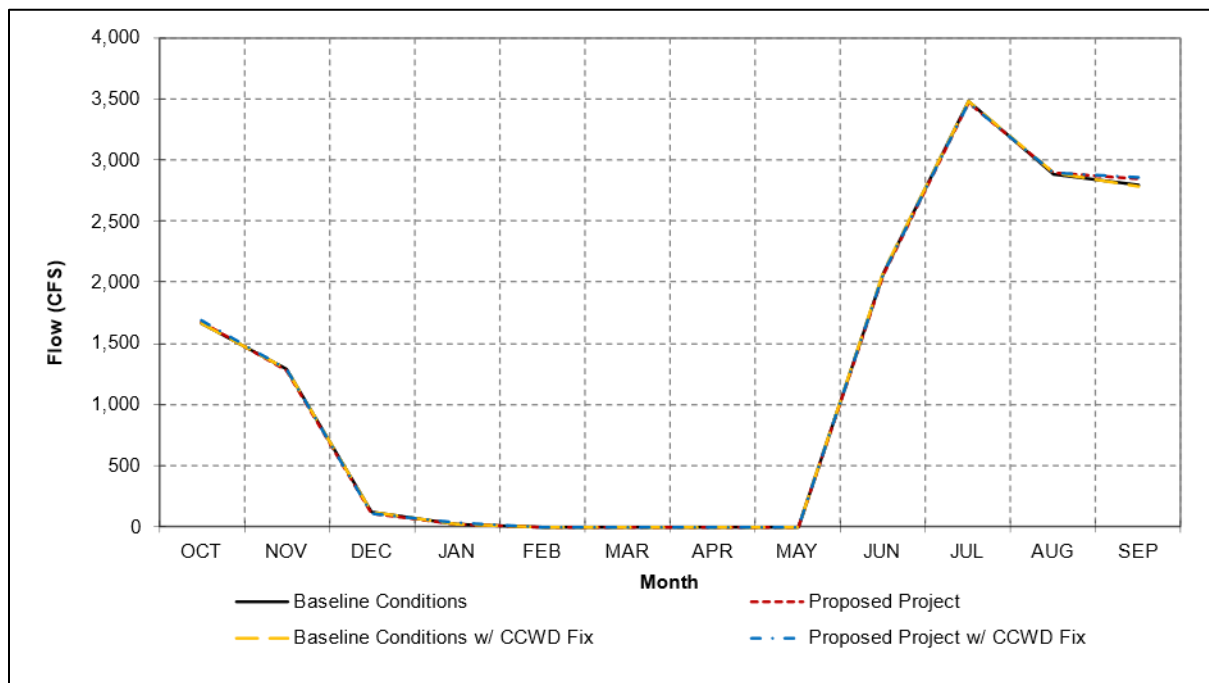
**Figure 4M-1. Sacramento River at Freeport Monthly Long-term Average Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



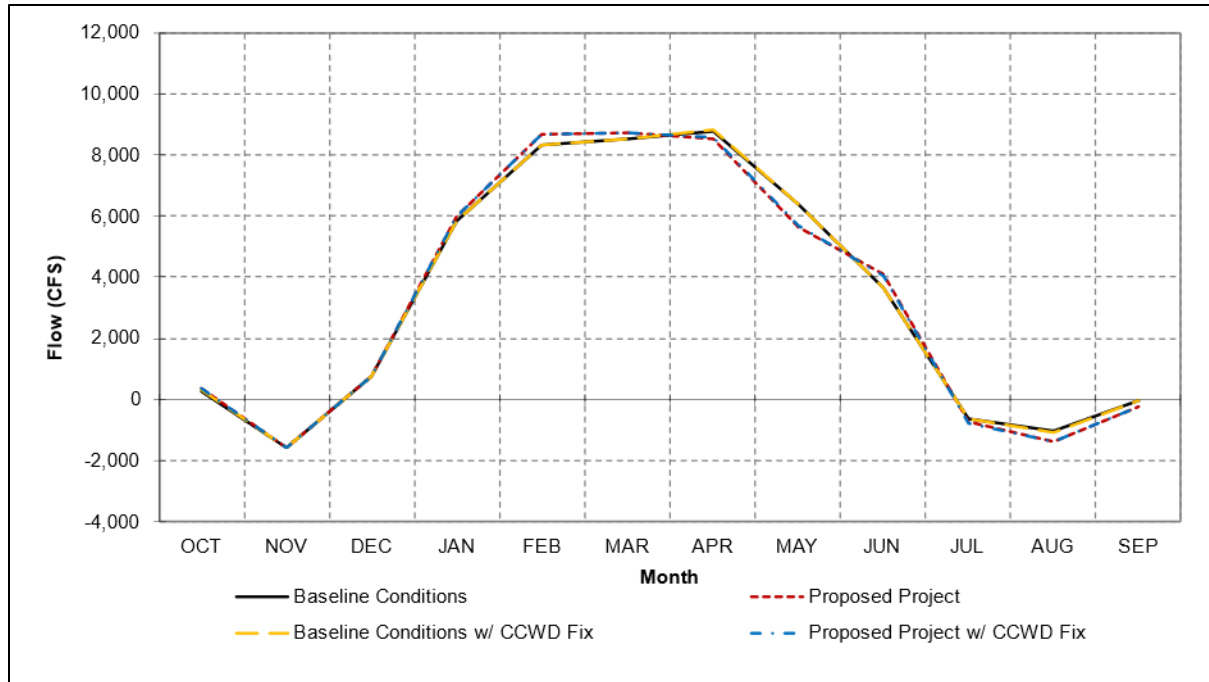
**Figure 4M-2. Monthly Long-term Average Yolo Bypass Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



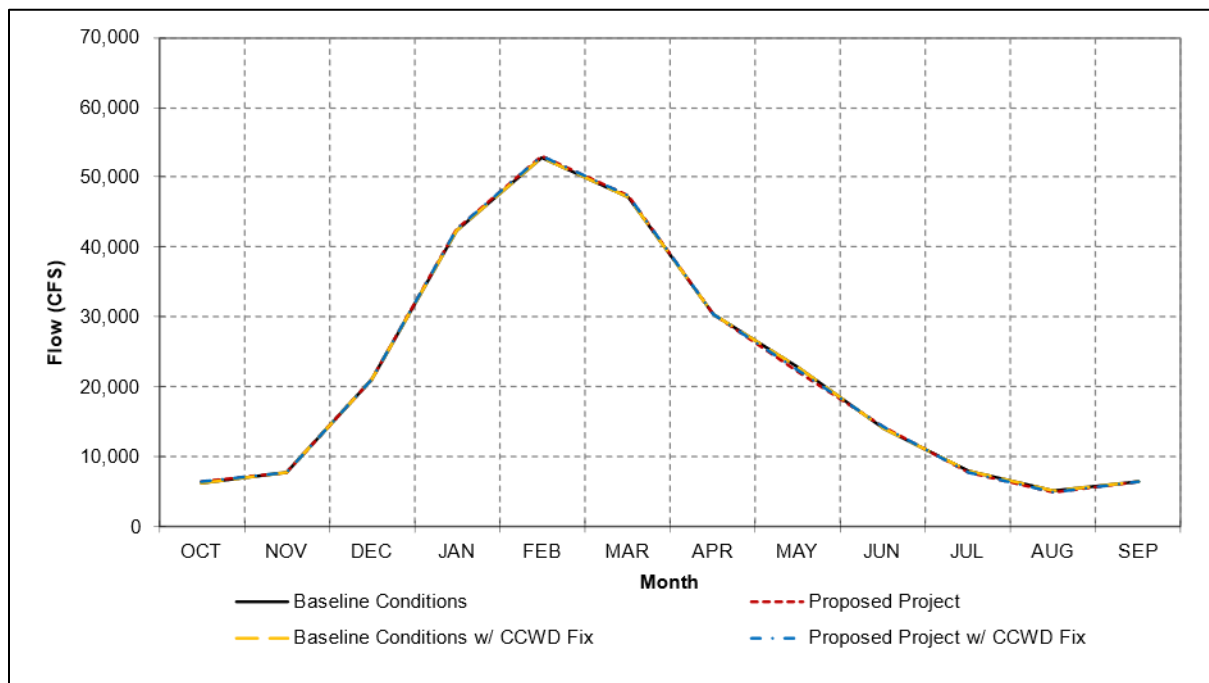
**Figure 4M-3. Monthly Long-term Average Georgiana Slough Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-4. Monthly Long-term Average Delta Cross Channel Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**

