

North Delta Diversion Priority Sensitivity Analysis

The proposed Delta Conveyance Project and project alternatives operations prioritize State Water Project (SWP) exports from the existing south Delta diversion over exports from the proposed new north Delta intakes. The Environmental Impact Report (EIR) assesses the potential impacts associated with proposed operations as described in Chapter 3, *Description of the Proposed Project and Alternatives*. However, DWR acknowledges that real-time operating conditions may support shifting diversions from the existing south Delta intakes to the proposed north Delta intakes during certain times of the year to improve aquatic conditions. While any amount of potential future shifting during winter and spring would be small, a specific amount of such future shifting is not known, or knowable at this time. For this reason, DWR concluded it would be too speculative to evaluate this shifting as part of the proposed project. Under these circumstances, CEQA permits a lead agency to note its conclusion and terminate further speculative discussion (CEQA Guidelines § 15145). However, DWR also recognizes that “[w]hile foreseeing the unforeseeable is not possible, [CEQA directs that] an agency must use its best efforts to find out and disclose all that it reasonably can” (CEQA Guidelines § 15144). To find out whether speculative future shifting based on future real-time operating conditions could result in a potential new impact or a substantial increase in the severity of an impact evaluated in the EIR, DWR prepared this appendix. To be conservative, the appendix considers theoretical shifting that exceeds any level of highly uncertain shifting that could occur under the proposed project in the future.

The sensitivity analysis compares the existing conditions (2020) and Alternative 5 (2020) to a version of Alternative 5 (2020) that assumes theoretical shifting from the existing south Delta diversion to the proposed north Delta diversion from December through June. The appendix discloses whether any of the surface water or water supply changes documented in Chapters 5, *Surface Water*, and 6, *Water Supply*, would be appreciably different with this theoretical shifting. Further analysis of key water quality constituents and through-Delta Chinook salmon is provided to disclose whether those specific impact conclusions documented in Chapters 9, *Water Quality*, and 12, *Fish and Aquatic Resources*, would change. As demonstrated in this appendix, the hypothetical shifting does not result in any new potential impacts or a substantial increase in the severity of an impact evaluated in the EIR. Therefore, not only would including shifting in the project modelling require speculative forecasting and is not required by CEQA, but the appendix demonstrates that even if a highly conservative shifting assumption was included it would not have resulted in changes to the analysis in the EIR.

4B.1 North Delta Diversion Priority Analysis

As described in Chapter 3, Section 3.16.3, *Integration of North Delta Intakes with South Delta Facilities*, California Department of Water Resources is proposing to operate the north Delta intakes in conjunction with the existing south Delta export facilities to augment the ability to divert excess flows or improve operational efficiency to meet Delta water quality requirements. The proposed operation of the project continues to prioritize the diversions from the south Delta export facilities to the same extent as under existing conditions, while only using the north Delta diversion to (1) augment exports in winter and spring when excess flows are present or (2) shift some diversions

from the south Delta facilities to the north Delta intakes if it is efficient to meet Delta water quality standards. Shifting of exports from south Delta facilities to proposed north Delta intakes has trade-offs and may occur if there would be operational efficiencies to do so at California Department of Water Resources' discretion under limited circumstances (e.g., to provide additional real-time south Delta fish protections; to reduce salinity at Jersey Point). This sensitivity analysis is conducted to understand the potential changes in the system operations and associated effects if the diversions at the proposed north Delta intakes are prioritized over the diversions at the existing south Delta export facilities during December through June (when shifting diversion location has the potential to improve aquatic conditions).

This appendix analyzes the differences between Alternative 5 (2020) as presented in Chapters 5 through 32 in this Final EIR and the Alternative 5 (2020) north Delta diversion priority scenario. River and Delta flows, reservoir storages, and Delta exports were analyzed using CalSim 3. To illustrate potential differences in biological effects, through-Delta survival of juvenile Chinook salmon was calculated. Finally, Delta Simulation Model II (DSM2) was used to analyze changes in electrical conductivity (EC) at three locations in the Delta.

4B.1.1 CalSim 3 Model Development

A version of the Alternative 5 CalSim 3 model was created that prioritizes north Delta diversion exports over south Delta exports during the period from December through June. The north Delta diversion priority version of Alternative 5 has the following differences from the representation of Alternative 5 that was analyzed for the Final EIR.

- The share of total SWP exports that is diverted at the north Delta intakes is maximized from December through June. This is distinct from Alternative 5 as analyzed in the Final EIR, whereby the north Delta diversion was used only to export Delta excess flows that could not otherwise be exported in the south Delta because of permit, capacity, or regulatory constraints. In the Alternative 5 north Delta diversion priority scenario, the north Delta diversion is still used to increase exports of excess flows in the same way as Alternative 5 analyzed in the Final EIR, but exports at the south Delta are also shifted to the north Delta diversion to the greatest extent possible. So, the only substantive change to SWP export operations in this scenario is the diversion location of exports (north vs. south) during the December through June period. In the Alternative 5 north Delta diversion priority scenario, the bypass flow requirements at the north Delta intakes and all other operational rules and capacities are unchanged from Alternative 5.
- The SWP's prioritization of north Delta diversion exports in this scenario has the effect of leaving more capacity in the south Delta for the Central Valley Project (CVP) under the Alternative 5 north Delta diversion priority scenario than exists in Alternative 5. This can occur due to the SWP not using all of the capacity available under applicable permits, regulations, and agreements that control south Delta exports and sharing between the projects. This available capacity can benefit the CVP by allowing for more wheeling of Delta surplus for CVP supplies at Banks Pumping Plant (which can only occur in the south Delta) and by increasing the regulatory export capacity available to be used by the CVP at Jones Pumping Plant. However, additional capacity that would be available to the CVP under the Alternative 5 north Delta diversion priority scenario compared to Alternative 5 could only be used by the CVP if the SWP is not subject to an export cut under the 2019 Incidental Take Permit (California Department of Water

Resources 2019). This latter condition is to ensure that Delta outflow increases facilitated by the incidental take permit export cuts are maintained and not exported by the CVP.

All other aspects of Alternative 5 are the same as the Alternative 5 evaluated in the EIR chapters, including not changing the requirements or operation of upstream reservoirs.

4B.1.2 Sensitivity Analysis Results

This section summarizes the key findings from the CalSim 3 and DSM2 simulations. The results are focused on the parameters that may differ between Alternative 5 and the Alternative 5 north Delta diversion priority scenario. Further analysis of key water quality constituents and through-Delta Chinook salmon is provided to disclose whether those specific impact conclusions documented in Chapters 9 and 12 would change. These resources were selected for further analysis because they are examples of what would be most likely to be affected by operational changes.

4B.1.2.1 CalSim 3

Tables 4B-1 and 4B-2 show major reservoir storages and monthly river flows, respectively, for existing conditions, Alternative 5, and the Alternative 5 north Delta diversion priority scenarios. Storages and river flows are very similar in the Alternative 5 north Delta diversion priority scenario and Alternative 5, as is the difference between those two scenarios and existing conditions. This shows that SWP prioritization of north Delta diversion exports over exports at the south Delta intakes from December through June has no appreciable effect on upstream operations.

Table 4B-1. Average End-of-May and End-of-September Storages for Shasta Lake, Lake Oroville, Trinity Lake, and Folsom Lake (thousand acre-feet) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios

End-of-Month Storage	Shasta Lake		Lake Oroville		Trinity Lake		Folsom Lake	
<i>Long-Term Average</i> ^a	May	September	May	September	May	September	May	September
Existing Conditions	4,051	2,827	3,007	1,964	1,867	1,438	839	546
Alternative 5	4,053	2,837	3,015	1,983	1,871	1,443	839	551
<i>Difference from Existing</i>	2	10	8	19	4	5	0	5
Alternative 5 NDD Priority	4,044	2,835	3,010	1,978	1,867	1,438	843	554
<i>Difference from Existing</i>	-7	8	3	14	0	0	4	8

Notes: Values may not sum to the totals due to rounding. CalSim 3 output variables used: Shasta—S_SHSTA; Oroville—S_OROVL; Trinity—S_TRNTY; Folsom—S_FOLSM.

