Section 5.3

The DSM2 model simulation of the SDIP Stage 1 did not properly include the dredging in Middle River. The dredging of Middle River will allow higher flows during flood events, and allows slightly higher tidal circulation with the proposed tidal gate operations. The DSM2 modeling has been modified to include the dredging in Middle River, and some reduced salinity results for Middle River at Mowry Bridge and Grant Line Canal at Tracy Boulevard Bridge were obtained. There were no simulated changes in EC at the CCWD Old River intake (SR 4) or at the CCWD Rock Slough intake. The corrected results are given in Table 5.3-1 below (page 5.3-30).

that are expected to reduce salinity at CCWD intakes. CCWD has agreed that these benefits will be considered along with the potential impacts from operating the tidal gates and pumping additional water at SWP Banks when judging the overall protection of water quality as described in the CALFED ROD.

All salinity impacts were found to be less than significant because changes would be within the large variations that are characteristic of the no action baseline conditions in the Delta. Salinity changes in many south Delta channels were found to be significantly beneficial, because the reductions were greater than 5% of the baseline value. These salinity benefits are the result of tidal gate operations that produce a tidal circulation of Sacramento River water that is drawn toward the CVP Tracy and SWP Banks. The changes in DOC at drinking water intakes were also found to be less than significant compared with the no action baseline conditions, which are dominated by high DOC during storm inflows and from Delta agricultural drainage. Because the SDIP would not change the DOC loading patterns, the simulated changes from shifting the Delta channel flows and the corresponding fraction of high DOC inflows (i.e., agricultural drainage, San Joaquin River) that are exported were found to be relatively small.

The changes in DWSC flows resulting from the SDIP alternatives would have a beneficial effect on the DO conditions in the Stockton DWSC during the summer, because the head of Old River tidal gate will be operated to reduce the diversions of San Joaquin River water into the south Delta channels. Water quality impacts under cumulative conditions would be similar to the direct and indirect impacts described for SDIP alternatives.

Summary of Significant Impacts

There are no significant impacts on water quality as a result of implementation of the project alternatives. Operation of the tidal gates provides substantial improvements in salinity in the south Delta channels. O~~There are o~~ccasional slight increases in salinity occur in the CCWD intakes and at SWP Banks, but these are less than 5% of the baseline values. The water quality benefits are less under Alternative 4B, which includes constructing only the head of Old River gate.

Affected Environment

Delta waters serve several beneficial uses, each of which has water quality requirements and concerns associated with it. The Delta is a major habitat area for important species of fish and aquatic organisms, as well as a source of water for municipal, agricultural, recreational, and industrial uses. Dominant water quality variables that influence habitat and food-web relationships in the Delta are temperature, salinity, suspended sediments (SS) and associated light levels for photosynthesis, DO, pH, nutrients (nitrogen and phosphorus), DOC, and turbulence is strong enough to maintain relatively high DO concentrations. The DO concentrations in the Stockton DWSC are generally the lowest, with several episodes of DO concentrations of less than 5 mg/l.

The causes of these low DO episodes in the DWSC have been under investigation by the CVRWQCB and the San Joaquin River DO TMDL steering committee for the past several years (Central Valley Regional Water Quality Control Board 2003). Because reduced flows are thought to be one of the primary factors influencing low DO in the DWSC, the potential impact of SDIP alternatives on DO in the DWSC were evaluated. The SDIP alternatives may influence the flow in the DWSC and could therefore impact DO concentrations.

The DO measured in south Delta channels was generally higher than in the Stockton DWSC, although several episodes of reduced DO were recorded. Because the tidal flow velocities in the south Delta channels are relatively high, the severe DO depletion that has been measured in the DWSC is not expected to occur regularly in the south Delta channels.

Environmental Consequences

Assessment Methods

SDIP project operations may cause water quality effects in the Delta by three primary mechanisms:

- Increased SWP Banks pumping may produce lower Delta outflow and thereby increase the concentrations of EC levels and mineral constituents, such as Cl^- and Br^- that are associated with salinity intrusion from Suisun Bay.
- SDIP changes in exports or operation of tidal gates in the south Delta may change the mixture of San Joaquin River water and agricultural drainage in south Delta channels, which might change the EC levels and concentration of water quality constituents, such as Cl^-, Br^-, and DOC at municipal and agricultural diversions and export locations.
- SDIP changes in San Joaquin River flows moving past the head of Old River into the Stockton DWSC may cause changes in the concentrations of DO in the portion of the DWSC near Stockton. This portion of the DWSC is identified by the RWQCB as being out-of-compliance with the DO objective, which is 5 mg/l from December to August, and 6 mg/l from September through November (to protect migrating adult Chinook salmon). A technical TMDL report has been submitted to EPA describing the major reasons for the low DO conditions; low river flow has been identified as one of the major causes for the low DO. The low DO TMDL implementation plan has been adopted by the CVRWQCB and SWRCB.[kk1]

This section provides an overview of the application of DSM2 for the water quality impact assessment of the SDIP alternatives. DSM2 provides an accurate

Because there are no measurements of agricultural drainage flows in the Delta, the MWQI measurements of DOC concentrations cannot be used directly to estimate the relative contributions of DOC from Delta agricultural land. Possible contributions of DOC from crop residue, wetlands plants, and peat soil leaching have not been directly measured. Several water quality experiments have been conducted to estimate these potential DOC source contributions for impact assessment purposes (Marvin Jung and Associates 1999). Results of these experiments are incorporated into the Delta Island Consumptive Use module of DSM2, which includes assumed monthly drainage volumes for each node in the model along with monthly estimates of drainage EC and DOC concentrations. These assumed drainage flows and EC values and DOC concentrations (see Appendix D) are assumed to hold constant between the 2001 and 2020 baselines, and to be the same for all SDIP alternatives. SDIP alternatives may, however, shift the contributions from the agricultural drainage DOC sources at the water supply intakes.

Methods for Assessing Impacts on Dissolved Oxygen

The simulated effects of SDIP alternatives on DO concentrations in the Stockton DWSC depend on the DSM2 simulated Stockton flows. The lower San Joaquin River is listed by the CVRWQCB as a Clean Water Act Section 303 impaired water body. The CVRWQCB initiated the preparation of a TMDL analysis in early 1999 and organized a forum for stakeholder involvement. A substantial amount of data collection has been conducted through CALFED stakeholders and funding.

The CVRWQCB has produced a series of reports on the Stockton DWSC low DO problem (Central Valley Regional Water Quality Control Board 2002). This series~~report~~ includes a comprehensive analysis of the seasonal data collected in the fall by DWR (boat surveys) and by the City of Stockton (NPDES weekly compliance monitoring) as well as the hourly data collected by DWR at the Rough & Ready Island water quality monitoring station since 1983. The tidal flow at Stockton has been measured by a UVM device since 1995.

Daily minimum DO concentrations from each of these data sources from 1996 to 2001 correlated with flow (during the late-summer and fall period). The general relationship suggests that the DWSC minimum DO concentration will increase as the flow is increased to about 1,500 cfs. The average DO increase is apparently about 0.15 to 0.20 mg/l for each 100 cfs of increased flow.

For impact evaluation purposes, the assumed change in DO is 0.2 mg/l for each 100-cfs increase in flow. A reduction in DO of 0.2 mg/l will also be assumed for any 100-cfs reduction in flow, within the range of 0 cfs to 1,500 cfs of Stockton flow. The DO concentration at a flow of 1,500 cfs is estimated from the available data to be about 6.0 mg/l. A flow of 1,000 cfs ~~will therefore~~ is assumed to correspond to a minimum DO of about 5.0 mg/l. A flow of 500 cfs ~~will~~ is assumed to correspond to a minimum DO of 4.0 mg/l. A monthly summer flow of 0 cfs is assumed to produce a DO of just 3.0 mg/l.

- historical EC data are available for this period.

The following locations in the Delta were selected for assessment of impacts related to Delta salinity conditions:

- Emmaton, one of the locations for Delta agricultural salinity objectives located on the Sacramento River downstream of Decker Island and Threemile Slough;
- Jersey Point, one of the locations for Delta agricultural salinity objectives, and an important location for monitoring effects of salinity intrusion into the central Delta;
- Rock Slough (at Contra Costa Canal), assumed to be representative of CCWD diversions at CCC pumping plant #1, where historical EC and Cl^- measurements are made and where a water quality objective in D-1641 is applied;
- Old River at SR 4, which is near the location of the CCWD pumping plant for the Los Vaqueros Reservoir;
- CCF, which is the location of SWP Banks;
- CVP Tracy, where Delta water is diverted from Old River into the DMC;
- Old River at Tracy Boulevard Bridge, which is a D-1641 water quality objective compliance location and represents water quality in the south Delta channels upstream of the agricultural barriers and tidal gates;
- Grant Line Canal at Tracy Boulevard Bridge, which is not a compliance location for D-1641, but does indicate the water quality of a major south Delta channel; and
- Middle River at Mowry Bridge, which is near the D-1641 compliance location in Old River at the head of Middle River (i.e., Union Island).

Impacts related to DOC were assessed for Delta diversions by CCWD at Rock Slough and near SR 4, and for exports by SWP and CVP. Agricultural diversions are not impacted by DOC concentrations. Impacts related to DO were assessed for the San Joaquin River in the DWSC at the Rough & Ready Island DO monitoring station.

Significance Criteria

The impact significance criteria for water quality variables that have regulatory objectives or numerical standards, such as those contained in the 1995 WQCP, are developed from the following general considerations:

- Numerical water quality objectives have been established to protect beneficial uses, and therefore represent concentrations or values that should not be exceeded (DO concentrations must be above the DO objective); violation of the limits would be significant.

- Natural variability caused by tidal flows, river inflows, agricultural drainage, and biological processes in the Delta channels is sometimes quite large relative to the numerical standards or mean values of water quality variables.
- Changes in water quality variables that are greater than natural variations, but are within the limits established by numerical water quality objectives, may cause significant impacts; a criterion for determining significant monthly changes is necessary.
- Monthly changes in a water quality variable that are greater than natural variations, but which occur infrequently enough such that the long-term average value is not raised by more than a specified percentage of the baseline value are considered to be less than significant; a criterion for determining significant long-term changes is necessary.

For variables with numerical water quality criteria, the numerical limits are assumed to adequately protect beneficial uses and provide the basic measure of an allowable limit that will adequately protect beneficial uses. Any increase in the variable that causes the variable to exceed the numerical objective is considered to be a significant impact. No change is allowed if the baseline value exceeds the maximum objective (or if the baseline DO is less than the DO objective). Variables without numerical limits would not have a maximum significance criterion.

Natural variability is difficult to describe with a single value, but it is assumed that 10% of the specified numerical criterion (for variables with numerical criteria) or 10% of the mean value (for variables without numerical criteria) would be a reasonable representation of natural variability that would be expected to occur without causing a significant impact. Appendix D discusses the observed variability in historical Delta salinity (EC) measurements. Simulated monthly changes that are less than 10% of the numerical criterion or less than 10% of the measured or simulated mean value of the variable would not be considered significant water quality impacts because the simulated change would not be greater than natural variability.

A monthly significance criterion is based on the assumption that some changes may be substantial in comparison with natural variability of the water quality variable, and could result in significant impacts. Because the change in water quality that should be considered substantial is not known, judgment must be applied to establish an appropriate significance threshold. Based on professional experience and the measured range of natural variability, the monthly significance criterion has been selected to be 10% of the numerical limits (for variables with numerical limits). It is assumed that this 10% change criterion would prevent relatively large changes that may have potentially significant impacts on beneficial uses. For variable without a numerical limit (e.g., DOC), a monthly change criterion of 10% of the mean value is used as the monthly criterion.

The allowable long-term average increase in a water quality variable that is less than significant is also difficult to determine from purely scientific evidence.

locations. The long-term change of 5% of the No Action average EC value applies at all stations.

There are also applicable objectives of 250-mg/l Cl^- concentration at ~~the four~~ three south Delta ~~export~~ locations (CCWD Rock Slough, ~~CCWD Old River,~~ SWP Banks, and CVP Tracy). The CCWD at Rock Slough chloride is also subject to a 150-mg/l objective for about half of each calendar year (5 months in critical year, 8 months in wet years). These chloride objectives are considered and the necessary Delta outflow to meet these chloride objectives is calculated within the CALSIM model (e.g., ANN module). These chloride objectives are therefore assumed to be satisfied with the simulated Delta outflow values from the CALSIM model. Chloride concentrations were not simulated with DSM2, and chloride was not evaluated as a salinity variable for the SDIP alternatives. Appendix D contains additional comparisons of chloride and EC values at the CCWD Rock Slough intake.

Criteria for Dissolved Organic Carbon

DOC concentrations in the Delta exhibit relatively large fluctuations (see Figure 5.3-5). Although no numerical water quality objectives have been developed for DOC concentrations, criteria for DOC can be determined from average data on Delta DOC and the estimated effects of DOC concentrations on THM concentrations in treated drinking water. Increases in monthly export DOC of more than 10% of the mean DOC concentration (assumed to be about 4 mg/l), or about 0.4 mg/l, are considered to be significant water quality impacts. Because THM standards involve annual average criteria, the significance criterion for the estimated long-term increase in export DOC concentrations should apply. The average DOC concentrations in the exports should be limited to a change that is small enough to prevent a change in long-term THM concentration of more than 8 µg/l (because 8 µg/l is 10% of the current THM standard of 80 µg/l).

A general correlation between DOC concentration and THM concentration suggests that about 10 to 20 µg/l of THM will result from each 1 mg/l of DOC in the raw water supply (State Water Resources Control Board 1995b). Therefore limiting the long-term DOC increases to about 0.4 mg/l would also likely limit the increase in long-term THM to less than 8 µg/l. Simulation of THM concentrations in treated water obtained from the Delta was not part of the SDIP impact evaluation because the simulated changes in EC and DOC can be used as surrogates for the potential effects on THM and other disinfection by-products at specific treatment plants using Delta water.

Criteria for Dissolved Oxygen

The minimum DO objectives in the Stockton DWSC are 5 mg/l from December through August and 6 mg/l from September through November (to protect adult migration of Chinook salmon). Any monthly estimated DO concentration less than the applicable objective is considered to be a significant impact. Any reduction in a monthly estimated DO concentration that is more than 10% of the applicable objective (0.5 mg/l reduction) is also considered to be a significant impact.

CALFED Programmatic Mitigation Measures

The maintenance and improvement of Delta water quality are a major purpose for the CALFED Program. There are, however, no programmatic mitigation measures for water quality that will be employed for the SDIP.

Adaptive Operations of South Delta Tidal Gates for Water Quality Improvement

Section 5.2, Delta Tidal Hydraulics, includes a discussion about how tidal gate operations will affect tidal level and tidal flow in the south Delta channels. This section describes the general influences of the tidal gate operations on south Delta salinity (EC) and gives some general water quality guidelines that will be incorporated into the adaptive management operations of the tidal gates. This section presents a description of what controls existing conditions of salinity in south Delta channels (with temporary barriers), and how tidal gate operations can provide beneficial effects for water quality improvement.

Sources of South Delta Salinity

Figure 5.3-9 shows the DSM2-simulated EC for the four sources of water for south Delta channels, and the resulting EC for the CVP and SWP exports for the 2001 baseline conditions, with temporary barriers. The highest EC line in the top graph is the assumed EC for agricultural drainage return flows in the south Delta. These EC values are general estimates based on drainage EC measurements collected by DWR as part of the Municipal Water Quality Investigations. The assumed EC values are highest in winter (about 1,250 µS/cm) during the months of salt leaching and winter storm pumping of drainage. The EC values in the summer are lower (about 750 µS/cm) because the drainage water originates from agricultural diversions that have not contacted the soils for long enough to dissolve much salt. The south Delta water generally contains less than 15% agricultural drainage, so the effects of the drainage EC are relatively small. However, the fraction of agricultural drainage in south Delta channels depends on the agricultural diversions from these channels and the net tidal flows (i.e., tidal flushing) in the south Delta channels.

The water source with the next highest EC value is the San Joaquin River at Vernalis. These CALSIM-estimated Vernalis EC values have been compared to the historical data in Figure 5.3-8. The D-1641 water quality objective at Vernalis is 1,000 µS/cm during the winter and 700 µS/cm during the irrigation

1. The CCF intake gates have two somewhat contradictory effects that must be balanced: If the gates are closed during the flood-tide flows prior to the high tide each day, the tidal flushing in south Delta channels can be maximized, and levels at high tide throughout the south Delta channels are preserved. This will allow Tom Paine Slough siphons to operate and provide the maximum tidal flushing upstream of the tidal gates. The CCF intake gates, however, must be opened for a sufficient period each day to maintain the CCF elevations above -2.0 feet msl to prevent pump cavitation problems at SWP Banks, which is often used for maximum off-peak (nighttime) pumping. The CCF priority 3 schedule will be used to achieve this balance.
2. The head of Old River fish control gate can be operated to reduce the San Joaquin River diversions into Old River. This will increase the San Joaquin River flow past Stockton and improve DO conditions in the DWSC. This may be beneficial for adult up-migrating Chinook salmon during the months of September through November. Closure in April and May will reduce the juvenile Chinook that are diverted towards the CVP and SWP pumping plants. However, reduced diversions will cause more water to be drawn from the central Delta to supply the CVP and SWP pumping, which may increase entrainment of some larval or juvenile fish (e.g., delta smelt). Reduction of the head of Old River diversions will also reduce the inflow of higher-salinity San Joaquin River water into the south Delta channels. Partial closure of the head of Old River gate will shift the distribution of San Joaquin River salinity away from the CVP Tracy facility toward the CCWD intakes and the SWP Banks facility.
3. The tidal gates at Grant Line Canal, Old River at DMC, and Middle River can be used to control the water levels in the south Delta channels. In addition, ebb-tide closure of the Old River and Middle River tidal gates can produce a net circulation upstream on Old River and Middle River and downstream in Grant Line Canal. This ebb-tide closure of Old and Middle River tidal gates has been simulated to have a beneficial effect on salinity in these south Delta channels and is the proposed operation for these gates. The ebb-tide closure of the tidal gates is not anticipated to substantially change the fish movement patterns that are triggered by or associated with tidal flows.

