Delta Independent Science Board

DELTA STEWARDSHIP COUNCIL

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December 16, 2022

California Department of Water Resources,
Attn: Delta Conveyance Office
P.O. Box 942836
Sacramento, CA 94236-0001

Delivered via email: deltaconveyancecomments@water.ca.gov

RE: Review of the Draft Environmental Impact Report for the Delta Conveyance Project

To whom it may concern:

In accordance with our responsibilities to provide scientific oversight of programs that support adaptive management, as specified in the Delta Reform Act of 2009, the Delta Independent Science Board (Delta ISB) is submitting our review of the draft Environmental Impact Report for the Delta Conveyance Project that was released by the California Department of Water Resources on July 27, 2022. Our review report is enclosed, along with references cited in our review.

To help inform our comments, we would like to thank the California Department of Water Resources for quickly responding to our data requests and for providing updates on the Delta Conveyance Project at our public meetings prior to the release of the draft Environmental Impact Report.

If you have any questions or comments on the review, or would like to meet to discuss any aspects of the review, please email us at disb@deltacouncil.ca.gov.

Sincerely,

Lisa Wainger, Ph.D.
Chair, Delta Independent Science Board

December 16, 2022

Attachment
Review of the Draft Environmental Impact Report for the Delta Conveyance Project by the Delta Independent Science Board

CC

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DEC 2022

Review of the Draft Environmental Impact Report for the Delta Conveyance Project

Delta Independent Science Board

DELTA STEWARDSHIP COUNCIL

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Created by the Delta Reform Act of 2009 and appointed by the Delta Stewardship Council, the Delta Independent Science Board is a standing board of nationally and internationally prominent scientists that provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Sacramento-San Joaquin Delta through periodic reviews.

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Acknowledgments

The Delta Independent Science Board would like to thank the following California Sea Grant fellow/postdoctoral scholars who assisted with project coordination along with conducting research and analysis to help inform the Board's review.

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Part I: Major Findings of the Delta Conveyance Project Draft Environmental Impact Report Review

1. Major Findings

The Delta Independent Science Board (Delta ISB) review of the Delta Conveyance Project draft Environmental Impact Report (EIR) assesses the scientific rigor used therein and provides suggestions for improvements. We address two basic topics in our review of the draft EIR:

A. Quality of the science: Does the EIR use robust, up-to-date, and comprehensive scientific approaches to evaluate project alternatives and their effects? Are the statements and conclusions supported by current scientific information and understanding? Are the time and space scales appropriate? Are assumptions and uncertainties clearly stated?
B. Completeness of the science: Are the analyses complete for understanding the impacts of the proposed project? Are the analyses missing key scientific approaches or scales of application that would provide further/better insight? Are additional analyses needed?

In general, we find that the quality of the science varies by the impact type evaluated. Several impact analyses are missing elements, thereby increasing the uncertainty of findings. There are multiple cross-cutting and chapter-specific analytic omissions, particularly regarding effects of operational decisions, mitigation effectiveness, and climate change uncertainty. Collectively, these omissions lead to a partially inadequate representation and discussion of potential project impacts and benefits.

The draft EIR uses a wide variety of analytical methods and detailed performance metrics to compare the performance and impacts of nine alternatives for a proposed Delta conveyance project. Relative to the “no project” alternative, the draft EIR asserts multiple improvements in water supply reliability by increasing operational flexibility and mitigating risks from sea level rise, earthquakes, and levee breaches. The potential impacts identified include some substantial environmental and social impacts, but the draft EIR concludes that due to "environmental commitments and mitigation measures," all ecosystem impacts evaluated will be reduced to "less than significant." The draft EIR concluded that some substantial social impacts are expected to persist, despite some offsetting mitigation.

We find that the draft EIR is generally thorough in identifying the range of potential ecological and social impacts for the nine proposed project alternatives. The thematic chapters (Chapters 5 to 35) often provide detailed, descriptive background on current conditions of the California Delta's water, ecological, economic, social, and physical systems. Many chapters include robust analyses of construction and maintenance impacts, but some key chapters do not comprehensively assess operational impacts. The analyses are often based on peer-reviewed but not necessarily comprehensive scientific methods, models, and understanding.

The draft EIR shows some improvement in analytic approaches relative to EIRs conducted for prior proposed Delta conveyance projects. A notable improvement is the assessment of climate change on the performance of the alternatives, albeit with a short time frame of 2040 for most effects and with only limited application of 2070 conditions to assess flood risk and some sea-level-rise impacts.

Despite these strengths, the draft EIR has major limitations in that it lacks information necessary to fully support some conclusions regarding impacts. The draft EIR lacks 1) clear illustrations of how the proposed project achieves the water supply and environmental benefits claimed; 2) clear evidence to support some of the findings of less than significant impacts; and 3) clear descriptions of uncertainty stemming from climate effects, mitigation effectiveness, analytic methods, and incomplete quantitative and mechanistic understanding of some underlying processes and relationships. The explanation of how impact significance was determined is uneven across indicators with some determinations being made based on scant evidence and unclear methods. Some concerns stem from a lack of attention to operations effects, which are admittedly challenging to predict. Nevertheless, more detailed and comprehensive analyses could be supported by the available science. For instance, several chapters do not rigorously define methods to adaptively manage environmental and social impacts nor mention how the methods would be implemented, especially those approaches needed to address operational decisions and responses to extreme and unexpected conditions.

We also find that the presentation of results creates multiple interpretation challenges. In particular, the Executive Summary does not fully reflect the impacts and benefits detailed in specific chapters because the findings are largely limited to performance metrics specified by the California Environmental Quality Act (CEQA). Applying the CEQA criteria generate analytical summaries that often appear insufficient for assessing some important scientific and social impacts. Specifically, the criteria often fail to fully characterize expected performance under climatic variability that can be reasonably anticipated for the future Delta. We are also concerned that multiple interacting and additive system drivers and cumulative temporal effects may not have been captured by the impact indicators that were largely narrowly focused on individual species and stakeholder groups and that report annual average system conditions.

The most relevant information for understanding potential benefits and impacts is often widely dispersed through multiple chapters and appendices, making a synthesis of impacts and an evaluation of scientific rigor difficult. Impacts identified in the Executive Summary and in specific chapters often fail to provide clear and concise answers to the most relevant scientific and social issues. We also recognize that because information is not always well synthesized in the report, some Delta ISB concerns may reflect a lack of clarity in the draft EIR presentation of analytic results.

Our major concerns about the draft EIR, ones that span thematic impacts, are described in Part I of our review. Comments on individual chapters can be found in Part II of our review.

1.1. Major Concerns

The Delta ISB has eight major cross-cutting concerns regarding the draft EIR:

1. Ecologically and socially relevant impacts are obscured in summary metrics that use mean conditions averaged over space and time to estimate or characterize effects from water flow changes instead of more relevant time/space scales.
2. The summary of impacts embeds optimistic assumptions about the reliability of mitigation performance, making risks to ecosystems difficult to assess.

3. Uncertainty due to regional climate change is inadequately evaluated. The use of the year 2040 to represent potential future conditions in the Delta is insufficient for understanding the range of potential future benefits and impacts over the long operational lifespan of the proposed tunnel.
4. Adaptive management planning is not given adequate or rigorous attention, given the potential effects caused by operations and mitigation efforts.
5. Impacts driven by interactions across ecological or social systems, among drivers or across landscapes or by accumulated effects through time are largely missing.
6. Multiple sources of scientific and analytic uncertainty are incompletely described or evaluated, despite being necessary to understand the reliability of findings.
7. The draft EIR does not include a sufficiently diverse set of alternatives that fully explore and compare options for achieving stated water supply goals while minimizing impacts.
8. The draft EIR could more clearly and succinctly compare project alternatives in terms of benefits, impacts, and tradeoffs across alternatives.

2. Delta ISB's Review Mandate, Process, and Approach

The Delta ISB reviewed the draft EIR in accordance with our responsibilities under the Delta Reform Act of 2009 to evaluate the broad range of scientific programs that support adaptive management of the Delta, including review of major Delta conveyance proposals. The Delta ISB review is a technical/scientific assessment of the quality and scope of the scientific analyses used for informing decisions. We included recommendations for analyses that may not be required under CEQA but that the Delta ISB feels are necessary to adequately evaluate and compare alternatives and understand the reliability of impact assessments.

The Delta ISB brings advantages of independence and broad perspectives on the adequacy of the scientific approaches, methods, and topics and their value for making water and environmental management decisions with long-term pervasive impacts. As a result, the Delta ISB is well-positioned to evaluate the adequacy of the scope and general methods of the scientific and technical analyses applied to the Delta Conveyance Project. However, given the draft EIR's extensive breadth, depth, length, and complexity, our review cannot examine all location-specific details in the draft EIR document nor fully address some questions that require specific and detailed knowledge of the systems being evaluated. Therefore, this review evaluates whether the analyses conducted largely support the conclusions, using our experience in applying accepted analytic methods across diverse socio-ecological systems.

The Delta ISB reviewed 29 of the 35 substantive chapters (excludes 36 to 39), the Executive Summary, and accompanying appendices of the draft EIR. Comments on the overall document and individual chapters were collected from individual members, then discussed at public meetings, categorized, and refined to create a draft report that was formally approved at a Delta ISB public meeting on December 8, 2022. Two drafts of this report were made available for public comments before being finalized.

3. Some Strengths of the Draft EIR

The draft EIR brings extensive information and analyses about potential project impacts. The document addresses a wide scope of potential impacts and thoroughly describes current socio-ecological conditions. Analyses often apply peer-reviewed techniques and "models of record" (i.e., models documented to be standard practice by agencies) to evaluate potential impacts. These analyses use an array of modeling tools operating at different scales, covering tributary watersheds of the Delta and downstream service areas. Many chapters (e.g., Geology and Seismicity, Water Supply) use state-of-the-practice analytic methods and models to evaluate potential impacts. Some chapters (e.g., Agricultural Resources) thoroughly summarize impacts as the combination of construction, maintenance, and mitigation activities, which aids in understanding the likely magnitude of additive impacts across these activities.

The authors of the draft EIR appear to have invested considerable time addressing prior issues identified with previous conveyance project documents (reviewed by Delta ISB in 2014, 2015, and 2017). This draft EIR has improved overall writing and summaries compared to prior versions and provides generally adequate details regarding many impacts. The report is more advanced than past EIR analyses in examining the alternatives. The development of both 2020 and 2040 conditions for evaluating the project, and 2070 for a few conditions, enhances understanding of some future project risks and benefits (although see limitations identified in comments below).

4. Major Review Comments

While many of the analyses in the draft EIR apply appropriate scientific methods and understanding, we found several areas to be incomplete or insufficient to fully characterize potential impacts and their uncertainty. We describe our major concerns below. Additional chapter-specific strengths, weaknesses, and recommendations for improvement, including important analytic concerns not detailed here, are described in Part II.

4.1. Metrics or analyses that use mean conditions averaged over space or time obscure relevant impacts and variability

In the draft EIR Executive Summary, much of the CEQA criteria used to calculate or represent project impacts summarizes conditions over relatively long-time intervals and coarse spatial scales. Such summary criteria smooth over variability and can fail to adequately represent ecologically and socially relevant effects that may occur over short durations or fine spatial scales. Among our multiple concerns with the summary criteria is the classification of construction impacts as short term, even though impacts can last up to 15 years or more. Fifteen years of disruptions to transportation, business operations, recreation, and other activities have the potential to be socially and economically meaningful to those affected. Several examples presented below (e.g., water supply reliability, ecological effects, and social effects) highlight the mismatch between what was assessed and the scientific questions.

4.1.1. Water supply reliability

Taken as a whole, the EIR lacks clear and compelling evidence of how the proposed project operationally meets the objectives of improving water supply reliability across diverse water years, while minimizing the project's impacts and the risks from sea level rise, earthquakes, and levee breaches, in comparison to a future without the project. Importantly, the quantitative assessment of increased water supply reliability that is attributable to the increase in total Delta water export is examined on average, which lacks the temporal detail needed to fully understand benefits and constraints. The average volumes can be uninformative without information on interannual variability, particularly during droughts. These averages were applied to characterize important effects on conveyance capacity, storage capacity, water demands, water availability, water rights, habitat effects, and environmental requirements. Many constraints on water diversions to the tunnel appear to have been included in the analytic details, but the net effects of operational rules and climate variability on tunnel usage and water supply are poorly summarized.

The report would be strengthened by an analysis of the proportion of actual water demands that would be met by the project, relative to a future without the project that includes the likely development of alternative water sources. We suggest that the Water Supply chapter analyze temporally and spatially disaggregated model results to better characterize potential project outcomes under varying hydrologic conditions at demand locations. For instance, a monthly analysis of CalSim model output data provided by the California Department of Water Resources shows that much of the tunnel diversions occur during the high flow months of December through March (Figure 1). From April to November, occasional high discharge events occur, providing the opportunity to divert a high percentage of river flow through the tunnel (as indicated by circles in Figure 1 for Alternative 5). On average, the amount of Sacramento River flows diverted ranges from zero to about 40 percent. Relevant to understanding the cost-effectiveness of the proposal, even in high flow months, tunnel use is below 40% for about half of the time (Figure 2).

Further, the model data suggest that available winter and spring reservoir capacity may limit the ability to meet water supply demand during summer months particularly under climate change. This effect is not well characterized in the draft EIR. Increased exports can only improve water supply reliability if they improve supply when demand exceeds supply. Given a higher demand during the summer months, the benefit of the exported water will be realized largely from storage of water in winter and spring. However, the seasonal storage pattern in the receiving San Luis reservoir in the CalSim model output shows that its capacity may not be adequate to store the increased exports during February and March and that the carryover storage may not last through September and October (Figure 3).

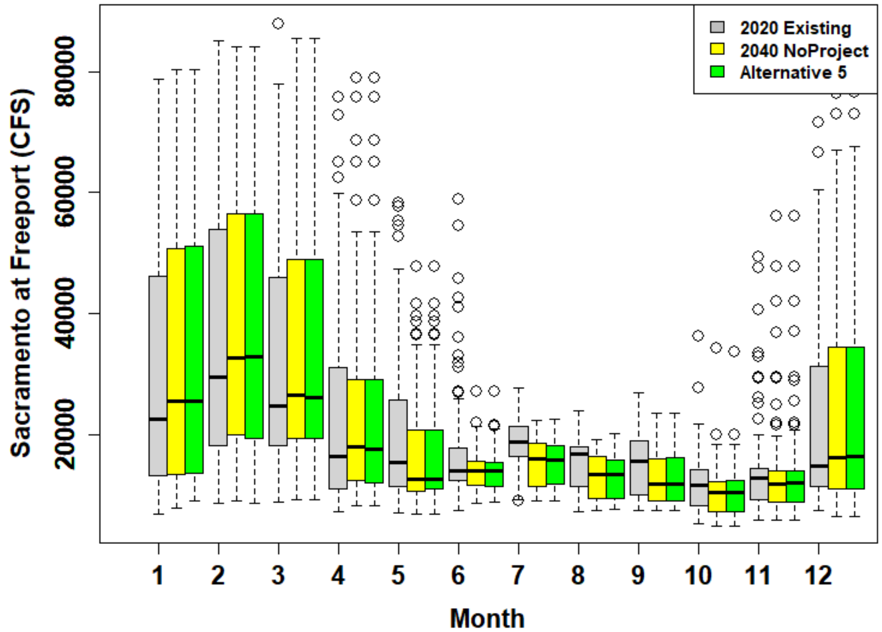

Figure 1. Monthly variation of Sacramento River discharge diverted via the North Delta Diversion facility and the tunnel for Alternative 5 (2040), No project (2040) conditions, and Existing conditions (2020). The boxes in the figure represent the 25th and 75th percentile of flow by scenario, and the horizontal black line inside the box shows the median flow. Whiskers and circles represent the broad range of flows (5th-95th percentiles) and outlier values, respectively. Both 2020 Existing Condition, and 2040 No Project scenarios are shown, although no pumps would be present at this location for either condition. Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx* and *DCP EIR water supply_2040Data.xlsx*) provided by the California Department of Water Resources at the request of the Delta ISB.

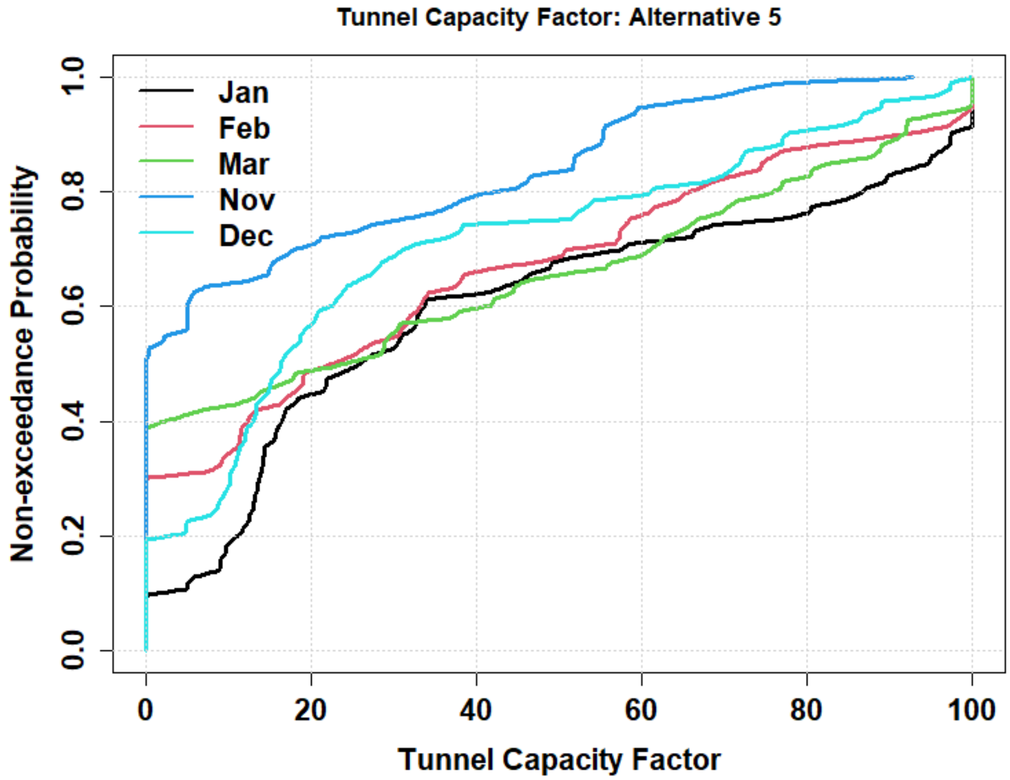

Figure 2. Tunnel capacity use for high river flow months. The figure shows that projected average monthly tunnel use is often small relative to its maximum conveyance capacity. Lines in the figure show how often a given tunnel capacity is expected to be used for months that typically have high river flow. Probabilities on the vertical axis show the likelihood that a given tunnel capacity (capacity factor = use/capacity in percent) will be achieved. For example, the likelihood that 40% of the tunnel's capacity (factor = 40) will be used in March is about 60% (probability = 0.6). Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx* and *DCP EIR water supply_2040Data.xlsx*) provided by California Department of Water Resources at the request of Delta ISB.