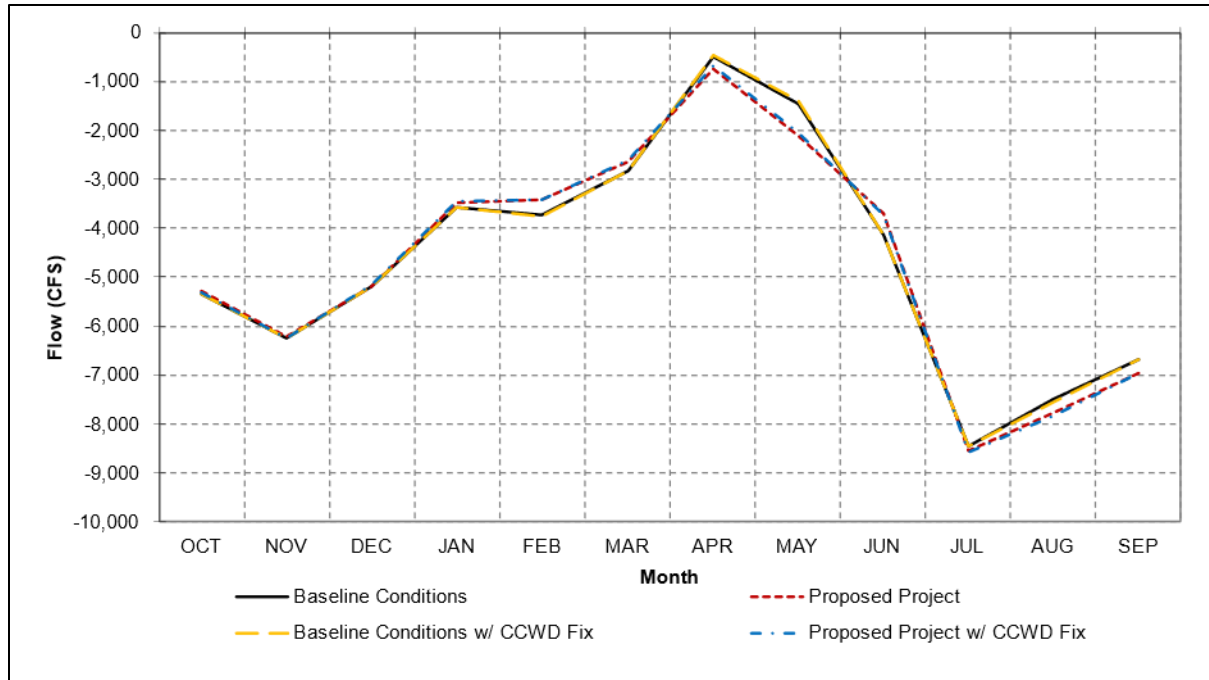


**Figure 4M-5. Monthly Long-term Average Qwest Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



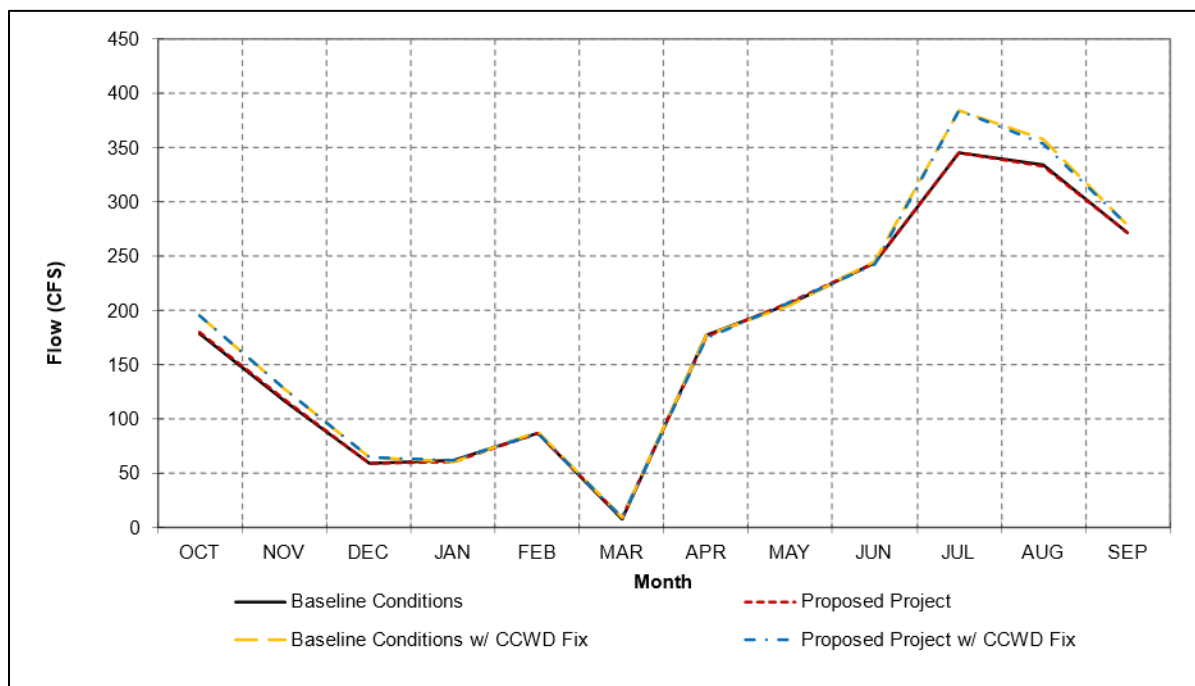
**Figure 4M-6. Monthly Long-term Average Delta Outflow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



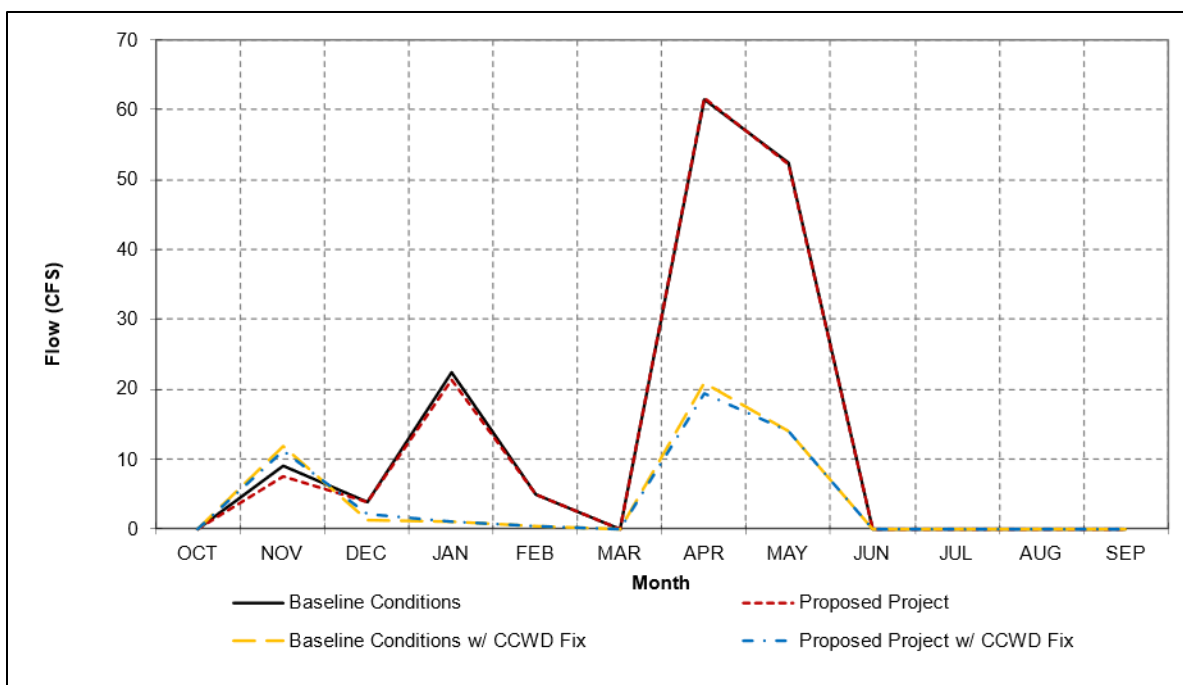


**Figure 4M-7. Combined Old and Middle River Monthly Long-term Average Flow for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**