The operations of the tidal gates will vary on a day-by-day basis depending on the inflows, export pumping, and water quality and fish conditions ~~measured~~ at Vernalis and in the south Delta. The adaptive management of the south Delta gates will be reviewed and guided by the Gate Operations Review Team (GORT) as described in Chapter 2. The general features of these gate operations have been simulated for each SDIP alternative that are compared to the existing conditions baseline with temporary barriers in the following sections.

The GORT may not always operate the tidal gates as simulated for the EIS/EIR impact evaluation. Therefore, some of the salinity reductions and increases in the south Delta and DO improvements in the DWSC may not be as great as simulated for the SDIP alternatives. Variations in the future gate operations that may deviate from the simulated gate operations described in the following water quality impact analyses would be controlled by the GORT, after reviewing available tidal flow, water quality, and fish data. It is assumed that the benefits and impacts of these real-time operations would be similar to the effects identified in ~~would be more beneficial for the range of potential effects than~~ the simulated gate operations used for the impact assessment. ~~. However, n~~No new water quality impacts are anticipated for the range of gate operations that would~~ill be~~ likely be directed by the GORT.

Alternative 1 (No Action)

Under the No Action Alternative, the SDIP project components, including dredging activities in Old River, Middle River and West Canal and the operable fish control and tidal gates would not be constructed or operated; diversion and pumping would not increase. SWP and CVP operations would remain the same. There would be no impact on surface water resources from dredging activities or placement, and existing conditions as described above would remain.

The existing conditions baseline does include the seasonal installation of the fish control barrier at the head of Old River and the temporary agricultural barriers in the south Delta channels. These temporary barrier installation and removal activities may result in localized temporary water quality changes, but these are considered to be the existing conditions, and are not identified as impacts.

2020 Conditions
Under Alternative 1 for 2020 conditions, the SDIP project components would not be built or operated; diversion and pumping would not increase. SWP and CVP operations would remain nearly the same. There would be no impact on water quality from dredging activities or placement of the temporary barriers, and existing conditions as described above for 2001 conditions would remain nearly the same.

Alternative 2A

Stage 1 (Physical/Structural Component)

Construction of the tidal gates will influence water quality only temporarily in the south Delta channels. Localized effects during construction and dredging of channels will be minimized with appropriate dredging procedures. The construction impacts may be comparable to those created by the installation and removal of the four temporary barriers each year. Operation of the tidal gates during Stage 1 of Alternative 2A will provide substantial water quality benefits at many south Delta channel locations. The simulated effects on EC are shown for nine selected impact assessment locations.

Table 5.3-1. DSM2-Simulated Electrical Conductivity Changes for Alternative 2A Stage 1 under 2001 and 2020 Conditions for the 1976–1991 Period

	EC Base Average	EC Alternative Average	EC Change	EC % Change	Number of Increases >10% Base	Average >10% Increase	Number of Increases >100 µS/cm	Average of Increases >100 µS/cm
A. 2001 Conditions								
Emmaton	1,074	1,075	1	0.1	0		0	
Jersey Point	1,079	1,081	2	0.2	0		0	
Rock Slough	532	531	-1	-0.2	0		0	
Old River at SR 4	468	470	2	0.5	1	27	0	
SWP Banks	447	450	4	0.8	2	34	0	
CVP Tracy	530	473	-57	-10.8	6	82	1	121
Old River at Tracy Blvd	595	491	-104	-17.5	11	102	5	147
Middle River at Mowry Bridge	601	~~445~~33	-1~~55~~68	-2~~5~~7.9	~~8~~5	~~57~~46	0	
Grant Line Canal at Tracy Boulevard	595	~~560~~48	-~~35~~47	-7~~5~~.98	~~14~~10	~~61~~53	0	
B. 2020 Conditions								
Emmaton	1,072	1,073	1	0.1	0		0	
Jersey Point	1,081	1,083	2	0.2	0		0	
Rock Slough	539	538	-1	-0.2	0		0	
Old River at SR 4	469	471	3	0.6	1	25	0	
SWP Banks	446	452	~~5~~6	~~102~~1.~~1~~3	2	3~~4~~3	0	
CVP Tracy	526	47~~4~~5	-5~~2~~1	-9.~~9~~7	8	8~~3~~1	~~2~~1	~~109~~10
Old River at Tracy Blvd	595	493	-102	-17.2	12	117	5	192
Middle River at Mowry Bridge	603	~~530~~29	-~~72~~74	-12.~~0~~3	~~9~~5	~~63~~58	~~1~~0	~~101~~
Grant Line Canal at Tracy Boulevard	601	~~561~~50	-51~~40~~	-~~6~~8.~~56~~	11	6~~9~~2	1	1~~24~~16

EC = electrical conductivity (in µS/cm).
SR = State Route.
µS/cm = microSiemens per centimeter.

Impact WQ-5: Salinity Changes at Jersey Point. Figure 5.3-13 shows the monthly EC values for Alternative 2A Stage 1 at Jersey Point and the EC values for the 2001 baseline No Action Alternative for 1976–1991 as simulated by DSM2. The bottom graph indicates the changes in EC, with the Alternative 2A Stage 1 EC values plotted against the No Action EC values. The changes in EC were negligible. Table 5.3-1A indicates that the average EC at Jersey Point for the 2001 baseline for the 16-year period simulated with DSM2 was 1,079 µS/cm. The average simulated EC for Alternative 2A Stage 1 was 1,081 µS/cm. No mitigation is required.

Impact WQ-6: Salinity Changes in Rock Slough. Figure 5.3-14 shows the monthly EC values for Alternative 2A Stage 1 in Rock Slough (at entrance to CCC) and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Simulated Rock Slough EC above the 1,000-µS/cm objective is not expected because it is assumed that CVP and SWP Delta management operations will maintain the D-1641 salinity objectives. Table 5.3-1A indicates that the average EC at Rock Slough for the 2001 baseline was 532 µS/cm. The average simulated EC for Alternative 2A Stage 1 was 531 µS/cm. No mitigation is required.

Impact WQ-7: Salinity Changes in Old River at State Route 4 Bridge. CCWD constructed the Los Vaqueros intake and pumping plant just upstream of the SR 4 Bridge. Photograph 5.3-11 shows the Los Vaqueros intake, located just upstream (i.e., south) of the SR 4 Bridge on the western bank of Old River. Because the Los Vaqueros intake is several miles upstream from the mouth of Rock Slough, and because it is located directly on Old River, the EC measurements at the Los Vaqueros intake are usually lower than corresponding EC measurements at CCC Pumping Plant #1. Some of the water pumped at the Los Vaqueros intake supplies the CCC through a connecting pipeline. Photograph 5.3-12 shows the Los Vaqueros Reservoir, located southwest of the Los Vaqueros intake. The Los Vaqueros Reservoir provides emergency storage and water quality "blending" water to reduce the CCWD delivered chloride concentrations.

Figure 5.3-15 shows the monthly EC values for Alternative 2A Stage 1 in Old River at the SR 4 Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The bottom graph indicates the changes in EC at CCF, with the Alternative 2A EC values plotted against the No Action EC values. The ~~applicable~~ EC objective of~~is~~ 1,000 µS/cm is not applied to this intake. The monthly EC change criterion (10% of baseline~~maximum~~) is therefore ~~100~~ 47 µS/cm. The red line on the graph indicates a 100-µS/cm increase from the baseline EC value. No months had an EC change of larger than 47 µS/cm.

Table 5.3-1A indicates that the average EC in Old River at the SR 4 Bridge for the 2001 baseline for the 16-year period simulated with DSM2 was 468 µS/cm. This is slightly lower (13%) than the average Rock Slough EC. The average simulated EC for Alternative 2A was 470 µS/cm. The average increase at SR 4 was therefore 2 µS/cm (0.5% of the baseline average). No mitigation is required.

Impact WQ-8: Salinity Changes at Clifton Court Forebay (SWP Banks Pumping Plant). Photograph 5.3-13 shows SWP Banks, which supplies drinking water to the South Bay Aqueduct and the SWP California Aqueduct.

Figure 5.3-16 shows the monthly EC values for Alternative 2A Stage 1 at CCF, which provides the water for export at SWP Banks, and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-1A indicates that the average EC at CCF for the 2001 baseline was 447 µS/cm. The average simulated EC for Alternative 2A Stage 1 was 450 µS/cm. The average increase at SWP Banks was therefore about 4 µS/cm (0.8% of the baseline average). No mitigation is required.

Impact WQ-9: Salinity Changes at CVP Tracy Pumping Plant. Photograph 5.3-14 shows the intake to the CVP DMC. The DMC supplies drinking water to the City of Tracy and other communities. The CVP Tracy facility is located about 2.5 miles to the south.

Figure 5.3-17 shows the monthly EC values for Alternative 2A Stage 1 at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-1A indicates that the average EC at CVP Tracy for the 2001 baseline was 530 µS/cm. This EC is higher than the average SWP Banks EC because CVP Tracy pumps more of the San Joaquin River water that is diverted down Old River and Grant Line Canal. The average simulated EC for Alternative 2A Stage 1 was 473 µS/cm. The average EC at CVP Tracy was therefore reduced by 57 µS/cm (10.8% of the baseline average) because of the tidal gate operations that reduced the diversions of San Joaquin River water and provided tidal circulation past the CVP Tracy intake on Old River. Some of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. Although there were a few months with simulated increases in the EC values, the overall change is considered a substantial improvement. No mitigation is required.

Impact WQ-10: Salinity Changes in Old River at Tracy Boulevard Bridge. Figure 5.3-18 shows the monthly EC values for Alternative 2A Stage 1 in Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at the Old River at Tracy Boulevard Bridge is 700 µS/cm from April through August, and 1,000 µS/cm for the remaining months. The monthly change criterion (10% of objective) is therefore 70 µS/cm during the irrigation season, and 100 µS/cm for the remaining months. The bottom graph indicates the changes in EC at Old River at the Tracy Boulevard Bridge, with the Alternative 2A EC values plotted against the No Action EC values. The red line on the graph indicates a 100-µS/cm increase from the baseline EC value. EC changes of more than 100 µS/cm will be above the red line. The solid dots indicate months when the EC objective is 700 µS/cm. A change that is slightly below the red line would indicate a significant monthly change in these months.

Table 5.3-1A indicates that the average EC at Old River at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. This is higher than the average CVP Tracy EC because the Tracy facility pumps a higher fraction of the Sacramento River water. The average simulated EC for Alternative 2A Stage 1 was 491 µS/cm. The average reduction in EC at Old River at the Tracy Boulevard Bridge was therefore about 104 µS/cm (17.5% of the baseline average). This is a substantial improvement in water quality that was achieved by the tidal gate operations. Some of the simulated reduction in EC in Old River at Tracy Boulevard Bride may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. Although there were some months with simulated increase in the EC values, the overall change is a significant improvement in the baseline EC. No mitigation is required.

Impact WQ-11: Salinity Changes in Grant Line Canal at Tracy Boulevard Bridge. Figure 5.3-19 shows the monthly EC values for Alternative 2A Stage 1 in Grant Line Canal at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. There is no applicable EC objective at Grant Line Canal at the Tracy Boulevard Bridge. Grant Line EC values are evaluated to represent this important south Delta channel. Table 5.3-1A indicates that the average EC at Grant Line Canal at the Tracy Boulevard Bridge for the 2001 baseline was 595 µS/cm. This is identical to the average EC at Old River at Tracy Boulevard Bridge. The average simulated EC for Alternative 2A Stage 1 was 560 µS/cm. The average reduction was therefore 35 µS/cm (5.9% of the baseline average). Although there were some months with an increase in EC values, this was a substantial improvement in water quality achieved with the tidal gate operations. No mitigation is required.

Impact WQ-12: Salinity Changes in Middle River at Mowry Bridge. Figure 5.3-20 shows the monthly EC values for Alternative 2A Stage 1 at Middle River at the Mowry Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at Middle River at the Mowry Bridge is 700 µS/cm during the April–August irrigation season, and 1,000 µS/cm for the remaining months. Table 5.3-1A indicates that the average EC at Middle River at the Mowry Bridge for the 2001 baseline was 601 µS/cm. This is the highest EC value of any of the south Delta channels upstream of the barriers, because the Middle River at Mowry Bridge salinity has the greatest contribution from the San Joaquin River. The average simulated EC for Alternative 2A Stage 1 was 445 µS/cm. The average reduction was therefore 155 µS/cm (25.9% of the baseline average). This very large reduction was the result of tidal gate operations that provided flushing of Middle River water upstream of Victoria Canal. Although there were some months with an EC increase, this was a substantial improvement in water quality achieved with the tidal gate operations. No mitigation is required.

Impact WQ-13: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations. Figure 5.3-21 shows the San Joaquin River at Stockton flows simulated by DSM2 for the 2001 baseline conditions and Alternative 2A Stage 1. Only flows of less than 1,500 cfs are assumed to have an effect on the DWSC DO concentrations for this impact assessment. ~~(Central Valley Regional Water Quality Control Board 2003)~~. Because the simulated operation of the head of Old River fish control gate assumed complete closure of the gate in April and May, the San Joaquin River Stockton flows were increased substantially during these months. A constant diversion flow of 500 cfs was simulated in the months of June–September, so the simulated Stockton flow was increased in many of these months. During some of the summer months, the 500 cfs assumed for the Old River diversion was greater than the simulated diversion under existing conditions. Therefore, slightly reduced flow at Stockton was simulated in several months compared to the existing conditions. It is important to note that actual operations of the head of Old River gate during Stage 1 could only reduce the diversions into Old River, and could only increase the flows at Stockton. Therefore, the simulated reductions in Stockton flow that produced a slight reduction in estimated DO concentrations were ignored in the assessment of DO impacts.

The bottom graph of Figure 5.3-21 indicates the relationship between CVP and SWP pumping and the fraction of the San Joaquin River that continues past the head of Old River to Stockton. At relatively low export pumping (as a fraction of San Joaquin River flow at Mossdale), the fraction of the San Joaquin River flow that continues past Stockton is about 50%. As pumping increases, the fraction of the flow continuing past Stockton decreases. Under the 2001 baseline, which includes some months with temporary agricultural barriers, the fraction of the flow continuing past Stockton is increased to about 75% of the Vernalis flow, but this fraction decreases with increasing export pumping. For Alternative 2A Stage 1, there are two months when the head of Old River fish control gate is assumed to be completely closed and exports are low to implement the VAMP. In many other months, the flow at Stockton was increased by the head of Old River tidal gate operations.

Figure 5.3-22 shows that the estimated effect of DSM2-simulated flows with Alternative 2A Stage 1 was to increase the Stockton DWSC DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). During most of these months, the simulated flows at Stockton are increased and the DO estimates are increased. There are some months when the simulated flows at Stockton were reduced (by the 500 cfs assumed Old River diversion) and the estimated DO concentrations were reduced. This would be identified as a significant DO impact, except that this reduction in flow cannot actually occur under Stage 1 operations of the head of Old River gate. Table 5.3-2 gives the June–October average estimated DO concentrations in the DWSC for 1976–1991. The average baseline DO in these months was 4.87 mg/l, and the estimated DO for Alternative 2A Stage 1 was increased to 5.03 mg/l. This is an improvement in the simulated flow and DO conditions at Stockton that resulted from the head of Old River tidal gate operations. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operation selected by the GORT.

average EC at Rock Slough for the 2001 baseline was 532 µS/cm. This is only about half of the average EC at Jersey Point. The average simulated EC for Alternative 2A Stage 2 was 539 µS/cm. The average increase at Rock Slough was therefore about 7 µS/cm (1.3% of the baseline average). Because this long-term increase is less than 5% of the baseline average, the overall change in salinity is considered to be less than significant. No mitigation is required.

Impact WQ-17: Salinity Changes in Old River at State Route 4 Bridge Resulting from Stage 2. CCWD in cooperation with CBDA Drinking Water Program is reducing the influence of treated wastewater and agricultural drainage from Byron Tract near the CCWD Old River intake. These improvements in salinity are not included in the DSM2 modeling results used to evaluate SDIP salinity impacts. Figure 5.3-26 shows the monthly EC values for Alternative 2A Stage 2 in Old River at the SR 4 Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2.

Table 5.3-3A indicates that the average EC at Old River at the SR 4 Bridge for the 2001 baseline for the 16-year period simulated with DSM2 was 468 µS/cm. This is slightly lower (13%) than the average Rock Slough EC. The average simulated EC for Alternative 2A Stage 2 was 478 µS/cm. The average increase at SR 4 was therefore about 10 µS/cm (2.1% of the baseline average). Because this long-term increase is less than 5% of the baseline average, the overall change in salinity is considered to be less than significant. The monthly EC change criteria at SR 4 is 47 µS/cm (10% baseline). At SR 4, there were ~~just~~ 27 months with an EC change of more than ~~100~~ 47 µS/cm. Although these relatively large monthly changes could occur under the Alternative 2A Stage 2 operations, the overall EC change is small enough to avoid any reductions in beneficial uses and the simulated changes at Old River at the SR 4 Bridge are considered to be less than significant. No mitigation is required.