NDD = north Delta diversion.

^a Long-term average is the average end-of-month storage for the water years October 1921–September 2015 simulated in CalSim 3.

1 **Table 4B-2. Monthly Flows on Major Rivers under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority**
 2 **Scenarios (cubic feet per second)**

-Scenario	January	February	March	April	May	June	July	August	September	October	November	December
Long-Term Average ^a												
Sacramento River—Keswick												
Existing Conditions	8,098	10,693	8,668	6,229	8,134	10,038	13,138	9,789	7,197	5,879	6,365	7,640
Alternative 5	8,132	10,750	8,663	6,264	8,141	10,049	12,978	9,821	7,127	5,882	6,372	7,649
<i>Difference from Existing</i>	<i>34</i>	<i>57</i>	<i>-5</i>	<i>35</i>	<i>7</i>	<i>11</i>	<i>-160</i>	<i>32</i>	<i>-70</i>	<i>3</i>	<i>7</i>	<i>9</i>
Alternative 5 NDD Priority	8,167	10,801	8,671	6,282	8,209	10,229	12,796	9,722	7,176	5,889	6,347	7,619
<i>Difference from Existing</i>	<i>69</i>	<i>108</i>	<i>3</i>	<i>53</i>	<i>75</i>	<i>191</i>	<i>-342</i>	<i>-67</i>	<i>-21</i>	<i>10</i>	<i>-18</i>	<i>-21</i>
American River—Nimbus												
Existing Conditions	4,076	4,783	3,229	3,150	4,929	4,874	3,658	2,641	1,844	1,425	2,552	3,119
Alternative 5	4,062	4,794	3,237	3,169	4,924	4,894	3,610	2,592	1,838	1,453	2,591	3,119
<i>Difference from Existing</i>	<i>-14</i>	<i>11</i>	<i>8</i>	<i>19</i>	<i>-5</i>	<i>20</i>	<i>-48</i>	<i>-49</i>	<i>-6</i>	<i>28</i>	<i>39</i>	<i>0</i>
Alternative 5 NDD Priority	4,076	4,792	3,238	3,158	4,879	4,842	3,653	2,614	1,846	1,446	2,602	3,134
<i>Difference from Existing</i>	<i>0</i>	<i>9</i>	<i>9</i>	<i>8</i>	<i>-50</i>	<i>-32</i>	<i>-5</i>	<i>-27</i>	<i>2</i>	<i>21</i>	<i>50</i>	<i>15</i>
Feather River—Thermalito												
Existing Conditions	4,303	5,618	5,948	3,594	4,017	3,939	7,030	5,082	2,955	2,244	1,882	2,955
Alternative 5	4,336	5,611	5,980	3,609	4,002	3,960	6,970	4,993	2,880	2,384	1,891	2,927
<i>Difference from Existing</i>	<i>33</i>	<i>-7</i>	<i>32</i>	<i>15</i>	<i>-15</i>	<i>21</i>	<i>-60</i>	<i>-89</i>	<i>-75</i>	<i>140</i>	<i>9</i>	<i>-28</i>
Alternative 5 NDD Priority	4,356	5,667	5,953	3,621	4,004	3,977	6,947	5,001	2,872	2,362	1,899	2,916
<i>Difference from Existing</i>	<i>53</i>	<i>49</i>	<i>5</i>	<i>27</i>	<i>-13</i>	<i>38</i>	<i>-83</i>	<i>-81</i>	<i>-83</i>	<i>118</i>	<i>17</i>	<i>-39</i>
Sacramento River—below Freeport												
Existing Conditions	30,647	37,093	32,686	22,956	20,901	17,205	18,378	15,004	14,602	11,598	13,913	23,039
Alternative 5	30,684	37,122	32,735	23,017	20,893	17,250	18,133	14,901	14,437	11,736	13,958	23,028
<i>Difference from Existing</i>	<i>37</i>	<i>29</i>	<i>49</i>	<i>61</i>	<i>-8</i>	<i>45</i>	<i>-245</i>	<i>-103</i>	<i>-165</i>	<i>138</i>	<i>45</i>	<i>-11</i>
Alternative 5 NDD Priority	30,729	37,187	32,745	23,033	20,916	17,408	17,992	14,827	14,467	11,718	13,950	22,995
<i>Difference from Existing</i>	<i>82</i>	<i>94</i>	<i>59</i>	<i>77</i>	<i>15</i>	<i>203</i>	<i>-386</i>	<i>-177</i>	<i>-135</i>	<i>120</i>	<i>37</i>	<i>-44</i>
San Joaquin River—Vernalis												
Existing Conditions	4,011	5,067	5,544	6,040	5,534	4,276	2,546	1,813	1,801	2,771	1,981	2,553
Alternative 5	4,018	5,074	5,552	6,049	5,546	4,288	2,558	1,824	1,810	2,778	1,987	2,559

-Scenario	January	February	March	April	May	June	July	August	September	October	November	December
<i>Difference from Existing</i>	7	7	8	9	12	12	12	11	9	7	6	6
Alternative 5 NDD Priority	4,022	5,079	5,563	6,053	5,551	4,293	2,563	1,829	1,813	2,782	1,989	2,562
<i>Difference from Existing</i>	11	12	19	13	17	17	17	16	12	11	8	9

Notes: Values may not sum to the totals due to rounding. CalSim 3 output variables used: Sacramento River—Keswick: C_KSWCK; American River—Nimbus: C_NTOMA; Feather River—Thermalito: C_FTR059; Sacramento River—Freeport: C_SAC048; San Joaquin River—Vernalis: C_SJR070.

The location “Sacramento River below Freeport” is immediately upstream from the proposed north Delta diversion. It differs from the location “Sacramento River at Freeport,” site of the U.S. Geological Survey gage (11447650), reported in Appendix 5A, *Modeling Technical Appendix*, Section B, *Hydrology and Systems Operations Modeling*, Attachment 3, *CalSim 3 Model Results for Existing Condition and Alternatives at 2020*, and Attachment 5, *CalSim 3 Model Results for No Project Alternative and Alternatives at 2040*. Water enters the Sacramento River between these two locations from the Sacramento Regional Wastewater Treatment Plant and from runoff from the left bank of the Sacramento River from the watershed between the American River and the Delta.

NDD = north Delta diversion.

^a Long-term average is the average annual flow for the period October 1921–September 2015 simulated in CalSim 3.

Table 4B-3 and Figure 4B-1 show the different components of Delta exports for the existing conditions, Alternative 5, and Alternative 5 north Delta diversion priority scenarios. These results are summarized below.

- North Delta diversion exports are higher in the Alternative 5 north Delta diversion priority scenario than in Alternative 5 from December through June, and south Delta exports are correspondingly lower, due to prioritization of use of the north Delta diversion.
- There is a slight increase in total Delta exports in the Alternative 5 north Delta diversion priority scenario compared to Alternative 5, primarily visible in December through January and May through June on Figure 4B-1. This is due to minor export benefits that accrue to the CVP due to north Delta diversion prioritization by the SWP. The availability of additional capacity to the CVP discussed earlier allows the CVP to export a modest amount of additional Delta surplus in the Alternative 5 north Delta diversion priority scenario than it does in Alternative 5. The timing of increases in wheeling of surplus actually leads to a slight decrease in annual average Jones Pumping Plant exports, but the net effect of this increased available capacity is a modest increase in annual average exports for the CVP as a whole (see Table 4B-3). On an annual average basis, SWP total exports do not change appreciably in the Alternative 5 north Delta diversion priority scenario compared to Alternative 5.