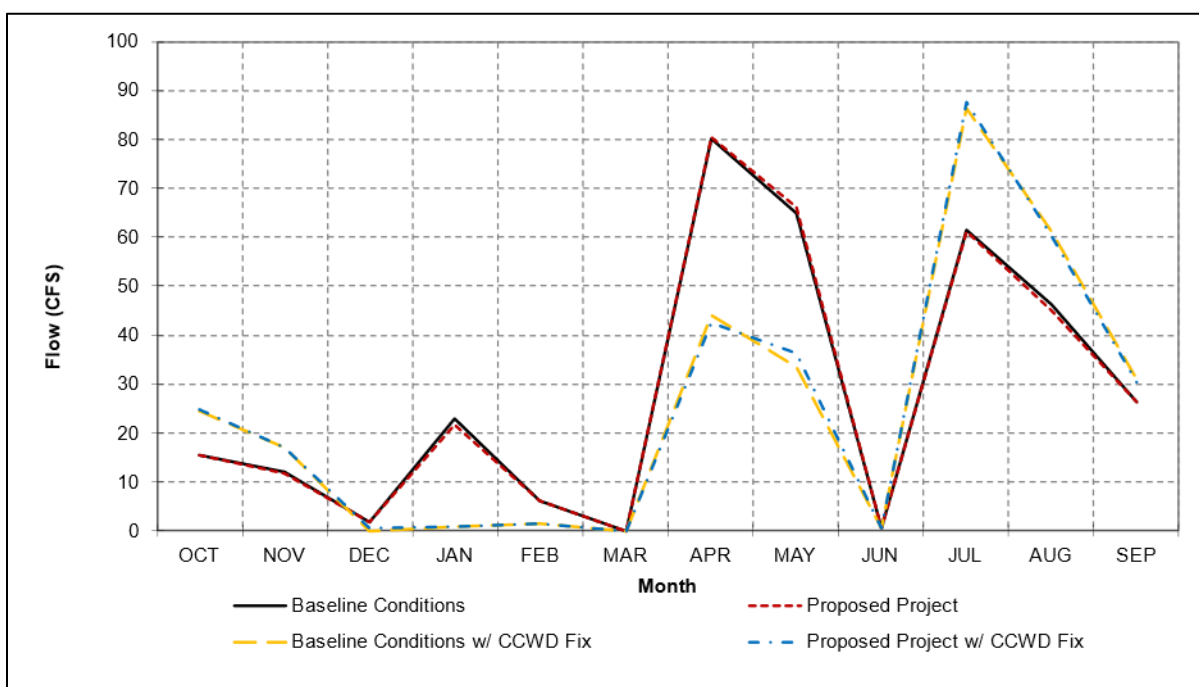
### 4M.3.2 CCWD Diversions Figures



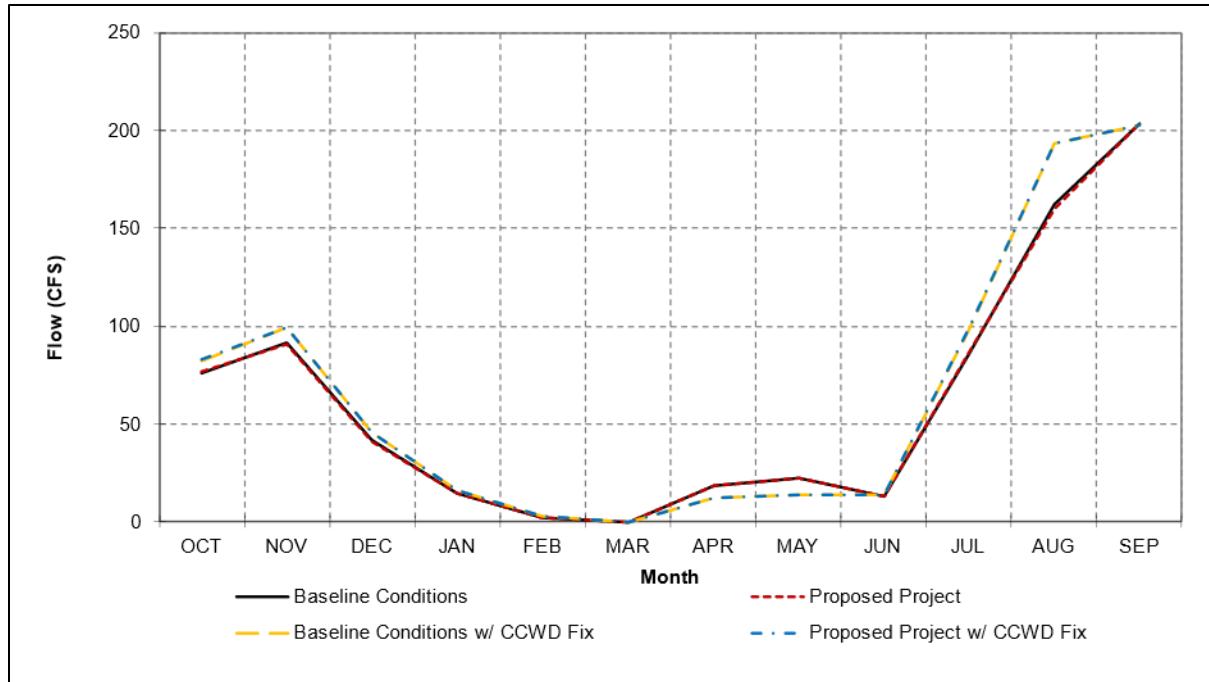
**Figure 4M-8. Monthly Long-term Average CCWD CVP Water Supply Diversions for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



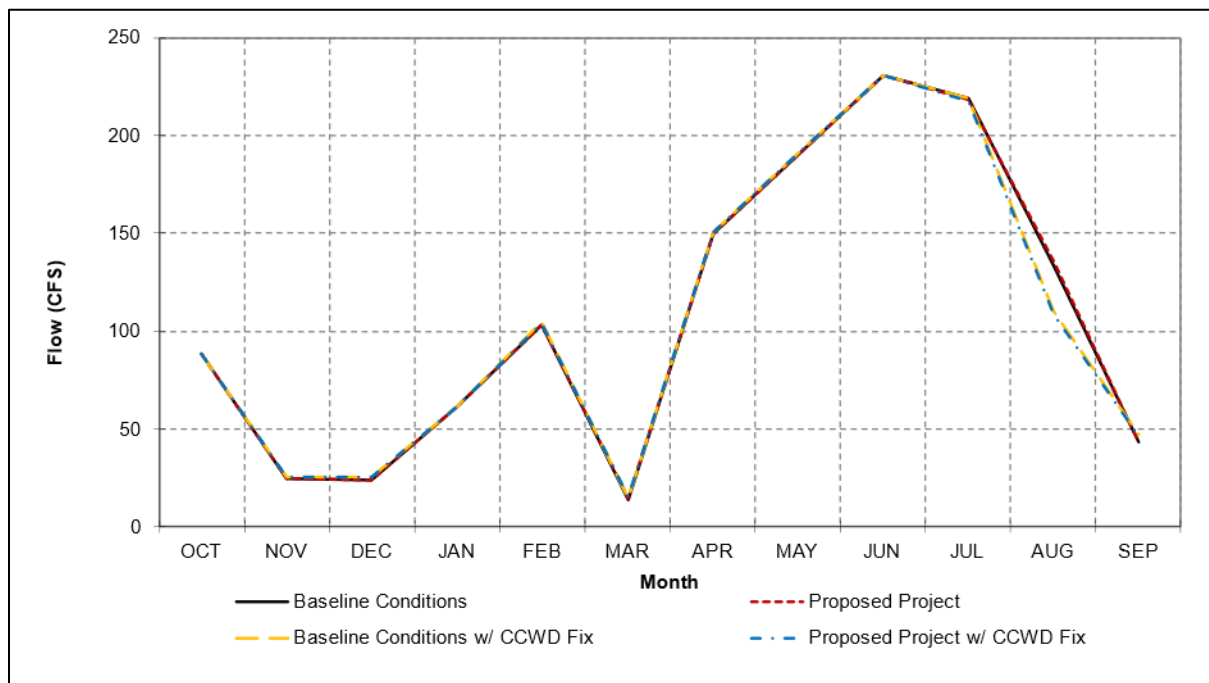
**Figure 4M-9. Monthly Long-term Average CCWD Los Vaqueros Water Right Diversions for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-10. Monthly Long-term Average CCWD Old River Diversions for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**