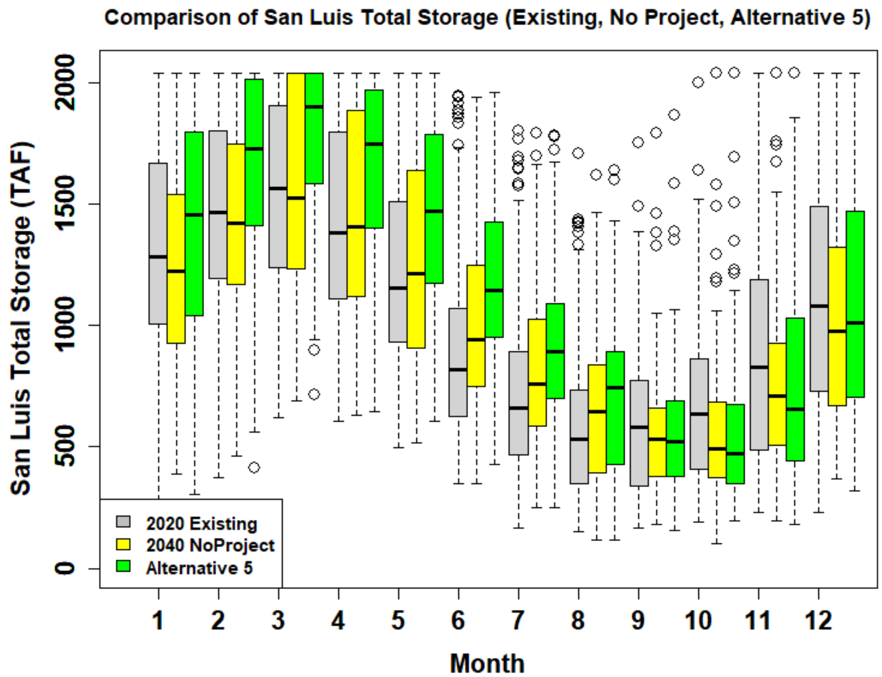

Figure 3. San Luis Reservoir capacity under the 2020 Existing, 2040 No project, and 2040 Alternative 5 conditions. The figure suggests that reservoir storage will sometimes limit useable tunnel capacity. For Alternative 5, the green bars or the whiskers marking the possible range of water storage are at or near maximum total storage capacity (2028 TAF) in the spring, which is the critical storage period for improving summer water deliveries. The boxes in the figure represent the 25th and 75th percentile of volume by scenario, and the horizontal black line shows the median volume. Whiskers and circles represent the broad range of volumes (5th-95th percentiles) and outlier values, respectively. Increased exports during wetter periods are expected to improve reliability of water supply obligated under contracts. Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx* and *DCP EIR water supply_2040Data.xlsx)* provided by the California Department of Water Resources at the request of the Delta ISB).

4.1.2. Ecological effects

We question the validity of assessing downriver operational impacts on fish and aquatic resources using monthly mean values for calculations. Monthly values smooth the data and reduce the highs and lows of daily changes and may obscure important impacts resulting from short-term fluctuations. Kimmerer (2004) points out how many critical biological processes are responsive to short-term changes in drivers, on the order of days or less. By examining the daily flow with tunnel diversions mentioned in Appendix 5A-B (page B-59), the change in frequency and duration of low flow conditions by alternative can be adequately assessed. A statement made in the draft EIR Appendix 5A-B is that "Initial comparisons of monthly versus daily operations at these facilities indicated that diversion potential was likely overstated…using a monthly time step" (Appendix 5A-B, B.7.1, page B-59, lines 6-8). Monthly analyses can both overestimate and underestimate diversion quantities and daily downstream flows (at different times) compared to a more realistic daily application of diversion flow rules. Therefore, an explicit analysis of daily versus monthly downstream flow and diversion estimates using a representative portion of the hydrologic record, would allow a better assessment of the applicability of using monthly data to characterize the daily biological impacts from a north of Delta diversion.

Similarly, the relationships between instream flows and temperatures might be improved by considering daily ranges and the relative influences of different temperature drivers. Given the large effects of temperature on fish physiological functions (e.g., metabolic and growth rates), and the sensitivity of those rates to temperature duration and thresholds, the use of monthly mean temperatures needs to be re-assessed for this important variable. In addition, analyses in the draft EIR assume that water temperatures are largely driven by atmospheric temperatures rather than by flow. They base this assumption, in part, on correlations of monthly water and atmospheric temperatures in the San Francisco estuary (Kimmerer 2004). However, other studies clearly demonstrate a relationship between flow (and residence time) and temperature based on shorter (e.g., daily) time steps (e.g., Wagner et al. 2011, Vroom et al. 2017). A daily time-step model of how flow diversion affects downstream temperatures, residence times, and stratification is warranted.

Seasonal flows, including periodically high discharges, are needed as cues for migration, reproduction, and other life stages, and the draft EIR does not appear to have fully assessed nor clearly summarized potential impacts of reducing high flows on aquatic habitat. Although the analysis (using CEQA criteria) suggests that, with mitigation, fish impacts will be less than significant, ecological consequences would be expected if the siphoning of ~30% or more of some river flows into a tunnel occurred throughout the year (calculation based on Figure 3-37 and Tables 3-14 and 3-15 of the draft EIR; see also Figure 1 above). The draft EIR does not provide strong evidence that the proposed mitigation would compensate for this key modification to the aquatic systems.

The finding of a less than significant impact on riparian habitat (Impact BIO-3: Impacts of the Project on Valley/Foothill Riparian Habitat) appears inconsistent with the criterion from Chapter 13 of “a substantial adverse effect on a sensitive natural community is defined as a net loss of habitat function, including a net loss of acreage” (page 13-74, lines 10-11). Riparian habitat is scarce throughout the Delta, and riparian habitat’s influences extend well beyond their footprint. An impact to 2.7% of the riparian areas, or a loss of 23 – 75 acres (Table 13-0), can be ecologically significant. Riparian habitat supports a wide variety of wildlife species, as documented in the report. These areas are also important for their spatial positions in the landscape and for additional ecological reasons (Naiman et al. 2005).

4.1.3. Social effects

Other concerns about calculations that use coarsely aggregated data to determine impact significance arise in some of the social effects. The CEQA criteria frequently summarize effects over large areas (e.g., counties) in ways that could be inconsistent with a local user perspective, as would typically be explored in social analysis. Impacts to communities or populations that are deemed to be of no impact or less than significant using CEQA criteria could still constitute substantial concerns to particular communities within the Delta. An example is that the land-use effect “Impact LU-1: Displacement of Existing Structures and Residences and Effects on Population and Housing” has a no impact rating, despite that “Between 61 and 93 permanent structures would be removed within the water conveyance facility footprint” (Chapter 14, page 14-22). Similarly, by assuming that recreation areas are largely substitutable, the CEQA recreation impact criterion fails to address the harms from lost use or inability to make low-cost or nearby substitutes specific to a lost recreation type. While the shortcomings of the summary performance criteria are explained in the detailed chapter analyses where local issues are considered, the local effects are not well represented in the draft EIR Executive Summary.

4.2. Assumptions about mitigation obscure risks to ecosystems

Risks to ecosystems are not possible to adequately assess from the EIR, for at least three reasons. First, in many cases, the draft EIR only presents an analysis of net impacts after mitigation measures have been implemented and should instead separately present impacts before and after mitigation. Second, some of the assumptions about the effectiveness of mitigation measures are overly optimistic because the uncertainty associated with the effectiveness of mitigation measures is not adequately assessed and represented. Third, in some cases, mitigation actions substitute different ecological functions or species to offset impacted ones. All three of these issues will need to be addressed to make it possible to assess ecological risks from project implementation.

Regarding the first point, the manner in which analysis results are presented makes it difficult to independently assess how an underperforming mitigation project could lead to a net loss of ecological benefits. By combining the magnitude of ecological impacts and the expected offset due to mitigation, the potential for alternative outcomes, if mitigation were less than fully effective, cannot be assessed. Presenting impacts prior to mitigation will clarify the potential impacts.

With regard to the second item, the findings of “less than significant” impacts for many ecological outcomes are based on assumptions that mitigation will completely offset the anticipated ecological impacts. However, ample scientific evidence suggests that mitigation is often less than fully effective at replacing lost ecological structures and functions (NRC 2001; Hough and Harrington 2019). Acknowledging and clearly planning for variability of mitigation performance (see Section 4.4) is needed to adequately represent expected ecological impacts. Even if the uncertainty of mitigation cannot be well characterized, the EIR should present impacts prior to mitigation to give readers the opportunity to qualitatively weigh uncertainty.

With regard to the third item, the summaries of ecological impacts do not provide an opportunity to evaluate the degree to which the planned mitigation is an adequate substitute for lost ecosystem structures and functions. The EIR needs to specifically clarify which mitigation actions will be used to offset specific impacts so that equivalency can be evaluated. While the draft EIR describes a variety of methods to minimize or mitigate project impacts, including avoidance, on-site mitigation, and off-site (and sometimes out-of-kind) mitigation, specific analysis of the equivalency of impacts and mitigation was missing in several cases. We note that some aquatic system mitigations substitute different ecological functions or species to offset impacted ones. Specific discussions are needed of the tradeoffs associated with creating ecological structures and functions that differ from those impacted, such as using tidal wetland restoration to mitigate loss of flows on specific fish populations.

4.3. Uncertainty caused by regional climate change is inadequately evaluated

The draft EIR acknowledges the expected effects of climate change, including higher temperatures, changing seasonality of wet and dry periods, increased wildfire risks, saltwater intrusion, higher sea levels, and decreased water quality during droughts. However, the analyses in the draft EIR do not fully consider effects of changes in frequencies or intensities of extreme events or watershed-level responses to regional changes in climate. Further, potential changes in hydrologic responses have not been adequately assessed.

The EIR also uses inconsistent future projections across outcomes, which could alter the findings of potential impacts on water supply reliability, aquatic ecosystems, and social conditions. Even when effects have been analyzed, such as projected impacts for flood risk under 2040 and 2070 conditions, the results are buried in appendices (such as Appendix 3A and Appendix 4A) rather than incorporated into the main findings. This approach inhibits comparison across the project alternatives relative to the “no project” alternative.

In most cases where climate change is considered, the year 2040 is used, which is inadequate for judging future project performance since it is expected to be the first year of a long operational lifetime. Climate model results suggest that impacts of climate change will substantially increase after mid-century and therefore will be poorly represented by the year 2040. Further, the method used to generate the 2040 stream flows applied in the CalSim model is a simple adjustment based on the “central tendency” of 20 potential climate scenarios (2040 CT). This scenario represents average seasonal shifts in runoff but does not represent the wider range of potential future climate risks and omits the potential for future changes in inter-annual variability of inflow/drought patterns. The evaluation of a range of potential 2070 climate conditions in Appendix 4A shows some important uncertainties and their implications for water flows but has not been linked to the performance of project alternatives. In addition, feedbacks between climate change and changes in water demand (e.g., residential use, vegetation evapotranspiration) seem absent in the water supply modeling.

The draft EIR has focused primarily on the changes in spatiotemporal runoff from the tributary basins due to future warming and altered precipitation patterns assessed using climate model output. However, the EIR has not fully considered the implications of the potential increase in the frequency of future watershed disturbances that will likely occur due to climate change. The obvious example of such a disturbance is the effect of wildfires that may drastically alter the rainfall-runoff response. Watersheds with steep, forested terrains, when subject to wildfire, will result in flashier hydrographs with high peak flows that are multiple orders of magnitude greater than the pre-burn condition (Neary et al. 2011, Gottfried et al. 2003). Williams et al. (2022) also showed that increased aridity will likely be more common in the future, possibly leading to increased frequency of fire disturbances that will need to be accounted for in the projections of water supply and runoff-related hazards. Projected climate change and the associated increase in temperature will also influence the water budgets in tributary basins. For instance, Albano et al. (2022) have demonstrated that in the western US, the increasing water loss into the atmosphere, as quantified by the reference evapotranspiration, may be attributed to temperature increase over the 1980-2020 period exceeding the historical range of variability. The above research suggests that the hydrologic response of tributary basins will need to account for the nonstationarity that results from the altered landscapes with increasing frequency of extreme events and other implications of warming attributable to climate change and not only changes in runoff response due to precipitation or other drivers.

It is not clear if flooding has been adequately evaluated under changing climate conditions, even though projected conditions for the year 2072 have been examined. Project alternatives are compared using conditions of 100-year and 200-year floods in 2022 and 2072 and include sea-level-rise projections. However, it is unclear why there was no consideration for changing the magnitude of more extreme floods, given the evidence of changing hydrology, including amplification of atmospheric rivers in the coming decades. Further, changes in floods may extend beyond the limited area analyzed (Sacramento River between American River and Sutter Slough) and to Delta islands with implications for levee stability and the operation of upstream reservoirs.

Within some social impact chapters, future conditions for 2040 are evaluated for a “future without project” scenario only and not included in the evaluation of alternative conveyance projects. Many identified impacts are based only on qualitative assessments. This treatment makes it difficult to assess the likely magnitude of future effects relative to a baseline. The inconsistent evaluation of future social impacts could lead to misleading conclusions since factors such as changing regulations, community behaviors, and increasing scarcity of resources may influence future project impacts.

4.4. Adaptive management planning is inadequate

Adaptive management is critical for this type of project and is invoked in several places in the draft EIR without providing sufficient detail to assess its rigor. Having the opportunity to evaluate a proposed approach is important because of the degree to which the quality of the adaptive management plan influences the impact analysis. Among the concerns was that the how (and who) would do the adaptive management was not well described. With a project this large and complex, it is also highly likely that there will be impacts missed or mis-estimated in an EIR analysis. One would expect the authors to provide, at a minimum, a working “blueprint” or draft decision-tree of their adaptive management structure and process.

The adaptive management coverage in the draft EIR needs sufficient detail to evaluate whether determinations of the significance of impacts were adequately estimated. To provide assurance that the adaptive management plan will be adequate, it should identify funding sources, expertise, and administrative capacity to monitor and manage potential effects or impacts from the project, including those currently deemed less than significant. Details should also include establishing “Thresholds of Probable Concern” for biological responses, which would initiate the adaptive management process and actions if specific thresholds are exceeded. Similarly, social impacts that were deemed less than significant, based on limited qualitative data, should be monitored for concerning (and pre-determined) levels of change. Establishing management goals, performance metrics, and key decision triggers are essential parts of an effective adaptive management plan/program (Wiens et al. 2017) and should be described in the EIR to provide the opportunity for scientific scrutiny, even if detailed plans or modifications will be produced later.

It would be reassuring to see realistic plans for providing adaptive capacity in response to unexpected events and outcomes in both construction and operating phases. For instance, some adaptive management plans that are described could prove impossible to execute. Specifically, the project objective to minimize the ‘down river’ impact of operations caused by reduced flow does not provide a feasible and specific adaptive management approach. The stated plan to detect changes in fish abundance, which are projected to be of concern at 5%, seems challenging given that changes of 5% or less is likely to be indistinguishable from the natural variability of fish populations or from fish sampling variability. An adaptive management plan for the downstream effects needs to identify an amount of measurable change in a biological response, sustained over a specific period of time, that would trigger a change in flow intake or other operations. The plans for impingement management also raise concerns since the modeled relationship between flow and fish effects is based only on salmon, rather than species-specific models. The uncertainty of measuring the ecological effects and how such uncertainty could be addressed would need to be a part of any initial adaptive management plan.

4.5. Impacts driven by interactions across ecological or social systems, impact types, and space or by accumulated effects through time are largely missing

Better analyses of interactions and feedbacks among individual components and system-level responses to changes is critical for anticipating impacts and for designing effective adaptive management. By taking a species-by-species approach to examining effects (see Table ES-2 of draft EIR), the community-scale impacts from individual, interactive, and incremental changes are not adequately evaluated. From a systemic perspective, there is virtually no discussion of species interactions, food webs, or ecosystem productivity. Those interactions include the prospect of thresholds in system behavior that may produce dramatic changes. We suggest that an evaluation of aquatic ecosystem effects that includes additive and cumulative effects on fish populations at the community/ ecosystem level would improve impact conclusions. The analyses should include impacts on ecological functions including primary and secondary productivity, decomposition, and biogeochemical processes. Adding analyses of the effects of small population reductions that may compound over time to generate large population level effects would also improve the aquatic system impact analysis.

A more thorough analysis is needed to put new changes into the context of the past changes in the Delta that have severely reduced the aquatic ecosystem's ecological productivity and resilience. Although the cumulative impacts of the project's activities added to the ongoing stresses in the Delta are impossible to measure precisely, some effort to analyze the effects of accumulation of stressors and system-level analysis would improve understanding of potential impacts. A thorough analysis would also include impacts due to changes in inflows to the San Francisco Bay estuary and any gains in environmental resiliency from moving water through existing channels, rather than diverting it into a tunnel.

In terms of potential threshold effects, a thorough risk assessment would include the potential for unintended consequences. For example, the potential for the tunnel to result in invasive species transfers among water bodies, such as quagga and zebra mussels or non-native copepods, has not been assessed. Although a screening process is used to limit the potential transport of larger invasive species from the Sacramento River to the lower Delta and beyond, the risk is low but not eliminated. A thorough risk analysis would ask, "Will the tunnel be able to transport smaller, invasive larvae, veligers, or seeds to the lower Delta and beyond? Would Zebra mussel veligers survive in the tunnel transport system and beyond? What would happen to conveyance operations if they are discovered in the Sacramento River?

An example external to aquatic ecosystems is that a systems perspective is lacking when greenhouse gas emissions are estimated. The analysis for some project activities does not include the potentially substantial greenhouse gases created during the manufacture of the large amount of cement for concrete and grout needed for project construction. The potential magnitude is so large that it requires exploration and, if found to be significant (or unacceptable), mitigation actions proposed.

The lack of consideration of multiple drivers on outcomes is apparent in the water quality and public health analyses. Water quality impacts are almost entirely addressed from a drinking water perspective, rather than recognizing that biota are also affected by water quality changes. A prominent example is that changes in nutrient concentrations are largely ignored in the water quality analysis, despite their potential to lower dissolved oxygen levels or exacerbate harmful algal bloom (HAB) frequency or intensity, with potentially severe consequences for fish. HAB issues were mentioned in impacts under the "no-project" alternative, but only assessed for drinking water quality impacts, rather than being recognized for potentially broad effects on ecosystems, wild and domestic animals, human health, and recreational activities. Similarly, in the Public Health chapter, most impacts assessed were water-related (including the Vector-Borne Diseases), with no assessment of other potential public health impacts such as air quality, noise, and climate change. The impacts to biota or people could be better linked, similar to the approach taken in the Environmental Justice chapter of summarizing all sources of harm, chapter by chapter.

4.6. Uncertainty and risk need to be explicitly evaluated to understand reliability and confidence in findings

Given that there is always uncertainty in scientific assessment or prediction, we find the draft EIR sometimes lacks disclosures, discussions, and assessments of how uncertainty may alter assessments of potential project impacts, mitigation effectiveness, and tradeoffs. The confidence in some impact assessments appears low due to insufficient data or understandings. These uncertainties should be discussed uniformly by stating assumptions and differentiating scientifically supportable conclusions from inferences, expert opinion, and hypotheses.

Some sources of uncertainty can be calculated or estimated statistically. Other types of uncertainty can be explored by using alternative scenarios or models to compare projections. It is also useful to characterize the state of the science, particularly in terms of the degree of mechanistic understandings of cause and effect, to describe the level of confidence in projections. These different sources of uncertainty and confidence in findings can be clarified by using consistent definitions. For example, the Intergovernmental Panel on Climate Change (IPCC) has developed categories of uncertainty and confidence in findings to support clear communication (Reisinger et al. 2020).