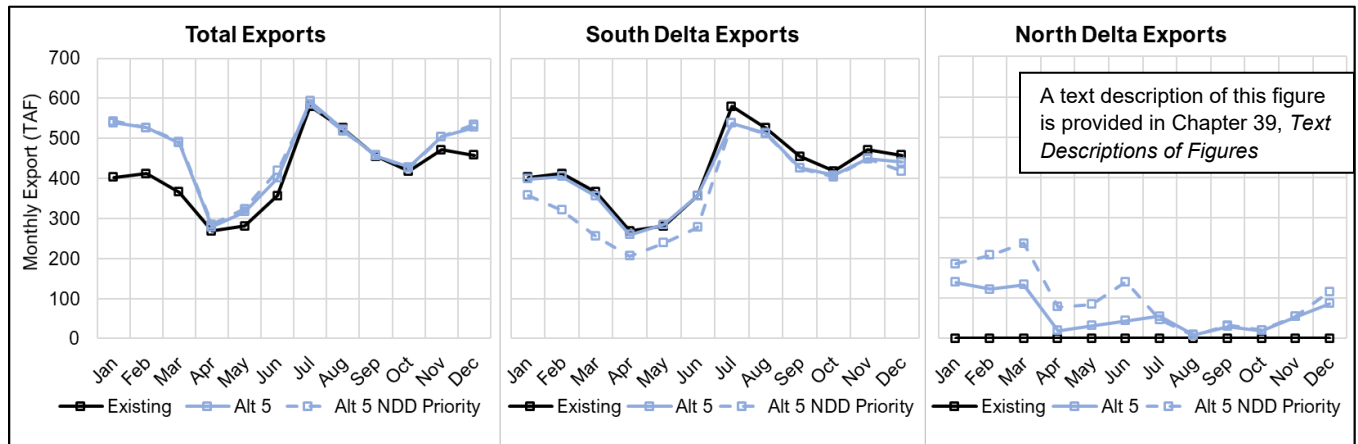
Table 4B-3. Annual Average Exports at Banks Pumping Plant, Jones Pumping Plant, and the North Delta Diversion; and Delta Outflow (thousand acre-feet) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios

Long-Term Average ^a	Banks SWP Exports	NDD SWP Exports	SWP Total Exports	Banks CVP (wheeling) Exports	Jones CVP Exports	CVP Total Exports	Total SWP + CVP Exports	Delta Outflow
Existing Conditions	2,401	0	2,401	68	2,470	2,538	4,939	15,216
Alternative 5	2,198	746	2,944	76	2,512	2,588	5,532	14,626
<i>Difference from Existing</i>	<i>-203</i>	<i>746</i>	<i>543</i>	<i>8</i>	<i>42</i>	<i>50</i>	<i>593</i>	<i>-589</i>
Alternative 5 NDD Priority	1,732	1,213	2,945	111	2,502	2,613	5,558	14,603
<i>Difference from Existing</i>	<i>-668</i>	<i>1,213</i>	<i>545</i>	<i>43</i>	<i>31</i>	<i>75</i>	<i>619</i>	<i>-613</i>

Notes: Values may not sum to the totals due to rounding. CalSim 3 output variables used: Banks SWP—C_CAA003_SWP_TD; NDD SWP—C_CAA003_IF; Banks CVP—C_CAA003_CVP; Jones CVP—C_DMC000_TD; Delta Outflow—NDOI.

CVP = Central Valley Project; NDD = north Delta diversion; SWP = State Water Project.

^a Long-term average is the average annual storage for the period October 1921–September 2015 simulated in CalSim 3.

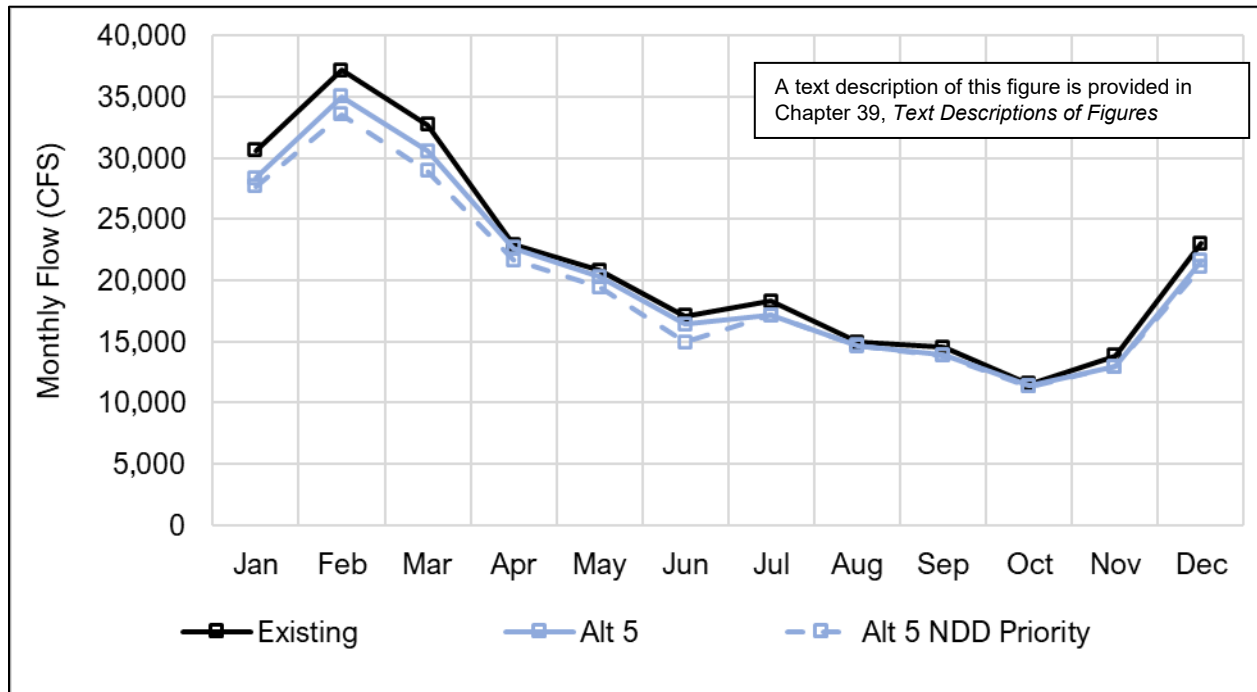


Alt = alternative; NDD = north Delta diversion; TAF = thousand acre-feet.

Figure 4B-1. Total Delta (SWP and CVP) Exports, South Delta (SWP and CVP) Exports (EXPORTACTUALTD), and North Delta (SWP) Exports (EXPORTACTUALIF), Monthly Average (thousand acre-feet) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios