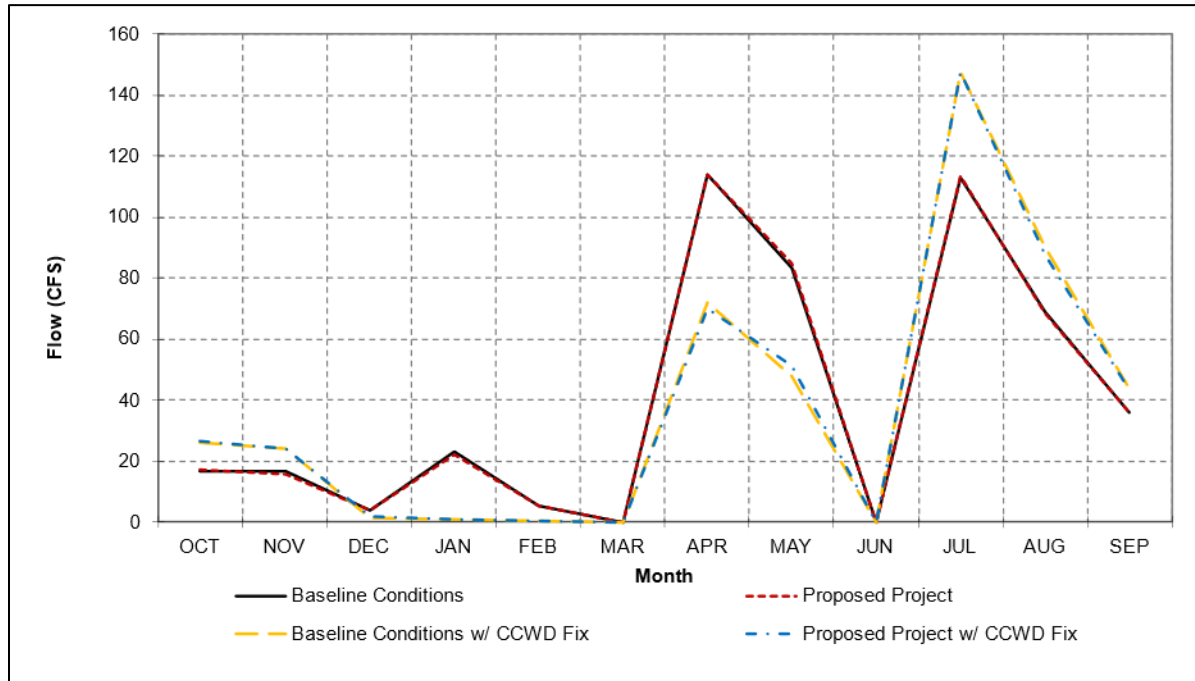


**Figure 4M-11. Monthly Long-term Average CCWD Victoria Canal Diversions for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**

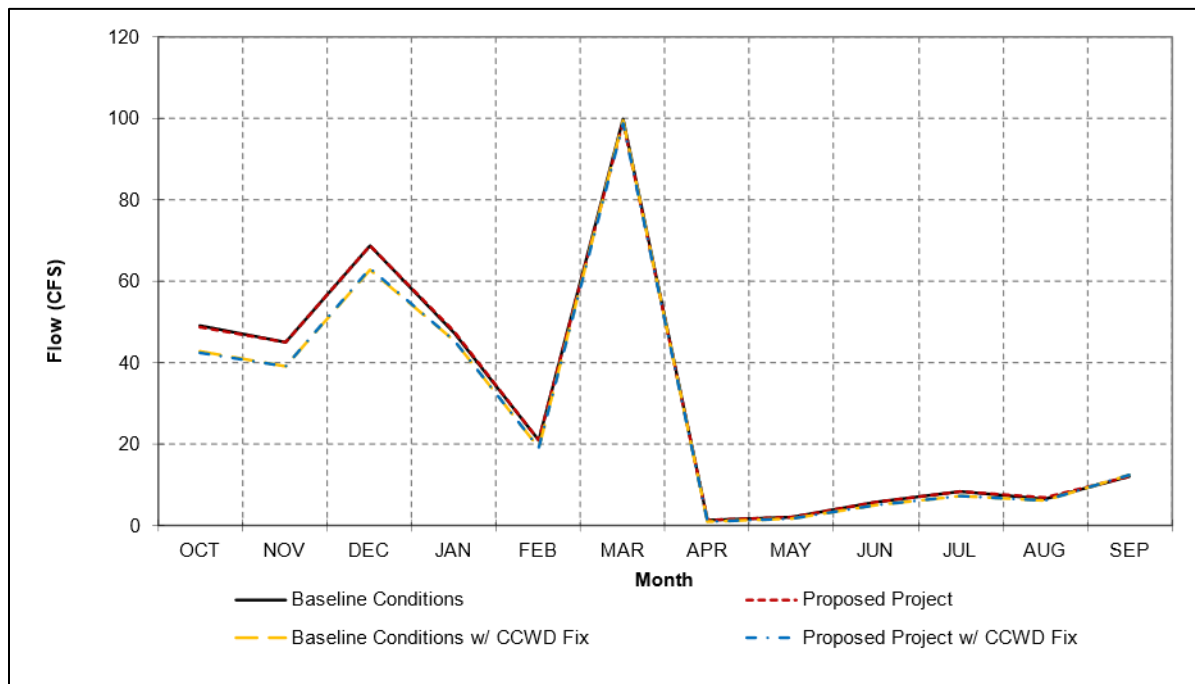


**Figure 4M-12. Monthly Long-term Average CCWD Rock Slough Diversions for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**

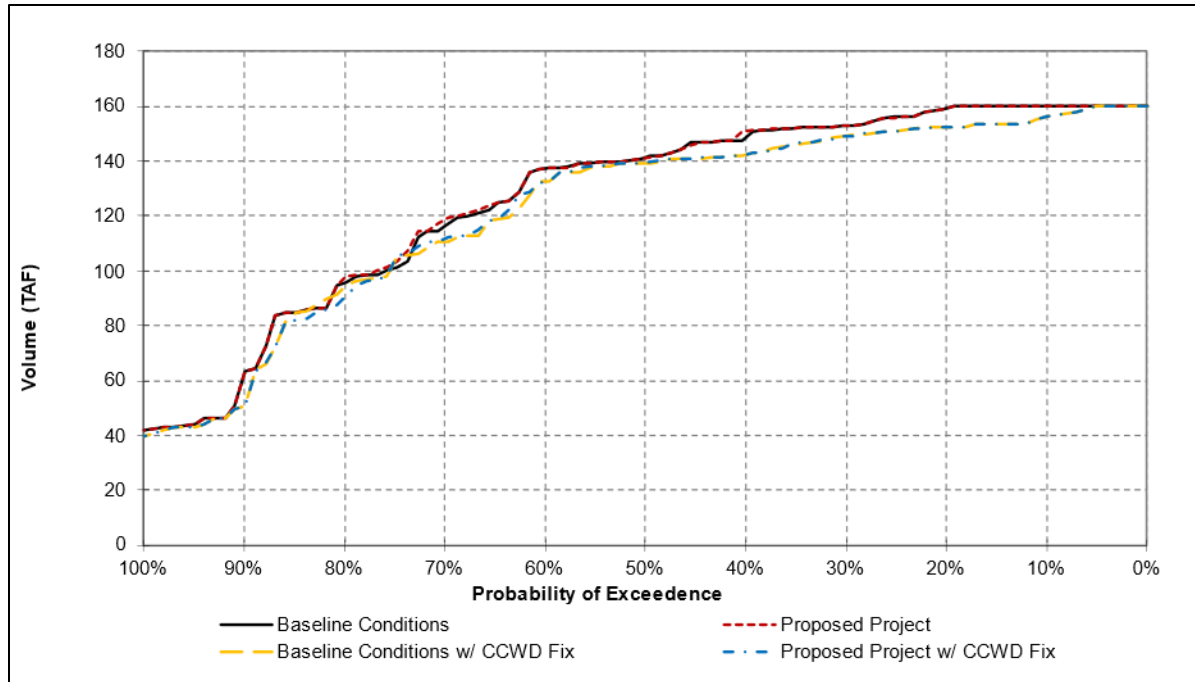
### 4M.3.3 Los Vaqueros Storage and CCWD Delivery Figures