Although some sources of uncertainty are explored in the draft EIR, we find that model results are not used effectively to bracket a range of potential outcomes. Further, how uncertainties may accumulate or propagate across coupled analyses and models to influence confidence in results has not been explored. Some major gaps are that the draft EIR does not present changes in contaminant concentrations as a consequence of hydrological alterations (i.e., changes in the proportion of primary source waters at various Delta locations) nor ecosystem function at the landscape scale, such as reduced runoff from snowpack during critical drought conditions or increased fire risk. Similarly, changes in built infrastructure (levee failure) and human behavior (water demand) under a changing climate are not consistently applied to interpreting project effects.

Some specific examples where a discussion of uncertainty would be useful are in the possible effects of reduced flows in the lower Sacramento River on water supply benefits and impacts to ecological endpoints and environmental flows. The effect of flow variability on aquatic habitat or persistence of species of concern under existing or future climate were not addressed in the Surface Water (Chapter 5) nor in Appendix 3C (Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions). Similarly, uncertainties of changing conditions on harmful algal blooms (HABs), with and without the project were not well characterized. HABs are becoming increasingly common in the Delta, and warmer temperatures, reduced flow, high residence time, and more concentrated nutrients are likely to exacerbate the problem.

The analyses of fish impacts seem to assume that mechanistic relationships between flows and fish populations are well established rather than recognizing the substantial scientific uncertainty that currently exists (Delta ISB 2015). Similarly, scientific understanding is limited for understanding species interactions, including food web effects or predator-prey interactions. This lack of a reasonably complete understanding causes estimates of some relationships to have low confidence such as how changes in abundance of one species can influence another species. This limitation may be particularly relevant in exploring impacts of species that are not considered in the draft EIR (e.g., aquatic invertebrates). The uncertainty of system behavior, which is not acknowledged in the analyses, includes the potential for thresholds to be crossed or other non-linear system behaviors that can lead to precipitous biological responses.

Another major concern is whether the uncertainty of seismic risk was reflected in the estimates of potential project outcomes and benefits. The seismic hazard in the Delta has significant uncertainty because of the difficulty in characterizing the activity of geologic faults in the Delta. The activity of the West Tracy Fault, a significant potentially active fault in the Delta, is proposed to be assessed by exploration late in the preconstruction period. This belated investigation is a concern given the potential for this fault to expose the project to strong ground motion (Chapter 10, page 10-46, lines 30-34). Understanding seismic risk is also critical to evaluating one of the four justifications for the Delta Conveyance Project, i.e., minimizing disruption to State Water Project (and potentially Central Valley Project) water deliveries south of the Delta by earthquake induced breaching of Delta levees (page ES-7, lines 9-13). The West Tracy Fault, along with other blind potentially active faults in the Delta, are the primary seismic threats to levee stability. Estimating their activity is essential to evaluating the potential range of seismic hazard in the Delta and threats to levee stability.

In addition, multiple seismic risk assessments are cited throughout the draft EIR but not clearly used to characterize overall uncertainty of impacts. Whereas the primary assessment in the draft EIR of the seismic hazard in the Delta (Chapter 10) is based on a comprehensive probabilistic seismic hazard analysis described in the earlier DWR Delta Risk Management Strategy (DRMS) report, the draft EIR also cites 30-year earthquake probabilities for the San Francisco Bay Area from two U.S. Geological Survey reports (Chapter 1, page 1-17, lines 5-7 and Chapter 7, page 7-23, lines 3-5). The two reports focused on the greater Bay Area and the high event probabilities (62 and 72%) primarily derive from highly active faults in the urban areas well west of the Delta. These probabilities do not add much to the understanding of seismic hazard in the Delta, and misleadingly imply an overstated seismic hazard in the Delta.

We suggest that the draft EIR could be more robust by clearly stating the uncertainties, unknowns, and the specific assumptions made in light of assessments and conclusions.

4.7. Diversity of project alternatives is narrow

The alternative conveyance structures considered in the draft EIR are conceptually similar and do not fully reveal the rationale behind each selected alternative. While the alternatives cover a reasonable range of Delta tunnel capacities, they only consider three tunnel alignments (central, east, and east + Bethany PP) and omit several western Delta alignments and through-Delta canal alternatives that have been discussed in past planning. Although it is not feasible or desirable to compare all possible alternatives, a comparison of a broad range of project options is consistent with an objective approach to finding the most environmentally and socially beneficial solution.

For example, two of the major purposes for the conveyance structure are to reduce risk to water supply from seismic events and sea level rise. Both hazards could cause levee failures that would threaten State Water Project deliveries. An alternative approach to address these threats, such as extensive remediation to improve levee stability in the Delta, was not evaluated. At a minimum, the rationale for omitting earlier versions of project alternatives would help stakeholders and decision makers understand the full range of options available and constraints to meeting the objectives.

4.8. The EIR would be a more effective decision support document by clearly and succinctly comparing project alternatives in terms of benefits, impacts, and tradeoffs

This document is not well structured or written to achieve the purpose of providing clear guidance for selecting a project alternative, despite a large volume of relevant information and analyses. In particular, the summary tables used to compare alternatives do not systematically compare benefits relative to costs and impacts, across alternatives. Benefit-cost analysis is an approach to assess whether a project's benefits exceed costs, using monetized public and private benefits. Although many benefits are difficult to monetize, even a partial analysis can suggest whether a project is likely to be socially desirable. Alternatively, a cost-effectiveness analysis uses benefit indicators to compare relative benefits per dollar spent across alternatives. Metrics to support a quantitative cost-effectiveness analysis are limited in the current report since the main benefits of water supply reliability and flood damage avoided are not clearly quantified.

Aspects of the presentation of many key results in the executive summary make it extremely difficult to simply and comprehensively compare the tradeoffs embedded in alternatives. Improving the summary criteria and reducing some of the repetition throughout the report might enhance its readability and accessibility. We recommend that a combination of graphical representations of quantitative metrics, coupled with summary tables of non-quantitative assessments, be developed to better serve decision makers and stakeholders trying to understand project effects within this complex socio-ecological system. Table 1 provides an example of the kind of summary comparison that allows readers to more easily compare alternatives for a few major quantitative performance objectives. Graphics and tables might be used to isolate the subset of significant effects to compare alternatives more succinctly.

Table 1. Example Comparative Summary of Performance across Selected Alternatives. This table is a notional example of how tradeoffs among alternatives could be made more accessible and easier to interpret. Such a table would use selected performance criteria from the EIR to compare representative alternatives across a common footing. A finite number of performance criteria are presented here as an example, taken from the draft EIR or calculated from data provided by the California Department of Water Resources. These criteria are grouped by goals of water supply, ecosystem, and in-Delta objectives. Comparing rows of the table across the columns reveals differences among alternatives. For example, comparing the effect of increase in tunnel size (left to right in Row 3) to effects on modeled average annual water exports (Rows 4 and 5) shows that water exports increase more slowly than maximum tunnel capacity across the presented alternatives.

		2020 Climate and conditions				
	Project Alternative	**Existing Conditions**	**Alt. 4b**	**Alt. 4c**	**Alt 5**	**Alt. 4a**
	Tunnel capacity (cfs)	0	3,000	4,500	6,000	7,500
Water supply* **	Average Total Exports (cfs, CalSim results) *	6,891	7,494	7,631	7,708	7,749
	Avg Exports (MAF/yr) *	4.98	5.42	5.52	5.57	5.60
	% Avg export increase from No Project *	0	8.7%	10.7%	11.9%	12.4%
	Avg North Delta Diversion (cfs, CalSim)*	0	773	935	1,034	1,071
	Avg North Delta Diversion (MAF/yr)*	0	0.56	0.68	0.75	0.77
	Tunnel capacity factor*	-	0.26	0.21	0.17	0.14
Ecosystem	Permanent aquatic habitat loss (ac, Table 12-0)	0	11,600	14,700	8,700	18,300
	Bench inundation loss (ac, Table 12-0)	0	1,600	2,200	2,500	2,800
	Mid. SWP SD Spring Run Salmon Entrainment (%) **	0	-4%	-7%	-8%	-5%
	Mid. SD adult Delta Smelt entrainment change (%) **	0	6	12	16	18
	Lost Terrestrial and Avian Habitat (ac, Table 13-0)	0	3,400	3,700	3,200	4,600

		2020 Climate and conditions				
	Project Alternative	**Existing Conditions**	**Alt. 4b**	**Alt. 4c**	**Alt 5**	**Alt. 4a**
In-Delta objectives	Converted Farmland (acres, Table 15-0, AG-1)	0	4,404	4,813	3,788	5,380
	Land Use Incompatibility (ac, Table 14-0, LU-2)	0	3,361	3,761	2,667	4,342
	Conflicts w/ existing structures (Table 14-2)	0	61	71	71	90
	Noise -Residences exceeding criteria (Table 24-0)	0	79	214	230	230
	Lost Delta ag production (Table 17-0, $\$10^6$/yr)	0	3.1	4.5	4.5	5.7
	Changes in Delta agricultural jobs (Table 17-0)	0	-51	-61	-49	69
	Change in net employment (rows 4+5 Table 17-0)	0	-9	-5	4	-17
	Peak construction employment (Table 17-0)	0	1990	2597	3086	3647

Abbreviations: ac = acres, Alt = alternative, ag = agricultural, avg = average, cfs = cubic feet per second, MAF = million acre feet, SD = south Delta, SWP = State Water Project, Tbl = table, yr = year.

** indicates that the results were calculated by the Delta ISB from CalSim data from the California Department of Water Resources.*

*** indicates that the data originated from Table 12-0.*

**** These water supply performance estimates are based on CalSim 3 model runs for 2020 conditions using 1922-2015 historical streamflows to represent hydrologic variability*

Summary tables are common for comparing the relative impacts of alternatives across major evaluation criteria. Such tables are necessarily simplified but are important for helping people understand and focus on important trade-offs among alternatives (Lund 2021). Because such tables can become incomprehensible for complex problems, as seen in the draft EIR’s Executive Summary, further distillation is usually needed. Such overall distillations usually focus on a few criteria that seem most important and often omit criteria where performance differs little across alternatives. Inferior alternatives are also often omitted, as a mercy to readers. To be useful, such distillations are usually fit onto one or two pages, and in no way replace the need for more complete presentations in the body and appendix of planning documents.

For this example table, central tunnel alignment alternatives are eliminated for brevity and because they generally were presented as similar to or lower performing than their eastern alignment variants. The presented alternatives also are ordered by nominal tunnel capacity to ease comparison. A finite number of criteria are presented, taken from the draft EIR or calculated from data provided by DWR. These criteria are grouped by broad goals for the Delta: water supply, ecosystem, and in-Delta objectives. Results for 2020 analyses (CEQA existing conditions) were used for this example to be able to include most outcomes; 2040 outcomes were not quantitatively analyzed for all metrics shown. Ideally, results for 2040 or later periods would be included to capture the period of proposed operation of the project.

Of the hundreds of criteria presented in the draft EIR, many can be eliminated from a summary table because they seem to lack significant differences in performance. Many other criteria are eliminated for this table because the differences are small or seem redundant with other more easily understood criteria. Indicators should be retained when small differences in performance are viewed as important. Additional criteria, such as economic costs and benefits, could be added if available. We hope that this example distilled summary table might be used to improve the final project EIR's summary presentation and discussion.

5. Conclusions

Part I of this review summarizes our main cross-cutting findings for the full draft EIR. Part II of our review summarizes our findings on individual chapters of the draft EIR.

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Part II: Comments on Individual Chapters of the Draft Environmental Impact Report for the Delta Conveyance Project

Each chapter of the Delta Conveyance Project draft Environmental Impact Report (EIR) released by the California Department of Water Resources (DWR) discussed here was reviewed by several members of the Delta Independent Science Board (Delta ISB) based on their areas of expertise. All Delta ISB members had the opportunity to review all chapters and provide input. Chapter reviews evaluate the overall scientific rigor of the methods used in the draft EIR and include details not included in the Part I. For each chapter reviewed, some specific suggestions are made on areas for improvement, where needed.

Contents

Executive Summary

The Executive Summary is meant to concisely define the context, project objectives, and alternatives examined and summarize some of the main points and impact metrics for each chapter. It provides a broad assessment of nine alternatives (Table ES-2) of the Delta Conveyance Project by addressing a range of potential impacts, many of which are necessary to address the California Environmental Quality Act (CEQA) requirements of an EIR. It also provides some summaries of impacts that are not required under CEQA (Table ES-2). The Executive Summary is somewhat uneven in achieving its goals. Because the Executive Summary touches on all parts of the analysis, the Delta ISB's comments on this chapter are also covered in more detail in the topic-specific chapters.

Strengths

1. The Executive Summary lays out the main features of the draft EIR (e.g., introduction, purpose, objectives, scoping, public involvement, controversies, lead/responsible/trustee agencies, alternatives, comparative environmental impacts).
2. The proposed project objectives are clear: They "focus on the SWP's (State Water Project's) ability to respond to sea level rise and climate change, minimize water delivery disruption due to Delta seismic risk, improve water supply reliability, and provide operational flexibility to improve aquatic conditions in the Delta."
3. The background and history of the effort and the concerns raised appear to be comprehensive. The public engagement process seems well conceived and well implemented.
4. The overview of the project and the proposed alternatives and the Summary of Key Project Features by Alternative generally are described clearly.
5. The development of the proposed alternatives is well described. The initial selection of 21 alternatives were passed through a two-tier filtering process. The first filter dealt with climate, seismic and operational resiliency, and water supply reliability. The second filter concerned lessening or preventing environmental impacts.
6. Summaries for the individual chapters are provided, and usually well written, and include reasonably comprehensive tables.

7. The overview discussing “Approaches for Addressing Potential Environmental Impacts” is a helpful section to include.

Concerns and Potential Weaknesses

Organization

1. The Executive Summary is too long to effectively summarize the main impacts and issues and could benefit from better organization. The length of the draft EIR is at odds with the State CEQA Guidelines §15141—that the EIR text should normally be less than 150 pages, and proposals of unusual complexity should normally be less than 300 pages, and summary less than 15 pages. The Executive Summary primarily summarizes the main points of individual chapters and does not attempt a greater or more useful synthesis. There is little interpretation or insightful discussion for decision-makers. Relatedly, the main summary table (ES2) is dense and hard to compare across the project alternatives. The Executive Summary could more succinctly compare the impacts that differ by alternative, particularly those that are significant, across the different stages of project development (e.g., construction versus operations versus maintenance impacts). The definition and description of “significance’ on page ES-10 is not adequate.
2. Table ES-10 is challenging to interpret, and limited information is provided in the text to clarify the results being presented. The summaries of the individual chapters are somewhat repetitive with the introductions to each of the chapters in the body of the report. The chapter summaries often appear to avoid potentially difficult issues by deflecting detailed discussions to appendices or reports.
3. The Section on “Approaches for Addressing Potential Environmental Impacts” does not provide sufficient details needed for scientific evaluation and could be better organized, by providing links to information in subsequent chapters.

Project Rationale

1. Clarification on why some previously proposed alternatives are not being considered in this document is needed to assess the thoroughness of proposed solutions from a decision science perspective.
2. No details are provided on how the project would, as stated in the Executive Summary, “provide operational flexibility to improve aquatic conditions in the Delta and better manage risks of further regulatory constraints on project operations.”

Assessment Metrics

1. The scope of the Executive Summary omits highly relevant information from the draft EIR chapters. The specific draft chapters provide extensive details of modeling results of performance metrics and an interpretation of impact significance. However, the assessment summary (Table ES-2) cites numerous instances where analysis of certain performance metrics is not required under CEQA and omits them. A case in point is the assessment of projects with respect to water supply reliability under climate change. Table ES-2 caption states "CEQA does not require an analysis of climate change; therefore, while a discussion of the potential effects of the project in combination with climate change is presented in Chapter 30, those effects are not considered." Yet, if the Delta Conveyance Project is expected to address future implications of climate change, omitting such information fails to address multiple performance criteria for improving water supply reliability.
2. There is no comparison of project cost estimates for the nine alternatives despite the relevance of costs to informing technical comparison of alternatives. It is not clear how impact significance is evaluated based on the content of this chapter.

Future Conditions

1. A major concern is the use of 2040 as the future epoch for alternative assessment, which is a date less than 20 years from today. The Delta Conveyance Project is expected to last and perform well beyond 2040, and therefore an analysis of future conditions using the year 2040 is likely to underestimate future change and variability. Because the climate is deemed nonstationary (Milly et al. 2008), the climatic conditions (rainfall patterns, sea level rise, temperature) and related water demands will evolve continuously. Therefore, an assessment using a scenario centered around 2040 needs to be fully justified. It is well known that, before 2050, implications of various Greenhouse Gas Scenarios (in the form of RCPs/Representative Concentration Pathways) will not deviate much from each other, and, depending on the future warming scenario, they could deviate significantly after 2050.
2. A second major concern is the use of a single central tendency (CT) scenario rather than multiple scenarios that would show a range of potential futures and capture some of the uncertainty of projections. Because of uncertainties in climate models, it is not possible to predict the likelihood of a single

scenario. Standard practice is to use a range of scenarios (e.g., Very Dry to Very Wet) to understand the system behavior for each alternative under a variety of climate futures. Further, there is no discussion of the interannual variability of the performance metrics, even within a single scenario.

3. It is not clear if the modeling adequately captures the potentially severe consequences of more intense extremes (e.g., atmospheric rivers) and the associated changes to the flood flows from tributaries. If the upstream reservoir operations do not change, future changes in the rain-snow regimes due to warming (precipitation occurring in the form of rain early in the season) are likely to cause early and possibly large floods coming into the Delta, which were not captured in the 2040 scenario. Such high flows coupled with higher sea levels will lead to compound hazards on the interior levees. There is high variability in monthly flows to project alternatives due to climate change (ES 5.1). The implications of the projected pumping schedule can be included in the Executive Summary to help understand whether there is a reduction of water flowing to the Delta under some conditions (e.g., information from Appendix 4B).

<u>Synthesis</u>

1. There is no synthesis or integration of the potentially additive, cumulative, or competing effects of the project alternatives across the multiple impact types. For example, ecological impacts are considered independent of each other with no synthesis or evaluation of the ecological system as a whole (Table ES-2). Yet individual impacts are often influenced by change in the ecosystem, and vice versa. Similarly, the combined effect of social impacts on overall community well-being is not evaluated.

2. While a focus on “important” species and habitats is needed, an overall evaluation of how the proposed project will impact ecosystem resiliency, connectivity, and productivity is missing. The vital ecological links among the thousands of species and the biophysical processes driven by flood flows (functional flows) are never addressed.

3. The degree of confidence in the results is not mentioned but approaches to assess confidence are available in the scientific literature, with the Intergovernmental Panel on Climate Change reports being one example (Reisinger et al. 2020).

4. The review approach is designed only to minimize impacts, but benefits are not discussed despite being relevant to comparing alternatives (ES.4.2).