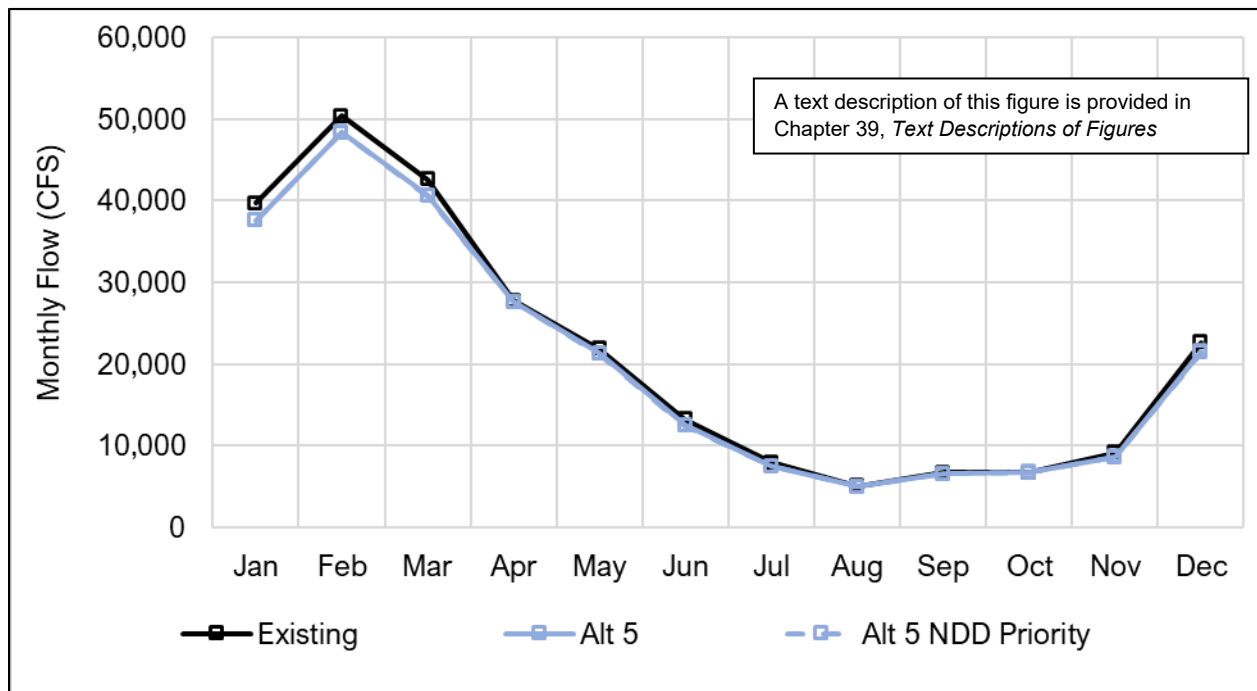
Figures 4B-2 through 4B-5 show Sacramento River flows downstream of the north Delta intakes, Delta outflow, X2 position, and Old and Middle River flows for the existing conditions, Alternative 5, and Alternative 5 north Delta diversion priority scenarios. The following differences were observed.

- Sacramento River flow downstream of the north Delta intakes (at Hood) is lower from December through June in the Alternative 5 north Delta diversion priority scenario than it was in Alternative 5 (Figure 4B-2). This is due to increased use of the north Delta diversion due to its prioritization during this period. Flows during the remainder of the year are the same.
- Delta outflow is nearly identical in terms of the monthly pattern. Though not visible on Figure 4B-3, there is a minor decrease during the period from November through May in the Alternative 5 north Delta diversion priority scenario compared to Alternative 5. This is due to the slightly increased exports by the CVP, which were previously discussed.
- X2 position is nearly identical in the Alternative 5 north Delta diversion priority scenario compared to Alternative 5.
- Old and Middle River flows are substantially less negative in the Alternative 5 north Delta diversion priority scenario compared to Alternative 5 from December through June. This is due to lower south Delta exports, because some of those exports in Alternative 5 are shifted to the north Delta diversion in the Alternative 5 north Delta diversion priority scenario.



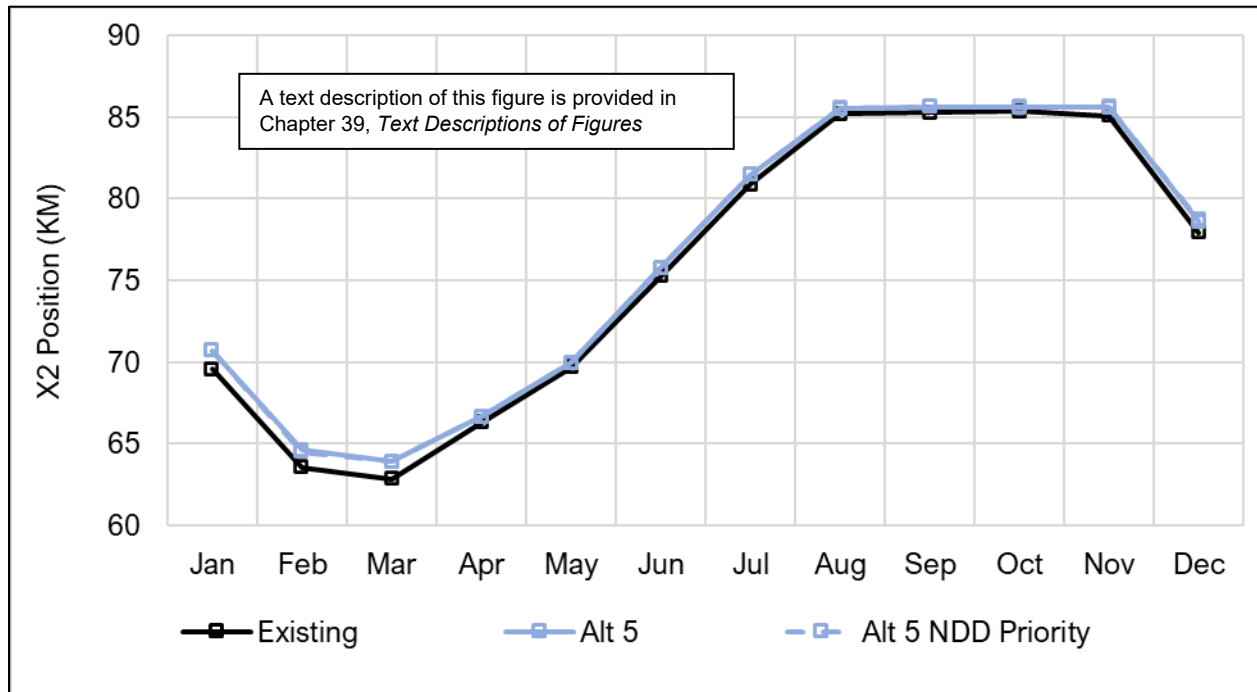
Alt = alternative; CFS = cubic feet per second; NDD = north Delta diversion.

Figure 4B-2. Sacramento River Flow Downstream of the North Delta Intakes (at Hood) (C_SAC041), Monthly Average (cubic feet per second) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios



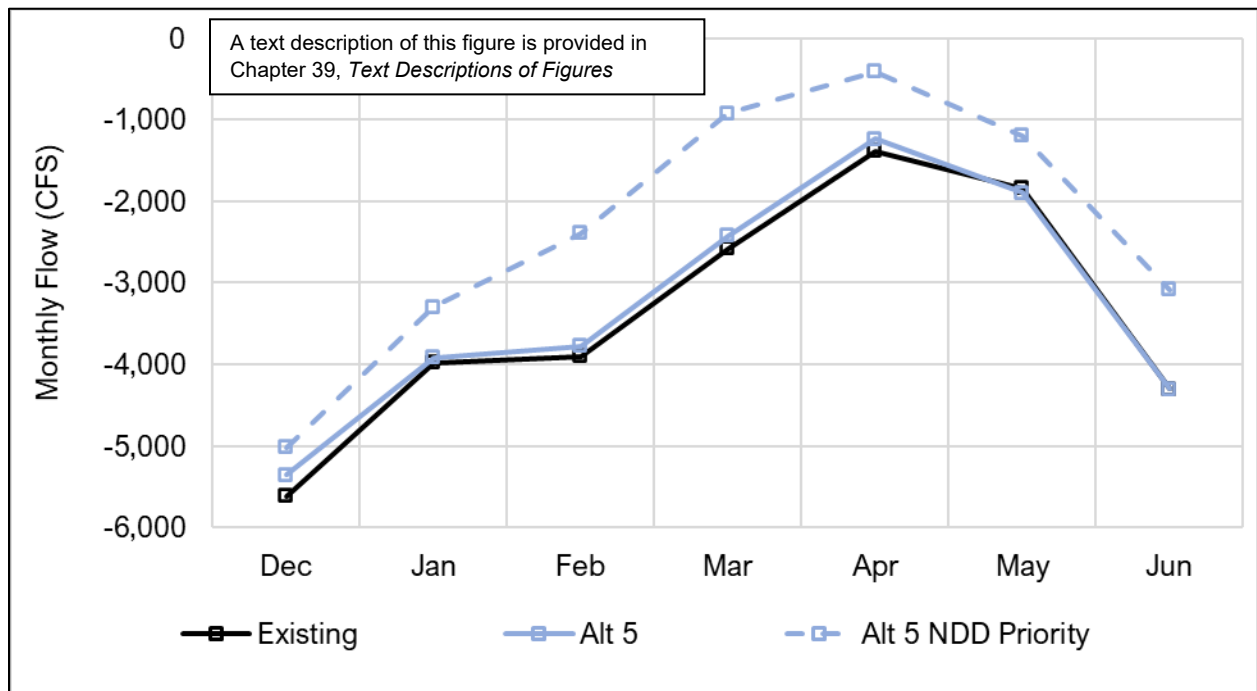
Alt = alternative; CFS = cubic feet per second; NDD = north Delta diversion.