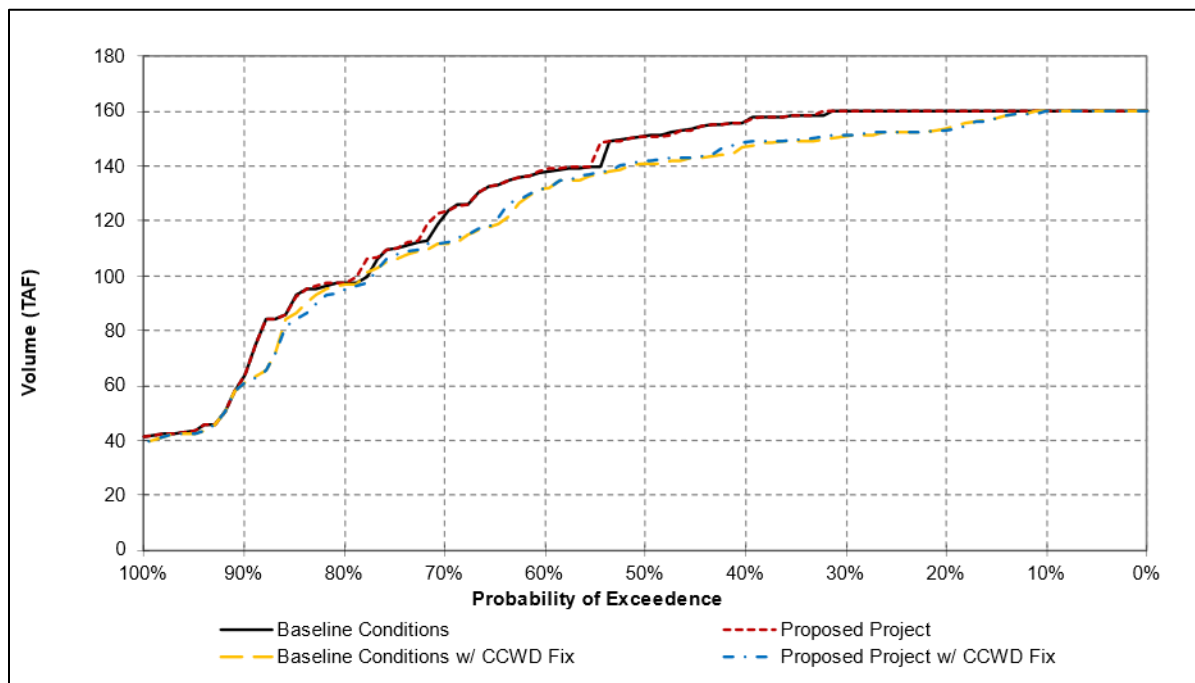
**Figure 4M-13. Monthly Long-term Average Los Vaqueros Reservoir Fill for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



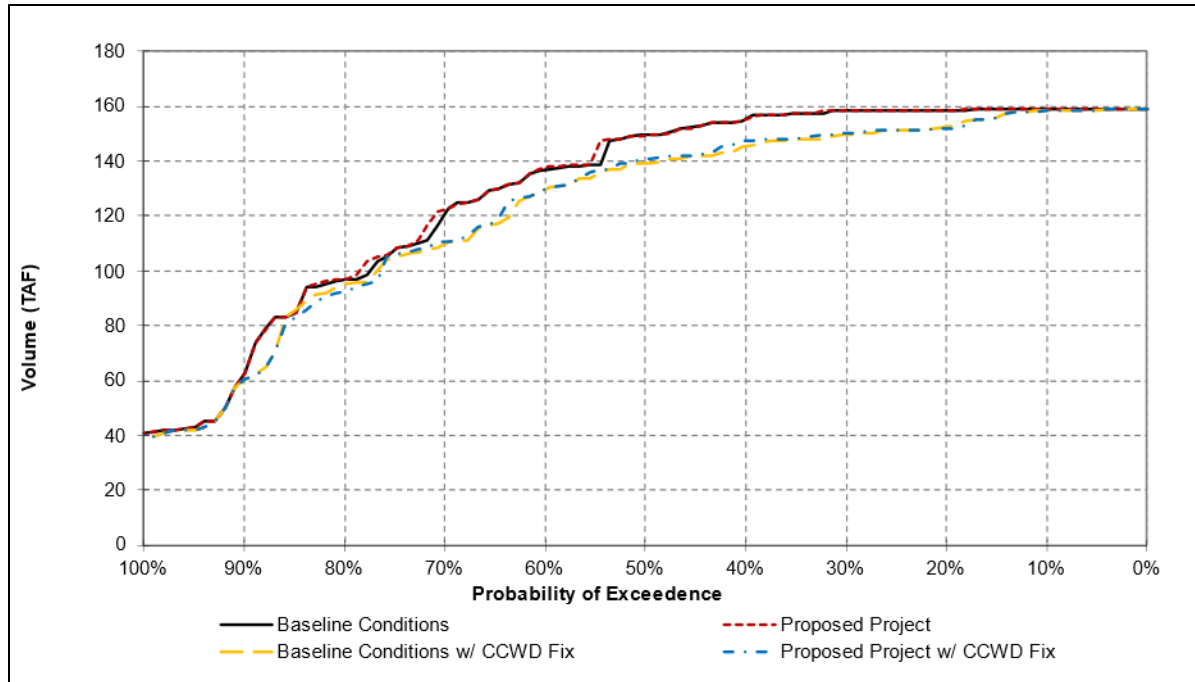
**Figure 4M-14. Monthly Long-term Average Los Vaqueros Reservoir Releases for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



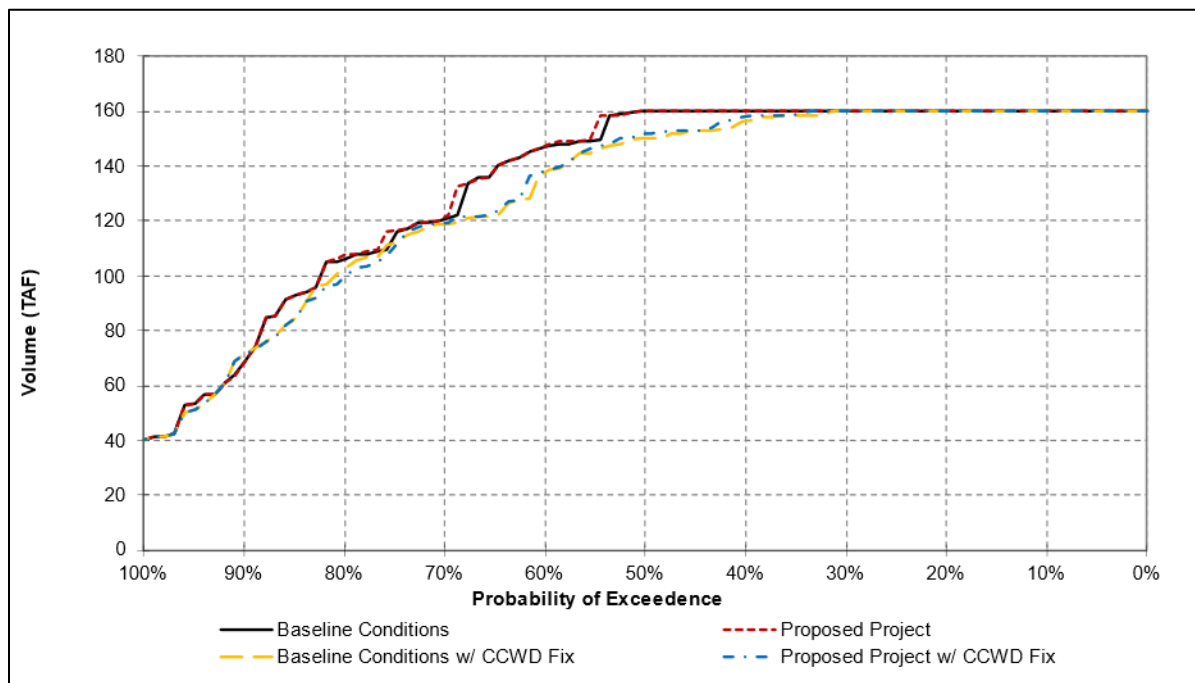
**Figure 4M-15. End of April Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



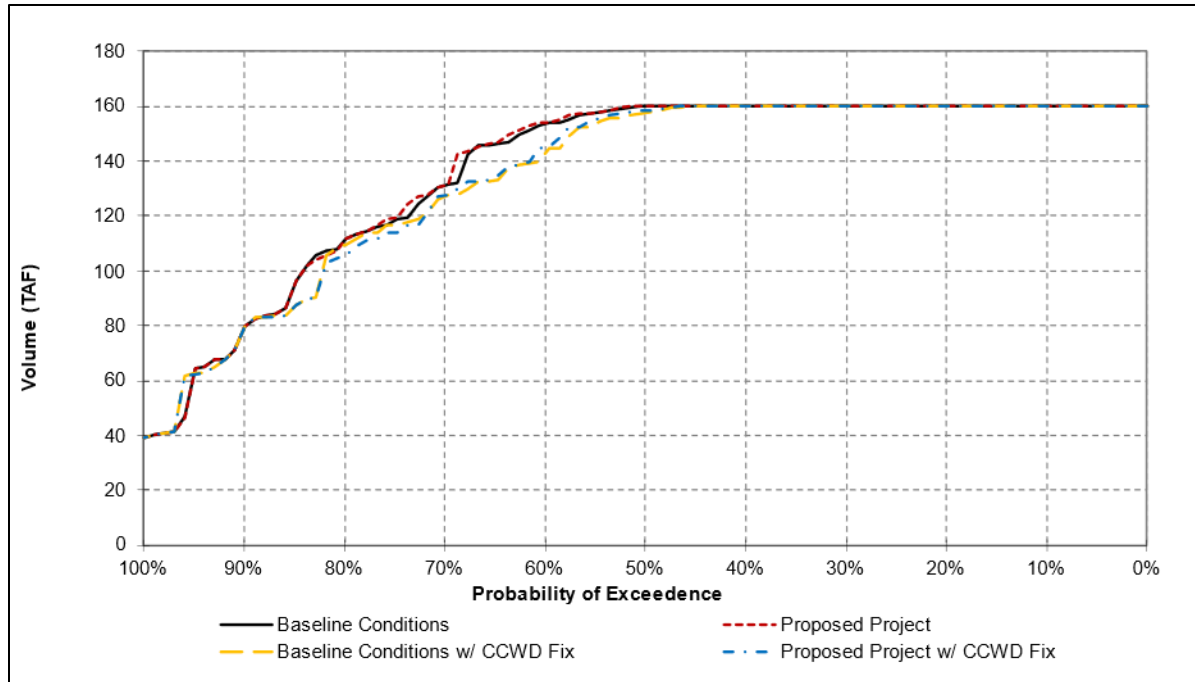
**Figure 4M-16. End of May Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