5. The draft EIR is vague in describing which of the proposed environmental mitigation approaches (via EC/Environmental Commitment, CMPs/Compensatory Mitigation Plans and BMPs/Best Management Practices) addresses which impacts. While the specifics of restoration planning are not required of an EIR, the reconciliation of the tension between water supply reliability and promoting ecological rehabilitation is an important part of management practices (Roe and Eeten 2002) and is relevant to understanding tradeoffs. In addition, the compensatory mitigation plan for special status species and aquatic resources does not consider maintenance (ES.4.2.2).
6. Construction impacts are described in detail, but the presentation is somewhat nonuniform. Some aspects are described more rigorously (e.g., flood protection) than others (e.g., air quality). For example, in the air quality section only PM10 is described, although PM2.5 (which is mentioned in passing) is an equally or more important pollutant criterion with both primary and secondary standards. Given that a local school is located within half a mile of the project, and the construction is supposed to last for 12-14 years, consideration of PM2.5 impacts is imperative (Dimitrova et al. 2012).
7. Discussion of how adaptive management will be used to manage uncertainty is lacking. It is mentioned that the project provides flexibility for adaptively managing the system, although no details are included in the Executive Summary.
8. The response to seismic disturbance is a concern for subterranean water conveyance tunnels, and the EIR deals with surface fault rupture, ground failure, tunnel floatation, and seiche. Rock-concrete interaction may cause significant damage to such tunnels, which ought to be considered (Mei et al. 2022).
9. The proposed project (Alternative 5 to Bethany Reservoir directly) might have major operational benefits for improving quality of water deliveries to urban users, due to less mixing of freshwater river flow with more saline Delta waters, but this benefit is not well described.

<u>Other Concerns</u>

1. Table ES-2 – For those species that experience significant impacts, the mitigation plan is often to develop a plan ”to avoid and minimize impacts” to that species, with no discussion of how that will be accomplished.
2. Special status species are not defined here (ES.4.2.2) nor in the Glossary or Appendix 3F.

3. ES.5.1 – The summary of impacts de-emphasized impacts that cannot be quantified.

Suggestions for Improvement

1. Overall, it would be helpful to see a higher-level comparison or summary table of the alternatives across impacts and objectives, rather than using the same tables from each chapter (e.g., Table 1 in the Delta ISB main review report). The descriptive summary and synthesis should include key issues, conclusions, uncertainties, and assumptions, all written in an understandable and logical way. The summary should clarify, for each chapter, what was the conclusion of the relative effects of the nine alternatives?
2. The tables could be improved by including performance of alternatives on the four assessment criteria (page ES-12) of climate resiliency, seismic resiliency, water supply reliability, and operational resiliency. Ordering alternatives by project route and size would make comparisons of performance easier to understand.
3. A clear statement as to the scope of the assessment being provided in the Executive Summary and rationale for metric selection should be stated early to avoid any confusion.
4. It would be helpful to separate out impacts before and after mitigation, so that the baseline risks and impacts could be better evaluated separately from the assumption about the effectiveness of mitigation activities. Although the draft EIR includes a helpful glossary, the Executive Summary would be more effective with a section defining the terms repeatedly used (e.g., mitigation) and the abbreviations used to address significant impacts (e.g., LTS, S, and so forth). In addition, how significance was determined could also be better explained or references provided on where to find such details.
5. Individual chapter summaries could be presented more consistently and with better visual cues or formatting to aid in readability. Identifying key methods, key impacts, key mitigation measures, and rationale for how the mitigation measures can reduce key impacts to “less than significant” (LTS), if relevant, would be useful.
6. It would be beneficial to include the performance of the system for the No Project Alternative (NPA) so that a comparison could be made with the “lift” that would be provided by a particular conveyance alternative. A credible comparison should be included even if CEQA may not require it.

7. To better understand potential impacts, it would be helpful to include risk of impact in addition to severity of impact (e.g., when discussing biological impacts, see line 8, page ES-27). In addition, confidence in results could be characterized.
8. It would be helpful to mention in ES.3 why the United States Fish and Wildlife Service or National Marine Fisheries Service Biological Opinion are excluded as they were known at the time of the Notice of Preparation. This exclusion introduces biases in comparisons of project alternatives with the no-project alternative.
9. The summary of air quality impacts in the Executive Summary could be improved by including PM2.5, which is highly relevant to understanding potential health outcomes. In addition, the estimated number of people with high particulate matter exposure would provide better understanding of risks (Table ES-21, sensitive receptors to localized criteria pollutant emissions).

References

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Chapter 1: Introduction

The introduction offers details on the project background and context, including issues related to climate change, levee risks, the regulatory environment, history of past planning efforts on Delta Conveyance, and an introduction to the current planning. The description of the current planning describes key agency roles in the EIR process and other sources of authority over the design and construction of the Delta Conveyance Project. In particular, the section on climate change recognizes some potential impacts of future climate change including the disruption of the water supply management balance and the risks to infrastructure within the Delta region due to sea level rise and seismic stability. The chapter concludes with a summary of areas of concern that arose during the public scoping, which are examined in additional chapters.

Strengths

1. The chapter generally is interpretable for decision-makers and is succinct. It builds context nicely, offers a comprehensive overview of the rationale for and history of the Delta Conveyance Project, as well as the legal and institutional context surrounding it. Overall, it provides a good summary of the complexities encountered during proposal planning and the challenges facing the project.
2. The large list of agency approvals and permits required for the project in Tables 1-1 and 1-2, is useful.

Concerns and Potential Weaknesses

1. The discussion of the regulatory environment is framed in a way that comes across as negative – that is, as constraints on the ability to export water. The discussion would be more balanced if the benefits or value of protecting the environment and public health were acknowledged more explicitly.
2. While the introduction lists topics of known controversy generated from the public meetings, there is little information provided on how the largest impacts will be addressed. As a result, the Delta ISB cannot provide a scientific evaluation of the degree of resolution of public concerns, based on the information in this chapter. A detailed analysis of the controversial topics is not provided, even though there were over 2,000 respondents.

Suggestions for Improvement

Some parts of the chapter are dense and will be challenging to understand for those without deep expertise on Delta issues (e.g., use of acronyms, technical jargon, and legal terminology). The introduction could be more accessible to a wide audience.

Below are a few specific examples of areas that could be clarified.

1. The first half of page 1-19 and the first paragraph on page 1-20 are particularly dense. Perhaps use subheadings in some of the longer and denser sections (e.g., 1.2.3.3; 1.2.3.4; 1.2.4.4), or rewrite to improve clarity.
2. Some key terms are not well defined (e.g., ITP, Delta Cross Channel, HCPs, NCCP; D-1641) when they are first introduced.
3. Factual descriptions of the context are sometimes vague and a clearer write up is warranted. For instance, on page 108, lines 38-40, the EIR states "The largest system outflow is the portion of inflow that travels through the Delta…The second largest outflows are exports." Specificity on the amount of outflow for each category would be useful, rather than saying "the largest." Similarly, statistics provided on page 1-11 (lines 1-8) on the number of diversions give no indication of the amount of water removed. Additionally, the discussion of the Sustainable Groundwater Management Act (Section 1.3.3.4; page 1-20) is vague.
4. Clarification is needed on multiple points. For example, "Withdrawing water from aquifers, which eventually reaches the ocean, causes sea level to rise." (page 1-14).
5. Several key concepts are introduced in one section before an explanation is offered (e.g., Delta levee risk introduced under the climate change section in 1.2.3.2 before Delta levee risks are explained in 1.2.3.3). The chapter could be improved by providing explanations when concepts are first introduced.

Chapter 2: Purpose and Project Objectives

This chapter identifies the importance of the conveyance project to ensure a reliable water supply with constraints of "operational limits for fish and wildlife protection, water quality, and environmental and legal restrictions." The project's purpose is articulated, reiterated from previous chapters, and details of the project's scope are given.

Strengths

This chapter clearly presents the purpose of the project: The SWP is designed to deliver 4.2 MAF of water to 29 contractors serving 28 million Californians, but the reliability of delivery is threatened by the hydrologic conditions associated with the climate change. The regulatory environment has also limited the water deliveries. The Delta Conveyance Project is informed by past efforts to increase the delivery reliability such as the Bay-Delta Conservation Plan/California WaterFix, the CALFED Bay-Delta Program, and the Delta Risk Management Strategy. This chapter largely focuses on the water supply reliability half of the coequal goals of Delta management.

Concerns and Potential Weaknesses

1. The chapter correctly identifies future threats but does not reflect analyses provided elsewhere in the draft EIR. For example, given the statement, "Factors such as the continuing subsidence of lands, risk of seismic activity and levee failures within the Delta, sea level rise, precipitation change, warmer temperatures, and wider variations in hydrologic conditions associated with climate change threaten the reliability of the current SWP water conveyance system," one might expect an analysis of such threats. However, the description of the No Project Alternative does not seem to articulate that, without the conveyance project, the water supply reliability will be severely impacted. Future changes in the inflows to Delta could be highly variable due to climate change, yet the analyses appear to discount that potential.
2. The chapter does not address adaptive management or uncertainties.

Suggestions for Improvement

1. It would be helpful to include a high-level summary of how the proposed project is expected to achieve the stated objectives that includes a balanced discussion of uncertainties, unknowns, and assumptions. That is, how does creating new diversion points in the north Delta and conveying that water through a new tunnel specifically address current risks to sea level rise, climate change, earthquakes, levee breaches, etc., relative to current operations of the SWP? Simply saying that the Delta Conveyance Project will accomplish these objectives does not explain 'how,' compared to current operations, these objectives are achieved. This information can be gleaned from Appendix 3A and Appendix 4A, but it would help the reader to see these assumptions laid out more explicitly, either in this chapter or in the introduction.
2. Provide a "blueprint" of the Adaptive Management process and identify important uncertainties, as well as their respective resolutions.
3. Chapter 2 overlaps somewhat with the introductory chapter and could probably be omitted, with any unique contributions added to other chapters.

Chapter 3: Description of the Proposed Project and Alternatives

This chapter and its eight appendices describe the construction, maintenance, and operation of new conveyance facilities from the Sacramento River watershed to existing SWP facilities and compares nine alternative project proposals. The No Project Alternative describes the actions that project participants (other than DWR) might undertake to address long-term supply issues due to climate change and sea level rise, if the project is not approved. Alternative 5 is the proposed alternative.

Chapter 3 is generally comprehensive and provides clear details of proposed project design, operations, and maintenance for comparing project alternatives. However, some important information is missing.

Strengths

1. The Introduction provides a helpful “roadmap” to topics addressed in this chapter.
2. Figures and tables provide good summaries and distillations of project details.
3. The discussion of how sea-level-rise projections informed the design of the proposed project is useful. The draft EIR directly covers designing the project to accommodate expected changes in climate and sea levels.
4. Appendices are very detailed.
5. Adaptive management of operations is discussed. An Operations Adaptive Management and Monitoring Program (OAMMP) will be used to monitor and guide the design and operation of new north Delta intakes and determine whether they result in unanticipated effects that warrant refinements in design, management, and/or operation. The OAMMP proposes to address uncertainties of potential effects of the project.
6. Extensive details are presented on the conceptual layouts of each alternative including the proposed project, Alternative 5, which is associated with the new Bethany complex. The descriptions provide a useful explanation of how each component associated with a given alternative fits into the overall conveyance of water from intakes at the Sacramento River through the Delta to the delivery points of the SWP and, in some cases, the Central Valley Project (CVP).

7. Specific details associated with the engineering aspects of the Alternatives and the intakes are provided. The summary information provided in comparative tables is useful.
8. Appendix 3B includes DWR Best Management Practices to Reduce GHG Emissions (Environmental Commitment EC-13). The draft EIR acknowledges that the project will produce substantial greenhouse gas (GHG) emissions and will use current best management practices to minimize emissions.
9. The No Project Alternative is considered at two timeframes (2020 and 2040), which should improve representation of impacts compared to only using 2020.
10. A construction schedule is provided, which would support analysis of cumulative effects of concurrent activities.

Concerns and Potential Weaknesses

1. The analysis does not consider a thorough suite of likely future conditions when evaluating alternatives and inconsistently applies some of that understanding to evaluating the No Project alternative. As an example, existing proposed water development projects are considered for the No Project alternative but not for the other alternatives. Similarly, this project should not be viewed in isolation from other projects that are likely to move forward to address water supplies elsewhere in the West that serve the same Southern California region (e.g., the Colorado River). To accurately assess benefits and impacts, this project, and its environmental effects, need to be evaluated in light of California's reliance on other water sources and their expected availability and variability in the future.
2. Appendix 3C includes the claim that the effects of climate change and sea level rise are reasonably foreseeable but does not identify a time frame. A logical question is why is the foreseeable future limited to 2040? This assumption prevents the assessment of project performance during the actual operation after completion. As discussed in many sections of the report, including the Climate Change chapter, the future hydrology could be highly variable and uncertain, which will have potential implications for the system performance.
3. It is not clear if the Bethany and San Luis reservoirs have the capacity to receive all excess water that would be delivered via the proposed Bethany Alternative.

4. Various assumptions made in the comprehensive GHG emissions change estimates (Attachment 3F.2) and large uncertainties expected in climate modeling have not been assessed nor addressed in the compensatory mitigation plan. In addition, the project has not estimated the amounts of greenhouse gases and associated air pollution generated by some materials used, which could be included in the mitigation plan.
5. One of the key impacts of the project would be impacts downstream as a result of the reduced flow in the Sacramento River. Yet remaining river flow was not presented in a way relevant to assessing biological effects. To understand potential impacts, the Delta ISB had to calculate how much Sacramento River flow would be diverted under operational rules. Most other downstream impacts result from this key driver. Impact analyses were also largely done on a monthly basis, yet operations could change “weekly, daily, and sub-daily”. Elsewhere in our review, we provide some initial analyses on impacts calculated on a daily basis using the available subset of the decision rules.
6. Overall, the CMP appears limited in scope and duration and lacks details, making a scientific evaluation of CMP effectiveness impossible. The CMP states that it will “compensate for the loss of natural communities, habitats for terrestrial and aquatic species, and aquatic resources by enhancing channel margins and creating tidal wetland habitat for aquatic resources and special-status species on lands owned by DWR (I-5 Ponds 6, 7, and 8) or partners (Bouldin Island). Strategies in the CMP also include obtaining mitigation bank credits or establishing site protection instruments (such as a conservation 15 easement) for mitigation sites.” Additional information on the sequencing of CMP actions, species targeted, abundances expected, relative types of habits and their general characteristics, water sources to establish and maintain the habitats, and the duration of ecological maintenance (e.g., suppression of invasive species) are needed before a scientific evaluation can be done.
7. The Delta Reform Act 2009 recommends the use of adaptive management for decision-making. This chapter mentions such actions, but the discussion of adaptive management is mainly relegated to three short paragraphs in Appendix 3F (Section 6.4). Without a long-term adaptive management plan, it is difficult to ensure effective mitigation. As one example, a change of hydrodynamic regime is expected with the north Delta intake operations. Mitigation of various impacts there needs to be aligned with the species recovery needs. An adaptive management program is being contemplated to

understand these impacts, and some general modeling studies have been conducted (CMP-25), but more details on the structure, framework, and key performance measures of the approach are needed to evaluate its effectiveness.

8. It is unclear whether an effort will be made to reduce the aquatic environmental effects of artificial light, especially around active construction sites. Mitigation of some terrestrial ecological impacts (birds) is discussed in Chapter 13. Artificial light is an important environmental concern as it affects behavior and other ecological processes (e.g., predation).

9. The draft EIR should clarify if water transfers are allowed and, if so, determine the potential environmental consequences and any operational concerns. While the proposed project does not include water transfers, the paragraph on page 3-147 starts with: "Although the Delta Conveyance Project is not proposed specifically to accommodate water transfers, new Delta conveyance facilities could provide the ability for water transfers to occur through the facility by providing increased capacity…".

10. The environmental conditions under which water will be diverted is not limited to the winter, a condition that is not always made clear in the report and that could generate distinct environmental consequences relative to water diversions during consistently high flow periods. The draft EIR Figure 3-37, which provides a visual depiction of maximum allowable diversions in winter/spring and expected diversions in summer/fall, suggests that substantial diversions can occur year-round and take nearly 30% of the flow at times. This is a significant environmental concern for a variety of reasons: instream temperatures, the salt wedge, estuarine conditions, migration, wetland inundation, riparian conditions (including reproduction), maintaining rearing habitat, channel geomorphic processes, and so forth. Further, calling the diversion "Storm Water Capture" is potentially misleading. First, "storm water" needs to be defined for the Sacramento River, and second, the seasonal water diversions are being taken under normal annual hydrologic conditions.

11. The newly approved Delta Plan Ecosystem Amendment seeks to expand habitat by nearly 80,000 acres in the coming decades and retains the target of doubling the size of the adult salmon population. The consequences of the proposed diversions on the Ecosystem Amendment and adult salmon are incompletely addressed. A careful scientific evaluation is needed to determine if the project may impair the ability to meet these targets.

12. The draft EIR does not seem to have an adaptive strategy in the case that field conditions prove unsuitable for the proposed alternative (Alternative 5). Field conditions are planned to be determined based on alternative studies (or analysis of past studies) and have the potential to find unsuitable conditions (e.g., soil, geotechnical, seismic or hydrologic, agronomic; Section 3.15) for the most preferred tunnel route.
13. The mention of two No Project Alternatives, one for 2020 and more formally for 2040, is confusing. It appears that the 2020 No Project Alternative is the Existing condition.

Suggestions for Improvement

1. It will be helpful to present any analysis associated with the reservoir capacity issues.
2. Under Section 3.16, it would help to see the scientific rationale for the operational criteria for bypass flow requirements, pulse protection, and low-level pumping. Additionally, the description of the integration of north Delta intakes and south Delta facilities (3.16.3) would benefit from more clarity about the tradeoffs expected (line 33) and the conditions under which south Delta exports would be limited during excess flows (lines 31-32).
3. GHG switchover times (mitigation timescales) can be lengthy, and it would be useful to indicate the estimated response time of mitigation action (Hemes et al. 2019)
4. Daily analyses should be part of the assessment of project impacts on the Sacramento River physical and biological systems.
5. A long-term equitable funding plan (cost estimates and governance) for the community benefits program would help to establish trust that the program will address concerns, beyond the traditional mitigation measures, that could help reconcile with local Delta communities (Appendix 3G).
6. We recommend that additional concerns raised above also be addressed.

References

Hemes, K.S., Chamberlain, S.D., Eichelmann, E., Anthony, T., Valach, A., Kasak, K., Szutu, D., Verfaillie, J., Silver, W.L., and Baldocchi, D.D. 2019. Assessing the carbon and climate benefit of restoring degraded agricultural peat soils to managed wetlands. Agricultural and Forest Meteorology: 268, 202-214.

Chapter 4: Framework for Environmental Analysis

This chapter addresses resource impact evaluation, resource-specific analysis, existing conditions of all resources at the Notice of Preparation, baseline assumptions for comparison of alternatives, magnitudes and spatial extent of impacts, and the efficacy of mitigation measures.

Strengths

1. In general, the chapter provides a representative summary of the approach to the environmental analysis, organization of the EIR, and CEQA requirements that guide the approach.
2. The chapter presents extensive details of the conceptual layouts of each alternative including the proposed project, Alternative 5. The descriptions explain how each component associated with a given alternative fits into the overall conveyance of water from intakes at the Sacramento River through the Delta to the delivery points of SWP and in some cases, CVP.
3. The North Delta diversion priority analysis (Appendix 4B) will be very informative for future decision making about exporting water from the proposed new north intakes at certain times of the year (higher quality of water) over exports from existing south diversions.