Figure 4B-3. Delta Outflow (NDOI), Monthly Average Flows (cubic feet per second) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios



Alt = alternative; KM = kilometer; NDD = north Delta diversion.

Figure 4B-4. X2 Position, Monthly Average Position (X2_PRV) (kilometers) under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios



Alt = alternative; CFS = cubic feet per second; NDD = north Delta diversion.

Figure 4B-5. Old and Middle River Flow (C_OMR014), Monthly Average (cubic feet per second) December–June under Existing Conditions, Alternative 5, and Alternative 5 North Delta Diversion Priority Scenarios

4B.1.2.2 Through-Delta Survival of Juvenile Chinook Salmon

Through-Delta survival of juvenile Chinook salmon was estimated for existing conditions, Alternative 5, and Alternative 5 north Delta diversion priority scenarios using a spreadsheet version of the through-Delta survival function formulated by Perry et al. (2018; for additional details on the method, see Chapter 12, Impact AQUA-2: *Effects of Operations and Maintenance of Water Conveyance Facilities on Sacramento River Winter-Run Chinook Salmon, Operations and Maintenance—All Project Alternatives, Far-Field Effects, Indirect Mortality Within the Delta*, discussion of *Through-Delta Survival*). The period examined was September through June, encompassing the range of the through-Delta migration period (note that most migration occurs in November/December–April/May). This analysis focuses only on potential variations in effects from differences in north Delta operations but does not account for changes in the south Delta. As discussed above, less south Delta exports under prioritization of north Delta exports would increase Old and Middle River flows (Figure 4B-5). This has the potential to reduce entrainment risk of juvenile Chinook salmon and other fish species; however, for listed species (salmonids and smelts), winter-spring south Delta entrainment risk would be specifically managed to limit potential negative effects on these species under all scenarios.

In general, north Delta diversion prioritization for Alternative 5 gave little difference in estimates of the probability of juvenile Chinook salmon through-Delta survival relative to the original Alternative 5 (Table 4B-4). The Alternative 5 north Delta diversion priority scenario and Alternative 5 were mostly within 0% to 1% of each other in terms of the difference from existing conditions. For most of the September through June period of interest, there were few exceptions to this pattern (e.g., 2% greater negative difference under the Alternative 5 north Delta diversion priority scenario in February of above normal years and May of wet years). The largest differences were in June, at the end of the juvenile Chinook salmon migration period when there are relatively few individuals migrating, with lower probability of survival under the Alternative 5 north Delta diversion priority scenario relative to the Alternative 5 scenario of 2% to 5% (Table 4B-4).

The analysis illustrated that during the main period of juvenile Chinook salmon migration, and in particular for listed winter- and spring-run Chinook salmon, there would be expected to be little difference in through-Delta survival with priority given to diversions at the north Delta intakes relative to the proposed operation. There is greater potential for incrementally lower survival with north Delta priority diversions at the end of the migration period in June. However, these results reflect neither (a) proposed tidal mitigation to address north Delta hydrodynamic effects, which would lessen potential effects such as the proportion of flow entering the interior Delta via Georgiana Slough relative to riverine flow downstream of the north Delta intakes, nor (b) real-time considerations for shifting operations only when appropriate to improve aquatic conditions (e.g., avoiding time periods when considerable fish migration is occurring).

Table 4B-4. Probability of Juvenile Chinook Salmon Through-Delta Survival, Averaged by Month and Water Year Type

Water Year Type	Existing Conditions	Alternative 5 NDD Priority	Alternative 5
September			
Wet	0.37	0.37 (-1%)	0.37 (-1%)
Above normal	0.36	0.36 (0%)	0.36 (-1%)

Water Year Type	Existing Conditions	Alternative 5 NDD Priority	Alternative 5
Below normal	0.31	0.29 (-7%)	0.29 (-6%)
Dry	0.27	0.26 (-2%)	0.26 (-2%)
Critically dry	0.26	0.25 (-3%)	0.25 (-3%)
October			
Wet	0.37	0.37 (0%)	0.37 (0%)
Above normal	0.34	0.34 (1%)	0.34 (1%)
Below normal	0.31	0.32 (2%)	0.32 (2%)
Dry	0.34	0.34 (2%)	0.34 (0%)
Critically dry	0.32	0.32 (0%)	0.31 (-2%)
November			
Wet	0.40	0.39 (-2%)	0.39 (-2%)
Above normal	0.38	0.38 (0%)	0.37 (0%)
Below normal	0.37	0.37 (1%)	0.37 (1%)
Dry	0.33	0.33 (0%)	0.33 (0%)
Critically dry	0.31	0.31 (1%)	0.31 (0%)
December			
Wet	0.47	0.46 (-3%)	0.46 (-2%)
Above normal	0.46	0.44 (-3%)	0.45 (-2%)
Below normal	0.48	0.47 (-2%)	0.47 (-2%)
Dry	0.42	0.41 (-3%)	0.41 (-3%)
Critically dry	0.38	0.37 (-3%)	0.38 (-1%)
January			
Wet	0.61	0.60 (-2%)	0.60 (-2%)
Above normal	0.58	0.56 (-3%)	0.56 (-3%)
Below normal	0.48	0.46 (-3%)	0.47 (-3%)
Dry	0.43	0.42 (-2%)	0.42 (-2%)
Critically dry	0.42	0.41 (-2%)	0.41 (-2%)
February			
Wet	0.64	0.63 (-2%)	0.63 (-1%)
Above normal	0.60	0.58 (-4%)	0.58 (-2%)
Below normal	0.51	0.50 (-3%)	0.50 (-3%)
Dry	0.50	0.48 (-3%)	0.49 (-3%)
Critically dry	0.44	0.43 (-2%)	0.43 (-1%)
March			
Wet	0.62	0.60 (-3%)	0.61 (-1%)
Above normal	0.59	0.56 (-4%)	0.57 (-3%)
Below normal	0.50	0.48 (-5%)	0.48 (-4%)
Dry	0.48	0.46 (-3%)	0.46 (-3%)
Critically dry	0.42	0.41 (-2%)	0.42 (-1%)

Water Year Type	Existing Conditions	Alternative 5 NDD Priority	Alternative 5
April			
Wet	0.57	0.56 (-2%)	0.57 (-1%)
Above normal	0.50	0.49 (-2%)	0.49 (-1%)
Below normal	0.44	0.44 (0%)	0.44 (0%)
Dry	0.41	0.41 (0%)	0.41 (0%)
Critically dry	0.38	0.38 (-1%)	0.38 (0%)
May			
Wet	0.55	0.53 (-3%)	0.54 (-1%)
Above normal	0.50	0.48 (-3%)	0.49 (-2%)
Below normal	0.44	0.44 (-1%)	0.44 (0%)
Dry	0.41	0.41 (0%)	0.41 (0%)
Critically dry	0.37	0.37 (-1%)	0.37 (0%)
June			
Wet	0.43	0.40 (-8%)	0.41 (-4%)
Above normal	0.39	0.34 (-13%)	0.35 (-10%)
Below normal	0.33	0.31 (-5%)	0.33 (0%)
Dry	0.33	0.32 (-3%)	0.33 (0%)
Critically dry	0.29	0.29 (-2%)	0.29 (0%)

Source: Based on Perry et al. (2018).

Notes: Percentage values in parentheses indicate differences of alternatives compared to existing conditions. Absolute and percentage values are rounded; as a result, differences between absolute values and differences between percentages may not always appear consistent.