Impact WQ-18: Salinity Changes at Clifton Court Forebay (SWP Banks Pumping Plant) Resulting from Stage 2. Figure 5.3-27 shows the monthly EC values for Alternative 2A Stage 2 at CCF, which provides the water for export at SWP Banks, and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at SWP Banks is 1,000 µS/cm. The monthly change criterion (10% of maximum) is therefore 100 µS/cm. Table 5.3-3A indicates that the average EC at CCF for the 2001 baseline was 447 µS/cm. The average simulated EC for Alternative 2A Stage 2 was 457 µS/cm. The average increase at SWP Banks was therefore about 10 µS/cm (2.2% of the baseline average). Because this long-term increase is less than 5% of the baseline average, the overall change in salinity is considered to be less than significant. No mitigation is required.

Impact WQ-19: Salinity Changes at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-28 shows the monthly EC values for Alternative 2A Stage 2 at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at CVP Tracy is 1,000 µS/cm. The monthly change criterion (10% of maximum) is therefore 100 µS/cm. Table 5.3-3A indicates that the average EC at CVP Tracy for the 2001 baseline was 530 µS/cm. This EC is higher than the average SWP Banks EC because CVP Tracy pumps more of the San Joaquin River water that is diverted down Old River and Grant Line Canal. The average simulated EC for Alternative 2A Stage 2 was 479 µS/cm. The average reduction at CVP Tracy was therefore about 52 µS/cm (9.7% of the baseline average). This is a substantial improvement in EC values that results from the tidal gate operations. Some of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. The additional pumping under Alternative 2A Stage 2 did not substantially increase the simulated EC values at CVP Tracy that were achieved with Stage 1. No mitigation is required.

Impact WQ-20: Salinity Changes in Old River at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-29 shows the monthly EC values for Alternative 2A Stage 2 in Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at the Old River at Tracy Boulevard Bridge is 700 µS/cm from April through August, and 1,000 µS/cm for the remaining months. The monthly change criterion (10% of objective) is therefore 70 µS/cm during the irrigation season and 100 µS/cm for the remaining months. The bottom graph indicates the changes in EC at Old River at the Tracy Boulevard Bridge, with the Alternative 2A EC values plotted against the No Action EC values. The red line on the graph indicates a 100-µS/cm increase from the baseline EC value. The solid dots indicate months when the EC objective is 700 µS/cm. A change that is slightly below the red line would indicate a significant monthly change in these months.

Table 5.3-3A indicates that the average EC at Old River at the Tracy Boulevard Bridge for the 2001 baseline was 595 µS/cm. This is higher than the average CVP Tracy EC because the Tracy facility pumps a higher fraction of the Sacramento River water. The average simulated EC for Alternative 2A Stage 2 was 495 µS/cm. The average reduction in EC in Old River at the Tracy Boulevard Bridge was therefore about 99 µS/cm (16.7% of the baseline average). This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required. It should be noted that s~~S~~ome of the simulated reduction in EC in Old River at Tracy Boulevard Bridge may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. ~~This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.~~

Impact WQ-21: Salinity Changes in Grant Line Canal at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-30 shows the monthly EC values for Alternative 2A Stage 2 in Grant Line Canal at the Tracy

Impact WQ-26: Increases in Dissolved Organic Carbon at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-40 shows the monthly DOC concentrations at CVP Tracy for Alternative 2A Stage 2 compared with the 2001 baseline DOC concentrations. Three of the monthly increases were greater than the 0.4-mg/l maximum change criterion. Table 5.3-4 indicates that the overall average DOC concentrations for the 1976–1991 period was 3.71 mg/l for the baseline and was 3.68 mg/l for Alternative 2A Stage 2. Therefore, the DOC impacts at CVP Tracy are less than significant. No mitigation is required.

Although none of the simulated DOC concentrations for the other SDIP alternatives are shown graphically in this section, the simulations indicate that there are no significant DOC impacts at any of the water supply intakes for any of the SDIP operational scenarios. The changes in pumping and channel flows are not large enough to make a substantial difference in the agricultural drainage contributions, so the corresponding DOC concentrations are not significantly changed from the 2001 existing conditions baseline or from the 2020 future no action baseline.

Impact WQ-27: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations Resulting from Stage 2. Figure 5.3-41 shows that the estimated effect of Alternative 2A Stage 2 DSM2-simulated flows on the Stockton DWSC DO was to increase the DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). There are some months when the estimated DO concentrations were reduced because the simulated flows at Stockton were reduced (by the 500 cfs assumed for the Old River diversion). This would be identified as a significant DO impact, except that this reduction in flow would not actually occur under Stage 2 operations of the head of Old River gate. Gate operations will reduce the Old River diversions that would have occurred under existing conditions. The possible effects of increased pumping on the head of Old River diversions will be controlled with the gate to provide increased flows at Stockton. Table 5.3-2 gives the June–October average estimated DO concentrations in the DWSC for 1976-1991. The average baseline DO in these months was 4.87 mg/l, and the estimated DO for Alternative 2A Stage 2 was 5.03 mg/l. This is a substantial improvement in the simulated flow and DO conditions at Stockton that is the result of the head of Old River tidal gate operations. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operation selected by the GORT.

2020 Conditions

The water quality effects for Alternative 2A Stage 2 under 2020 conditions are generally the same as the impacts and mitigation measures described above for Alternative 2A under 2001 conditions. DSM2-simulated EC values for Alternative 2A Stage 2 under 2020 conditions are presented in Tables 5.3-3B.

Impact WQ-17: Salinity Changes in Old River at State Route 4 Bridge Resulting from Stage 2. Figure 5.3-43 shows the monthly EC values for Alternative 2B at Old River at the SR 4 Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-5A indicates that the average EC at Old River at the SR 4 Bridge for the 2001 baseline No Action Alternative for the 16-year period simulated with DSM2 was 468 µS/cm. The monthly EC change criteria is 47 µS/cm (10% baseline); 14 months had an EC change of greater than 47 µS/cm. The average simulated EC for Alternative 2B was 478 µS/cm. The average increase at SR 4 was therefore about 10 µS/cm (2.1% of the baseline average). No mitigation is required.

Impact WQ-18: Salinity Changes at Clifton Court Forebay (SWP Banks Pumping Plant) Resulting from Stage 2. Figure 5.3-44 shows the monthly EC values for Alternative 2B at CCF, which provides the water for export at SWP Banks, and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-5A indicates that the average EC at CCF for the 2001 baseline No Action Alternative was 447 µS/cm. The average simulated EC for Alternative 2B was 457 µS/cm. The average increase at SWP Banks was therefore about 11 µS/cm (2.3% of the baseline average). No mitigation is required.

Impact WQ-19: Salinity Changes at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-45 shows the monthly EC values for Alternative 2B at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-5A indicates that the average EC at CVP Tracy for the 2001 baseline No Action Alternative was 530 µS/cm. The average simulated EC for Alternative 2B was 479 µS/cm. The average reduction at CVP Tracy was therefore about 51 µS/cm (9.6% of the baseline average). This is a substantial improvement in EC values that results from the tidal gate operations. No mitigation is required. It shouold be noted that sSome of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. ~~This is a substantial improvement in EC values that results from the tidal gate operations. No mitigation is required.~~

Impact WQ-20: Salinity Changes in Old River at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-46 shows the monthly EC values for Alternative 2B in Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The applicable EC objective at the Old River at Tracy Boulevard Bridge is 700 µS/cm during the April–August irrigation season and 1,000 µS/cm in the remainder of the months. The monthly change criterion (10% of maximum) is therefore 70 µS/cm during the irrigation season and 100 µS/cm in the remaining months. The bottom graph indicates the changes in EC in Old River at the Tracy Boulevard Bridge, with the Alternative 2B EC values plotted against the No Action EC values. The solid dots indicate months when the EC objective is 700 µS/cm. A change that is slightly below the red line would indicate a significant monthly change in these months.

Table 5.3-4 indicates that the average EC at Old River at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 2B was 496 µS/cm. The average reduction in Old River at the Tracy Boulevard Bridge was therefore about 99 µS/cm (16.6% of the baseline average). This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required. It should be noted that s~~S~~ome of the simulated reduction in EC in Old River at Tracy Boulevard Bridge may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. ~~This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.~~

Impact WQ-21: Salinity Changes in Grant Line Canal at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-47 shows the monthly EC values for Alternative 2B in Grant Line Canal at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-5A indicates that the average EC in Grant Line Canal at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 2B was 550 µS/cm. The average reduction in Grant Line Canal at the Tracy Boulevard Bridge was 45 µS/cm (7.6% of baseline). No mitigation is required.

Impact WQ-22: Salinity Change in Middle River at Mowry Bridge Resulting from Stage 2. Figure 5.3-48 shows the monthly EC values for Alternative 2B in Middle River at the Mowry Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2.

Table 5.3-5A indicates that the average EC at Middle River at the Mowry Bridge for the 2001 baseline No Action Alternative was 601 µS/cm. The average simulated EC for Alternative 2B was reduced to 436 µS/cm. The average reduction in Middle River at the Mowry Bridge was therefore 165 µS/cm (27.5% of the baseline average). This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.

Impacts WQ-23 to WQ-26: Increases in Dissolved Organic Carbon at Water Supply Intakes Resulting from Stage 2. The DSM2-simulated changes in DOC for Alternative 2B are nearly identical to the simulated changes for Alternative 2A. The simulated DOC values for Alternative 2B are given in Table 5.3-6. The simulated DOC changes for Alternative 2B are less than significant. No mitigation is required.

Impact WQ-27: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations Resulting from Stage 2. The monthly average San Joaquin River flows at Stockton simulated by DSM2 for Alternative 2B are nearly identical to those simulated for Alternative 2A because the simulated gate operations are the same for these alternatives. The estimated effects on DO of Alternative 2B are therefore nearly identical to those estimated for Alternative 2A.

Figure 5.3-49 shows that the estimated effect of Alternative 2B simulated flows on the Stockton DWSC DO was to increase the DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). There are some months when the estimated DO concentrations were reduced because the simulated flows at Stockton were reduced (by the 500 cfs assumed Old River diversion). This would be identified as a significant DO impact, except that this reduction in flow would not actually occur under Stage 2 operations of the head of Old River gate. Gate operations will reduce the Old River diversions that would have occurred under existing conditions. The possible effects of increased pumping on the head of Old River diversions will be controlled with the gate to provide increased flows at Stockton. The calculated DO impacts are summarized in Table 5.3-2 for Alternative 2B. The average DO for the June–October period for Alternative 2B was 5.03 mg/l, an average of 0.16 mg/l more than the 2001 baseline average DO value for these months. This is a benefit for DO concentrations in the DWSC that resulted from the head of Old River tidal gate operations. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operation selected by the GORT.

2020 Conditions

The water quality benefits for Alternative 2B Stage 2 under 2020 conditions are assumed to be the same as the benefits described above for Alternative 2B Stage 2 under 2001 conditions. DSM2-simulated EC values for Alternative 2B Stage 2 under 2020 conditions are presented in Table 5.3-5B.

the average EC at Rock Slough for the 2001 baseline No Action Alternative was 532 µS/cm. The average simulated EC for Alternative 2C was 543 µS/cm. The average increase at Rock Slough was therefore about 11 µS/cm (2.1% of the baseline average). This impact is less than significant. No mitigation is required.

Impact WQ-17: Salinity Changes in Old River at State Route 4 Bridge Resulting from Stage 2. Figure 5.3-51 shows the monthly EC values for Alternative 2C in Old River at the SR 4 Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at Old River at the SR 4 Bridge for the 2001 baseline No Action Alternative for the 16-year period simulated with DSM2 was 468 µS/cm. The monthly EC change criteria is 47 µS/cm (10% baseline); 17 months had an EC change of greater than 47 µS/cm. The average simulated EC for Alternative 2C was 480 µS/cm. The average increase at the SR 4 Bridge was therefore about 12 µS/cm (2.6% of the baseline average). This impact is less than significant. No mitigation is required.

Impact WQ-18: Salinity Changes at Clifton Court Forebay (SWP Banks Pumping Plant) Resulting from Stage 2. Figure 5.3-52 shows the monthly EC values for Alternative 2C at CCF and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at CCF for the 2001 baseline No Action Alternative was 447 µS/cm. The average simulated EC for Alternative 2C was 459 µS/cm. The average increase at SWP Banks was therefore about 12 µS/cm (2.7% of the baseline average). This impact is less than significant. No mitigation is required.

Impact WQ-19: Salinity Changes at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-53 shows the monthly EC values for Alternative 2C at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at CVP Tracy for the 2001 baseline No Action Alternative was 530 µS/cm. The average simulated EC for Alternative 2C was 482 µS/cm. The average reduction at CVP Tracy was therefore about 49 µS/cm (9.2% of the baseline average). This is a substantial improvement in EC values that results from the tidal gate operations. No mitigation is required. It should be noted that s~~S~~ome of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. ~~This is a substantial improvement in EC values that results from the tidal gate operations. No mitigation is required.~~

Impact WQ-20: Salinity Changes in Old River at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-54 shows the monthly EC values for Alternative 2C in Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at Old

River at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 2C was 498 µS/cm. The average reduction in Old River at the Tracy Boulevard Bridge was therefore about 96 µS/cm (16.2% of the baseline average). This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required. It should be noted that s~~S~~ome of the simulated reduction in EC in Old River at Tracy Boulevard Bridge may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the full closure during April and May, and the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operations selected by the GORT. ~~This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.~~

Impact WQ-21: Salinity Changes in Grant Line Canal at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-55 shows the monthly EC values for Alternative 2C in Grant Line Canal at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at Grant Line Canal at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 2C was 550 µS/cm. This is a substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.

Impact WQ-22: Salinity Change in Middle River at Mowry Bridge Resulting from Stage 2. Figure 5.3-56 shows the monthly EC values for Alternative 2C at Middle River at the Mowry Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-7A indicates that the average EC at Middle River at the Mowry Bridge for the 2001 baseline No Action Alternative was 601 µS/cm. The average simulated EC for Alternative 2C was reduced to 436 µS/cm. This is a very substantial improvement in EC that was achieved with tidal gate operations. No mitigation is required.

Impacts WQ-23 to WQ-26: Increases in Dissolved Organic Carbon at Water Supply Intakes Resulting from Stage 2. The DSM2-simulated changes in DOC for Alternative 2C are nearly identical to the simulated changes for Alternative 2A. The simulated DOC values for Alternative 2C are given in Table 5.3-8. The simulated DOC changes for Alternative 2C are less than significant. No mitigation is required.

Table 5.3-8. DSM2-Simulated Dissolved Organic Carbon Values for Alternative 2C under 2001 Conditions for the 1976–1991 Period

	DOC Base Average	DOC Alternative Average	DOC Change	DOC % Change	Number of Changes >0.4 mg/l	Average Change >0.4 mg/l
2001						
Rock Slough	3.37	3.34	-0.03	-0.9	1	0.74
Old River at State Route 4	3.73	3.78	0.05	1.3	13	0.64
CVP Tracy Pumping Plant	3.71	3.68	-0.04	-1.0	2	0.70
SWP Banks Pumping Plant	3.80	3.78	-0.02	-0.4	2	0.52

DOC = dissolved organic carbon.
mg/l = milligrams per liter.

Impact WQ-27: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations Resulting from Stage 2. The monthly average San Joaquin River flows at Stockton simulated by DSM2 for Alternative 2C are nearly identical to those simulated for Alternative 2A because the simulated gate operations are the same for these alternatives. The estimated effects on DO of Alternative 2C are therefore nearly identical to those estimated for Alternative 2A.

Figure 5.3-57 shows that the estimated effect of Alternative 2C DSM2-simulated Stockton flows on the Stockton DWSC DO was to increase the DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). There are some months when the estimated DO concentrations were reduced because the simulated flows at Stockton were reduced (by the 500 cfs assumed Old River diversion). This would be identified as a significant DO impact, except that this reduction in flow would not actually occur under Stage 2 operations of the head of Old River gate. Gate operations will reduce the Old River diversions that would have occurred under existing conditions. The possible effects of increased pumping on the head of Old River diversions will be controlled with the gate to provide increased flows at Stockton. Table 5.3-2 indicates that the average calculated DO for Alternative 2C was about 0.16 more than the 2001 baseline value. This is a benefit for DO concentrations in the DWSC that resulted from the head of Old River tidal gate operations. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated. In particular, the partial closure to limit the head of Old River diversion to 500 cfs during the summer months may not be the gate operation selected by the GORT.

2020 Conditions

The water quality benefits for Alternative 2C under 2020 conditions are assumed to be the same as the benefits described above for Alternative 2C under 2001 conditions. DSM2-simulated EC values for Alternative 2C under 2020 conditions are presented in Table 5.3-7B.

U.S. Department of the Interior, Bureau of Reclamation,
and the California Department of Water Resources

Water Quality

Impact WQ-19: Salinity Changes at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-59 shows the monthly EC values for Alternative 3B Stage 2 at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-9A indicates that the average EC at CVP Tracy for the 2001 baseline No Action Alternative was 530 μS/cm. The average simulated EC for Alternative 3B Stage 2 was reduced to 480 μS/cm. The average decrease at CVP Tracy was therefore about 50 μS/cm (9.5% below the baseline average). Some of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. Because this long-term average EC is reduced compared to the baseline, this is a significant benefit for water quality that was achieved with tidal gate operations. No mitigation is required.

Impact WQ-20: Salinity Changes in Old River at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-60 shows the monthly EC values for Alternative 3B Stage 2 in Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The solid dots indicate months when the EC objective is 700 μS/cm. A change that is slightly below the red line would indicate a significant monthly change in these months.

Table 5.3-9A indicates that the average EC at Old River at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 μS/cm. The average simulated EC for Alternative 3B was reduced to 496 μS/cm. The average decrease in Old River at the Tracy Boulevard Bridge was therefore about 99 μS/cm (16.7% below the baseline average). Some of the simulated reduction in EC in Old River at Tracy Boulevard Bridge may not occur if the head of Old River tidal gate is not operated as simulated. Because this long-term average EC is reduced substantially compared to the baseline, there is a significant water quality benefit that was achieved with tidal gate operations. No mitigation is required.