Concerns and Potential Weaknesses

1. The chapter is replete with cross references to other chapters, which unnecessarily lengthens it (although this is a comparatively shorter chapter). For example, the short description 4.1.1.1 (environmental setting) could have been easily included when it was first described starting from line 32.
2. The cumulative impact assessment method(s) are not described clearly, although the application of cumulative assessments is mentioned at various places.
3. The mention of two No Project Alternatives one for 2020 and more formally for 2040 is confusing. It appears that the 2020 No Project Alternative is the Existing Condition.
4. The rationale for using 2040 for the No Project Alternative and the analysis of all the alternatives need to be justified. The stated justification appears on page 3-68 as "…No Project Alternative under future conditions when the Delta Conveyance Project is anticipated to be fully constructed and

operational. This condition is presented by the year 2040 for resources that consider modeling to help characterize the alternatives." The CEQA guideline does not appear to specify the criterion that the No Project Alternative time epoch needs to coincide with a time when the project is "constructed and operational." In fact, the CEQA guidelines suggest that the No Project condition includes some reasonably "foreseeable" change in the existing condition and changes that would be reasonably expected to occur.

5. Appendix 4A entitled "Consideration of 2070 Conditions" is a step forward. It provides what a 2070 (median) hydrology may look like under climate change and provide possible operations that could be implemented to address such a future condition. However, this Appendix clarifies that it "is not required by the California Environmental Quality Act (CEQA) and is not used to support the CEQA findings presented in Chapters 7 through 32 of this Draft Environmental Impact Report (Draft EIR)". It is not clear if CalSim 3 modeling was conducted for 2070 scenarios and, if so, why they were not included in the EIR. That information would alleviate the above concerns regarding the use of 2040 as the only future condition.
6. Appendix 4B is the first time CalSim 3 model is introduced, although it has been alluded to a few times. This introduction to the model is inadequate to gauge its limitations and capabilities. A separate standalone appendix is recommended as CalSim 3 has been extensively used.
7. In general, relegating the results of the longer-term analyses on project and alternative performance to the appendices hinders creation of a clear decision-supporting narrative.

Suggestions for Improvement

1. It is not clear if the Bethany Reservoir has the capacity to receive all excess water that would be delivered via the proposed Bethany Alternative. It will be helpful to present any analysis associated with this issue.
2. Including a clearer explanation for why costs are not included in this EIR, and whether and by whom financial costs will be considered, would be a useful addition.
3. We recommend that additional concerns raised above also be addressed.

Chapter 5: Surface Water

Chapter 5 summarizes the changes to surface water that could result from the project within the Study area of the Sacramento River and Delta.

Strengths

1. The chapter is well-written, and the tables and appendixes are appropriate and informative. The explanation of Delta hydraulics is informative.
2. The summary of climate change effects on surface water resources is presented reasonably well.
3. The modeling assumptions and limitations are explained relatively well for a non-technical audience. Some of the best available models (e.g., CalSim 3) are used in the analysis. Five appendixes present multi-model and multi-objective framework details, allowing a holistic assessment of the project: overview, hydrology and systems operational modeling, one-dimensional hydrodynamics modeling (DSM2), water temperature modeling, SALMOD, egg mortality modeling, and sea level and Delta water quality modeling. The models have been used to assess the project impact on surface water (upstream storage and river flow), emphasizing Trinity, Sacramento, Feather, and American rivers.
4. The sea-level-rise modeling appendix, based on 3-D modeling, is useful and thought-provoking.

Concerns and Potential Weaknesses

1. Connections between Delta inflows and tidal flows are not clear. The explanation for why “DWR believes that CalSim 3 results are subject to the uncertainty that is within 5% and likely much lower” (lines 22-24; page 5-13) needs to be provided.
2. Discussing future water conditions only under the “No Project Alternative” does not appear to be realistic.
3. The discussions are not well focused on impacts of the project on surface water, and indecisive discussions are given on topics identified as ‘not required by CEQA for EIR.” In many instances, the impacts are relegated to a few sentences.
4. It seems that the daily 3-D modeling and particle tracking could have been adapted and used to assess biological impacts in the Sacramento River.

5. North of Courtland, the difference between existing conditions and project alternatives is about 1,000 cfs, representing diversions at proposed pumps. During dry and critical years this difference is about 300 cfs. The pumps have a capacity of 6,000 cfs, which means that there is substantial unused diversion capacity during normal times and north Delta diversion pumps will work at full capacity only a small percentage of time. This less than full use of tunnel capacity calls for an explanation of why the alternative with 6000 cfs of diversion capacity was identified as the preferred alternative. San Luis Reservoir obtains increased storage, but the water is delivered to Bethany. This alternative requires careful management of Bethany Reservoir, which is the forebay for the South Bay Pumping Plant. Is 6,000 cfs feasible with the Bethany discharge structure that feeds the South Bay aqueduct?
6. While no exact quantification of model uncertainty is available, DWR believes CalSim 3 results are subject to uncertainty within 5% and likely much lower (Presented in Appendix 5A). This is the first time that CalSim 3 has been used for environmental analysis, and just mentioning a guessed uncertainty of 5% is not scientifically appropriate. Previous applications of CalSim 3 for Delta exports show drastic variability for different climate model projections, varying from +21% to -44% (Wang et al. 2018). Large uncertainties for these calculations may be expected. The 1,783-page Appendix B or 4,059-page Appendix D do not show any model tests comparing model results with field data.
7. Reverse flows are a serious concern with the operations of extra pumps, and the 92-year CalSim simulations with and without the project show impacts of project operations will increase reverse flows and their frequency only slightly. This discussion should be expanded, as it is hard to believe that when a non-negligible fraction of the river flow is diverted there is no change in the strength of the reverse flows.
8. Cumulative Effects: The draft EIR authors provide a comprehensive description of the Programs, Projects, and Policies that may be affected by the Delta Conveyance Project (Appendix Table 3C-2). Unfortunately, there are no analyses or discussions of possible cumulative effects.
9. Although the Tulare basin rarely flows into the Delta, it can in some very wet years. It is a major direct and indirect user of Delta water, and its hydrology affects these water demands. Perhaps it should be added as an influence on surface water dynamics.

Suggestions for Improvement

1. A summary table of major impacts expected/studied, and the results of modeling ought to be presented.
2. Concerning the implications of flow changes in the Delta due to climate change in the upper basins, a thorough assessment of the saltwater intrusion towards the east and within the Delta may help improve the presentation.
3. All major modeling efforts are in the appendixes, including those not relevant to the chapter (e.g., SALMOD or water quality). They can be moved to appropriate places, or the modeling can be a stand-alone chapter that can be consulted by those who are reading part of the report.
4. Table 5-1 could add total annual inflows.
5. Define "carriage water" and explain the magnitude of reduced flows downstream of SWP and CVP reservoirs when considering the split between carriage water savings (lines 25-26, page 5-27).
6. In the text, lines 14-15, page 5-28, can this section generally describe the magnitude of the differences in percent changes in long-term average monthly flows between project alternatives in the Sacramento Basin? They are shown in Table 5-4, but the text needs to highlight the key messages for the reader.
7. The effects of Delta tides on salinity dispersion are quite important and can be counterintuitive. The tidal hydraulics section might be beefed up with some examples of how water quality in the Delta is affected by various changes in Delta hydraulics from changes in operations, barriers, and levee failures.
8. The report would be strengthened by an analysis of the proportion of actual water demands that would be met by the project, relative to a future without the project that includes the likely development of alternative water sources. We suggest that the Water Supply chapter provide temporally and spatially disaggregated model results to better characterize potential project outcomes under varying hydrologic conditions at demand locations. For instance, a monthly analysis of CalSim model output data provided by DWR shows that much of the tunnel diversions occur during the high flow months of December through March (Figure 5.1). From April to November, occasional high discharge events occur, providing the opportunity to divert a high percentage of river flow through the tunnel (as indicated by circles in Figure

5.1 for Alternative 5). On average, the percent of Sacramento River flows diverted ranges from zero to about 40 percent. Relevant to understanding the cost-effectiveness of the proposal, even in high flow months, tunnel use is below 40% for about half of the time (Figure 5.2).

9. Further, the model data suggest that available winter and spring reservoir capacity may limit the ability to meet water supply demand during summer months particularly under climate change. This effect is not well characterized in the draft EIR. Increased exports will only be able to improve water supply reliability if they improve supply when demand exceeds supply. Given a higher demand during the summer months, the benefit of the exported water will be realized largely from storage of water in winter and spring. However, the seasonal storage pattern in the receiving San Luis reservoir in the CalSim model output shows that its capacity may not be adequate to store the increased exports during February and March and that the carryover storage may not last through September and October (Figure 5.3).
10. We recommend that additional concerns raised above also be addressed.

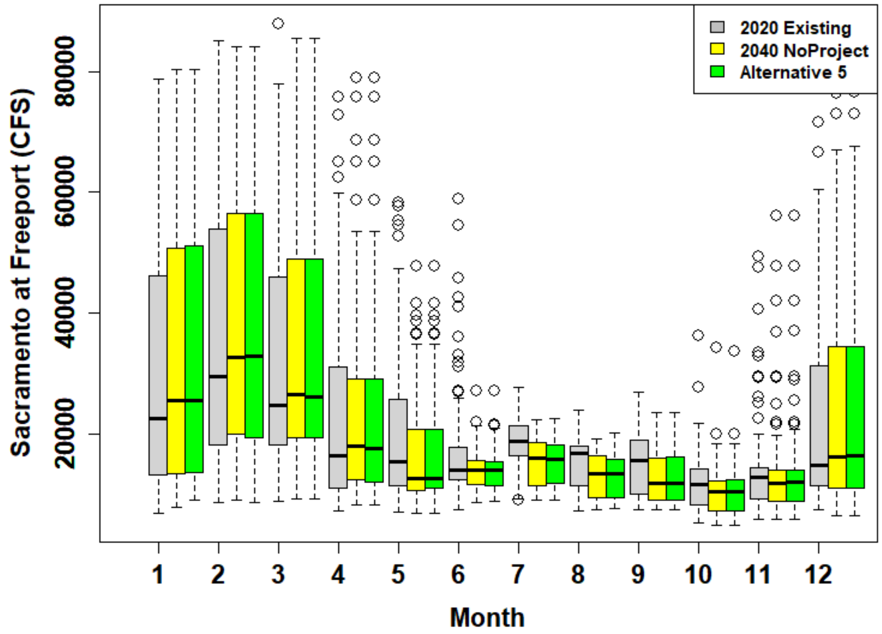

Figure 5.1. Monthly variation of Sacramento River discharge diverted via the North Delta Diversion facility and the tunnel for Alternative 5 (2040), No project (2040) conditions, and Existing conditions (2020). The boxes in the figure represent the 25th and 75th percentile of flow by scenario, and the horizontal black line inside the box shows the median flow. Whiskers and circles represent the broad range of flows (5th-95th percentiles) and outlier values, respectively. Both 2020 Existing Condition, and 2040 No Project scenarios are shown, although no pumps would be present at this location for either condition. Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx and DCP EIR water supply_2040Data.xlsx*) provided by the California Department of Water Resources at the request of the Delta ISB.

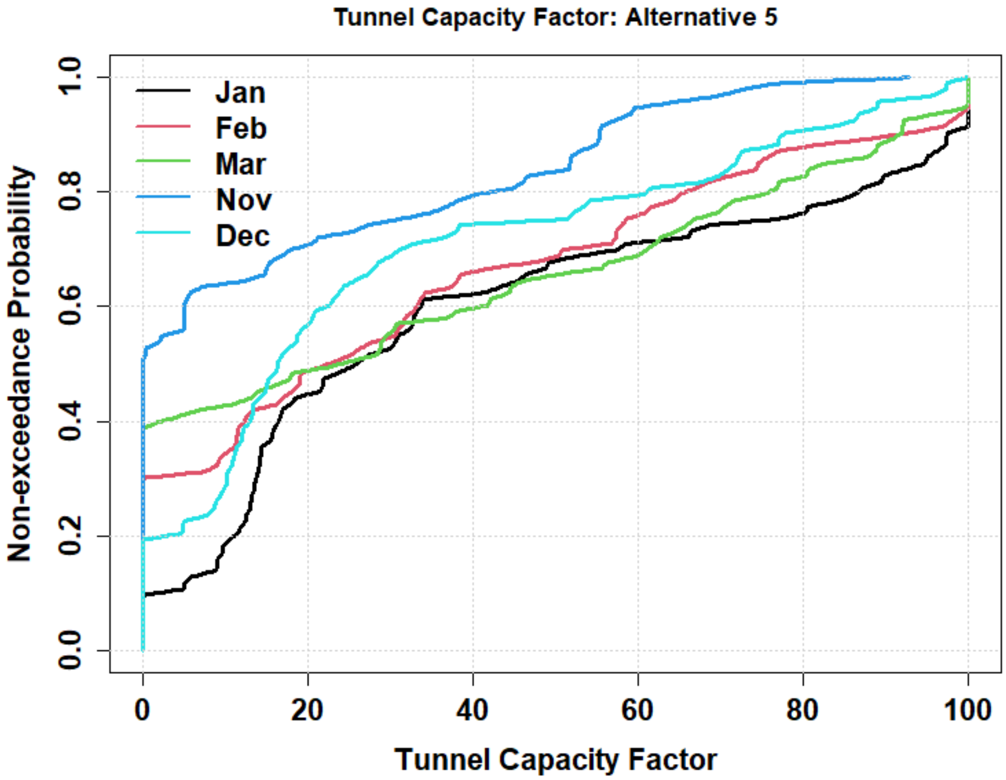

Figure 5.2. Tunnel capacity use for high river flow months. The figure shows that projected average monthly tunnel use is often small relative to its maximum conveyance capacity. Lines in the figure show how often a given tunnel capacity is expected to be used for months that typically have high river flow. Probabilities on the vertical axis show the likelihood that a given tunnel capacity (capacity factor = use/capacity in percent) will be achieved. For example, the likelihood that 40% of the tunnel's capacity (factor = 40) will be used in March is about 60% (probability = 0.6). Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx* and *DCP EIR water supply_2040Data.xlsx*) provided by California Department of Water Resources at the request of Delta ISB.

11.

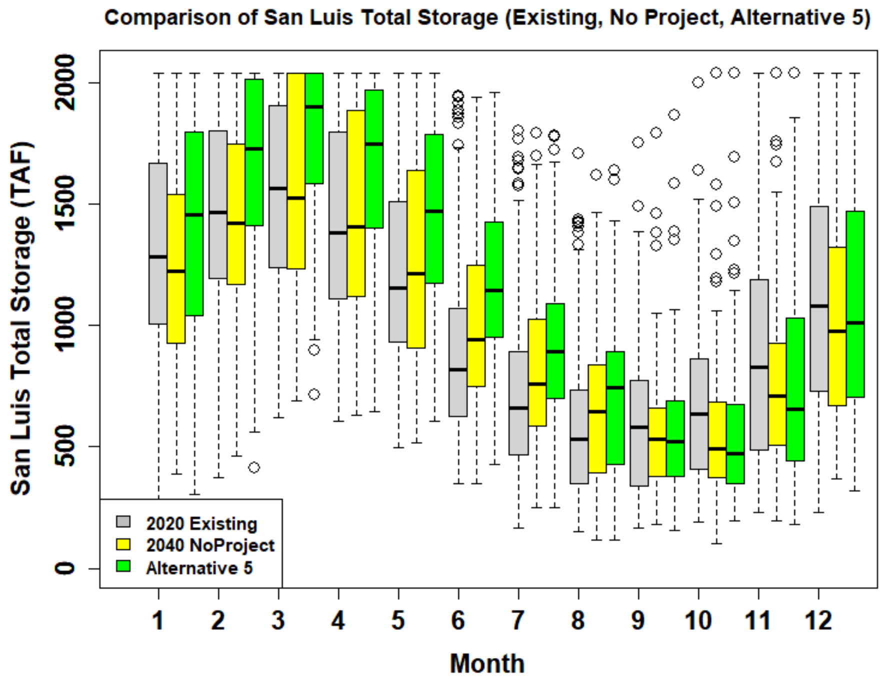

Figure 5.3. San Luis Reservoir capacity under the 2020 Existing, 2040 No project, and 2040 Alternative 5 conditions. The figure suggests that reservoir storage will sometimes limit useable tunnel capacity. For Alternative 5, the green bars or the whiskers marking the possible range of water storage are at or near maximum total storage capacity (2028 TAF) in the spring, which is the critical storage period for improving summer water deliveries. The boxes in the figure represent the 25th and 75th percentile of volume by scenario, and the horizontal black line shows the median volume. Whiskers and circles represent the broad range of volumes (5th-95th percentiles) and outlier values, respectively. Increased exports during wetter periods are expected to improve reliability of water supply obligated under contracts. Data source: Two Microsoft Excel spreadsheets (*DCP EIR water supply_2020Data.xlsx* and *DCP EIR water supply_2040Data.xlsx)* provided by the California Department of Water Resources at the request of the Delta ISB).

Chapter 6: Water Supply

Chapter 6 provides a concise and moderately detailed analysis of potential changes to the SWP and CVP water supplies from the proposed project and several alternatives.

The main CEQA results are based on CalSim 3 model runs for 2020 conditions with over 90 years of historical hydrology, representing a range from very dry to very wet years. This analysis is supplemented with CalSim 3 model results employing an adjustment to the historical hydrology based on a "central tendency" scenario of a range of 2040 climate change conditions.

The analysis and results summarize a fairly standard water delivery reliability analysis for a single source (Delta exports in this case) (Delta ISB 2022) under existing conditions and a future assuming implementation of planned projects. However, the analysis lacks a detailed assessment as to how water supply reliability is improved for users that would typically be included in these analyses. The analysis is supplemented by additional Delta export reliability analysis for climate conditions in the near future (2040), which provides some insights.

Supplemental Analyses by the Delta ISB and Implications (using Draft EIR Data)

The Delta export delivery reliability analysis, which uses average Delta exports for each alternative, does not present a full picture of variability in Delta exports across months and across years. Many of these results are available from the modeling work already done but are not presented in much detail in the EIR. The Delta ISB created several new analyses to supplement the results presented in the EIR and its appendices. Data for these additional analyses were provided by DWR from their CalSim 3 model runs at the request of the DISB. Together, these results seem to support the following findings about the project and its alternatives.

1. Tunnel capacity has only a modest effect on total and north Delta diversion water exports (Figure 6.1).

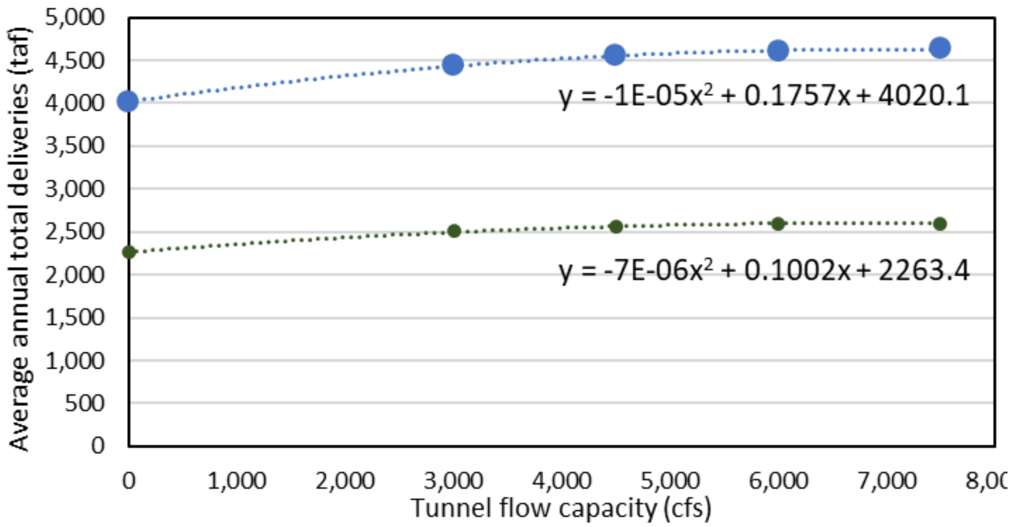

Figure 6.1. Total water project export deliveries for all and drier years (data from draft EIR Table ES-4). The figure shows that average annual water deliveries are likely to be much reduced in dry years (green line) compared to all years (blue line) and that both increase only modestly with increasing tunnel capacity.