Results are not future predictions and are intended only to compare alternatives.

NDD = north Delta diversion.

4B.1.2.3 Delta Simulation Model 2 (Water Quality)

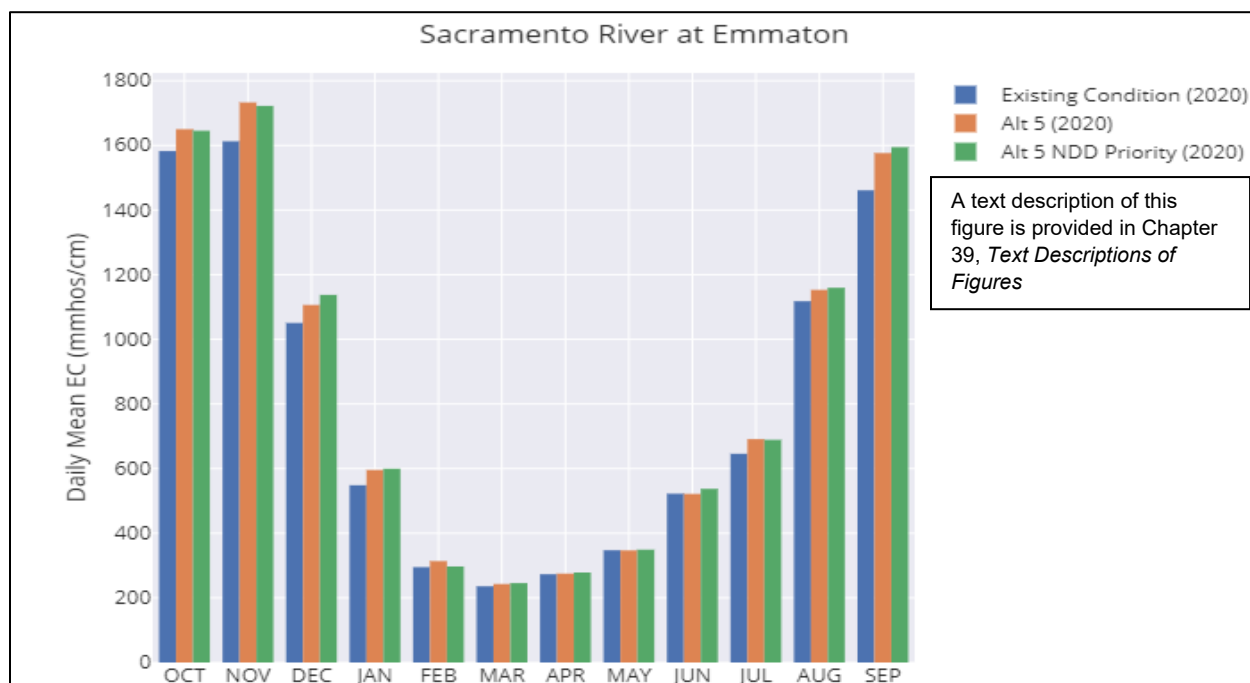
A set of DSM2 simulations were performed on the Alternative 5 north Delta diversion priority scenario for 93 years of hydrology (water years 1923–2015), and the results were compared to results for the existing conditions and Alternative 5. Figures 4B-6 through 4B-8 show the long-term monthly average water quality as expressed in EC at three locations (Sacramento River at Emmaton, San Joaquin River at Jersey Point, and Old River at Rock Slough). Figures 4B-9 through 4B-11 show the probability of exceedance of daily average EC at the same three locations, with each line in the figures showing roughly 34,000 data points (one for each day within the simulation period). In general, the water quality results for the Alternative 5 north Delta diversion priority scenario are very close to those of Alternative 5, especially at Emmaton and Jersey Point. There is a small increase in EC levels at Old River at Rock Slough, mostly corresponding to the months of January through June.

Tables 4B-5 through 4B-6 show the probability of exceedance of State Water Resources Control Board Water Right Decision 1641 (D-1641) water quality objectives at Emmaton and Jersey Point. The results clearly demonstrate that D-1641 water quality objectives can be met at a very similar probability for existing conditions, Alternative 5, and Alternative 5 north Delta diversion priority scenarios.

Table 4B-7 shows the probability of exceedance of D-1641 water quality objectives at Rock Slough (based on model results at Old River at Rock Slough) for the requirement not to exceed daily average chloride concentration of 250 milligrams per liter (mg/L). All three scenarios appear to meet this objective at a very similar probability.

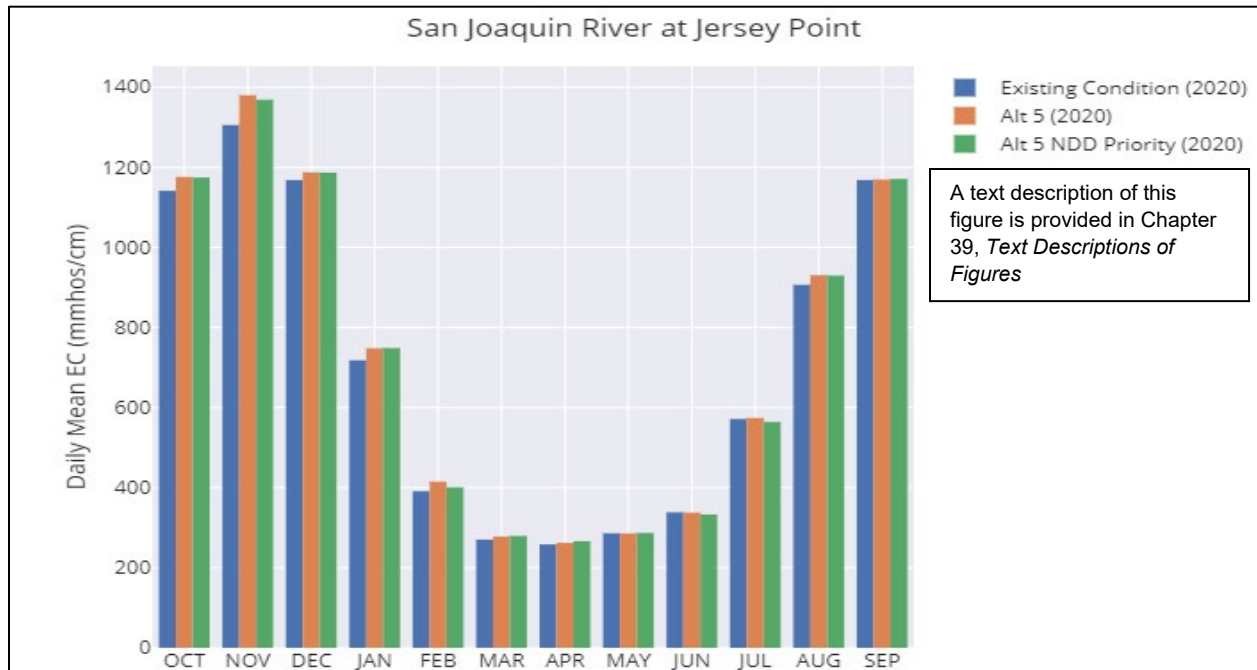
Table 4B-8 shows the probability of meeting the D-1641 water quality objective requiring the daily average chloride concentration at Rock Slough (based on model results at Old River at Rock Slough) to be below 150 mg/L for a certain number of days within a calendar year (depending on the water year type). According to these results, this water quality objective can generally be met for all three scenarios for all years.

Based on these results, it can be concluded that the water quality under the Alternative 5 north Delta diversion priority scenario would be very similar to that under Alternative 5 for most locations in the Delta. This is mainly due to the fact that shifting to north Delta diversion priority is primarily in the winter and spring months, and this had little effect on the Delta outflow, which is one of the main factors affecting ocean salt intrusion in the Delta.