Impact WQ-21: Salinity Changes in Grant Line Canal at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-61 shows the monthly EC values for Alternative 3B Stage 2 in Grant Line Canal at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-9A indicates that the average EC in Grant Line Canal at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 μS/cm. The average simulated EC for Alternative 3B Stage 2 was 541 μS/cm. The average reduction in Grant Line Canal at Tracy Boulevard Bridge was therefore about 54 μS/cm (9.1% of the baseline average). Because this long-term reduction is more than 5% of the baseline average, the simulated changes at Grant Line Canal at Tracy Boulevard Bridge are considered to be a significant water quality benefit that was achieved with tidal gate operations. No mitigation is required.

Impact WQ-22: Salinity Changes in Middle River at Mowry Bridge Resulting from Stage 2. Figure 5.3-62 shows the monthly EC values for

Alternative 3B Stage 2 in Middle River at the Mowry Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-9A indicates that the average EC at Middle River at the Mowry Bridge for the 2001 baseline No Action Alternative was 601 µS/cm. The average simulated EC for Alternative 3B was reduced to 430 µS/cm. The average decrease at Middle River at the Mowry Bridge was therefore 171 µS/cm (28.4% below the baseline average). This is a substantial water quality benefit that was achieved with tidal gate operations. No mitigation is required.

Impacts WQ-23 to WQ-26: Increases in Dissolved Organic Carbon at Water Supply Intakes Resulting from Stage 2. The DOC concentrations were not simulated with DSM2 for Alternative 3B, because DOC is not expected to substantially change with south Delta tidal gate operations. The DOC impacts would be similar to those simulated for Alternative 2B. The expected DOC changes for Alternative 3B are less than significant. No mitigation is required.

Impact WQ-27: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations Resulting from Stage 2. The monthly average San Joaquin River flows at Stockton simulated by DSM2 for Alternative 3B are similar to those simulated for the other SDIP alternatives, because the simulated head of Old River fish control gate operations are the same for all of these alternatives.

Figure 5.3-63 shows that the estimated effect of Alternative 3B simulated Stockton flows on the Stockton DWSC DO was to increase the DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). There are some months when the estimated DO concentrations were reduced because the simulated flows at Stockton were reduced (by the 500 cfs assumed Old River diversion). This would be identified as a significant DO impact, except that this reduction in flow would not actually occur under Stage 2 operations of the head of Old River gate. Gate operations will reduce the Old River diversions that would have occurred under existing conditions. The possible effects of increased pumping on the head of Old River diversions will be controlled with the gate to provide increased flows at Stockton. Table 5.3-2 gives the calculated changes in DO for Alternative 3B Stage 2. The average DO was increased by 0.13 mg/l with Alternative 3B. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated.

2020 Conditions

The water quality benefits for Alternative 3B under 2020 conditions are assumed to be the same as the benefits described above for Alternative 3B under 2001 conditions. DSM2-simulated EC values for Alternative 3B under 2020 conditions are presented in Table 5.3-9B.

Impact WQ-19: Salinity Changes at CVP Tracy Pumping Plant Resulting from Stage 2. Figure 5.3-65 shows the monthly EC values for Alternative 4B Stage 2 at CVP Tracy and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-10A indicates that the average EC at CVP Tracy for the 2001 baseline No Action Alternative was 530 µS/cm. The average simulated EC for Alternative 4B Stage 2 was reduced to 508 µS/cm. The average decrease at CVP Tracy was therefore about 22 µS/cm (4.2% below the baseline average). Some of the simulated reduction in EC at the CVP Tracy Pumping Plant may not occur if the head of Old River tidal gate is not operated as simulated. Because this long-term average EC is reduced compared to the baseline, there is a small water quality benefit. No mitigation is required.

Impact WQ-20: Salinity Changes in Old River at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-66 shows the monthly EC values for Alternative 4B Stage 2 at Old River at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. The solid dots indicate months when the EC objective is 700 µS/cm. A change that is slightly below the red line would indicate a significant monthly change in these months.

Table 5.3-10A indicates that the average EC at Old River at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 4B was 621 µS/cm. The average increase at Old River at the Tracy Boulevard Bridge was therefore about 27 µS/cm (4.5% of the baseline average). Some of the simulated increases in EC in Old River at Tracy Boulevard Bridge may be greater if the head of Old River tidal gate is not operated as simulated. Because this long-term increase is about 5% of the baseline average, the overall change is considered to be a significant impact on baseline EC. However, several of the largest EC changes were during months when the assumed Vernalis EC (simulated by CALSIM) was greater than the EC objectives. It is unlikely that these high Vernalis EC values are correct. Furthermore, the simulated operations of the head of Old River gate could potentially be changed to allow less San Joaquin River flow into the south Delta channels. Adaptive management of the gate operations is expected to reduce this simulated impact to less than significant. No further mitigation is expected to be required.

Impact WQ-21: Salinity Change in Grant Line Canal at Tracy Boulevard Bridge Resulting from Stage 2. Figure 5.3-67 shows the monthly EC values for Alternative 4B Stage 2 at Grant Line Canal at the Tracy Boulevard Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-10A indicates that the average EC in Grant Line Canal at the Tracy Boulevard Bridge for the 2001 baseline No Action Alternative was 595 µS/cm. The average simulated EC for Alternative 4B Stage 2 was reduced to 581 µS/cm. The average decrease in Grant Line Canal at the Tracy Boulevard Bridge was therefore about 14 µS/cm (2.4% below the baseline average). Because this long-term average EC is reduced compared to the baseline, there is a small water quality benefit. No mitigation is required.

Impact WQ-22: Salinity Change in Middle River at Mowry Bridge Resulting from Stage 2. Figure 5.3-68 shows the monthly EC values for Alternative 4B Stage 2 in Middle River at the Mowry Bridge and the changes from the monthly EC values for the No Action Alternative for 1976–1991 as simulated by DSM2. Table 5.3-10A indicates that the average EC in Middle River at the Mowry Bridge for the 2001 baseline No Action Alternative was 601 µS/cm. The average simulated EC for Alternative 4B Stage 2 was reduced to 544 µS/cm. The average decrease at Middle River at the Mowry Bridge was therefore 56 µS/cm (9.4% below the baseline average). This is a significant water quality benefit resulting from the head of Old River tidal gate operation. No mitigation is required.

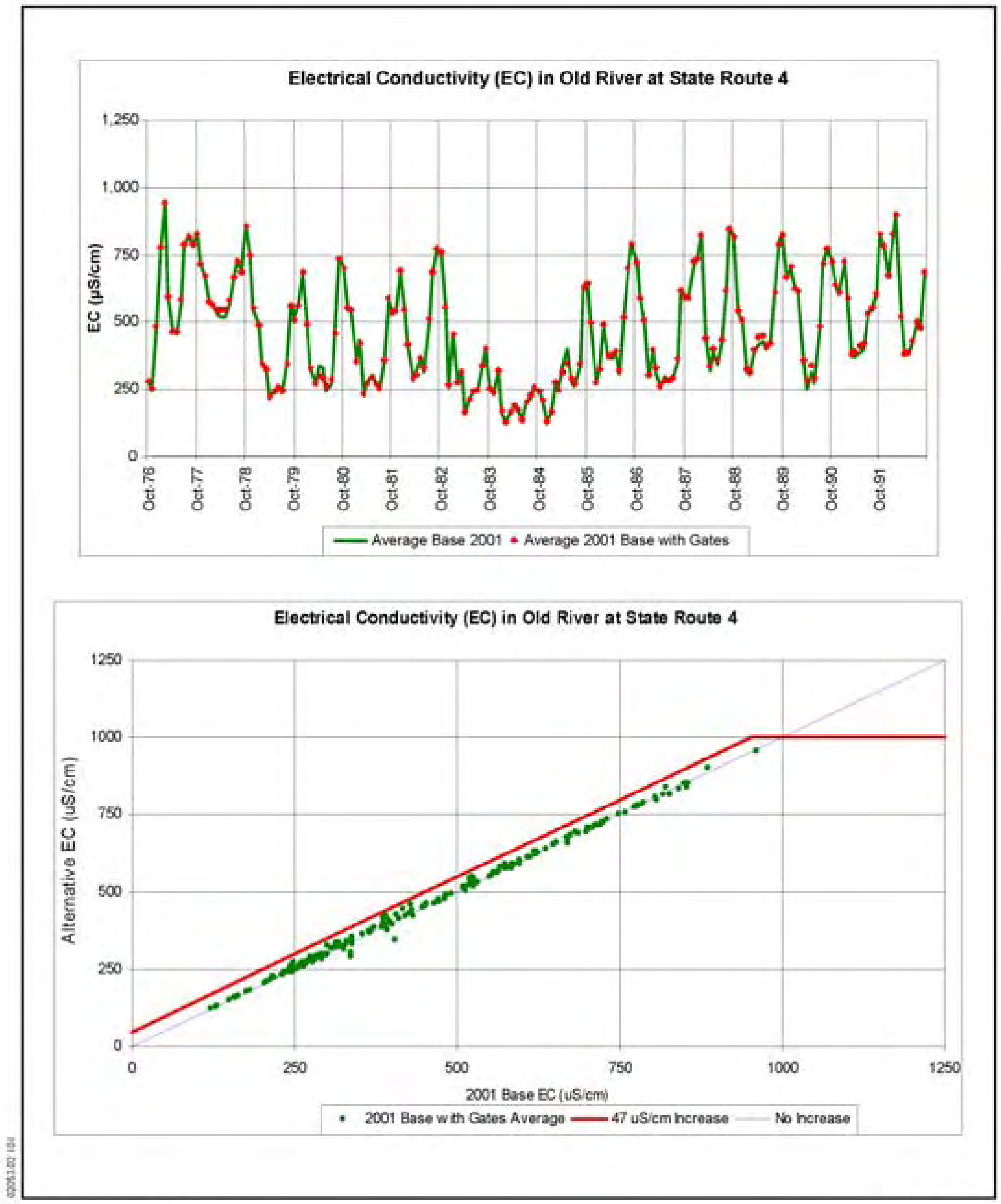
Impacts WQ-23 to WQ-26: Increases in Dissolved Organic Carbon at Water Supply Intakes Resulting from Stage 2. The DOC concentrations were not simulated with DSM2 for Alternative 4B, because DOC is not expected to change with south Delta tidal gate operations. The DOC impacts would be similar to those simulated for Alternative 2B. The expected DOC changes for Alternative 4B are less than significant. No mitigation is required.

Impact WQ-27: Changes in Stockton Deep Water Ship Channel Dissolved Oxygen Concentrations Resulting from Stage 2. The monthly average San Joaquin River flows at Stockton simulated by DSM2 for Alternative 4B are nearly identical to those simulated for Alternative 2B because the simulated head of Old River fish control gate operations are the same for these alternatives. The estimated effects on DO of Alternative 4B are therefore nearly identical to those estimated for Alternative 2B.

Figure 5.3-69 shows that the estimated effect of Alternative 4B simulated Stockton flows on the Stockton DWSC DO was to increase the DO by as much as 1 mg/l (equivalent to a flow increase of 500 cfs). There are some months when the estimated DO concentrations were reduced because the simulated flows at Stockton were reduced (by the 500 cfs assumed Old River diversion). This would be identified as a significant DO impact, except that this reduction in flow would not actually occur under Stage 2 operations of the head of Old River gate. Gate operations will reduce the Old River diversions that would have occurred under existing conditions. The possible effects of increased pumping on the head of Old River diversions will be controlled with the gate to provide increased flows at Stockton. Table 5.3-2 indicates that the average DO was increased by 0.13 mg/l with Alternative 4B. No mitigation is required. Some of the simulated increases in DO concentrations caused by increased flows may not occur if the head of Old River tidal gate is not operated as simulated.

2020 Conditions

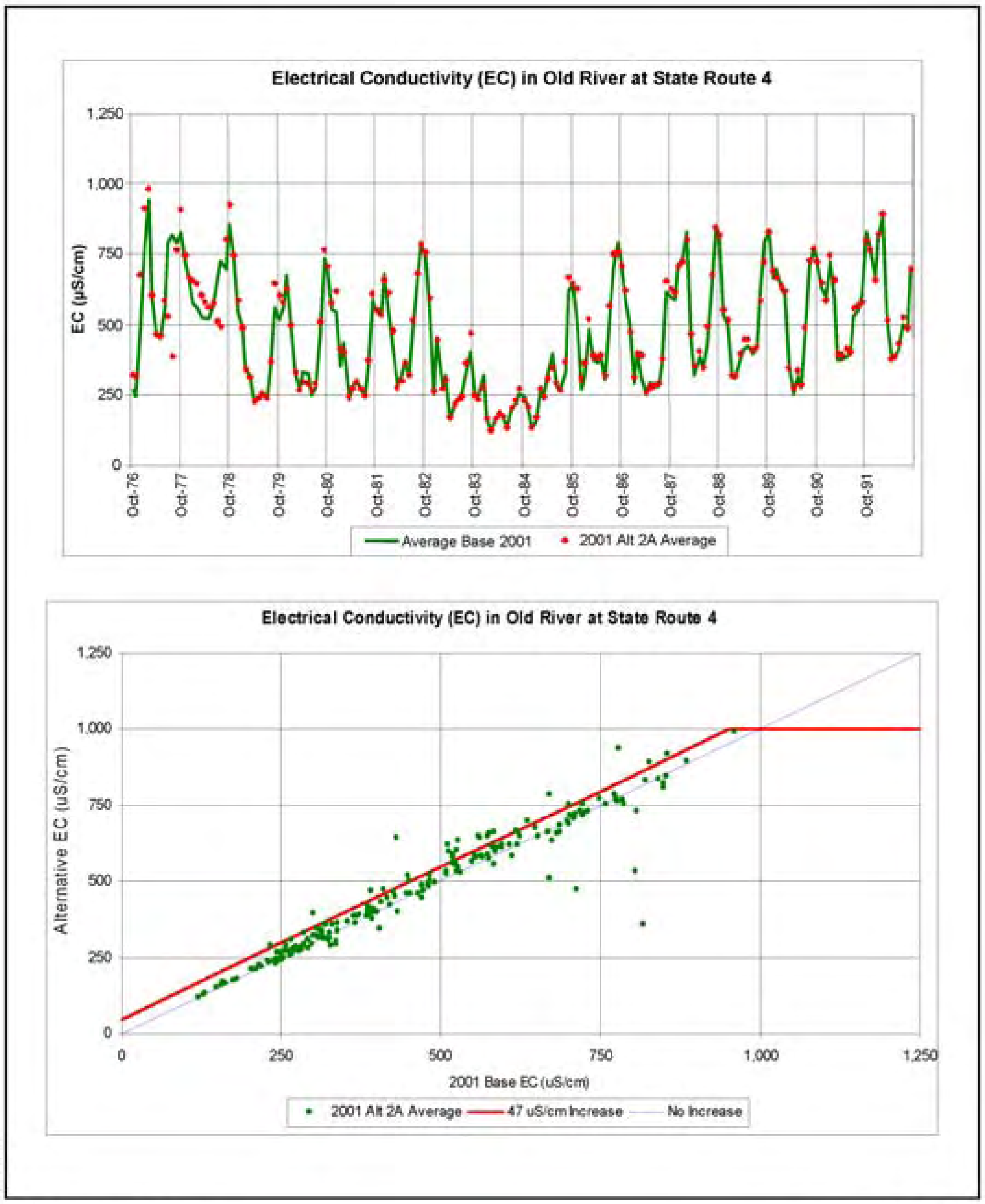
The water quality benefits for Alternative 4B Stage 2 under 2020 conditions are assumed to be the same as the benefits described above for Alternative 4B