2. Increases in Delta water supply exports come from reduced Delta outflows to San Francisco Bay. Because only a small proportion of additional water export capacity is used, average reductions in outflow are small, but daily differences can be substantial (see Chapter 12 review). Both additional water exports and reductions in Delta outflows tend to be concentrated in a few months.

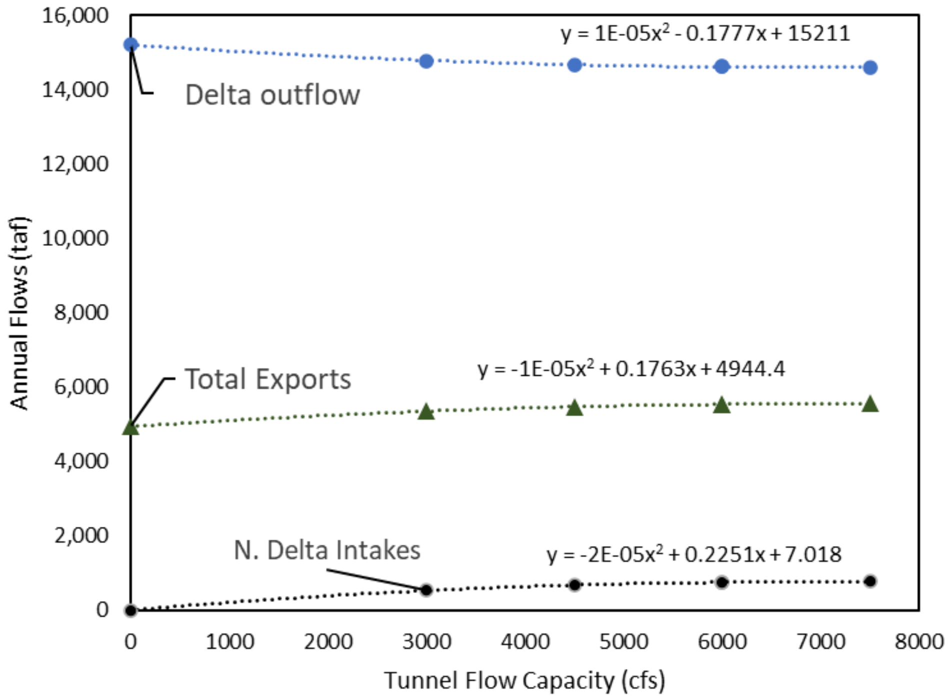

Figure 6.2. Delta exports, outflows by tunnel capacity (data from Table 6-7 of draft EIR). The figure shows reductions in average annual Delta outflows and roughly equal increases in total water exports from the Delta. North Delta intake diversions increase slightly faster with tunnel capacity than total Delta exports, reflecting a modest shift in diversions from south-of-Delta to north-of-Delta locations.

3. The tunnel export capacity utilization rate is small on average, less than 15% for the preferred alternative, as an annual average over the 93-year simulation period for 2020 conditions (Table 6.1). The tunnel capacity factor is the ratio of additional annual North Delta diversions to those that would occur with the tunnel operating at 100% of its physical capacity. The tunnel capacity factors are small overall and decrease with increased tunnel capacity. A small tunnel capacity utilization factor raises the effective capital costs of water delivered since capital costs for this capacity must be paid regardless of diversion flows.

Table 6.1. Exports by tunnel capacity for 2020 conditions (data from draft EIR Table 6-7).

Tunnel Capacity (cfs)	Alternative (Alts)	Avg Delta Outflow (taf/yr)	Total Delta Export (taf/yr)	North Delta Intakes (taf/yr)	Tunnel Capacity Utilization Factor
0	Existing Conditions	15,216	4,939	0	
3,000	Alts 2b, 4b	14,777	5,377	558	0.200
4,500	Alts 2c, 4c	14,681	5,478	675	0.164
6,000	Alts 1,3	14,631	5,528	740	0.134
6,000	Alt 5	14,626	5,532	746	0.135
7,500	Alts 2a, 4a	14,604	5,563	773	0.114

Strengths

1. The chapter lays out the many connections between water supply and the other chapters in the draft EIR from the perspective of annual mean flow conditions.
2. The summary comparison of alternatives (Table 6-0) is a helpful overview and introduction.
3. The overview of California's surface water supplies is informative. The chapter provides a brief description of water uses in California, statewide, and the variety of water sources available, though it seems to neglect the integral roles of local and regional groundwater and surface water storage for much of the state.
4. Useful presentations are made of the major Delta water projects, their facilities, and their upstream watershed components, as well as in-Delta project water operations, such as for Suisun Marsh, and other relevant local and regional water diversions.

Concerns and Potential Weaknesses

1. As a primary objective of the Delta Conveyance Project, water supply is extremely important. However, Chapter 6 is only 49 pages long with much of the chapter (about 33 pages) devoted to a general description of the system features and their operations. Given the importance of this topic, the description and explanation of the performance of alternatives, as described in Appendix 6A, is inadequate. The statement that "No specific impact assessment results are presented in this chapter because the effects of these changes are not considered environmental impacts under CEQA" (page 6-2,

lines 14, 15) is confusing. If water supply reliability is a primary objective and impacts the project's service area, then it should be analyzed and discussed more completely regardless of CEQA requirements. In the overview of "Alternative Water Sources" (Section 6.1.4), it would help to know how these alternative water sources might shape demands for SWP and CVP Delta water exports and what proportion of SWP and CVP contracts could be covered by such alternative sources by 2040 and later. It is not clear if the contractual obligations were revised to reflect future conditions due to climate change (see next comment).

2. The chapter concludes on page 6-33 (and as analyzed in Appendix 3H) that sufficient supplies exist for water transfers in all water year types with current facilities because maximum historical water transfers were less than permitted volumes. Does this conclusion consider what the demands on the proposed projects would be if water transfer activity increases in the future due to increased use of markets for water (given that markets may become more salient tools in hotter and drier years) or if new environmental conditions further restrict transfer operations? The current analysis seems to be based on past water transfer years and doesn't seem to consider the potential for more extreme or otherwise changed conditions in future years.

3. The large reductions in water availability and Delta water deliveries estimated from today's conditions to the 2040 (CT) no project conditions (Table 6-2) would seem to have major implications for water management generally in California, not just for this Delta conveyance project. The chapter could have better described how future conditions will affect water availability for alternative surface and groundwater sources, for example, and availability and expense of Colorado River purchases for southern California cities.

4. Contradictory trends, relevant to water supply, are presented but not discussed. Changes in conditions from today until 2040 CT decrease Delta exports, despite an increase in average annual unimpaired inflows and Delta outflows (draft EIR Table 6-4). These contradictory trends might be reasonable given seasonal shifts in hydrology and changes to extreme events but seem worth discussing (and comparing to other climate scenarios developed for the EIR).

5. The sources of existing condition Delta exports 4.0 MAF/year in Table ES-4 and 4.9 MAF/year in Table 6-7 are unclear. The numbers in Table 6A-1 seem more compatible with Table ES-4. Are Tables ES-4 and 6A-1, 6A-3 specifically for projected 2040 conditions and Table 6-7 specifically for 2020 conditions?

6. Multiple future uncertainties have not been well characterized including the many risks to water supply operations that could result from a changing environment. For example, zebra and quagga mussels, which are a risk for the Delta, have moderately well-known effects on water pumping, conveyance, and storage operations (as well as water quality). Potentially important non-stationary changes are likely to include other invasive species, changes in environmental flow regulations, and implementation of groundwater sustainability regulations. Mechanistic, causal discussions and explanations of operations and operational strategy were not presented. This omission limits the Delta ISB review scope.
7. What are the relative SWP water quality impacts of the Bethany Reservoir alternative compared with other alternatives that would blend north Delta diversions with Clifton Court diversions into Bethany Reservoir? It seems that for some finer scale California Aqueduct operations, this might have positive impacts on South Bay Aqueduct water quality, and perhaps, if operated without Clifton Court Forebay blending, might provide water quality benefits for users further down the California Aqueduct (particularly urban water users).

   Analyses do not explore the uncertainty of the future climate and sea level during operations, which occur well beyond 2040. The composite climate change scenarios (2040 CT and 2040 Median), even as central tendencies of 10-20 General Circulation Model (GCM) results, seem substantially different hydrologically, even for this near-term time horizon. Having a spread of reasonable 2070 scenarios might give a better picture of the range of conditions that the project and region should prepare for. Using a central tendency alone will wash out the need to prepare for important reasonable extremes.

   Because of the importance and uncertainty of future climate to the water supply and environmental performance of the project, it is useful to examine the potential impacts of a wider variety of future climates than what is in the draft EIR. The draft EIR's analyses and data show important differences among the major hydrologic scenarios developed, yet these differences and their implications for project impacts are scarcely discussed.

   Unimpaired Inflows under varying climates are worthy of consideration. The draft EIR considered a range of future hydrologic conditions and modeled the operational implications for two of these conditions (chapters 6 and 30, and appendices 6A and 30A): 1) 2020 hydrologic conditions roughly represent current historical unimpaired inflows to the Central Valley system from 1922 – 2015; and 2) 2040 CT hydrologic conditions represent a "central tendency" of hydrologic conditions from 20 climate simulations or GCMs, as described in Chapter 30 and its appendix.

The uncertainty of future climate across months and years increases with time. Even for one timeframe (2040 in this case), there are substantial differences in water availability depending on the estimation method used. The 2040 CT estimate of potential future conditions used in Chapter 5 includes 0.5 feet of sea level rise, which is much lower than the Median 2040 used in the report. The Median 2040 scenario is based on a different selection of GCMs, resulting in an estimate of 1.8 feet of sea level rise by 2040. An even more extreme scenario for 2070 was used with a large range of sea-level-rise projections.

The use of alternative future scenarios in water supply analysis could lead to different conclusions. Yet, operational simulations with CalSim are made only for 2020 and 2040 CT future conditions. The Delta ISB has analyzed model output data provided by DWR to explore some of the potential differences in current and future conditions when multiple scenarios are used. The monthly distribution of monthly major unimpaired inflows for 2020, 2040CT, 2040 Median, and 2070 are presented in Figure 6.3.

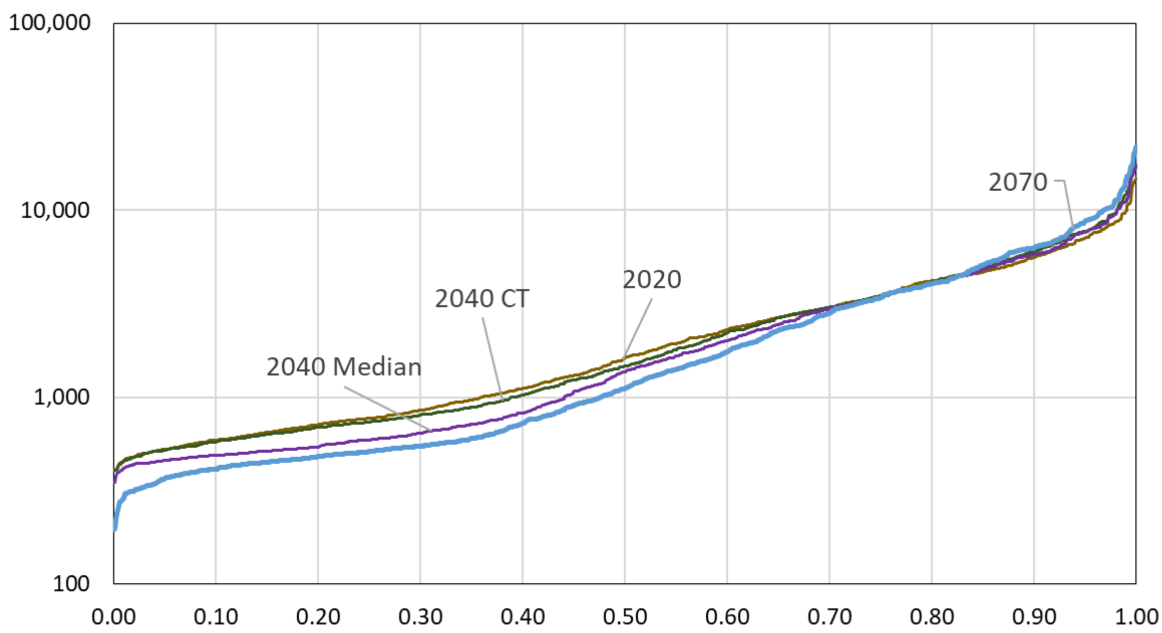

Figure 6.3. Relative frequency of monthly unimpaired major reservoir inflows for 2020 and three future climate scenarios (Source: Spreadsheets provided by DWR).

In the drier 50% of months (represented by the portions of colored lines to the left of the vertical line at 0.50 frequency), 2040 Median inflows are substantially less than the wetter 2040 CT inflows. In much of this range (about 30 to 60% of the time) 2020 inflows are a little higher than 2040 CT. In the wettest 15% of months (>0.85 frequency), 2020 inflows are the lowest, 2020 CT and 2040 Median flows are in the middle, and 2070 inflows are the highest. In the driest 70% of months, 2070 inflows are substantially less than for other scenarios. (Note the x axis has a log scale to better shows differences across scenarios for low flows.)

8. Exports relative to inflows: The draft EIR lacks a thorough analysis of Delta exports by alternative (reflecting the water supply benefits) that accounts for variable inflow time series to represent future climate and tunnel capacities. The annual average of major unimpaired inflows and water exports for these scenarios are shown in Table 6.2).

Table 6.2. Annual average of major unimpaired inflows and water exports for climate scenarios in draft EIR.

Scenario	Mean annual inflow (taf/yr)	Difference from 2020	Ave. Delta Export (cfs)	Ave. Exports w/ Alt. 5 (cfs)
2020	29,682	0	6,849	7,671
2040 CT	30,542	+860	5,746	6,486
2040 Median	28,854	-828	na	na
2070	29,453	-229	na	na

na – No analysis or this case was prepared using CalSim.

Trends in average inflows do not alone determine trends in water exports. As shown in Table 6.2, the 2040 CT inflows average 860 taf/year more than for 2020, but the average exports are 1,100 cfs (about 780 taf/year) less, due to 2040 CT's greater variability of inflows.

The Alternative 5 project with 2040 CT conditions provides on average about 5% less than average exports under 2020 no project conditions, despite the 2040 CT scenario having 3% more annual unimpaired inflow. This result is surprising.

As seen in Figure 6.4, over all but the wettest 2% of months, without a project, water exports are much less with the wetter but more variable 2040

CT hydrology. With the drier 2040 Median hydrology, water exports are likely to be still less.

Adding tunnel capacity and operations for the preferred alternative (Alternative 5) increases exports for both 2020 and 2040 CT cases, in all but the driest 20-30% of months, when the additional conveyance capacity provides little or no export benefits. In both cases adding the Alternative 5 infrastructure and operations increase total average exports by about 700 to 800 cfs (about 550 taf/year).

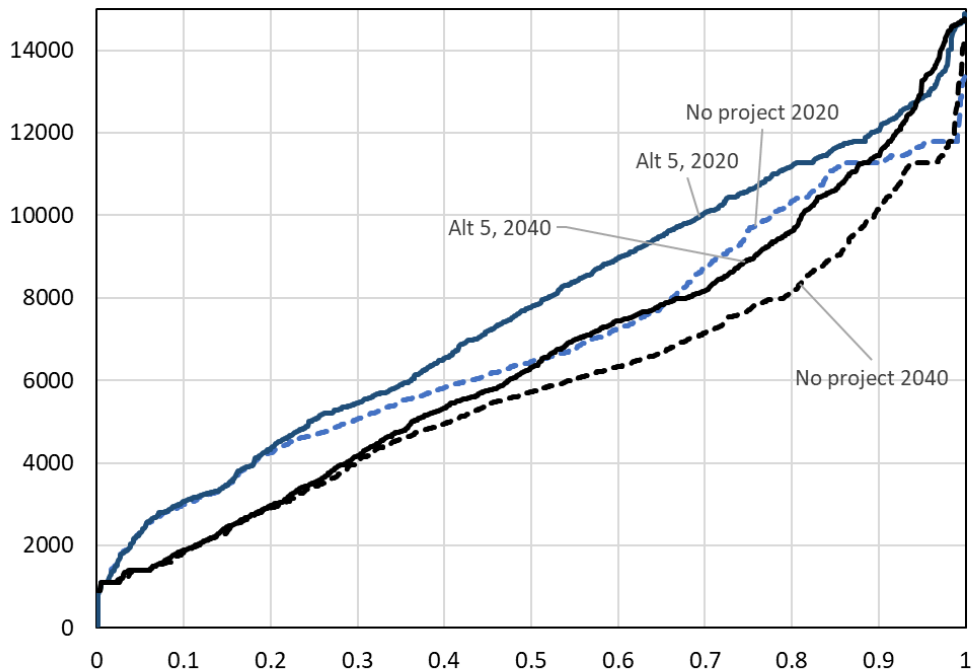

Figure 6.4. Monthly cumulative total export frequency (cfs) for no project and Alternative 5 for 2020 and 2040 CT (Source: Spreadsheets consisting of hydrology and CALSIM 3 model results provided by DWR).

Suggestions for Improvements

1. More explanation and discussion of how the operation and export performance of the system under the no action and preferred alternative would be helpful. A qualitative explanatory discussion (perhaps supplemented with a few diagrams) of the strategic thinking on Delta water export operations would give readers and water supply managers some improved understanding of the portfolio of water supply operations and project effects.

Although the chapter provides concise comparison of Delta water project deliveries for the examined alternatives, including totals would be helpful, along with a more explicit comparison with past, recent, and projected conditions. More discussion of the water demand assumptions would be helpful. The impression is given that demands for water from the Delta are large relative to the amount of water likely to be available for export. This would mean that most water-use reduction and alternative water supply efforts in the service areas of Delta water exports would not make big alterations to demands for Delta water exports. Some demonstration and discussion of this possibility seem desirable (or even necessary), particularly in light of implementation of the Sustainable Groundwater Management Act (SGMA). Several interesting studies exist of this possibility (Alam et al. 2020 is one of the better studies). If demands for Delta water exports could be largely met by proposed alternatives, or without the project, then more detailed analyses of these demands and alternative water supplies seems to be in order.

2. More scenarios exploring uncertainty of climate change, sea level rise, and water demand would help to clarify the range of potential project benefits and impacts. Further discussion of already developed 2040 and 2070 climate scenario implications would be an easy start in this direction.
3. Examining invasive species risks would reveal potential unintended consequences of the project. Major water agencies have been looking at and adapting to some invasive species, and that work can provide a basis for discussing these impacts, potential adaptations to them, and the effect of proposed project alternatives on adaptation strategies. The analysis would address the question, Would such anticipated invasive species substantially affect proposed tunnel performance and what might be done about them? Similar analyses and discussions for potential changes in environmental regulations would also be useful.
4. That in-Delta water use has remained relatively constant over the past century and averages about 4% of Delta inflows may be worth more discussion and emphasis, particularly given potential concerns that the proposed project and sea level rise might hinder in-Delta water use.
5. We recommend that additional concerns raised above also be addressed.