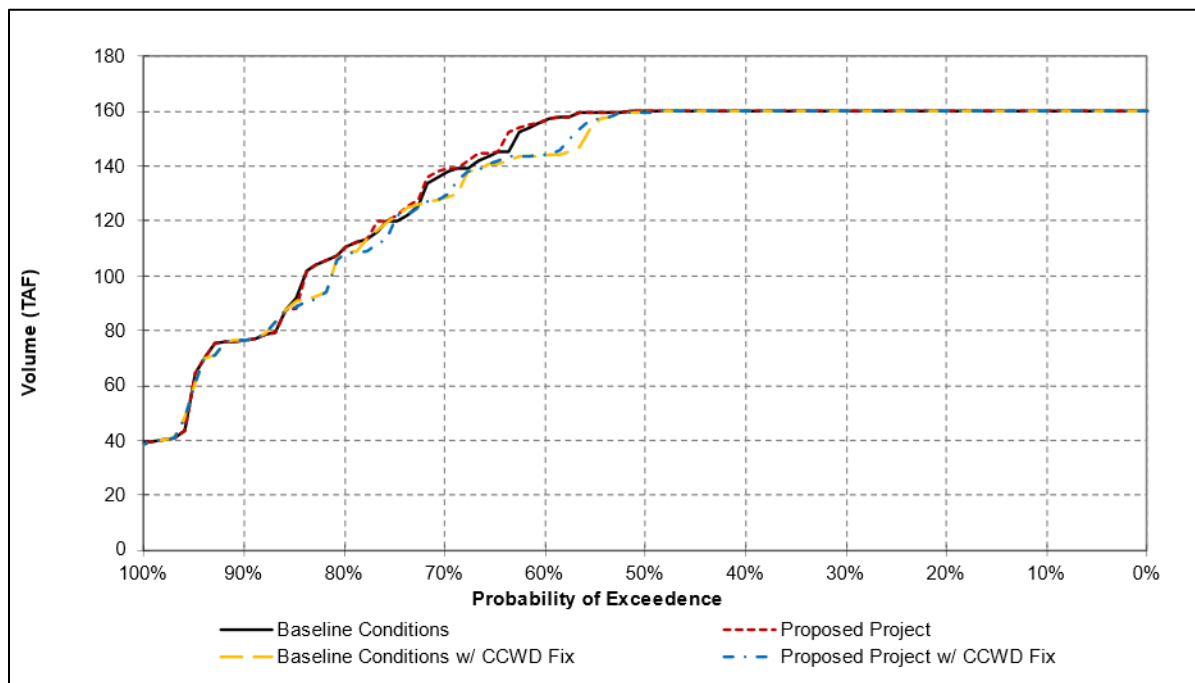
**Figure 4M-17. End of June Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



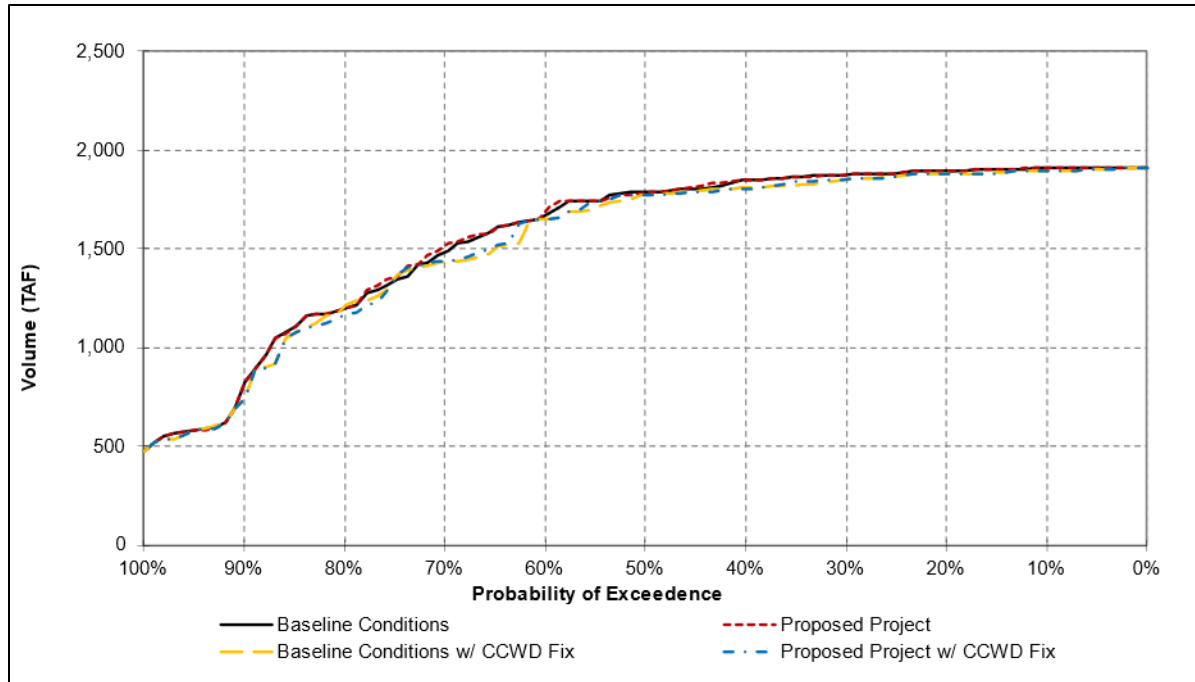
**Figure 4M-18. End of July Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



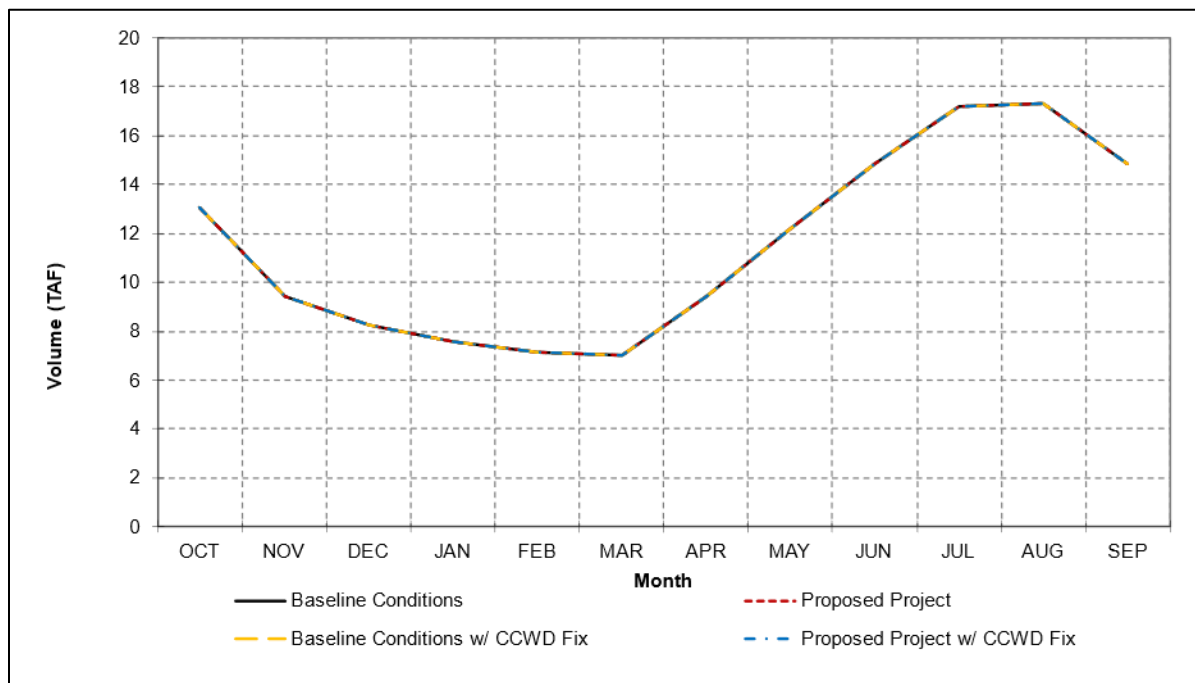
**Figure 4M-19. End of August Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-20. End of September Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