Jones & Stokes

Figure 5.3-15

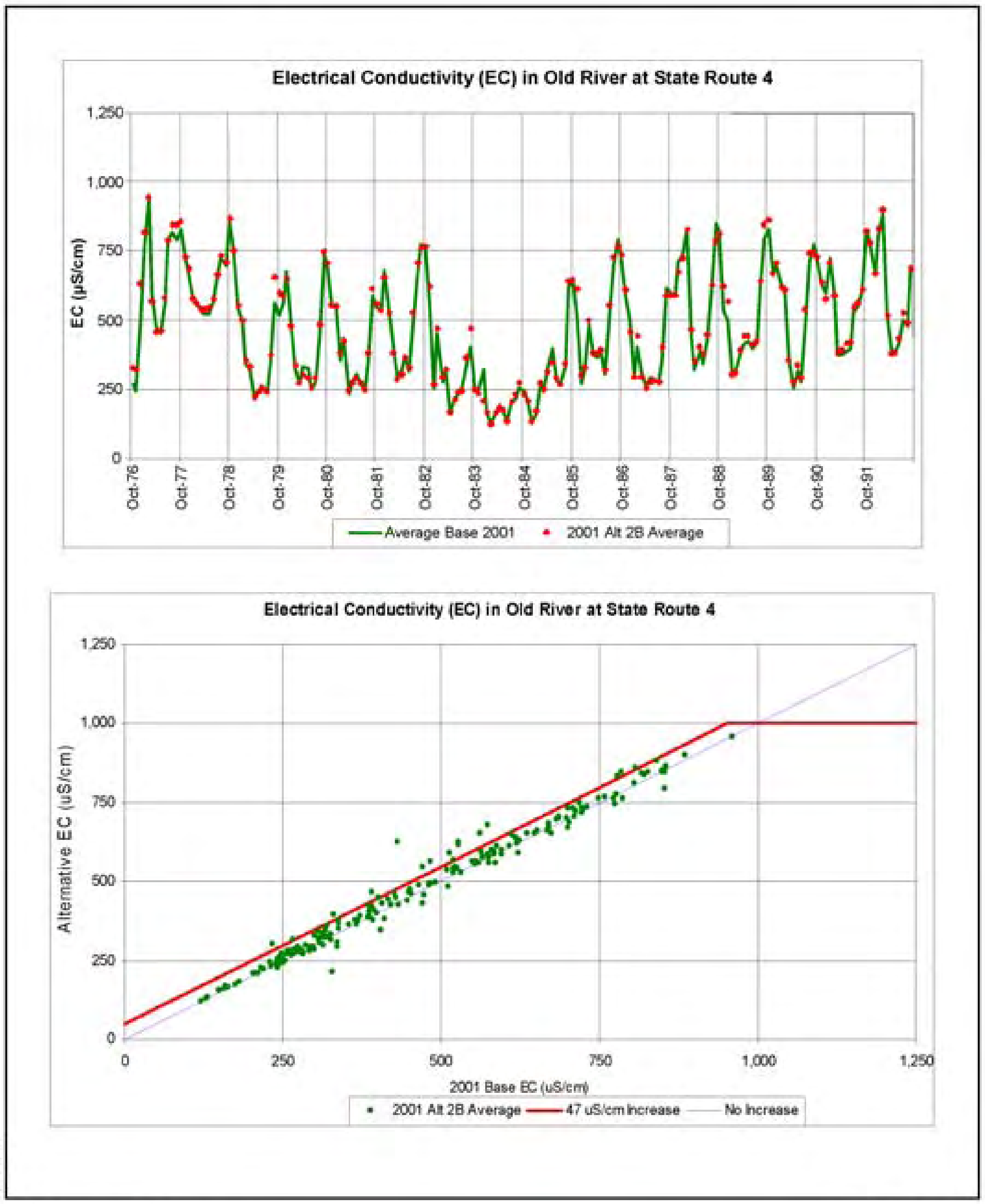
DSM2-Simulated Monthly Electrical Conductivity in Old River near State Route 4 Bridge for 1976–1991 with Alternative 2A Stage 1 (2001 Base with Gates) Compared with 2001 No Action Baseline



Jones & Stokes

Figure 5.3-26

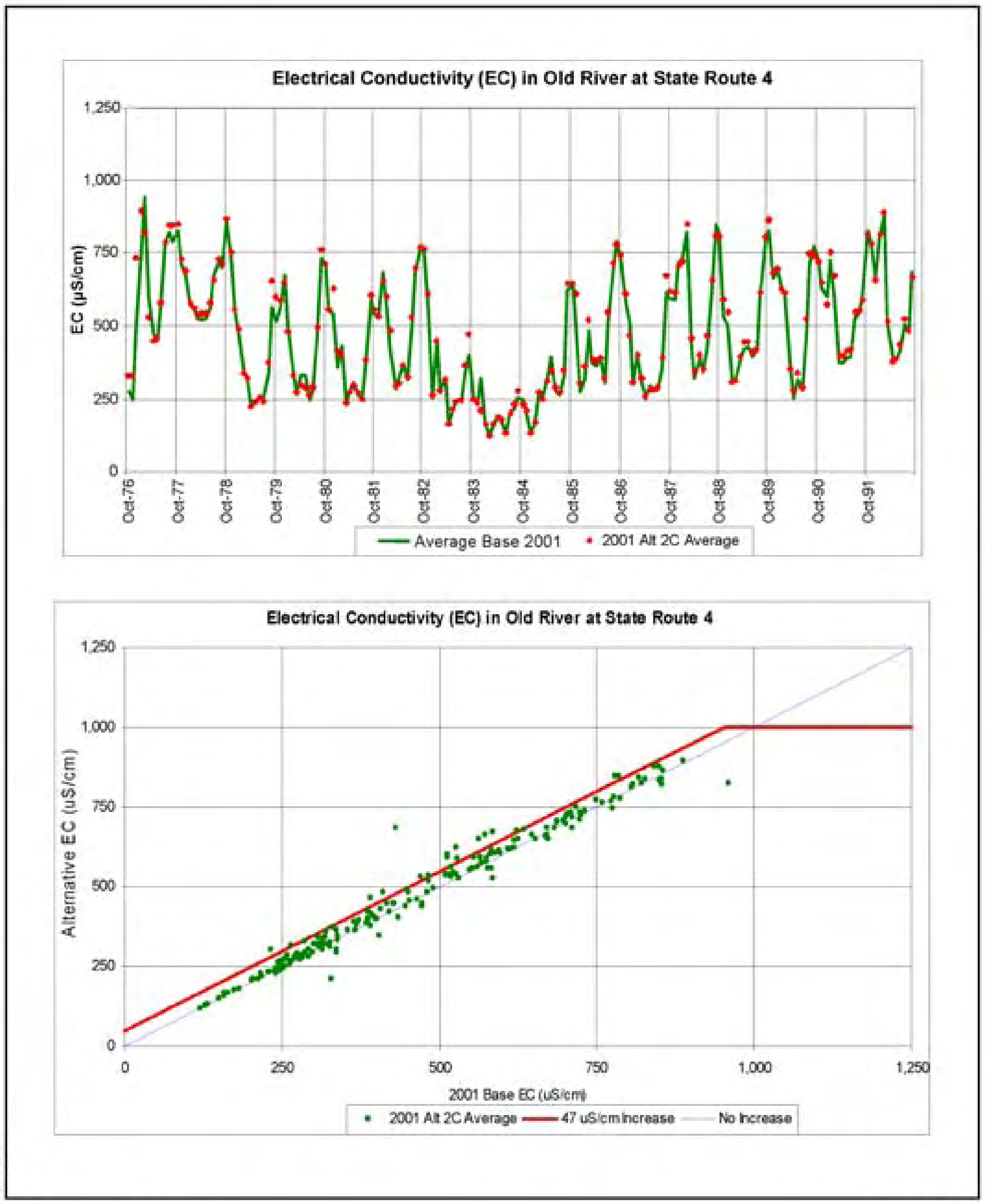
DSM2-Simulated Monthly Electrical Conductivity in Old River near State Route 4 Bridge for 1976–1991 with Alternative 2A Stage 2 Compared with 2001 No Action Baseline



Jones & Stokes

Figure 5.3-43

DSM2-Simulated Monthly Electrical Conductivity in Old River at State Route 4 for 1976–1991 with Alternative 2B Stage 2 Compared with 2001 No Action Baseline



Jones & Stokes

Figure 5.3-51

DSM2-Simulated Monthly Electrical Conductivity in Old River at State Route 4 for 1976–1991 with Alternative 2C Stage 2 Compared with 2001 No Action Baseline

Section 6.1

6.1 Fish

Introduction

This assessment covers species within aquatic environments potentially affected by the SDIP, including the Sacramento, American, Feather, San Joaquin, and Trinity Rivers, the Delta, and Suisun Bay. Although many fish species occur within the affected aquatic environment, the assessment focuses on Central Valley fall-/late fall–run Chinook salmon (ESA, ~~candidate~~species of concern), Sacramento River winter-run Chinook salmon (ESA and CESA, endangered), Central Valley spring-run Chinook salmon (ESA and CESA, threatened), Southern Oregon/northern California coasts coho salmon (ESA and CESA, threatened), Central Valley steelhead (ESA, threatened), delta smelt (ESA and CESA, threatened), splittail (ESA, listing withdrawn), striped bass (an important sport fish), and green sturgeon (ESA, ~~proposed~~ threatened). The response of the selected species to project actions provides an indicator of the potential response of other species. The full range of environmental conditions and fish habitat elements potentially affected is encompassed by the assessment for the species specifically discussed.

This section includes the following information:

- a summary of significant impacts that could result from implementation of the SDIP alternatives;
- a description of the affected environment, including the life histories and existing environmental conditions for factors that may affect the abundance and survival of the selected species;
- a description of the assessment methods that were used to evaluate potential impacts of the SDIP alternatives; and
- a description of the effects (i.e., environmental consequences) for each SDIP alternative on fish and fish habitat, including identification of significant impacts and measures to mitigate significant impacts.

Summary of Significant Impacts

Implementation of the SDIP alternatives includes construction and operation of gates in the south Delta, dredging, and water supply operations that affect fish and fish habitat in the Delta and rivers upstream of the Delta. Construction of the gates results in less-than-significant impacts because environmental commitments (Chapter 2, "Project Description") and BMPs will be implemented and the area disturbed by construction of gates would be similar to the existing footprint of the temporary barriers. Operation of the permanent gates would have less-than-significant impacts given that effects on net and tidal flow would be similar to conditions with the existing temporary barriers, and operability would increase flexibility to minimize existing effects. Dredging would increase channel depth, but habitat area and quality would be similar to pre-dredged that were included in the calculations of habitat conditions for the SDIP alternatives. Actual occurrence and relative abundance may vary between months and from year to year.

Chinook Salmon

After 2–5 years in the ocean, adult Chinook salmon leave the ocean and migrate upstream in the Sacramento and San Joaquin rivers. The names of the Chinook salmon runs (i.e., fall, late fall, winter, and spring) reflect the variability in timing of the adult life stage (Table 6.1-2). Spawning occurs in the cool reaches of Central Valley rivers that are downstream of the terminal dams and in tributary streams. After the eggs hatch, juvenile Chinook salmon remain in fresh water for 3–14 months.

Historical records indicate that adult spring-run Chinook salmon enter the mainstem Sacramento River in March, and continue to their spawning streams where they hold until September in deep cold pools (Table 6.1-2). Spring-run Chinook salmon are sexually immature during their spawning migration. Spawning occurs in gravel beds in late August through October, and emergence begins in December. Spring-run Chinook salmon migrate downstream as young-of-year or yearling juveniles. Young-of-year juveniles move between February and June, and yearling juveniles migrate from October to March, with peak migration in November (Cramer, S.P. 1996).

Adult fall-/late fall–run Chinook salmon enter the Sacramento ~~and San Joaquin~~ River ~~systems~~ from July through February and spawn from October through March (Table 6.1-2). Adult fall-run Chinook salmon enter the San Joaquin River tributaries from October to December and spawn during these months (Table 6.1-2) (Baker and Morhardt 2001). Optimal water temperatures for egg incubation is 44 to 54°F (6.7 to 12.2°C) (Rich 1997). Newly emerged fry remain in shallow, lower-velocity edgewaters (California Department of Fish and Game 1998). Sacramento River j~~J~~uveniles migrate to the ocean from October to June and San Joaquin River juveniles migrate from late February through June (Baker and Morhardt 2001)(Table 6.1-2).

Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July (Table 6.1-2). Adults migrate upstream past RBDD on the Sacramento River from mid-December through July, and most (85%) of the spawning population has passed RBDD by mid-May, trailing off in late June (Table 6.1-2). Spawning takes place from mid-April through August, and incubation continues through October (Table 6.1-2). The primary spawning grounds in the Sacramento River are above RBDD. Juvenile winter-run Chinook salmon rear and migrate in the Sacramento River from July through March (Hallock and Fisher 1985; Smith pers. comm.). Juveniles move downstream in the Sacramento River above RBDD from August through October and possibly November, rearing as they move downstream. Juveniles have been observed in the Delta during October through December, especially during high Sacramento River discharge in response to fall and early-winter storms. Winter-run salmon juveniles migrate through the Delta to the ocean from December through as late as May (Stevens 1989).

During spawning, the female digs a redd (a nest in clean gravel) and deposits eggs. A male fertilizes the eggs during the creation of the redd. Optimal water temperature for egg incubation is 44 to 54°F (6.7 to 12.2°C) (Rich 1997). Newly emerged fry remain in shallow, lower-velocity edgewaters (California Department of Fish and Game 1998). Juveniles rear in their natal streams, the mainstem of the Sacramento River, and in the Delta.

Cover, space, and food are necessary components for Chinook salmon rearing habitat. Suitable habitat includes areas with instream and overhead cover in the form of cobbles, rocks, undercut banks, downed trees, and large, overhanging tree branches. The organic materials forming fish cover also provide sources of food, in the form of both aquatic and terrestrial insects.

Juvenile Chinook salmon move downstream in response to many factors, including inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The number of juveniles that move and the timing of movement are highly variable. Storm events and the resulting high flows appear to trigger movement of substantial numbers of juvenile Chinook salmon to downstream habitats. In general, juvenile abundance in the Delta appears to be higher in response to increased flow (U.S. Fish and Wildlife Service 1993).

Steelhead

Steelhead have one of the most complex life histories of any salmonid species. Steelhead are anadromous, but some individuals may complete their life cycle within a given river reach. Freshwater residents typically are referred to as rainbow trout, while anadromous individuals are called steelhead (National Marine Fisheries Service 1996a).

Historical records indicate that adult steelhead enter the mainstem Sacramento River in July, peak in abundance in September and October, and continue migrating through February or March (Table 6.1-2) (McEwan and Jackson 1994; Hallock 1989). Most steelhead spawn from December through April (Table 6.1-2), with most spawning occurring from January through March. Steelhead have been captured in the San Joaquin River tributaries, but their populations are small (McEwan 2001). The timing of adult migration in the San Joaquin is unknown, but may be similar to the Sacramento River fish. Unlike Pacific salmon, some steelhead may survive to spawn more than one time, returning to the ocean between spawning migrations.

The female digs a redd in which she deposits her eggs. The duration of egg incubation in the gravel is determined by water temperature, varying from approximately 19 days at an average water temperature of 60°F (15.6°C) to approximately 80 days at an average temperature of 40°F (4.4°C). Steelhead fry usually emerge from the gravel 2 to 8 weeks after hatching (Barnhart 1986;

Reynolds et al. 1993). Newly emerged steelhead fry move to shallow, protected areas along streambanks and move to faster, deeper areas of the river as they grow. Most juveniles occupy riffles in their first year of life and some of the larger steelhead live in deep fast runs or in pools. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates.

Juvenile migration to the ocean generally occurs from December through ~~August~~ June (Table 6.1-2). Most Sacramento River steelhead migrate in spring and early summer (Reynolds et al. 1993). Sacramento River steelhead generally migrate as 1-year-olds at a length of 6 to 8 inches (15.2 to 20.3 centimeters [cm]) (Barnhart 1986; Reynolds et al. 1993). Most juvenile steelhead ~~Although steelhead have been~~ are collected ~~in most months~~ at the state and federal pumping plants in the Delta from January through June, with the peak numbers salvaged at these facilities ~~occur~~ in March and April ~~in most years~~ (Foss 2004). A few juvenile steelhead are captured in the eastside tributaries of the San Joaquin (McEwan 2001) and their timing may be similar to the Sacramento River.

After 2–3 years of ocean residence, adult steelhead return to their natal stream to spawn as 3- or 4-year-olds (National Marine Fisheries Service 1998).

Coho Salmon

Coho salmon are anadromous fish that migrate as adults into the Trinity River and other coastal streams and rivers to spawn. Adult migration occurs from mid-September through December, when water temperatures are from 39 to 57°F (4 to 14°C) and spawning typically takes place between November and January (Table 6.1-2) (Moyle 2002). Coho salmon adults spawn in waters with velocities of 0.82–1.0 feet/sec (0.25–0.31 meter per second (m/sec) and depths of 11.8–12.2 inches (0.3–0.31 meter) (Hampton 1988). Redds are formed near the heads of riffles in medium-to-small gravel that provide good flow and aeration. Spawning occurs over about a week. Optimal embryo development takes place when water temperatures are 40 to 55°F (4.4 to 13°C) (Emmett et al 1991, 137). Embryos hatch after 8–12 weeks depending on the water temperature, and remain in the gravel for 4–10 weeks until their yolk sacs are absorbed (Leidy and Leidy 1984). Eggs and aelvins have been observed in water temperatures from 40 to 70°F (4.4 to 21°C (Emmett et al 1991, 137). After hatching, the juveniles move to shallow water along the stream margins (Moyle 2002).

Habitat includes backwaters, side channels, and stream margins adjacent to large, slow runs or pools. Coho salmon will shift their habitat use depending on the season, but use mostly deep pools with overhead cover in the summer (Moyle 2002). Cover is the most important rearing habitat feature; coho salmon seek areas with overhanging vegetation (e.g., brush and logs) and thick clusters of aquatic vegetation (Hampton 1988). Optimal growth temperature ranges from 53.1 to 57°F (11.7 to 13.9°C), and they prefer velocities of 0.3 to 1.5 feet/sec (0.09 to 0.46 m/sec) (Moyle 2002). Juveniles are absent from tributaries that reach temperatures warmer than 64°F (17.8°C) for more than a week.

pThe certainty of the assessment relationship is low, primarily because specific data on steelhead spawning in the Sacramento, Feather, and American Rivers are not extensive. Also, the magnitude of species response is weakly supported. It is possible that spawning habitat is not limiting and that the assessment overstates the habitat need. Adequate flows for spawning and incubation have been defined in previous years within different rivers. Flows can be used as a baseline to predict spawning and post-spawning success, but additional habitat measurements such as depth, velocity, spawning gravel quality, and water temperature are necessary for successful spawning and incubation. Flow-habitat relationships for steelhead are also substantially different from the relationships for Chinook salmon because substrate, depth, and velocity preferences differ. As with Chinook salmon, the relationships assume saturation of the spawning habitat. More detailed evaluation of the magnitude of effects and other aspects of the relationships is warranted.

Delta Smelt

The assessment of changes Delta inflow on delta smelt spawning habitat is based on the hypotheses that reduction in spawning habitat will result in reduced larval production. Implementation of the SDIP is unlikely to substantially affect environmental conditions (i.e., fresh water) that maintain the existing habitat area in the Delta. The extent of salinity intrusion into the Delta, as represented by the change in the location of X2, will be evaluated to ~~confirm~~ determine if there is an ~~minimal~~ effect on spawning habitat area.