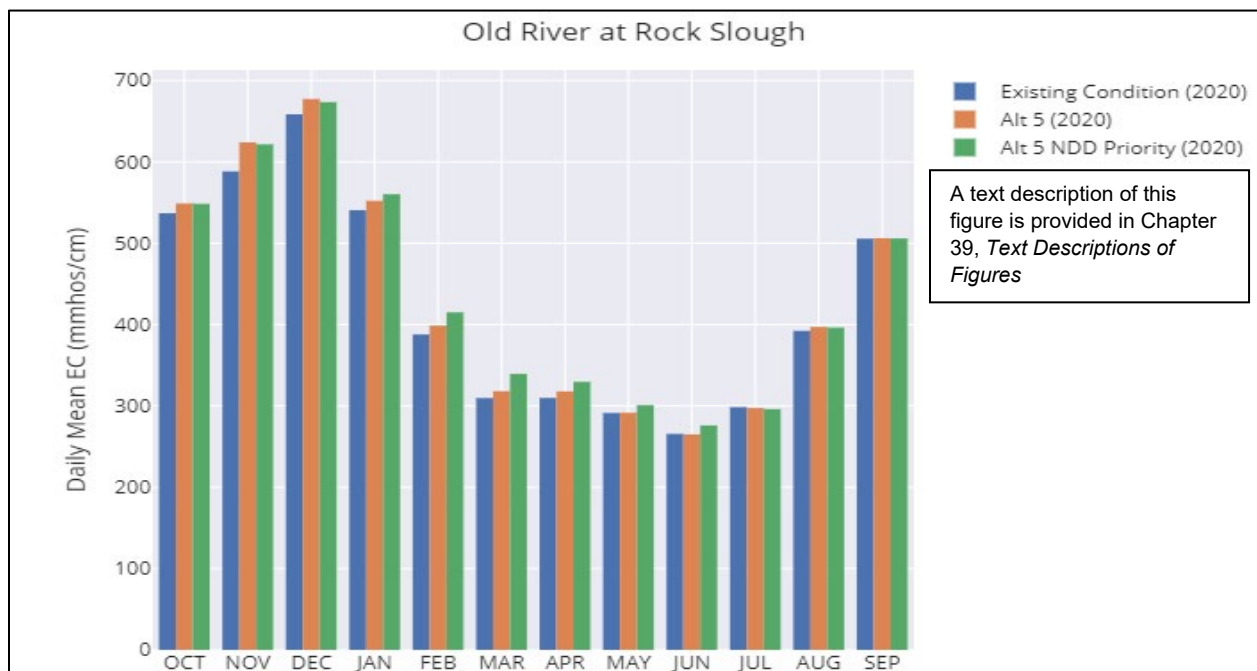
Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-6. Long-Term Monthly Average Water Quality (Electrical Conductivity) at Sacramento River at Emmaton



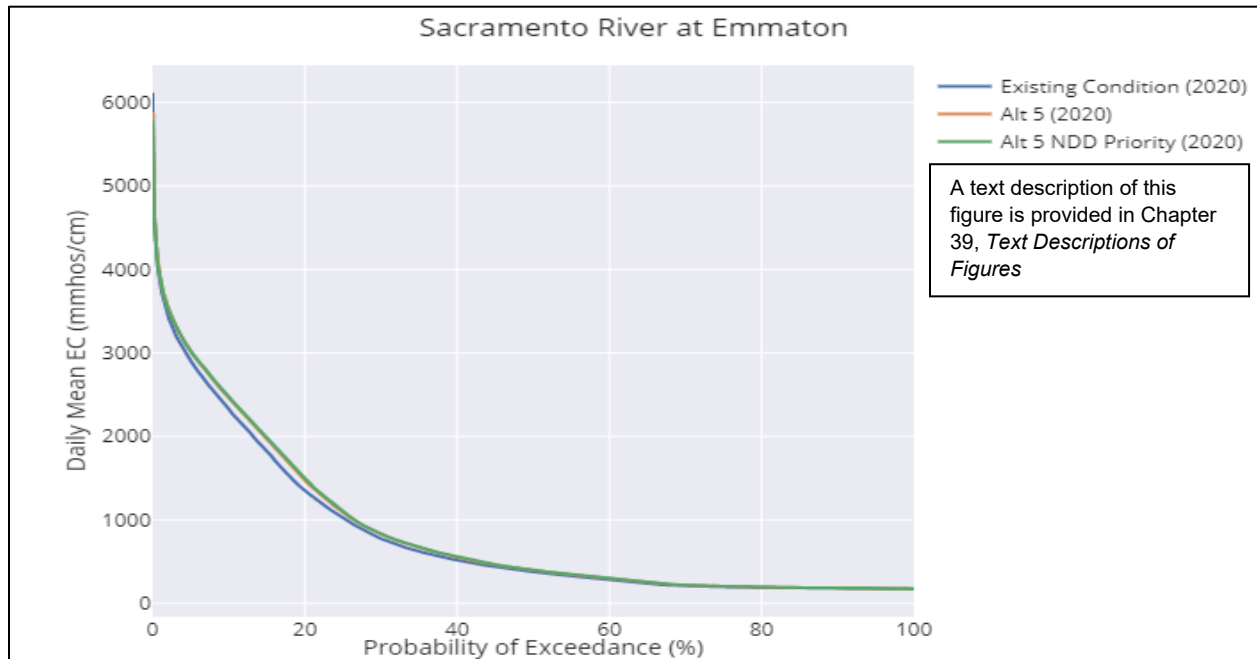
Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-7. Long-Term Monthly Average Water Quality (Electrical Conductivity) at San Joaquin River at Jersey Point



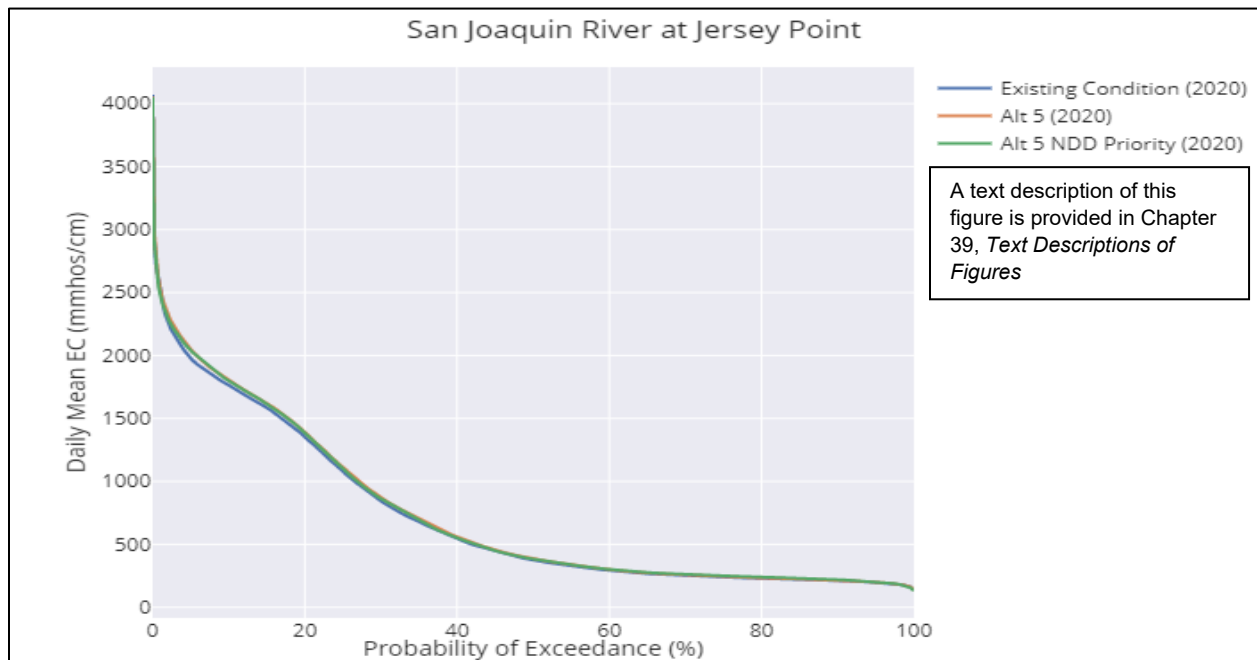
Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-8. Long-Term Monthly Average Water Quality (Electrical Conductivity) at Old River at Rock Slough