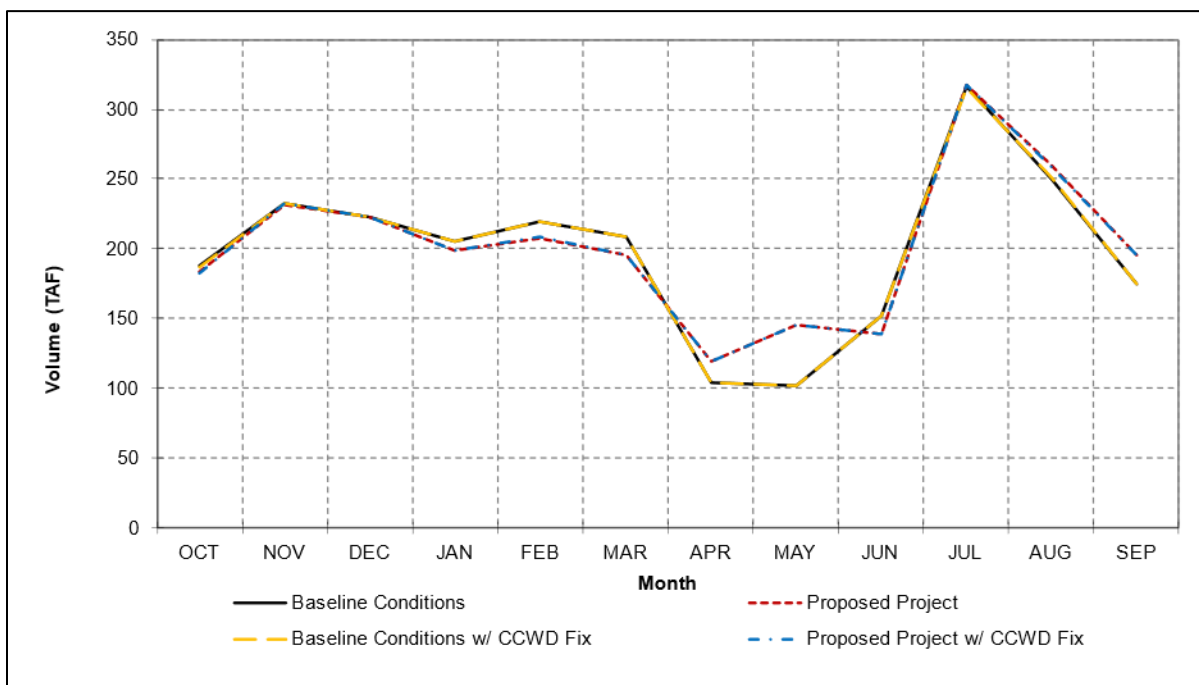
**Figure 4M-21. Annual Los Vaqueros Reservoir Storage for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



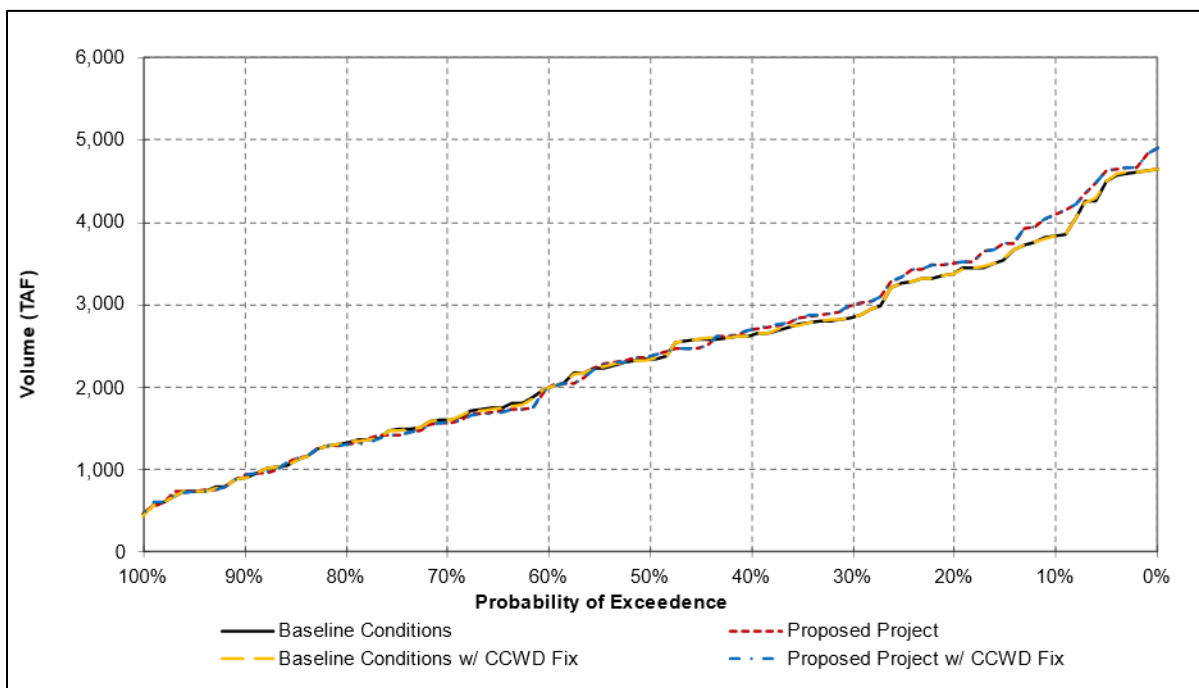
**Figure 4M-22. Monthly Long-term Average CCWD Deliveries for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