The certainty of the assessment relationship is minimal. Existing information does not indicate that spawning habitat is limiting. Very little is known about spawning habitat needs of delta smelt; therefore, the assumption that spawning habitat is not limiting is speculative. Spawning occurs in fresh water, based on collection of ripe females and larval catches. In drier years, most female and larval delta smelt have been found in the Sacramento River near Prospect Island and the Barker-Lindsey–Cache Slough complex (Wang and Brown 1993). In high outflow years, smelt are found in most of the Delta, Suisun Marsh, and the Napa River (Sweetnam 1999). In addition to poor understanding of spawning location, the primary spawning substrate in the Delta is unknown. Eggs are adhesive, and suitable substrate may be aquatic vegetation, rocks, or instream woody material (Moyle 2002).

Splittail

The assessment is based on the hypothesis that inundation of floodplain and bypasses during high flow years is needed to maintain population abundance. Change in spawning habitat area is assumed to result in a medium level of response—a change in spawning habitat area results in a proportional change in fry abundance.

Spawning habitat availability is dependent on inundation of floodplain and flood bypasses during January through April. The assessment is based on Sacramento River flow conditions that inundate the Sutter and Yolo Bypasses, the primary spawning areas for splittail. The Sutter Bypass is substantially inundated when Sacramento River flow near Colusa is greater than 25,000 cfs. The Yolo Bypass to 3.0 feet msl two times each day. The maximum change in SWP pumping (and CCF operations) could reduce the daily higher high tide from about 2.6 to 2.4 feet msl near the CCF gates (Section 5.2, Delta Tidal Hydraulics; Figures 5.2-60 through 5.2-62). The reduction in higher high tide attributable to change in SWP pumping is less with distance from the CCF gates. When closed during tide levels below 0.0 feet msl, the flow control gates block fish passage. When opened during tide levels greater than 0.0 feet msl, fish passage is restored. The volume of water exchanged during each tidal cycle is reduced by about 20% for the channels upstream of the gates on Middle River, Grant Line Canal, and Old River.

During the spring, the head of Old River fish control gate would be operated to block flow and movement of juvenile fall-run Chinook salmon and other fishes from the San Joaquin River into Old River from about April 15 through May 15, but could be operated as early as April 1 and extend through June 1. Juvenile Chinook salmon and juvenile steelhead begin migrating downstream before April 1 and may be vulnerable to entrainment. ~~, or~~ Closure of the Old River fish control gate before April 1 will be considered ~~other periods~~ as recommended by USFWS, NOAA Fisheries, and DFG (Table 6.1-12). Juvenile Chinook salmon move down the San Joaquin River past Stockton, a pathway believed to enhance survival relative to movement into Old River (Brandes and McLain 2001).

During fall, the head of Old River fish control gate would be operated to increase flow in the San Joaquin River past Stockton from about September 15 through November 30 or other periods as recommended by USFWS, NOAA Fisheries, and DFG. The increased flow in the San Joaquin River potentially improves water quality, including increased DO, in the San Joaquin River channel near Stockton (Giulianotti et al. 2003). Improved water quality could benefit upstream migrating adult Chinook salmon.

Chinook Salmon

The following assessment identifies potential construction-related impacts of implementing Alternative 2A on winter-, spring-, and fall-/late fall–run Chinook salmon in Central Valley rivers and the Delta. The assessment also identifies the impacts on Chinook salmon as a result of operating the gates. The environmental conditions affected under Alternative 2A were briefly discussed above. This section assesses the potential effects of those changes on survival, growth, fecundity, and movement of specific life stages for each run.

Impact Fish-1: Construction-Related Loss of Rearing Habitat Area for Chinook Salmon. Chinook salmon rear in the Delta. Construction of the gates in the south Delta and maintenance activities have the potential to permanently modify shallow vegetated areas that may provide rearing habitat for Chinook salmon. The area of shallow vegetated habitat affected by the gate footprints, riprapped levee, and dredging may total several acres (Table 6.1-12; Chapter 2, "Project Description," and Section 5.6, Sediment Transport).

The permanent gates constructed under Alternative 2A would have minimal effect on habitat within the construction footprint at the head of Old River, Predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the juvenile Chinook salmon moving past the structures. The determination is based on several factors. Design elements will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate juvenile Chinook salmon. Flow velocity would be similar to velocities within the channel upstream and downstream of the gates and agricultural intake extensions.

The transition zones between various elements of the gates (e.g., sheetpiles and riprap) could provide low-velocity holding areas for predatory fish. Predatory fish holding near the gates and agricultural intakes could prey on vulnerable species. The additional predator habitat created by the gates and intake extensions would have a less-than-significant impact on juvenile Chinook salmon because the increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural intakes. Disorientation and concentration of juvenile fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-6: Effects of Gate Operation on Juvenile and Adult Chinook Salmon Migration. The head of Old River fish control gate could be closed from April 14 to May 15 under Alternative 1 and could be closed from April 1 to May 31 under Alternative 2A (i.e., when San Joaquin River flow is less than 10,000 cfs) (Table 6.1-12), depending on decisions made by the GORT. Under Alternative 1 (No Action), a temporary fixed barrier is constructed each year. Under Alternative 2A, an operable gate would be constructed ~~with operable gates~~ that would allow a range of operations. Gate closure would minimize the movement of juvenile Chinook salmon into Old River. At a minimum, the gate would be closed during the same VAMP period (April 15 through May 15) as under Alternative 1, but the closure period could begin as earlier and end later as decided by the GORT to respond to real-time conditions. Although the effects of gate closure are similar for both Alternatives 1 and 2A, the operable gate constructed under Alternative 2A would provide increased opportunities (i.e., longer closure) for fish protection. The increased flexibility to operate the fish control gate is also considered a beneficial impact. The extent of this benefit depends on operations decided on by the GORT.

The head of Old River fish control gate may also provide benefits to adult Chinook salmon during upstream migration in September, October, November, and other months (Table 6.1-12). Hallock (1970) observed that adult Chinook salmon avoided water temperatures greater than 66°F if DO was less than 5 mg/l. Low DO in the San Joaquin River channel near Stockton may delay migration of fall-run Chinook salmon. High San Joaquin River flows past Stockton maintain higher DO levels (Hayes and Lee 2000). Closure of the head of Old River fish control gate increases the San Joaquin River flow past Stockton, but the increase in flow during years with low-to-average flow (less than 1,000 cfs) appears to have minimal effect on DO levels. Available data indicate that the operation of flow control gates could reduce DO in the San Joaquin River near Stockton during the summer, but closure of the head of Old River fish control gate September 15 through November 30 would result in DO levels that are the same for Alternatives 1 and 2A (Section 5.3, Water Quality; Figure 5.3-44). Migration of adult Chinook salmon would be protected. Although the benefit of closing the head of Old River fish control gate to upstream movement of adult fall-run Chinook salmon is uncertain for all flow conditions, an operable gate constructed under Alternative 2A would provide increased opportunities to evaluate the potential effects of increased flow under a wide range of San Joaquin River flow conditions (Table 6.1-12). The increased flexibility of an operable gate is a beneficial impact.

Gates in Middle River, Grant Line Canal, and Old River near Byron could affect access to rearing habitat in the south Delta channels and passage through the channels by adult and juvenile Chinook salmon during operation from April 15 through November and other months as needed (Table 6.1-12). Operation of the gates, however, generally avoids the period of adult and juvenile Chinook salmon movement through the Delta, except during May and June when juvenile Chinook salmon could be affected. During May, the proposed closure of the head of Old River Gate would transcend the effects of the gates on Middle River, Grant Line Canal, and Old River near Byron. In addition, the gate operations would have a beneficial effect relative to the existing temporary barriers. The existing temporary barriers are in place from mid-May through September and may also be in place in April to mid-May and in October and November, although the culverts on the Grant Line Canal barrier are tied open. Tidal flow overtops the barriers twice each day during the portion of tide that exceeds 1 foot msl. High tide approaches 3 feet msl, and total tidal volume in the channels upstream of the barriers is reduced by about 50% (Section 5.2, Delta Tidal Hydraulics). The gates constructed under Alternative 2A would operate from May through September. The gates would be open at tide elevations between 0.0 feet msl and about 3 feet msl, an increase in the tidal period currently allowed by the temporary barriers. Total tidal volume would approach 80% of the tidal volume without gates in place. Operable gates would have a beneficial impact on movement of adult and juvenile Chinook salmon because of the potential management flexibility and increased period of access to Middle River, Grant Line Canal, and Old River (i.e., passage conditions are provided at water surface elevations exceeding 0 feet msl under Alternatives 2A–2C versus passage provided at elevations exceeding 1 foot msl under Alternative 1). The increased flexibility of an operable gate is a beneficial impact.

Impact Fish-7: Effects of Head of Old River Gate Operation on Juvenile Chinook Salmon Entrainment. Closure of the head of Old River fish control gate during April 15 through– May 15, and possibly longer, under Alternative 2A would direct juvenile Chinook salmon down the San Joaquin River during most of the peak out-migration period. Installation of the temporary barrier reduces the number of juvenile Chinook salmon salvaged compared to years when the temporary barrier was not installed (San Joaquin River Group Authority 2003). Although the difference in the estimated survival with and without the gate is not statistically significant, relative survival for juvenile

Impact Fish-11: Construction-Related Loss of Steelhead to Direct Injury. Construction of the gates would include placement of sheetpiles and riprap and could directly injure fish present during the time of construction. Dredging could entrain and injure juvenile steelhead. Cofferdams, if used, would be installed to isolate gate construction areas from the channel. Placement of cofferdams in the channels could trap juvenile steelhead. Fish that become trapped inside the cofferdams could be killed during desiccation of the construction area and other construction activities. Direct injury associated with construction and maintenance activities, including dredging, would have a less-than-significant impact on steelhead because the number of fish injured is likely small given that:

- in-water construction, including the construction of a cofferdam, would occur between August and November;
- the area of construction activity is small relative to the channel area providing passage through the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years); and
- most juvenile and adult steelhead would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-12: Construction-Related Loss of Steelhead to Predation. Construction of gates and extension of agricultural intakes would add permanent structure and cover to the south Delta channels. The addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure. Similar to Chinook salmon, predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the juvenile steelhead moving past the structures. The determination is based on the same factors described for juvenile Chinook salmon (Impact Fish-7). No mitigation is required.

Impact Fish-13: Effects of Head of Old River Gate Operation on Juvenile ~~Steelhead Migration~~and Adult Steelhead Migration.~~.~~ Closure of the head of Old River fish control gate would minimize the movement of juvenile steelhead into Old River after April 15 (and possibly earlier), the same as for Chinook salmon juveniles (See Impact Fish-6). Most juvenile steelhead are salvaged between January and April at the state water facilities so entrainment can still occur before April 15. Although the effects of gate closure are similar for both Alternatives 1 and 2A, an operable gate constructed under Alternative 2A would provide increased opportunities for fish protection in response to new information on fish survival for variable flows and migration pathways. The increased flexibility is a beneficial impact.

Chinook salmon (Impact Fish-5), the addition of structure has the potential to increase the density of predator species and predation on fish moving around and past the structure. Concentrations of disoriented fish increase prey availability and create predator habitat.

Predation associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels could cause a small and likely negligible (i.e., less-than-significant impact) increase in mortality of the delta smelt moving past the structures. The determination is based on several factors. Design elements will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate delta smelt. Flow velocity would be similar to velocities within the channel upstream and downstream of the gates and the agricultural intake extensions.

The transition zones between various elements of the gates (e.g., sheetpiles and riprap) could provide low-velocity holding areas for predatory fish. Predatory fish holding near the gates and agricultural intakes could prey on vulnerable species. The additional predator habitat created by the gates and intake extensions would have a less-than-significant impact on delta smelt because the increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural intakes. Disorientation and concentration of juvenile and adult fish would be minimal given the size and design of the gates. No mitigation is required.

Impact Fish-20: Effects of Gate Operation on Delta Smelt Spawning and Rearing Habitat, and Entrainment. Under constant SWP and CVP pumping, gate closure causes additional net flow to be drawn from the San Joaquin River and south through Old River, Middle River, and Turner Cut (Section 5.2, Delta Tidal Hydraulics). The increased net flow toward the south may increase entrainment of larval and juvenile delta smelt (see the following section on Entrainment). The effects of gate closure are similar for Alternatives 1 and 2A, however the fish control gate constructed under Alternative 2A c~~w~~ould be operated for all of April and May. The GORT will use real time data to determine the best way to operate the gate before and after the April 15 through May 15 (VAMP) period.

Flow control gates in Middle River, Grant Line Canal, and Old River at DMC could affect access to spawning and rearing habitat for delta smelt in the south Delta channels. The gates constructed under Alternative 2A would be open at tide elevations between 0.0 feet msl and about 3 feet msl, an increase in the tidal range currently allowed by the temporary barriers. Total tidal volume would approach 80% of the tidal volume that would occur without gates in place. The flow control gates could have a beneficial impact on movement of delta smelt by enhancing access to Middle River, Grant Line Canal, and Old River. Measurable benefits to delta smelt, however, are likely small considering the assumed high probability that larval and juvenile delta smelt spawned in the south Delta would be entrained in diversions (see the following section on Entrainment).

construction and maintenance activities, including dredging, would have a less-than-significant impact on green sturgeon. This determination is based on the fact that:

- the area of construction activity is small relative to the channel area providing similar habitat quality in the south Delta;
- in-water construction and dredging would occur over a relatively short period (i.e., about 3 years) and be limited to the August to November timeframe; and
- most juvenile and adult green sturgeon would move away from construction activities and into adjacent habitat of similar quality.

No mitigation is required.

Impact Fish-40: Construction-Related Loss of Green Sturgeon to Predation. Increased predation could be associated with the addition of the operable gates and the agricultural intake extensions to the south Delta channels. Design elements, however, will minimize turbulence that could disorient fish and increase vulnerability to predation. The structures would not create conditions that could concentrate green sturgeon. The increase in potential predator habitat is small relative to habitat in adjacent areas, including the habitat currently created by the temporary barriers and habitat at the existing agricultural diversion intakes. Disorientation and concentration of juvenile fish would be minimal given the size and design of the gates. This impact is less than significant. No mitigation is required.

Impact Fish-41: Effects of Gate Operation on Green Sturgeon Migration. The head of Old River fish control gate weould be closed from April 15 through May 15~~4 to June 1~~ under both Alternatives 1 and 2A. Under Alternative 1, a temporary fixed barrier is constructed each year. Under Alternative 2A, an operable gate would be constructed with bottom-hinged gates that would allow a range of operations, including extension of the closure from April 1 through June 1, depending on decisions made by the GORT. Currently, there is no available data about the migratory paths of adult or juvenile green sturgeon. If green sturgeon migrate through the South Delta, the gate closure could minimize the movement of green sturgeon into the Sacramento River and out to the Pacific ocean. The effects of gate closure on sturgeon that may use the South Delta as a migratory path are unknown. However, closure of the Old River fish control gate would not preclude juvenile and adult sturgeon movement between the San Joaquin River upstream of Old River and the Sacramento River or Pacific Ocean. Closure of the head of Old River fish control gate increases the San Joaquin River flow past Stockton and green sturgeon that may migrate through the South Delta would presumably use the route past Stockton to migrate into the Saramento River and out to the Pacific Ocean. This impact is less than significant. No mitigation is required. Other gate operations would have the same effect on sturgeon.

mitigation measure ensures that impacts on fall-run Chinook salmon from the San Joaquin River would be less than significant.

SWP pumping capacity in excess of 6,680 cfs will not be allowed from May 16 through May 31 if EWA actions are taken to reduce entrainment. The reduction in allowable SWP pumping above 6,680 cfs provided by DWR as mitigation will not exceed the reduction in pumping for fish protection provided by EWA. The reduction from 8,500 cfs to 6,680 cfs will not be charged to the EWA as long as the EWA action reduces export pumping by at least 1,820 cfs.

Substantial uncertainty surrounds the assessment and the significance determination for entrainment-related impacts on fall-run Chinook salmon from the San Joaquin River. Uncertainty is associated with the following assessment assumptions:

- Entrainment-related loss increases linearly with increased SWP and CVP pumping. (Alternative assumptions: Entrainment-related loss is asymptotic, and increased SWP pumping beyond the asymptote results in minimal additional loss, or entrainment losses increase at higher pumping.)
- Most of the entrainment-related losses attributable to the SWP pumping are related to predation on juvenile Chinook salmon in CCF. (Alternative assumptions: Predation in CCF is not a major contributor to entrainment-related losses; and the level of predation in CCF is similar to predation in Delta channels.)
- Although the head of Old River fish control gate prevents fish from moving into Old River and increases survival, additional net movement of San Joaquin River flow into Turner Cut in response to increased SWP pumping increases entrainment-related mortality of juvenile Chinook salmon. (Alternative assumption: Net channel flow in Turner Cut, Old River, and Middle River does not affect survival of juvenile Chinook salmon in the San Joaquin River channel downstream of Stockton.)
- Entrainment-related mortality, including predation at the SWP and CVP pumping facilities, losses through the fish protection facilities, trucking and handling losses, and mortality attributable to SWP and CVP operations effects on channel flow conditions in the Delta, is sufficient to reduce juvenile abundance to a level that would affect population resilience and persistence. (Alternative assumption: Entrainment-related mortality and subsequent reduction in juvenile abundance would not affect population resilience and persistence.)