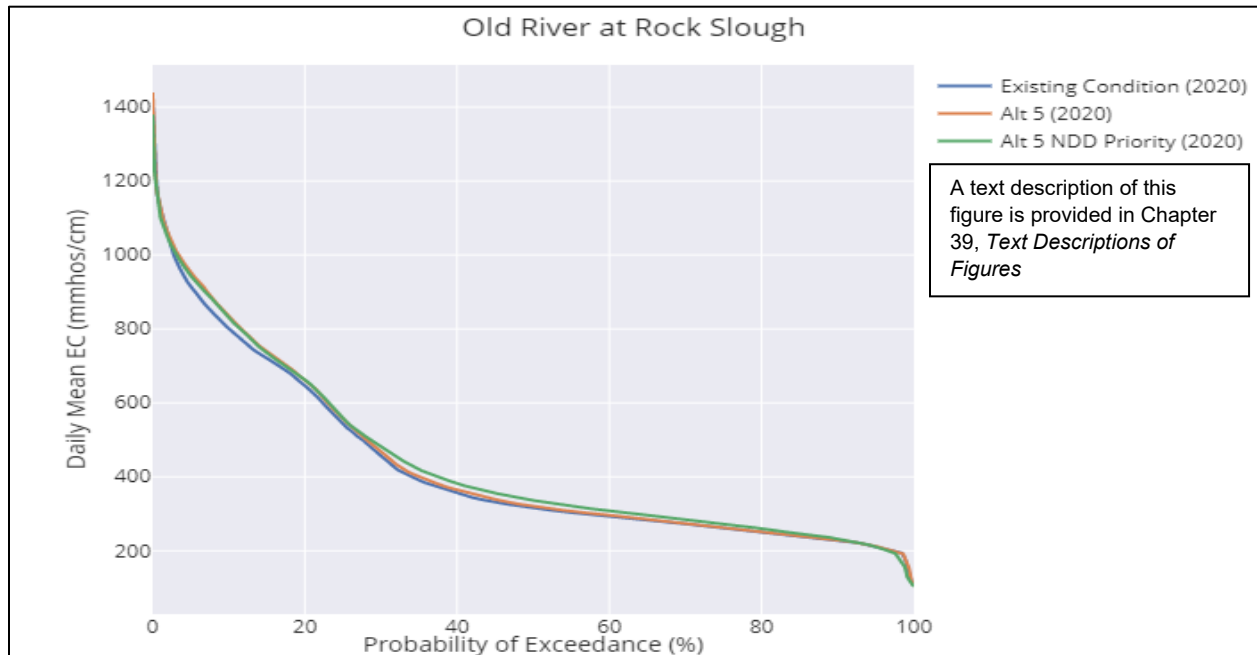
Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-9. Probability of Exceedance of Daily Average Electrical Conductivity at Sacramento River at Emmaton



Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-10. Probability of Exceedance of Daily Average Electrical Conductivity at San Joaquin River at Jersey Point



Alt = alternative; EC = electrical conductivity; mmhos/cm = millimhos per centimeter; NDD = north Delta diversion.

Figure 4B-11. Probability of Exceedance of Daily Average Electrical Conductivity at Old River at Rock Slough

Table 4B-5. Probability of Exceedance of State Water Resources Control Board Water Right Decision 1641 Water Quality Objective at Emmaton

Scenario	Number of Days Standards Are Applicable	Number of Days Exceeded	Percent of Days Exceeded
Existing Conditions (2020)	12,741	556	4.36
Alternative 5 (2020)	12,741	594	4.66
Alternative 5 NDD Priority	12,741	602	4.72

NDD = north Delta diversion.

Table 4B-6. Probability of Exceedance of State Water Resources Control Board Water Right Decision 1641 Water Quality Objectives at Jersey Point

Scenario	Number of Days Standards Are Applicable	Number of Days Exceeded	Percent of Days Exceeded
Existing Conditions (2020)	12,741	690	5.42
Alternative 5 (2020)	12,741	782	6.14
Alternative 5 NDD Priority	12,741	769	6.04

NDD = north Delta diversion.

Table 4B-7. Probability of Exceedance of State Water Resources Control Board Water Right Decision 1641 Water Quality Objectives at Rock Slough (maximum 250 milligrams per liter daily average chloride concentration)

Scenario	Number of Days Standards Are Applicable	Number of Days Exceeded	Percent of Days Exceeded
Existing Conditions (2020)	33,603	607	1.81
Alternative 5 (2020)	33,603	704	2.10
Alternative 5 NDD Priority	33,603	620	1.85

NDD = north Delta diversion.

Table 4B-8. Probability of Exceedance of State Water Resources Control Board Water Right Decision 1641 Water Quality Objective at Rock Slough (specified minimum number of days in a calendar year with daily average chloride concentration below 150 milligrams per liter, depending on the water year type)

Scenario	Number of Days Standards Are Applicable	Number of Days Exceeded	Percent of Days Exceeded
Existing Conditions (2020)	92	1	1.09
Alternative 5 (2020)	92	1	1.09
Alternative 5 NDD Priority	92	1	1.09

NDD = north Delta diversion.

4B.1.2.4 Delta Simulation Model 2 (Residence Time)

A detailed analysis was performed using DSM2-Qual (see Chapter 9, Impact WQ-14: *Effects on Cyanobacteria Harmful Algal Blooms Resulting from Facility Operations and Maintenance*) to see the effects of the north Delta diversion operations for different alternatives by looking at the changes in residence time in various local regions within the Delta that have been part of routine Delta monitoring programs and identified as primary cyanobacteria harmful algal bloom (CHAB) areas. This analysis was primarily performed for the months of June through November because this is the time period when CHABs can be present in the Delta. However, July through September is considered the peak period for CHABs to occur, as this is the time when water temperatures are the warmest (Lehman et al. 2017:98, 106). In general, changes in total south Delta exports can be good surrogates for potential changes in residence time for central and south Delta regions. The shift in operation of north Delta intakes included in this sensitivity analysis mainly occurs from December through June and, as shown earlier, only affects the total south Delta exports during this time window (Figure 4B-2). The total south Delta exports are not affected by the shifting to north Delta diversion priority, especially for the months of July through November (Figure 4B-2). Thus, it can be concluded that residence times under the Alternative 5 north Delta diversion priority scenario would be very similar to those under Alternative 5 for the months of July through November for most regions within the Delta. There may be some limited increase in residence time for the month of June under Alternative 5 north Delta diversion priority when compared to Alternative 5 because of the reduction in total south Delta exports. Although CHABs can be present in June, water temperatures are cool and growth rates are low compared to the peak growing season of July through September. As such, there is unlikely to be much additional growth, aggregation, or accumulation in June under the Alternative 5 north Delta diversion priority scenario even if there is some limited increase in residence time for that month.

4B.2 References Cited

- California Department of Water Resources. 2019. *Incidental Take Permit Application for Long-term Operation of the California State Water Project*. December.
- Lehman, P. W., T. Kurobe, S. Lesmeister, D. Baxa, A. Tung, and S. J. Teh. 2017. Impacts of the 2014 Severe Drought on the *Microcystis* Bloom in San Francisco Estuary. *Harmful Algae* 63:94–108.
- Perry, R. W., A. C. Pope, J. G. Romine, P. L. Brandes, J. R. Burau, A. R. Blake, A. J. Ammann, and C. J. Michel. 2018. Flow-Mediated Effects on Travel Time, Routing, and Survival of Juvenile Chinook Salmon in a Spatially Complex, Tidally Forced River Delta. *Canadian Journal of Fisheries and Aquatic Sciences* 75(11):1886–1901.