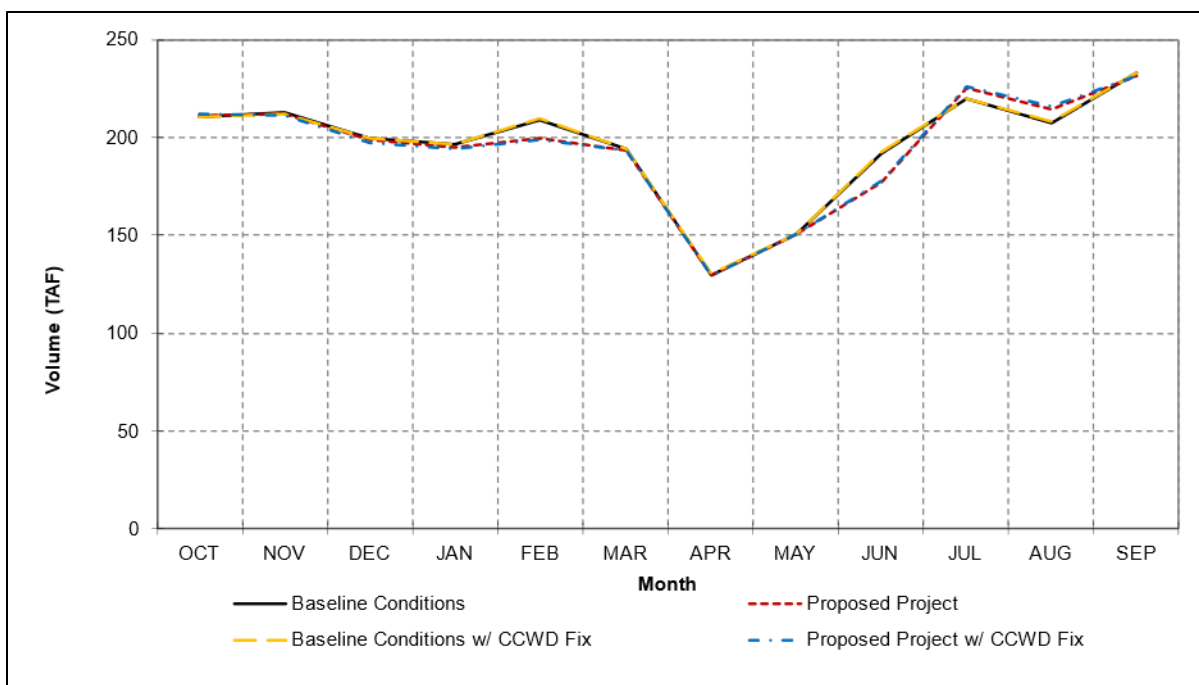
### 4M.3.4 Delta Exports Figures



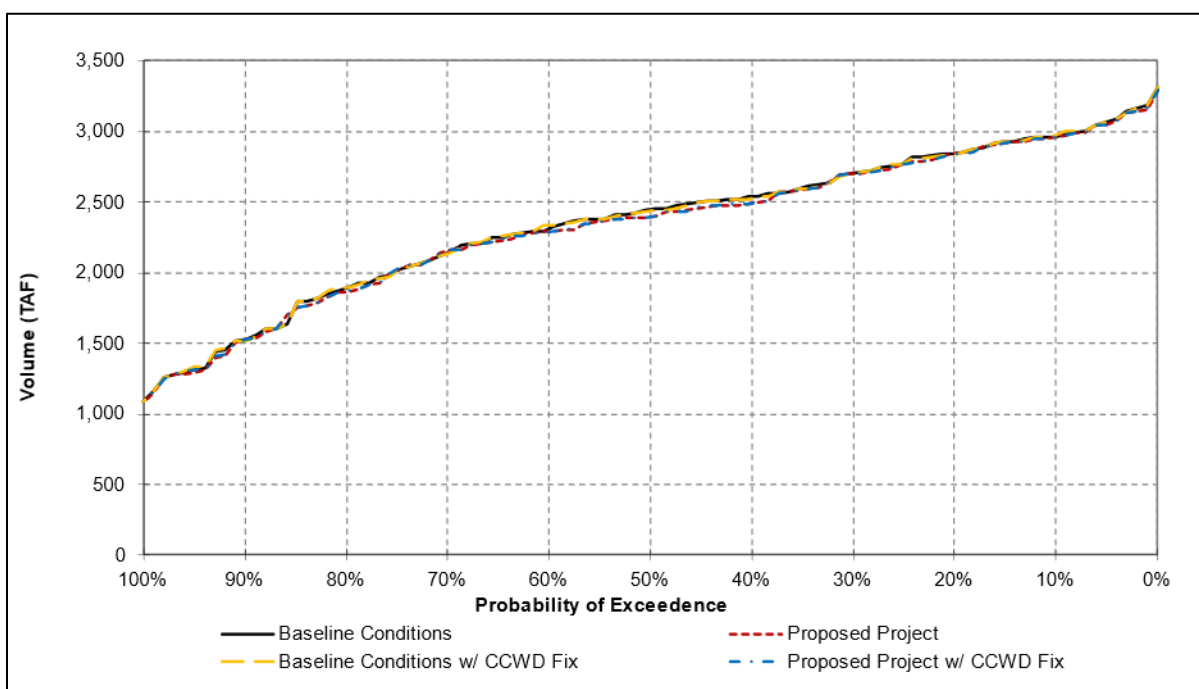
**Figure 4M-23. Monthly Long-term Average SWP Banks Pumping Plant Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



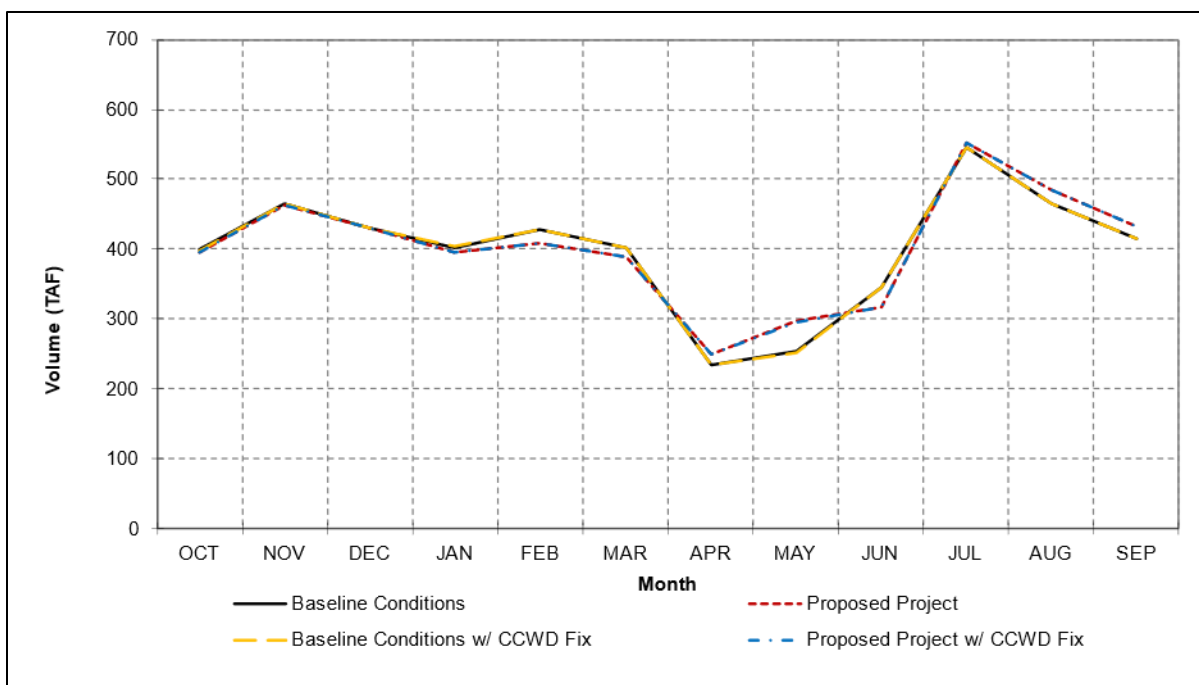
**Figure 4M-24. Annual SWP Banks Pumping Plant Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



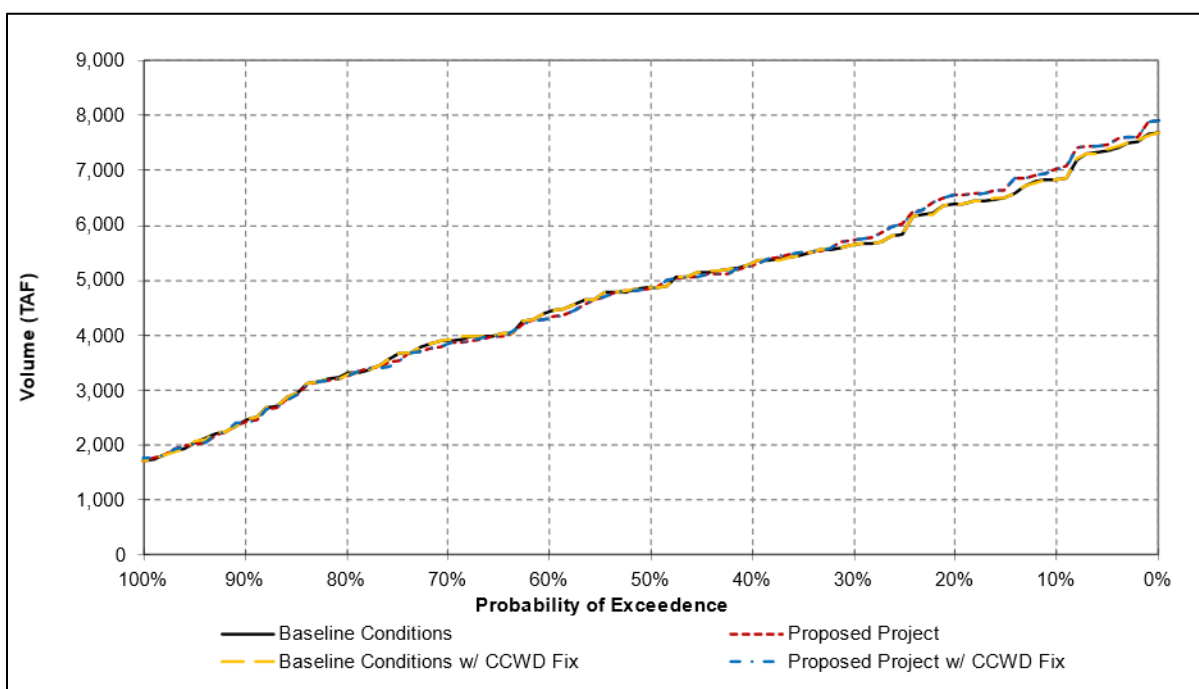
**Figure 4M-25. Monthly Long-term Average Jones Pumping Plant Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-26. Annual Jones Pumping Plant Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-27. Monthly Long-term Average Delta Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**



**Figure 4M-28. Annual Delta Exports for the Baseline Conditions and Proposed Project under Adjusted CCWD Old River Diversions**