To help address these uncertainties, DWR and Reclamation will continue to support IEP and ~~CALFED Science Program initiatives~~related CALFED Program activities to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, and the efficacy of the head of Old River fish-control gate. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the end of the impact assessment section. This mitigation measure may be replaced by the long-term

Mitigation Measure Fish-MM-2: Minimize Entrainment-Related Losses of Juvenile Winter- and Spring-Run Chinook Salmon That May Be Caused by Increased SWP Pumping from March 1 through April 14 and May 16 through May 31. The significant impact of increased entrainment-related mortality of juvenile winter- and spring-run Chinook salmon is attributable to a simulated increase in SWP pumping during March (winter run) and April–May (spring run). This mitigation measure ensures that impacts on winter- and spring-run Chinook salmon would be less than significant and includes the following components that build upon and integrate with Mitigation Measure Fish-MM-1:

SWP pumping capacity in excess of 6,680 cfs will not be allowed from March 1 through April 14 if EWA actions are taken to reduce entrainment. The reduction in allowable SWP pumping above 6,680 cfs provided by DWR as mitigation will not exceed the reduction in pumping for fish protection provided by EWA. The reduction from 8,500 cfs to 6,680 cfs will not be charged to the EWA as long as the EWA action reduces pumping by at least 1,820 cfs.

DWR and Reclamation will continue to support IEP ~~and CALFED Science Program initiatives~~and related CALFED Program activities to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, and the efficacy of the DCC closure that is assumed to protect these Sacramento River fish. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the beginning of the impact assessment section above. This mitigation measure may be replaced by the long-term EWA if it is sufficient to operate from the Stage 2 permited SWP pumping basline.

Impact Fish-48: Operations-Related Reduction in Food Availability for Chinook Salmon. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for juvenile Chinook salmon. Changes in water supply operations potentially affect prey habitat in the Sacramento, Feather, and American Rivers. The flow simulated for 1922–1994 in the Sacramento, Feather, and American Rivers for Alternative 2A varies relative to flow under Alternative 1 (Figure 6.1-5). The reduction in flow in some months and increases for other months and years has minimal effect on the range of flows that could affect rearing habitat area for juvenile Chinook salmon (Table 6.1-14) and would likely have minimal effect on habitat supporting prey organisms. The impact on food for Chinook salmon would be less than significant.

Inundated floodplain in the Yolo and Sutter Bypasses provides important access by fish to prey organisms and input of nutrients to the rivers and Delta (Sommer and Harrell et al. 2001). As previously discussed for juvenile Chinook salmon rearing habitat, the frequency of floodplain inundation in the Yolo and Sutter Bypasses was estimated under Alternative 1 for the 1922–1994 water years (Figure 6.1-10). Most flooding occurs from December though April, coinciding with downstream movement and rearing by juvenile Chinook salmon in all runs (Table 6.1-2). Changes in water supply operations under Alternative 2A could reduce flooding in November of one year for the Sutter Bypass and in December

Impact Fish-52: Operations-Related Reduction in Survival of Coho Salmon in Response to Changes in Water Temperature in the Trinity River. Simulated water temperature for the Trinity River is nearly the same for Alternative 1 and Alternative 2A (Figure 6.1-14), although warmer and cooler water temperatures occur in some months. (Note: Points that fall off of the 45° line in the figures for water temperature indicate warming [above the line] or cooling [below the line] relative to the No Action Alternative.) As indicated previously, changes in Trinity River flow are minimal and would not affect water temperature. The simulated changes in water temperature under Alternative 2A are caused by simulated changes in export of Trinity River water to the Sacramento River (Figure 6.1-15). Although the annual water volume exported to the Sacramento River is nearly the same under Alternative 1 and Alternative 2A, the monthly volume of Trinity River exports under Alternative 2A varies from the volume exported under Alternative 1.

Water exported to the Sacramento River is released from Trinity Reservoir to Lewiston Reservoir. Water in Lewiston Reservoir is either released to the Trinity River or exported to the Sacramento River. When Trinity Reservoir releases are low during warmer months, water traversing Lewiston Reservoir warms considerably prior to release to the Trinity River. Under Alternative 2A, the warming of water temperature in some months coincides with reduced export of Trinity River water and the cooling coincides with increased export.

~~Increased water temperature in the Trinity River during the fall months could have an adverse effect on coho salmon and other salmonids.~~ Survival indices were assigned to the water temperature simulated for each month of occurrence for adult migration, spawning, juvenile rearing, and smolt migration life stages of coho salmon in the Trinity River. Water temperature conditions under Alternative 1 are optimal (an index of 1) for most months (Table 6.1-25). For all life stages, the water temperature survival indices are nearly the same for Alternatives 1 and 2A (Table 6.1-26). The frequency of change in indices for adult migration show the most change, but only 8 months out of 288 simulated months of migration are affected, and the number of declines in the survival indices is similar to the number of increases. The shift in water temperature survival indices would not affect adult migration or other life stages. The change in water supply operations under Alternative 2A would not affect survival of coho salmon in the Trinity River. This potential impact is less than significant. No mitigation is required.

pumping that is above the existing permitted capacity. Under this mitigation component, for each 100 taf of non-EWA pumping above the existing permitted capacity, a pumping reduction credit, ranging from 10 taf to 30 taf, could be used by EWA to reduce pumping during periods of high fish density.

This relatively simple avoidance of impacts during periods of EWA actions, in addition to an EWA credit for mitigation of periods with remaining pumping above the existing permitted capacity, will reduce the delta smelt entrainment impacts to less than significant. DWR and Reclamation will coordinate with DFG, NOAA Fisheries, and USFWS to determine the appropriate credit percentage.

When an expanded EWA (i.e., greater than CALFED ROD EWA) is implemented by CALFED, as assumed in the 2004 OCAP documents, this SDIP mitigation measure would no longer be required because the expanded EWA is assumed to be sufficient to mitigate any entrainment impacts from the incremental pumping above the existing permitted capacity. The SWP has proposed increased funding through an amended Four-Pumps Agreement to support SDIP mitigation measures, including an expanded EWA. In the absence of the EWA, that increased funding would continue to be available to DFG to mitigate impacts of the SDIP through purchases of water to reduce pumping during critical periods for fish or other mitigation strategies developed through the adaptive management process.

DWR and Reclamation will continue to support IEP and related CALFED Program activities ~~CALFED Science Program initiatives~~ to better understand and quantify the actual entrainment-related losses at the CVP and SWP salvage facilities, improved salvage techniques for delta smelt, and the effects of the head of Old River fish control gate on the movement of relatively high densities of delta smelt from the vicinity of Franks Tract. This mitigation measure could be modified, as described under the adaptive management framework that is summarized at the beginning of the impact assessment section above, utilizing in whole or in part, increased funds available through the Four-Pumps Agreement.

Impact Fish-64: Operations-Related Reduction in Food Availability for Delta Smelt. Many of the same factors affecting rearing habitat area would be expected to affect food production and availability for delta smelt. As discussed above for rearing habitat area, changes in water supply operations potentially affect estuarine rearing habitat area for delta smelt in the Delta and Suisun Bay. Location of rearing habitat area downstream of the Delta is believed to increase food availability for delta smelt (U.S. Fish and Wildlife Service 1996). The broad and shallow areas of Suisun Bay allow algae to grow and reproduce rapidly, providing food for zooplankton, which are food for delta smelt. Greater rearing habitat area for delta smelt coincides with location downstream of the Delta and within the areas of higher zooplankton production. The change in estuarine rearing habitat area under Alternative 2A is small (generally less than 5%) and infrequent for most years during all months (Figure 6.1-18). Given the few rearing months affected, especially during April

Stage 2 (Operational Component)

The monthly state and federal operational patterns of Alternative 4B are the same as Alternative 2B (see Alternative 2B in Sections 5.1, Water Supply, and 5.3, Water Quality). Therefore, the operational impacts resulting from state and federal operations under Alternative 4B are the same as described for Alternative 2B.

Thus, operations-related impacts for Alternative 4B on Chinook salmon, steelhead, delta smelt, splittail, striped bass and green sturgeon are the same for operational impacts described for Alternative 2B under 2001 conditions.

2020 Conditions

Water supply for Alternative 4B under 2020 conditions are similar to water supply for 2001 conditions. Streamflows, pumping, and diversions associated with Alternative 4B simulated under 2020 conditions are similar to the 2001 conditions simulation. Therefore, the operations-related impacts for Alternative 4B under 2020 conditions and their levels of significance on Chinook salmon, steelhead, delta smelt, splittail, striped bass and green sturgeon are the same as the impacts described for 2001 conditions, and subsequently, are nearly the same as Alternative 2B under 2001 conditions.

Adaptive Management

To address uncertainties associated with the effectiveness of some of the mitigation measures described for SDIP alternatives, DWR and Reclamation will implement these measures based on the principles of adaptive management, which allow these measures to be adjusted over time, based on results of monitoring and research. The mitigation measures that are subject to adaptive management are related to measures designed to minimize effects on special-status fish species. These species and mitigation measures are shown below:

- Delta smelt—
  - Minimize Entrainment Losses of Juvenile Delta Smelt Associated with Increased SWP Pumping during March–June.
- Central Valley fall-/late fall–run Chinook salmon, Central Valley spring-run Chinook salmon, Sacramento winter-run Chinook salmon, and Central Valley steelhead—
  - Minimize Entrainment-Related Losses of Juvenile Fall-/Late Fall–Run Chinook Salmon Associated with Increased SWP Pumping during March–June.

Results of SDIP effectiveness monitoring and relevant monitoring and research will be conducted consistent with the CALFED Science Program and ~~conducted through the CALFED Science Program~~ will be used to determine the effectiveness of these mitigation measures in minimizing effects on special-status gate operation choices to provide maximum water level, water quality, and fish protection benefits from the flow control gate operations:

1. Operation of the CCF intake gates have two main effects that must be balanced: If the gates are closed during the flood-tide flows prior to the high tide each day, the tidal flushing in south Delta channels can be maximized, and levels at high tide throughout the south Delta channels are preserved. This will allow Tom Paine Slough siphons to operate and provide the maximum tidal flushing upstream of the flow control gates. Fish migration patterns for Chinook salmon or delta smelt might be triggered or cued to tidal fluctuations or diurnal periods (i.e., dawn and dusk). As more is learned about these diurnal or tidal migration patterns, the CCF gate schedule might be modified to reduce opening at peak fish density periods within the day. The CCF intake gates, however, must be opened for a sufficient period each day to maintain the CCF elevations above -2.0 feet msl to prevent cavitation problems at SWP Banks, which is often used for maximum off-peak (nighttime) pumping.

2. The head of Old River fish control gate can be operated to reduce the San Joaquin River diversions into Old River. This will increase the San Joaquin River flow past Stockton and improve DO conditions in the DWSC, which is assumed to provide fish habitat benefits. Reduction of the head of Old River diversions will also reduce the inflow of higher-salinity San Joaquin River water into the south Delta channels. This may also be beneficial for adult up-migrating Chinook salmon past Stockton during the months of September through November. However, reduced diversions will cause more water to be drawn from the central Delta to supply the CVP and SWP pumping, which may increase entrainment of some larval or juvenile fish (e.g., delta smelt) from the central Delta. Partial closure of the head of Old River gate will also shift the distribution of San Joaquin River salinity away from the CVP Tracy facility toward the CCWD intakes and the SWP Banks facility. There do not appear to be any substantial effects on water levels in the south Delta channels from reduced San Joaquin River diversions at the head of Old River if flow control gates are being operated. Closure of the fish control gate for fish protection or DO improvement may be possible for more of the time than was simulated in the DSM2 modeling of the SDIP alternatives~~.~~, or for less of the time than was simulated if other fish concerns appear to be more important. The GORT will direct these gate operation decisions, considering real-time data and the range of possible benefits and impacts. ~~The fish control gate operations must satisfy the SDIP objective to protect outmigrating Chinook salmon juvenile smolts, as well as satisfy HY-MM-2, WQ-MM-2, WQ-MM-3, and WQ-MM-4.~~

3. The flow control gates at Grant Line Canal, Old River at DMC, and Middle River can be used to control the water levels in the south Delta channels. In addition, ebb-tide closure of the Old River and Middle River flow control gates can produce a net circulation upstream on Old River and Middle River and downstream in Grant Line Canal. The simulation of the ~~This~~ ebb-tide closure of Old and Middle River flow control gates ~~was simulated~~indicated~~is expected~~that there would be ~~to have~~ a beneficial effect on salinity in these south Delta channels. ~~and should be considered for Alternatives 2A, 2B, and~~

~~2C, although only required as mitigation for Alternative 3B.~~ The ebb-tide closure of the flow control gates is not anticipated to substantially ~~change~~ interrupt ~~the~~ fish movement patterns that ~~are~~ may be triggered by or associated with tidal flows. The GORT will direct these gate operation decisions, considering real-time data and the range of possible benefits and impacts.

~~Mitigation Measures HY-MM-1, HY-MM-2, and HY-MM-3, as well as WQ-MM-1, WQ-MM-2, WQ-MM-3, and WQ-MM-4, involve operations of the CCF gates, the head of Old River fish control gate, and the Old River and Middle River flow control gates to provide more suitable tidal hydraulic and water quality conditions in the south Delta channels, and provide protection for migrating fish in the San Joaquin River. These mitigation measures will vary on a day-by-day basis depending on the inflows, export pumping, and water quality conditions measured at Vernalis and within the south Delta, as well as fish densities measured at the CVP and SWP salvage facilities and in the Mossdale trawls. Each of these mitigation measures therefore should be implemented using these recommended adaptive management procedures for operating the south Delta flow control gates.~~

Table 6.1-2. Assumed Life Stage Timing and Distribution of Selected Species Potentially Affected by the Proposed SDIP Alternatives — Page 1 of 3

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Late Fall–Run Chinook Salmon													
Adult Migration	SF Bay to Upper Sac River and Tributaries, Mokelumne River~~, and SJR Tributaries~~	■	■								■	■	■
Spawning	Upper Sacramento River and Tributaries, Mokelumne River~~, and SJR Tributaries~~	■	■	■									
Egg Incubation	Upper Sacramento River and Tributaries, Mokelumne River~~, and SJR Tributaries~~	■	■	■	■	■							
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries, Mokelumne River~~, and SJR Tributaries~~			■	■	■	■	■	■	■	■	■	
Juvenile Movement and Rearing	Upper Sacramento River and Tributaries, Mokelumne River~~, and SJR Tributaries~~	■	■	■	■	■	■				■	■	■
Fall-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries and SJR Tributaries[1]							■	■	■	▨	▨	▨
Spawning[2]	Upper Sacramento River and Tributaries and SJR Tributaries[1]										▨	▨	▨
Egg Incubation[2]	Upper Sacramento River and Tributaries and SJR Tributaries[1]	▨	▨	▨							▨	▨	▨
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries and SJR Tributaries[1]	▨	▨	▨	■	■	■						
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay and SJR Tributaries[1]	■	■	▨	▨	▨	▨						■
Spring-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries			■	■	■	■	■	■	■			
Spawning	Upper Sacramento River and Tributaries								■	■	■		
Egg Incubation	Upper Sacramento River and Tributaries								■	■	■	■	■
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries	■	■	■	■	■	■	■	■	■	■	■	■

Table 6.1-2. Continued

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Winter-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River												
Spawning	Upper Sacramento River												
Egg Incubation	Upper Sacramento River												
Juvenile Rearing (Natal Stream)	Upper Sacramento River to SF Bay												
Juvenile Movement and Rearing	Upper Sacramento River to SF Bay												
Steelhead													
Adult Migration	SF Bay to Upper Sacramento River and Tributaries and SJR Tributaries												
Spawning	Upper Sacramento River and Tributaries and SJR Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries and SJR Tributaries[1]												
Juvenile Rearing	Upper Sacramento River and Tributaries to SF Bay and SJR Tributaries												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay and SJR Tributaries												
Southern Oregon/Northern California Coasts Coho Salmon													
Adult Migration	Trinity River												
Juvenile Rearing	Trinity River												
Juvenile Movement	Trinity River												

Table 6.1-2. Continued

Page 3 of 3

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Splittail													
Adult Migration	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Sacramento River and SJR												
Spawning	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Lower Sacramento and SJ Rivers												
Larval and Early Juvenile Rearing and Movement	Suisun Marsh, Upper Delta, Yolo Bypass, Sutter Bypass, Lower Sacramento and San Joaquin Rivers												
Adult and Juvenile Rearing	Delta, Suisun Bay												
Delta Smelt													
Adult Migration	Delta												
Spawning	Delta, Suisun Marsh												
Larval and Early Juvenile Rearing	Delta, Suisun Marsh												
Estuarine Rearing: Juveniles and Adults	Lower Delta, Suisun Bay												

Notes:

SF Bay = San Francisco Bay.

SJR = San Joaquin River.

[1] Boxes with hash marks denote timing for the San Joaquin River and the Sacramento River.

[2] Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers

Sources: Brown 1991; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989; Baker and Morhardt 2001; Foss 2004.

Table 6.1-12. Continued

Project Actions	Impact Mechanisms Associated with Implementing Project Actions	Affected Environmental Conditions
Operate gates on Middle River, Grant Line Canal, and Old River and a fish control structure at the head of Old River	Operate the gates (i.e., Middle River, Grant Line Canal, and Old River) to maintain a minimum level above 0.0 feet mean sea level during May through September. Operate the head of Old River gate to minimize movement of juvenile fall-run Chinook salmon from the San Joaquin River into Old River from April 1 to May 31., or as recommended by USFWS, NOAA Fisheries, and DFG. Operate the head of Old River gate to increase flow in the San Joaquin River past Stockton during September 15–November 30.	Gate: the closure of the bottom-hinged gates at the head of Old River will block flow and fish movement; closure of the bottom-hinged gates at other gates will block flow and fish movement during levels less than 0.0 feet mean sea level. Level: operation of the gate will maintain level at 0.0 feet mean sea level in the channels on the upstream side of the gates and potentially reduce inter-tidal area. Flow velocity: operation of the gate will affect circulation in the channels on the upstream and downstream side of the gates. Net flow direction: depending on interaction between inflow and diversions, net flow direction may change in some channels. Soil moisture: higher level could increase soil moisture elevation on lands adjacent to the affected channels. Cover: change in level could affect maintenance and establishment of riparian and aquatic vegetation, affecting the availability of cover. Contaminants: change circulation may change residence time and volume and the concentration of salts, pesticides, nutrients, and other materials from agricultural return flows. Water temperature: change in circulation could change water temperature. Dissolved oxygen: change in circulation could change dissolved oxygen levels. Predator effectiveness: the operation of the gates could potentially create feeding areas for predator species and hydraulic conditions that disorient prey. Non-native predator species: change in cover, depth, and velocity may alter habitat to favor non-native species in the channels between gates. Food: change in residence time, in combination with change in contaminants, may affect food production.