References

Alam, S., Gebremichael, M., Li, R., Dozier, J., and Lettenmaier, D. P. 2020) Can Managed Aquifer Recharge mitigate the groundwater overdraft in California's Central Valley?. Water Resources Research 56: e2020WR027244.

[Delta ISB] Delta Independent Science Board (2022). Review of Water Supply Reliability Estimation Related to the Sacramento-San Joaquin Delta. Report to the Delta Stewardship Council. Sacramento, California, 193 pages, June 2022.

Chapter 7: Flood Protection

Strengths

This chapter addresses major localized concerns for flood impacts from the proposed project. The analyses have been designed to be consistent with the 2022 Central Valley Flood Protection Plan (CVFPP) and the State Plan of Flood Control (SPFC) as defined in California Water Code. The analysis appropriately incorporates sea level rise.

Concerns and Potential Weaknesses

1. The implications of flood protection associated with various alternatives have been determined using a different set of criteria. For water supply and other issues, the comparisons were made for the 2020 Existing Condition, 2040 No Project Scenario, and the conveyance alternatives. For Flood Projection, for reasons that are explained in this chapter, the comparison has been made between 2022 and 2072 time epochs under conditions of 100-year and 200-year floods. The reason for this difference in planning horizons relates to the consistency with CVFPP update. However, Appendix 7A describes evaluation project alternatives for the reference of 2040, which is consistent with evaluations described in other chapters of the report. The use of two different evaluations is somewhat confusing.
2. The implications of constriction due to the tunnel intake infrastructure have been investigated within a limited area (Sacramento River between American River and Sutter Slough). Flood magnitudes due to climate change could potentially be larger, due to various factors such as the potential for increasing frequency of the atmospheric river phenomenon. In addition, the changes in hydrology in terms of precipitation occurring more as rain as opposed to snow in the tributary basins may already be how the upstream reservoirs are operated and that could lead to a change in flood magnitudes.
3. Change in flood properties may extend beyond the aforementioned limited area to Delta islands with potential implications for levee stability. There is very little discussion on how the 100-year and 200-year flood magnitudes were determined. Because of climate change, and associated nonstationarity in hydrology, such floods are likely to be large in the future. It is not clear why there was no consideration for changing the magnitude of rare floods.

Suggestions for Improvement

1. A clear elaboration of the implications of larger floods due to climate change is needed. This analysis needs to be discussed system-wide including Delta levees, not just in the vicinity of major intake structures associated with the project alternatives.
2. We recommend that additional concerns raised above also be addressed.

Chapter 8: Groundwater

This chapter shows groundwater effects of the proposed project alternatives are rather small within the Sacramento-San Joaquin Delta and nearby areas. (This chapter is 20 pages longer than the Water Supply chapter, which seems an odd allocation of attention for a water supply project.)

Strengths

1. The chapter covers groundwater quantity and quality impacts within the Delta, particularly impacts from construction, operation, and mitigation activities. The relative abundance of surface water in the Delta and the overall porosity of aquifers mean that groundwater impacts should generally be low and temporary, with occasional potential to affect local wells, as the chapter and its analyses seem to suggest.
2. The analysis for in-Delta groundwater impacts, including effects on local wells, seems fairly well done, thorough, and complete. For each alternative, a few dozen wells would experience some small changes in groundwater elevations, within a range where compensation and mitigation seem reasonable.

Concerns and Potential Weaknesses

1. The chapter acknowledges that there will be groundwater impacts in the southern Central Valley water delivery areas. But the chapter and appendices provide weak analyses of these impacts.
2. There are likely to be substantial effects of the project proposals on groundwater in the southern Central Valley, particularly the Tulare basin. This is mentioned in the chapter. EIRs for earlier Delta conveyance proposals presented extensive analyses of such impacts. With the passage of SGMA, there is about 2 MAF/year of groundwater overdraft to be addressed in the southern Central Valley, a major export destination from the Delta. This estimate is based on historical Delta export levels. The roughly 600 TAF of deliveries from the proposed project would be at best almost a third of this deficit (far more than the likely contribution of additional local flood water capture). Under the worst case, this seems almost as much as the reduction in water exports likely from a changing climate. A quantitative discussion of project and alternative impacts on southern Central Valley groundwater overdraft and regional impacts, for example on agriculture, would be helpful for evaluating project alternatives. The examination of southern Central Valley groundwater also is important potentially for understanding the ability to

store water in San Luis Reservoir from a new tunnel facility. Moving water from San Luis to groundwater basins (such as Kern Water Bank and other storage areas) would free up capacity in San Luis to accommodate some additional Delta pumping. This analysis might require use of some of the regional groundwater models for this region, along with operating assumptions for how changes in export water and San Luis might be employed over dry and wet seasons and conditions.

3. The in-Delta groundwater effects of sea level rise seem to have been explicitly excluded from the 2040 groundwater modeling. While this effect is small, it would be useful to have a model run to explore this sensitivity, especially for places near more saline surface water, but also for some interior areas of the Delta. In both cases, one would expect the impacts to be small, but it will be a common question that can be easily answered with a model run or so.

Suggestions for Improvement

1. A more complete discussion and estimation of the effects of the alternatives on southern Central Valley groundwater is warranted.
2. Within the Delta, some analysis of the potential for effects from sea level rise (affecting both saltwater and freshwater infiltration and drainage) seems warranted. It also would be helpful to provide a summary of the general approach to groundwater mitigation and compensation for the few dozen wells in the Delta where project effects could be substantial.
3. We recommend that additional concerns raised above also be addressed.

Chapter 9: Water Quality

This chapter focuses on select aspects of water quality based on a Screening Analysis, consideration of Section 303(d) of the Clean Water Act, which specifies a list of water-quality impaired rivers and waterbodies, and several state and federal regulations such as regional water quality control plans. Under Section 303(d), both the Sacramento River and the San Joaquin River are considered impaired for existing conditions. The selected constituents of water quality examined are boron, bromide, chloride, electrical conductivity (proxy for salinity), mercury, nutrients (N and P), organic carbon, dissolved oxygen, selenium, pesticides, trace metals, total suspended solids/turbidity, and cyanobacterial harmful algal blooms (CHABs). Project alternatives are deemed to have less than significant impacts based on CalSim 3 and DSM2 projections of Delta hydrodynamics, water quality, and particle tracking throughout the Delta (if data are available). The period of record modeled is 1923 to 2015. When quantifiable data are available and sufficient, mass-balance calculations are used assuming that there is no decay, uptake, transformation, sorption, or other losses in the water column. Modeling and other such calculations are intended to be "comparative rather than predictive" meaning that impacts are considered less than significant when simulations do not significantly differ from existing conditions. When data are not available, impacts of the project are assessed qualitatively by examining other factors that could impact a constituent such as water temperature, changes in source waters, or channel velocity.

The chapter largely focuses on impacts related to operations and maintenance, because impacts due to construction are considered insignificant or negligible due to the expected implementation of Environmental Commitments and Best Management Practices.

Strengths

1. The chapter is detailed and covers many important aspects of water quality in the region. The supporting information in the Appendices is extensive.
2. Given that the concentrations of mercury and methyl mercury in the Delta are currently at levels that result in modelled concentrations in fish tissue that exceed the water quality objective for largemouth bass, the potential impacts of the project associated with mercury are a concern. The modeling for the draft EIR assessment focuses on whether the alternatives for the project would change the concentrations to an extent that would further exacerbate the concentrations in fish tissue in the Delta. In addition, the EIR

considers whether the freshwater emergent wetlands on Bouldin Island that would be created as compensatory mitigation measures would result in increased mercury concentrations in fish tissue. The approaches used to model the potential increases appear to be robust, and the consideration of the potential for the compensatory mitigation measures to increase methylmercury concentrations in fish is a strength of the analysis.

3. Another strength of the draft EIR with respect to mercury issues is the planned development and implementation of a mercury management and monitoring plan and the identified management measures that could be employed are sound. The approach of developing site-specific management plans related to mercury is also a strength.
4. Dissolved oxygen has an important influence on the survival of many aquatic organisms. The draft EIR correctly identifies the three main factors of water temperature, channel velocities, and oxygen-demanding substances as interacting to control dissolved oxygen.

Concerns and Potential Weaknesses

1. Throughout the chapter, consideration of aquatic and ecosystem health is underrepresented.
2. There are considerable uncertainties about chemical contaminants, in particular a lack of monitoring data, a lack of toxicity data for aquatic organisms, and, consequently, a lack of water quality criteria. Conclusions such as a "less than significant" impact, as repeatedly listed in this draft EIR, cannot be drawn, in some cases, based on available data. Instead, these uncertainties should be identified and the confidence in remaining assessments made clear.
3. The lack of existing objectives or criteria has been used to support statements about a lack of impact for bromide and for several other constituents. This is not scientifically sound. Each constituent has accepted thresholds or ranges that are considered safe for beneficial uses, regardless of whether these values are in a regional water quality control plan. Bromide, for example, should be $< 300\ \mu g\ L^{-1}$ according to experts convened by the California Urban Water Agencies (1998) because this is the value at which drinking water suppliers have the most flexibility for water treatment.
4. Throughout the chapter and for each constituent, a less than significant impact is partially attributed to the fact that project facilities "would not create new sources of X or contribute toward a substantial change in existing

sources of X in the Delta." While this may technically be true, this sidesteps a discussion of whether the proposed project would impact environmental flows in a way that alters water quality for a range of stakeholders. For example, diversions could change the proportion of source waters in parts of the Delta, which could result in "seasonal differences in Delta inflow rates from the Sacramento River relative to existing conditions." The analysis in Appendix 9B partially addresses this issue but may not have considered more extreme conditions (see Chapter 30 discussion).

5. The chapter does not adequately discuss changes to tidal and water quality mixing as a result of reductions in south Delta pumping and north-of-Delta diversions. Tidal mixing drives water quality throughout most of the Delta, especially in drier years and seasons.
6. The analysis of water quality does not seem to particularly examine conditions and potential problems in drier years, such as droughts. Appendix 9B seems to show greater San Francisco Bay water influence and dispersion in drier months, which seems likely to worsen in more extreme dry years.
7. Analytical data used for the screening exercise was limited to the Sacramento and San Joaquin rivers and San Francisco Bay, which are all large water bodies with high dilution factors. However, sources of numerous contaminants are more localized (e.g., domestic and industrial wastewater treatment plants, agricultural drains, stormwater). The screening is therefore bound to exclude many chemicals that may be of local relevance regarding toxicity and/or bioaccumulation. As described for mercury, the impacts of most contaminants on aquatic species are specific to subregions and individual habitats within the Delta and affected by many factors such as organic matter in the sediments, organic carbon levels, pH, temperature, and salinity. There is lack of discussion of how the project agencies would respond to such localized water quality problems discovered after the project becomes operational.
8. Regarding dissolved oxygen, the draft EIR only mentions nutrients in the context of “oxygen-demanding substances.” It concludes that because the project alternatives were found to not contribute significantly to nutrients that there would not be an impact on dissolved oxygen from the project alternatives. This approach ignores the role of production of organic material, both particulate and dissolved, that has an oxygen demand associated with its degradation. Organic matter degradation depends on the quality of the organic material and Delta flows, tides, and hydrodynamics, and not just the concentration. This process of oxygen consumption could be

considered for both the direct impact of the project and the impact of the compensatory mitigation measures that would create wetlands, as was done for the evaluation of mercury in a previous section. In that previous section, the changes in dissolved organic carbon concentrations were determined to be insignificant, but this analysis did not address any potential changes in organic matter quality and the potential for fresh organic matter to be more available and act as oxygen-demanding substances. Overall, the analysis for impacts on dissolved oxygen seems to be cursory. For example, the analysis does not consider diel variations that typically cause low dissolved oxygen concentrations at night due to respiration of plant material. Also, changes in temperatures, flow rates, residence times and degree of stratification down-river of the intakes are not evaluated based on daily analyses.

9. Regarding mercury, a potential weakness of the Mercury Management and Monitoring Plan is that some of the identified management measures may be difficult to implement or unrealistic, and they are not described in sufficient detail to evaluate. In particular, management measures that reduce the amount of organic material by mechanical removal may not be practical given the scale of the compensatory mitigation for the project.

10. Modeling results presented in the draft EIR show only small changes in mercury concentrations compared to existing conditions at select sites and pumping plants. To assess impacts on wildlife, it would be more useful to focus on areas important to wildlife, especially endangered species. A more localized approach may also be needed to assess the impact of flow alterations on fate and transport of contaminants.

11. The Mercury Management and Monitoring Plan relies on monitoring and adaptive management, but the funding source for these activities, which can be uncertain and labor and time intensive, is not disclosed. The nature of funding dictates how much and how long monitoring and adaptive management can be carried out, which is necessary to evaluate whether these efforts are of sufficient duration and scope to inform decisions. For example, adaptive management is cited as the primary mechanism to ensure that "new tidal habitat does not result in statistically significant or higher than average mercury concentrations," but the scale and duration of monitoring needed to detect significant changes are unclear.

12. There is also a Sediment Monitoring, Modeling, and Reintroduction Adaptive Management Plan, but it is unclear how this will be funded or who is responsible for implementation and analyses.

13. It is unclear how pesticide loads transported to the Delta would be affected if the Delta receives proportionally more water from the San Joaquin River under project alternatives.
14. Estrogenic compounds and pharmaceuticals are excluded from further consideration due to woefully inadequate data, even though they have been shown to harm reproductive organs and kidneys of fish at environmentally relevant concentrations elsewhere. The EIR needs to recognize these known unknowns.
15. The draft EIR does not discuss how insecticides used for mosquito abatement and herbicides used for macrophyte control could affect other organisms.
16. The importance of transport and accumulation of sediment-associated contaminants, e.g., due to mitigation projects, is not considered for chemicals with hydrophobic properties such as some groups of pesticides.
17. Only Microcystis, which occurs predominantly in freshwater, is considered in assessing impacts on HABs. However, marine cyanobacteria species are thought to have been responsible for extensive fish kills in San Francisco Bay and Suisun Bay in 2022. The draft EIR does not discuss the expected impacts on HABs if the central Delta becomes more saline and offers better habitat for these marine/brackish water species. Also, the EIR largely considers HABs as a drinking water issue only, even though HABs can affect biota and humans directly. Greater attention is needed to understand HAB effects, including over short time scales since toxic conditions can be transient.
18. Construction, which could involve "excavation/trenching, transport, handling, and use of a variety of hazardous substances and nonhazardous materials," may impact aquatic life and beneficial uses. However, it is not clear whether monitoring or oversight will occur during construction and what actions will be taken if impacts are discovered during activities.
19. The mass-balance assumption and approach are validated in 2012 for chloride and bromide but not for the other compounds.

Suggestions for Improvement

1. There are many unknowns about aquatic toxicity from large-scale construction projects, and sublethal toxicity in fish has been observed elsewhere. It is therefore recommended to conduct toxicity monitoring in adjacent water bodies, which can serve as a control, during construction of conveyance facilities.

2. It would be helpful to separate out impacts before and after mitigation, so that the baseline risks and impacts could be better evaluated separately from the assumption about the effectiveness of mitigation activities.
3. There are established methods of performing cumulative effect analyses that should be considered.
4. The topic of water temperature is addressed in the context of its impact on dissolved oxygen concentrations, but other potential consequences of changes in water temperature should also be examined across a range of timescales ranging from daily to annual. The analysis should examine the impacts of changes in water quality on aquatic ecology, food chain dynamics, and ecosystem health and services to the same extent as it considers water quality within the context of water supply.
5. We recommend that additional concerns raised above also be addressed.

References

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Chapter 10: Geology and Seismicity

Strengths

1. Chapter 10 includes a comprehensive state-of-the-practice application of probabilistic seismic hazard analysis (PSHA) to estimate the seismic hazard in the Delta. It is based on an earlier investigation supported by DWR known as the Delta Risk Management Strategy (DRMS) Phase I Investigation.
2. The maps of Delta earthquake potential and the information on historical earthquakes are informative.
3. The discussion of secondary seismic hazards such as liquefaction add to the strength of the presentation.

Concerns and Potential Weaknesses

The major challenge to assessing seismic hazard in the project area is blind faulting (i.e., faults that do not rupture the land surface). In typical seismic hazard assessments, faults are identified, and their seismic activity assessed in part by documenting fault offset of geologically dated shallow stratigraphic layers. This can be difficult to impossible to do for blind faults. Evidence for active faulting in the Delta is ambiguous. Indications of the potential for active faults are that the Delta sits in an eroded depositional basin in the California Coast Range province. This geologic province is known to have blind faults that have generated historical earthquakes (e.g., the 1983 M6.2 Coalinga earthquake). The 1892 Vacaville earthquake (noted in the report) confirms earthquake potential near if not in the Delta, but the source and location of the 1892 earthquake are poorly constrained. Blind faults have been identified in the Delta during oil and gas exploration. Two of these faults, the West Tracy and Midland, are of particular concern because they may be active. While the Delta Conveyance Project investigation follows standard PSHA practice and specifies assumptions about fault slip rate and activity, estimates of these two parameters have large uncertainties including whether these two potentially important faults are indeed active. The project proposes an extensive trenching program of the West Tracy Fault (Page 10-46, lines 30-34), which seems late in the preconstruction investigation for a fault that potentially has such a large project impact.

We have two concerns about the PSHA/seismic analysis as described in the report: (1) local site amplification and (2) ground-motion prediction equations (GMPE).

1. The text on page 10-28, line 6 indicates that the effect of local soils on ground motion was evaluated by changing the site condition for the GMPE that was used to generate the shaking map. It is unclear if local site effects are adequately considered simply by changing the site soil classification. The thickness and dynamic properties of peat will have a major impact on local seismic response, and this impact will vary over a wide range in the Delta along the proposed tunnel alignments. The tunnel itself, of course, lies below this layer.
2. The second concern derives from a discussion in Chapter 7, Flood Protection. In Section 7.1.3.4 (page 7-23, lines 1-10) of Chapter 7, the discussion, *Seismic Activity*, refers to a study of ground motion attenuation with distance in the Delta during the 2014 Napa earthquake that indicated greater attenuation in the Delta than is predicted by other generic GMPE's for the Western U.S., thereby reducing seismic hazard in the Delta. This assumption is optimistic and unnecessarily undermines the DRMS choice of GMPE's. Uncertainty associated with GMPE's is included in a PSHA.

In addition to describing the ground motion hazard in the Delta, the report indicates a concern for the secondary hazard of earthquake-induced liquefaction and associated vertical and horizontal ground deformation. The discussion of the impact of liquefaction does not consider the potential for ground oscillation, chaotic horizontal deformation associated with long-period seismic waves after the soil has been softened. This is a common mode of deformation in flat ground underlain by liquefying deposits, which is the topographic setting in most of the Delta when levees are excluded. Figure 10-5 implies that long-period ground motion in active Bay Area strike-slip faults will be significant, which increases the potential for liquefaction triggering and ground oscillation.

Suggestions for Improvement

1. Seismic hazards should be consistent over the report. The seismic hazard in the Delta is characterized differently in Chapters 1, 7, and 10. The characterization in Chapter 1 (page 1-17, lines 5-7) of a 72% probability of an earthquake with magnitude equal to or greater than 6.7 by 2043 disagrees with the characterization in Chapter 7 (page 7-23, lines 3-5) of a 62% probability by 2003 to 2032. Both characterizations are for the greater Bay Area, and neither is as useful as the Delta specific investigation of seismic hazard described in Chapter 10, which estimates ground motion exceedance probabilities.