Section 7.1

Local

Contra Costa County

The Contra Costa County General Plan incorporates policies developed by the DPC under the Delta Protection Act. The General Plan allows construction of public facilities regardless of underlying General Plan or zoning designations. Government Code Section 53091 states that county zoning ordinances "shall not apply to the location or construction of facilities for the production, generation, storage, or transmission of water."

San Joaquin County

The San Joaquin County General Plan includes the incorporation of policies developed by the DPC under the Delta Protection Act. The Community Development Section (IV) of the General Plan addresses protection of open space and natural resources. Section VI of the General Plan addresses the protection of resources, including agricultural lands. However, public water supply and treatment facilities are exempt from these requirements as set forth in California Government Code Section 53091.

The proposed gate sites in San Joaquin County would be adjacent to areas designated General Agriculture (40-acre and 80-acre) and Open Space/Resource Conservation (Riparian Habitat, Significant Vegetation, and Mineral Resources) on the General Plan 2010 map of San Joaquin County. Development in areas designated General Agriculture is restricted to agricultural and related uses; other uses generally would require a conditional-use permit.

Because public water supply and treatment facilities are exempt from zoning requirements, as set forth in California Government Code Section 53091, the SDIP is not subject to the requirements of the Chapter 9 County Development Title, which serves as the County Zoning Code.

Significance Criteria

For the purposes of this analysis, impacts on land use are considered significant if implementation of the alternatives would:

- result in a substantial alteration of the present or planned land use patterns of an area, including physical disruption or division of an established community;
- conflict with adopted environmental plans and goals of local jurisdictions, or state or federal regulatory agencies, including general plans, community plans, and zoning; or
- convert a substantial amount of important farmland (lands designated as prime, statewide important, unique, or locally important) to nonagricultural use, or impair the agricultural productivity of important agricultural land.

additional right-of-way and would not result in the conversion of additional land. (California Department of Water Resources 2003b.)

As described above, no significant land use conflicts would result from the construction of the permanent operable gates because most land use conversions would occur immediately adjacent to the gates and would result in the conversion of only a small amount of farmland. A total of approximately 21 acres would be converted in the south Delta region. Land uses adjacent to and in the vicinity of the gates would not be affected during construction of the gates. This impact is less than significant. No mitigation is required.

Impact LW-2: Conversion of Important Farmland to Nonagricultural Use as a Result of Constructing the Permanent Fish and Flow Control Gates. Constructing the gates would result in the permanent conversion of approximately 20 acres of farmland classified as *prime*, and less than 1 acre classified as *unique* (Table 7.1-1). Estimated agricultural conversion under Alternatives 2A–2C is shown in Table 7.1-1. Conversion of farmland is estimated to range from 1.16 acres at the head of Old River gate to 10.7 acres at the Grant Line Canal gate.

Table 7.1-1. Agricultural Conversion Estimates (acres)

	Alternatives 2A–2C		Alternative 3B		Alternative 4B	
Farmland Category	Permanent Conversion of Farmlands—Gates	Temporary Conversion of Farmlands—Spoils Ponds	Permanent Conversion of Farmlands—Gates	Temporary Conversion of Farmlands—Spoils Ponds	Permanent Conversion of Farmlands—Gates	Temporary Conversion of Farmlands—Spoils Ponds
Prime	20.3		9.6		1.16	
Unique	0.045		0.045			
Total Farmlands	20.35	205	9.65	205	1.16	205

Placement of spoils ponds for channel dredging activities has not yet been determined. However, most lands in the vicinity of the channels are prime and unique.
Total important farmlands in San Joaquin County in 2001: 630,990.
Total irrigated farmlands in Contra Costa County in 2001: 55,904.
Source: California Department of Conservation 2000.

The 21 acres of land that would be removed from agricultural production as a result of implementation of Alternatives 2A–2C represent substantially less than 1% of the approximately 630,990 acres of important farmland in San Joaquin County (Department of Conservation 2002a). The 21 acres that would be converted by Alternatives 2A–2C would include 20.3 acres of prime farmland (as defined by the NRCS) and 0.045 acre of unique farmland.

The temporary use of farmlands for spoils ponds and drying areas would result in the temporary conversion of up to 126 acres of prime farmland. (This number is calculated based on the assumption that all spoils ponds areas shown in Figure 2-10 would be used. However, it is anticipated that a substantially less amount of land would be needed to dry the spoils.) The spoils ponds would be used for up to seven years. They would be decommissioned and the areas would be returned to pre-project conditions. If suitable, the dredged material could be spread over these farmlands and used to stabilize levees. However, DWR and Reclamation have committed to ensuring that there is no permanent affect on the lands used for spoils ponds. Determination of the suitability of dredged material as well as potential disposal methods, are described in the Environmental Commitments section of Chapter 2.

A Farmland Conversion Impact Rating form, NRCS Form AD-1600, has been submitted to the NRCS for completion and review for consistency with FPPA (Appendix N). According to FPPA, if a project alternative site has an impact rating of less than 160 points, the site should be considered only minimally for protection, and no additional alternative project sites need to be evaluated. For Alternatives 2A–2C to exceed the 160-point standard established on the Farmland Conversion Impact Rating Form, the NRCS would need to assign at least 73 points to the relative value of the land to be converted.

Factors considered by NRCS in the evaluation of the relative value of the land to be converted are: total acres of prime and unique farmland affected by the project; total acres statewide and local important farmland affected by the project; percentage of farmland in county or local government unit to be converted; and percentage of farmland in government jurisdiction with the same or higher relative value. Because the total acreage of prime, unique, and local important farmland that would be converted is approximately 21 acres, and the total acreage to be converted represents substantially less than 1% of the total important farmland in San Joaquin County, the NRCS has determined that the relative value of the land to be converted will be 68 points and would not significantly contribute to the irreversible conversion of farmland to nonagricultural uses or be inconsistent with FPPA.

Because the total acreage of lands to be converted from important farmland to nonagricultural use would be spaced apart over a large geographical area, the remaining farmlands would continue to be usable for agriculture, and the relative value of the land would not exceed the NRCS threshold, this impact is considered less than significant. No mitigation is required.

Impact LW-3: Conflict with Williamson Act and Farmland Security Zone Contract Lands as a Result of Constructing the Permanent Fish and Flow Control Gates. Under Alternatives 2A–2C, 17.8 acres of the 21 affected by Alternatives 2A–2C are subject to Williamson Act contracts; 2.54 acres are currently under FSZ contract. Certain uses are considered compatible uses of land under Williamson Act contracts (contracted lands), including agricultural, open space, and recreational uses, and uses determined by the agency administering the contract to be consistent with the intent of the Williamson Act. Uses of contracted land other than agricultural and open space uses are typically considered incompatible. Conversion to public facility uses would require Williamson Act and FSZ contracts to be terminated only for the portions of contracted land acquired for the SDIP.

Section 7.10

Stage 2 (Operational Component)

Alternative 4B would not have an effect on the Trinity River flows or Shasta Reservoir storage according to CALSIM II modeling results (See Section 5.1, 6.1 and <http://modeling.water.ca.gov> for details). Therefore, there would be no adverse effects on Hoopa Valley Tribe fishery as a result of implementation of the SDIP. There is no impact and no mitigation is required.

Although the Colusa Rancheria is located adjacent to the Sacramento River, the river flows are not expected to fluctuate outside of the normal range with the implementation of Alternative 4B. Natural patterns of erosion and sedimentation along the river are expected to stay the same with the implementation of Alternative 4B. There is no impact and no mitigation is required.

The water that is proposed for pumping has already been contracted for, and all of the water used for the SDIP has been previously allocated. This project does not result in any new allocation of water. There is no impact and no mitigation is required.

2020 Conditions

Risks to ITAs associated with implementation of Alternative 4B under 2020 conditions would be similar to risks that would occur under 2001 conditions. Therefore, the impacts under 2020 conditions would be similar as those described above. All impacts are less than significant and no mitigation is required.

Cumulative Evaluation of Impacts

The SDIP would not result in any impacts on ITAs and therefore would not contribute to any cumulative impacts.

Comments Received From Tribes on the Draft EIS/EIR

The Hoopa Valley Tribe (Tribe) has expressed concerns about Reclamation's conclusions regarding potential impacts to the Tribe's federally-reserved fishing rights which are Indian trust assets. As stated in the Indian Trust Asset section above, these assets are legal property interests which the United States (Reclamation) must protect and maintain for the Tribe. The Tribe cites the following concerns about the SDIP DEIS and its potential to affect Indian trust assets:

1. The SDIP DEIS "fails to discuss the fact that the proposed Trinity Reserovoir carry-over storage may have negative effects on the survivial of Trinity River fisheries and does not comply with the storage mandates of the Trinity River EIS". The SDIP DEIS must conform to the Trinity River Mainstem Fishery Restoration EIS (Oct. 2000) and the Trinity River Record of Decision ("ROD"); it should clearly state that the proposed action here is not intended to change the Trinity ROD in any way".

2. The SDIP DEIS "only includes a limited analysis of the effects on coho salmon and does not analyze effects, including temperature, on fall and spring Chinook, winter and summer steelhead, lamprey and sturgeon".

3. The SDIP DEIS should acknowledge that CVPIA § 3406 (b)(23) mandates the "Secretary's fiduciary duty to meet instream flow requirements of the Trinity River" and that the SDIP DEIS "description and manner of addressing Indian trust assets is incomplete and incorrect".

Reclamation's responses correspond to the numbered statements above by the Hoopa Valley Tribe concerning the SDIP DEIS and its potential to affect Indian trust assets, follow:

1. The SDIP DEIS/EIR does conform to the Trinity River Mainstem Fishery Restoration EIS and Record of Decision. The minimum flows required under the ROD were specified in the 2001 baseline and alternatives (except the wet year and above normal year flows are less than those specified in the ROD) and all Trinity River ROD flows were included in the 2020 baseline and alternatives. The CALSIM output indicates that there would be no changes in Trinity River monthly flows in the 2001 or the 2020 alternatives.

Since flows in the Trinity River would not change, it is expected that the temperature and other habitat conditions would remain the same. The SDIP will therefore have no effects on the federally reserved fishing rights on the Klamath and Trinity Rivers.

The Stage 1 decision (the decision on the physical/structural component of SDIP) will be based solely on this draft EIS/EIR and does not include any changes in reservoir operations. Additionally, the Stage 2 decision to follow after the Stage 1 decision is made (the Stage 2 decision is on operational component) will not be implemented until additional information is obtained and a separate analysis is completed pursuant to CEQA and NEPA.

Although for most resources, the 2001 baseline was used for purposes of CEQA analysis, the CALSIM model used the 72-year historical record of hydrology, which represents a range of possible hydrological conditions for the CVP and SWP. This allows the project to be compared to a variety of year types including wet, dry and average years. Therefore, the CALSIM outputs are not based solely on 2001. Appendix Q of the Draft EIS/EIR contains a specific discussion of the potential effects of SDIP on the Trinity River Division of the CVP. Summary graphs show the comparison of 2020 baseline and Alternative 2A results for annual carryover storage, monthly Trinity River flows, and monthly Trinity exports to the Sacramento River. Except for some slight month-to-month modeling variability, these monthly values are not changed by the SDIP.

The Tribe may review the CALSIM results for the SDIP baselines and alternatives that are available in a single Excel spreadsheet (MacroSets_RussOutputs_10-18-05.xls) from the SDIP website (ftp://ftp.modeling.water.ca.gov/pub/SDIP/DSM2_SDIP_results).

No changes in minimum monthly Trinity River releases at Lewiston are simulated for the 2001 or 2020 alternatives. No additional exports from the TRD are simulated for the 2001 or 2020 alternatives. No changes in the pattern of carryover storage were simulated for the 2001 or 2020 alternatives.

2. The SDIP DEIS focuses on Coho salmon life history and the possible effects the project could have on the various Coho life-stages, such as adult migration, spawning and juvenile rearing. The analysis uses Chinook salmon water temperature criteria because the water temperature ranges and timing for adult and juvenile migration are comparable (See Appendix K, Table K.1-7). As stated in 1.above, since flows in the Trinity River would not change, it is expected that the temperature and other habitat conditions would remain the same.

While it is recognized that different species of fish have slightly different temperature criteria and life history strategies, Chinook salmon temperature criteria were used in the temperature assessment as representative of migration and rearing criteria for salmonids. Coho rearing life-stage provides an assessment for all months, although Coho would generally rear in the tributaries, which are unaffected by the Lewiston release flows. Steelhead have similar water temperature ranges to Coho. Lamprey and sturgeon have water temperature criteria that are slightly warmer than for Chinook salmon.

Chinook salmon temperature criteria indices (Table 6.1-7) were used for Coho because they have similar temperature tolerances. Table K.1-14 indicates that the temperature indices for rearing were 1.0 (<67 F) for all months. The temperature indices for adult migration (September-December) were less than 1.0 (greater than 60 F) in 10 months. The temperature modeling results indicated that Trinity River at North Fork water temperatures did not change with any of the project alternatives. The Lewiston water temperatures increased slightly in a few months, reducing the temperature indices (Table K.2A-16).

A complete temperature evaluation was not made for the other species, because the Chinook temperature criteria were representative and sufficient to indicate that no temperature effects on the Trinity River will result from the SDIP because no substantial changes in Trinity River flows, Trinity exports, or Trinity Reservoir carryover storage will occur under SDIP.

3. The Hoopa Valley Tribe appropriately cites in its comments the Central Valley Project Improvement Act (CVPIA) section 3406(b)(23) as Congressional

direction insuring "the development of recommendations based on the best available scientific data, regarding permanent instream fishery flow requirements . . ." and specifically directed the completion of the 12-year Trinity River Flow Evaluation Study (TRFES) [1]. Furthermore, upon concurrence of the Secretary and the Hoopa Valley Tribe, this section 3406(b)(23), congressionally mandates the Secretary to "implement accordingly[2]" any increase to the minimum Trinity River instream fishery releases and the operating criteria and procedures.

Should SDIP be realize, the CVP water it conveys will be subject to many authorities and constraints including provisions of Federal Law such as CVPIA, rules and regulations promulgated by the Secretary of the Interior, and applicable provisions of the Trinity River Mainstem Fishery Restoration Record of Decision(ROD), signed by the Chairman of the Hoopa Valley Tribe and the Secretary of the Interior, Bruce Babbitt, on December 19, 2000.

As the Tribe has noted, the Trinity River Mainstem Fishery Restoration Record of Decision ROD "culminated nearly twenty years of detailed, scientific efforts, conducted over the course of the past four Administrations, and documents the selection of actions determined to be necessary and appropriate to restore and maintain the anadromous fishery resources of the Trinity River"and "The necessity for these actions results from the various statutory obligations of the Department as well as the federal trust responsibility to the Hoopa Valley and Yurok Indian Tribes."3

"For reasons expressed in this ROD, the Department's agencies are directed to implement the Preferred Alternative as described in the FEIS/EIR . . ." and "This alternative best meets the statutory and trust obligations of the Department to restore and maintain the Trinity River's anadromous fishery resources, based on the best available scientific information, while also continuing to provide water supplies for beneficial uses and power generation as a function of Reclamation's Central Valley Project (CVP)."4

The ROD "recognizes that restoration and perpetual maintenance of the Trinity River's fishery resources requires rehabilitating the river itself, restoring the attributes that produce a healthy, functioning alluvial river system".5

Therefore, because (1) Reclamation's federal trust obligations to the Hoopa Valley Tribe are depicted and directed in the Trinity River Mainstem Fishery Restoration Record of Decision and CVPIA, and that (2) SDIP must utilize CVP water in accordance with all applicable legal requirements, and that (3) the Trinity River Mainstem Fishery Restoration Record of Decision and the CVPIA are among those requirements, and that (4) the nearest Indian trust assets to the SDIP project area, in the north-of-the-Delta area, is the Colusa Rancheria

[1] Section 3406(b)(23)(A) of the Central Valley Project Improvement Act (CVPIA) *P.L. 102-575 (1992)*
[2] Section 3406(b)(23)(B) of the Central Valley Project Improvement Act (CVPIA) *P.L. 102-575 (1992)*
[3] Paragraph 1, Page 2 from the Trinity River Mainstem Fishery Restoration Record of Decision (ROD)
[4] Paragraph 2, Page 2 from the Trinity River Mainstem Fishery Restoration Record of Decision (ROD)

[5] Paragraph 4, Page 2 from the Trinity River Mainstem Fishery Restoration Record of Decision (ROD)

(adjacent to the Sacramento River) located 90 miles north the project area, and lastly (5) there are no Indian tribes with a federally-reserved rights to the water potentially conveyed through the SDIP. Reclamation concludes that the SDIP will have no impact, direct or indirect, on the Hoopa Valley Tribe's trust assets or the trust assets of any other federally-recognized tribe, and therefore no changes are made to the final EIS.[6]

[6] Required statement as directed in the Environmental Compliance Memorandum No. ECM97-2, dated May 8, 1997.