The first two characterizations—Chapter 1 and 7—are based on sequential hazard assessments for the greater Bay Area by the U.S. Geological Survey. The 72% estimate is the current official government estimate and updates the 62% estimate. The assessments were conducted for the greater Bay Area of which the Delta is only a small portion. Because ground motion attenuates rapidly with distance, many M6.7 earthquakes in the Bay Area will not subject the Delta to strong ground motion. Accordingly, the statement that the 2003 to 2032 forecast "concluded that a major earthquake of magnitude 6.7 or greater in the Delta region has a 62% probability" (page 7-23, lines 3-4) is misleading and implies a higher seismic hazard in the Delta than is the actual case.

Both of these summaries of earthquake potential in the greater Bay Area are based on time-dependent earthquakes on major and well-documented Bay Area faults. The characterization of seismic hazard in Chapter 10 is based on the DWR DRMS and focuses on the Delta. It relies on a state-of-the practice methodology, PSHA), to estimate strong ground motion, the parameter needed for earthquake engineering analysis. While Delta specific and most relevant to assessing the seismic hazard for the Delta Conveyance Project, the earthquakes considered in the PSHA were time independent. The different assumptions about the timing of earthquakes presumably will lead to different estimates of seismic hazard.

2. The spectral period for the 475-year acceleration mapped in Figure 10-5 is not specified. We suspect that it is a one second spectral acceleration. If so, a comparable PSHA map of peak ground acceleration (PGA) would help the reader evaluate potential liquefaction hazard.
3. We recommend that additional concerns raised above also be addressed.

Chapter 11: Soils

Strengths

The chapter provides helpful maps depicting shallow soil conditions in the Delta, including thickness of organic soils (page 11-29) and surface elevation (page 11-33). It also contains a demonstration of how soil maps can be used to anticipate potential engineering problems during construction and operation of a facility.

Concerns and Potential Weaknesses

Uncertainty due to sea level rise has not been well addressed.

Suggestions for Improvement

Figure 11-9 portrays land elevation in the Delta. Land surface of southern transect of Alternative 5 is below mean sea level. What will happen when sea level rise submerges a portion of the Delta Conveyance Project? Should a higher elevation route have been selected?

Chapter 12: Fish and Aquatic Resources

Chapter 12 summarizes the expected impacts of the project alternatives on 15 species of fish "of management concern." This includes fish species listed as endangered or threatened by state or federal agencies, species listed by Moyle et al. (2015) as California Species of Special Concern (critical, high, or moderate status), and species of Tribal, commercial, or recreational importance. Winter-run, spring-run and fall-run Chinook salmon are each considered independently. Southern resident killer whale (*Orcinus orca*, federally listed as endangered) is also considered because of potential effects on their Chinook salmon (*Oncorhynchus tshawytscha*) prey.

Impacts from construction (primarily noise), maintenance, and operations are evaluated. Operational impacts are divided into near-field effects and far-field effects. Near-field effects are mainly impingement at the intakes. Far-field effects are downstream of the intakes and associated with changes to Sacramento River flows and associated conditions (e.g., temperature, turbidity).

Strengths

Substantial information on individual species impacts, much of it supported by published literature, is provided on important (key) species, and their food supplies and habitats. The literature review and data summaries appear to be reasonably comprehensive. The analyses of project effects on some specific fish (e.g., salmonids, smelt) are comprehensive and detailed. The emphasis on Chinook salmon, which includes some life-cycle models, and Delta smelt is understandable given the concerns for these species and the availability of published literature and data on these species.

Concerns and Potential Weaknesses

Substantial weaknesses were noted in the types of analyses conducted to estimate aquatic and riparian ecosystem impacts, as discussed under the suggestions. In general, the breadth (type of impact evaluated) and depth (amount of scientific analysis) were uneven among all species. Potential benefits to fish were stated but not backed up by the analyses presented. For example, a stated potential benefit of this project is to shift fish entrainment losses by shifting intakes between the (new) North Delta intakes and the existing south Delta intakes.

Suggestions for Improvement

General Clarity of Results

A clear statement of fundamental results needs to be stated at the beginning of each chapter section. These statements should be precise and include qualifiers where appropriate. Two basic questions need to be answered: 1) What are the impacts of the project on components of the Delta biological ecosystem? and, 2) What are the relative impacts of the various project alternatives? For example, the relative impacts of near-field (at the intakes) and far-field (downstream of the intakes) would be expected to vary with the amount of water diverted. It could be argued the near-field impact would be greater with more intakes or higher diversion rates. If there are downstream far-field effects, wouldn't the impacts be greater under higher intake capacity? How does this weigh into the evaluation of alternatives?

Depth and Breadth of Scientific Evaluation

Uncertainty of impacts on individual species needs to be acknowledged. One of the fundamental 'facts' is that there is not a quantitative, mechanistic understanding of the impacts of flows on most fishes (Delta ISB 2015). There are some studies (like Perry et al. 2018) that are used extensively in the Draft EIR and provide some correlations of life history models for certain life stages of Chinook salmon. While one can use this understanding to gain insight into other species, the level of applicability is largely unknown. The robustness of any conclusion varies with the available information on individual species. This known unknown needs to be clearly stated upfront, along with the assumptions being made, before any analyses or conclusions are proposed. It may not be possible to assess the impacts of this project on certain species because mechanistic or correlative understandings of the relationships of flow to growth, movements, survival, or population persistence are not known. The body of literature would support the notion that reduced flows are not beneficial to most species. Ecosystem impacts are fundamental issues that need to be addressed in the EIR. The aquatic ecosystem analyses are conducted almost entirely on a species-by-species basis with some references to food availability and predation. This approach dilutes the merit of evaluating the project from an ecosystem perspective. For instance, how do changing food resources (as for copepods) or abundances in certain species permeate throughout the ecosystem?

In general, water entering the tunnel will no longer provide ecological services to the Delta and, as well, may reduce ecological resilience to future changes whether natural or human caused. Higher discharges often are needed as cues for migration, reproduction, and other life history attributes—and cannot be replaced through mitigation. The higher discharges fill wetlands, provide "new" surfaces for riparian plant reproduction, and influence temperature and salinity regimes. The higher discharges provide connectivity and variability, known attributes that underpin a well-functioning ecosystem. These are fundamental issues that need to be addressed in the EIR.

No comprehensive cumulative effects analysis is presented for Chapter 12. Most importantly, the draft EIR does not consider cumulative impacts occurring among the species (community-scale impacts) from incremental flow changes. It is not known whether cumulative environmental effects are substantial when considered in a total integrative system analysis (e.g., organisms, contaminants, sediments, habitat, connectivity, variability).

Definition of Thresholds of Significance

It is important to define the severity of the impacts. The draft EIR defines "Threshold of Significance" (p 12-43 to12-44) as a "substantial" reduction in habitats, range or movement, a population drop below self-sustaining, a threat to a species persistence or a "significant" impact on special species or a sensitive natural aquatic community. These criteria are not quantitatively defined, but quantitative criteria were developed for some impacts without clear description of rationale. The draft EIR adopted a threshold for assessing potential significance of the alternatives' operations effects as "a change in a modeled outcome (e.g., a measure of the population abundance or survival between life stages or a habitat indicator that has been linked to population abundance) of 5% or greater relative to existing conditions." The 5% value was selected based on "best professional judgment of qualified fish biologists authoring this chapter." Quantitative results were given more weight than qualitative results, but the potential severity of impacts is not fully defined.

Although defining a significance level is standard practice in science, it would have been helpful to provide further rationale for how this value relates to the various criteria for 'thresholds of significance" previously discussed. A thorough discussion of the meaning of this value would aid readers in better understanding conclusions.

Perhaps some literature citations would be useful since the readers do not know the qualifications of the authors of this chapter. The 5% value appears to be an annual loss rate rather than a total project loss rate. Is this the case? For example, a 5% annual reduction in a population can result in an impact of nearly 40% loss of the base population in 10 years, all else being equal. Does 5% mean that the impact will not be significant or just not within the adopted definition of significant? This definition of significance is critical to all aquatic impacts and further discussion of the implications would be useful.

Do Monthly Means Provide the Best Assessment of Biological Impacts?

We question the validity of assessing downriver operational impacts on fish and aquatic resources using monthly mean values for calculations. Monthly values smooth the data and reduce the highs and lows of daily changes and may obscure important impacts that result from short-term fluctuations. Kimmerer (2004) points out how many critical biological processes are responsive to short-term changes in drivers on the order of days or less. Flows can also affect copepod abundances on a short time scale (Hamilton et al. 2020). Copepods are one of the most important and abundant food resources for zooplanktivorous fishes. It would be critical to see the daily versus monthly flow and diversion analysis mentioned in Appendix 5A-B (page B-59). Most calculations of far-field (downriver) impacts are assessed using monthly mean values. Daily flow may be more relevant for determining potential environmental impacts of this project. Alternatives could include a figure showing flow and bypass predicted using daily flow values (e.g., Figure 12.1), or include a clear description about when the monthly calculated values would overestimate versus underestimate downstream flows, temperature, velocities, or turbidity. For instance, the proportion of the Sacramento River diverted is often higher when operations are run on a daily basis given the operational protocols (see Figure 12.1 below). A statement made in the draft EIR Appendix 5A-B states that, "Initial comparisons of monthly versus daily operations at these facilities indicated that diversion potential was likely overstated…using a monthly time step." (Appendix 5A-B, B.7.1, page B-59, lines 6-8), but a very preliminary analysis by the Delta ISB using a daily time step shows a high proportion of daily flow is extracted relative to the proportion that would be extracted based on a monthly mean (Figure 12.1; see recognition of additional diversion restrictions in CalSim in Figure 12.2).

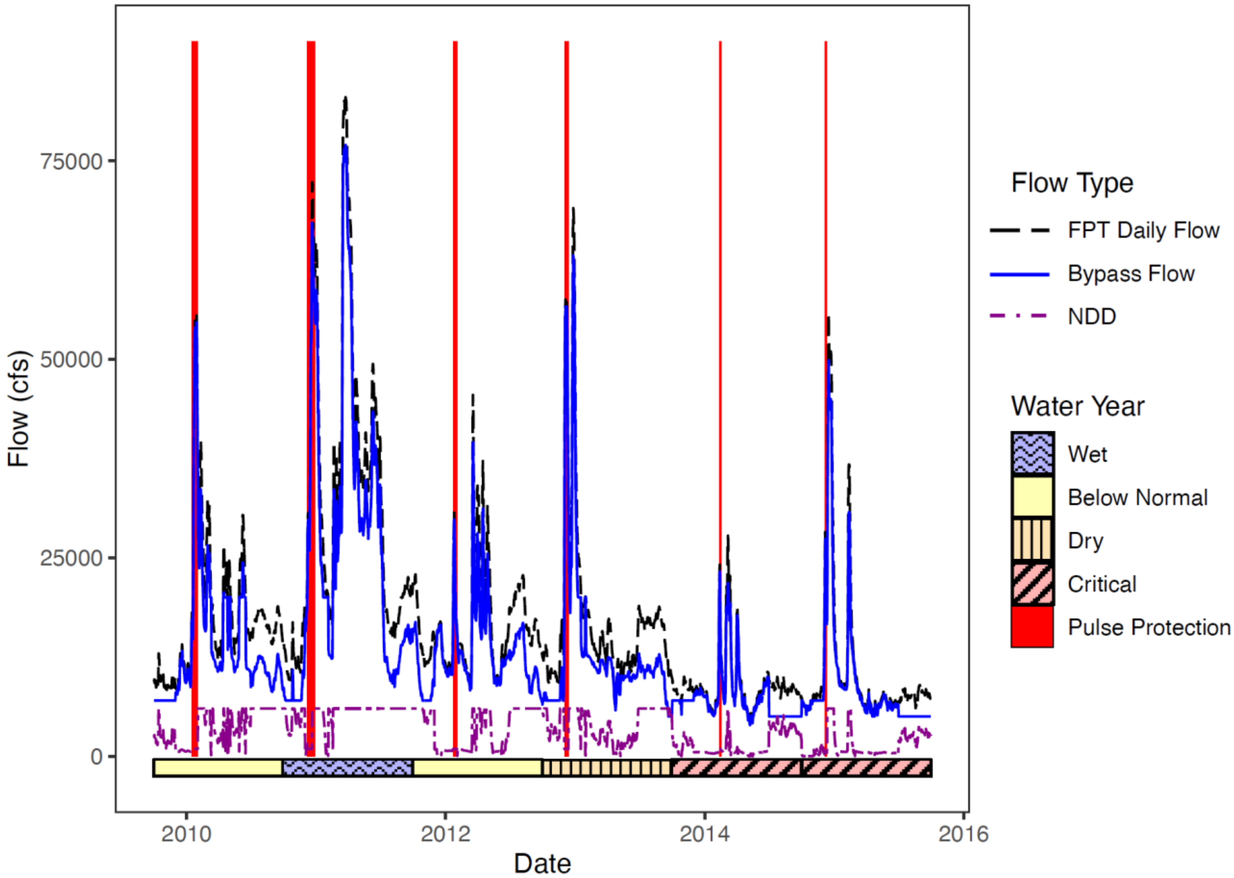

Figure 12.1. Daily flow estimates by the Delta ISB near proposed north Delta intakes under a subset of the proposed flow operations criteria* highlight the potential impact of intake operations on Sacramento River flows. This analysis illustrates calculated diversions of historic river flows at NDD (magenta, dash-dot line) and shows how an analysis with a daily time step would reveal the large variability of the proportion of river flow diverted on a given day. Note that the NDD line shown here does not represent diversions predicted by DWR that use a more complete set of operational rules than those depicted here. Using historic flow data (2009-2015) from the Sacramento River (Wilkin's Slough and Freeport stations), the daily bypass flow (blue solid line) and diversion amount (NDD; magenta dash-dot line) were calculated using criteria in draft EIR Tables 3-14 and 3-15* and compared to the daily mean flow at Freeport station (FPT daily flow; black dashed line). Shaded rectangles at the bottom of the figure indicate the water year classification of wet (purple wave shading), below normal (yellow solid shading), dry (orange vertical line shading), or critical (red diagonal line shading). Red vertical lines indicate the duration of a pulse protection period.

**This daily flow data analysis used only bypass criteria from Tables 3-14 and 3-15 and did not include the proposed velocity restrictions or consider diversions from any other intakes. As a result, values during the low-level pumping may be overestimates, as one of the restrictions is that pumping will not exceed 900 cfs total for all intakes, and only the NDD was considered here.*

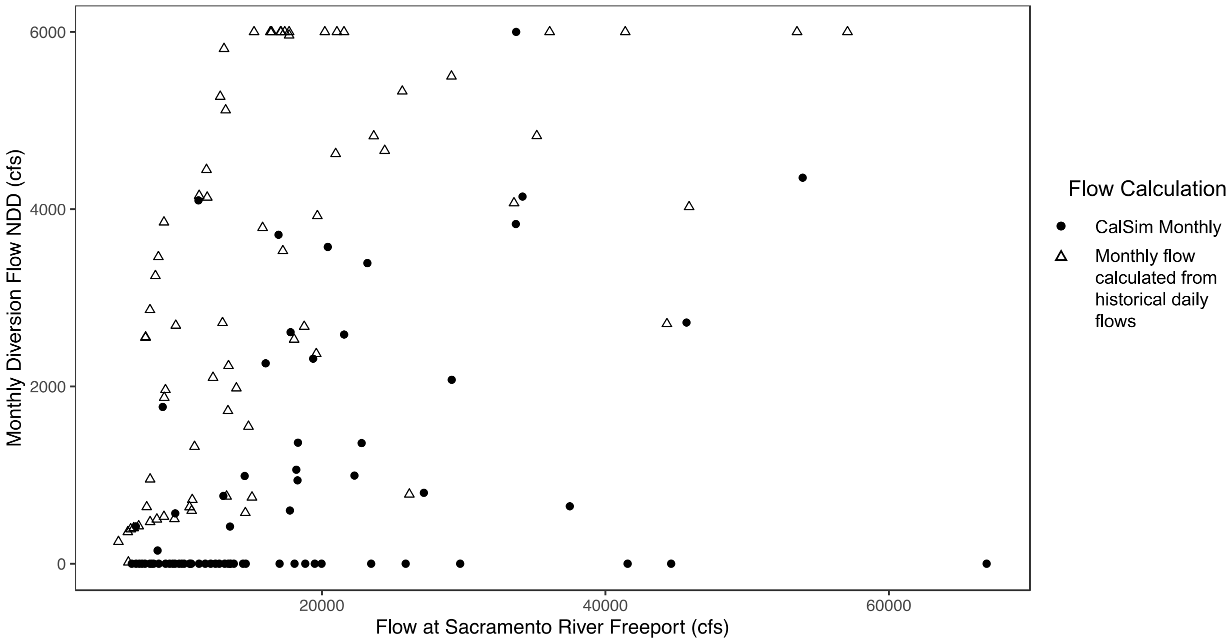

Figure 12.2. Monthly North Delta Diversion (NDD) Flow as a function of Sacramento River Flow calculated from daily flows differs from CalSim monthly calculations. Daily NDD flow amounts were calculated from Sacramento River flow data (Wilkin's Slough and Freeport stations). Monthly diversions calculated from daily historical flow values (open triangles) were compared to CalSim monthly diversion calculations (closed circles). Data are from 10/1/2009 – 09/30/2015.

Monthly analyses can both overestimate and underestimate diversion quantities and daily downstream flows (at different times) compared to a more realistic daily application of diversion flow rules. It would be important to see an explicit analysis of daily versus monthly downstream flow and diversion estimates over a period of several years (up to the entire hydrologic record), which would allow a better assessment of the daily fish impacts from a north Delta diversion (NDD).

Having greater clarity of model parameters and restrictions on diversions is essential for fully understanding how the tunnel will be operated. Details about restrictions and bypass criteria for NDD operation were spread between Chapter 3 and Appendix 5A-B. These include mention of a "linear constraint…applied in CalSim 3 to potential diversion at the north Delta intakes in all months" (Appendix 5A-B; page B-55, lines 19-20) and "diversion limitations from DSM2 modeling" (Appendix 5A-B; page B-55, line 22).

The EIR should present additional details about the pulse protection period duration (e.g., mean, maximum, minimum, and so forth) to help determine the ecological impacts. Pulse protection is ambiguous as presented in the draft EIR. Calculations using bypass criteria presented in Tables 3-14 and 3-15, and daily flow data, indicate the duration of individual pulse protection could be as little as 3 days total, once per year. Such short pulse protection may not provide a sufficient ecological cue for migration, phenology, and other ecological parameters.

Daily analyses should be part of the assessment of project impacts on the Sacramento physical and biological systems. Why wasn't 3D hydrodynamic modeling and particle tracking used in these analyses?

Adaptive Management

Establishing management goals, performance metrics and key decision triggers are essential components of an effective adaptive management plan/program (Wiens et al. 2017) and should be outlined in the EIR, even if detailed plans will be forthcoming later in the process. Adaptive management is an operational requirement for this type of project and is invoked in several places in the draft EIR. Unfortunately, the details are vague. With a project this large and complex, it is highly likely that there will be impacts missed or mis-estimated in an EIR analysis. One would expect the EIR to provide, at a minimum, a working "blueprint" of their adaptive management structure and process. Those plans should include identifying funding sources, expertise, and administrative capacity to monitor and manage potential effects or impacts of the project, including those currently deemed less than significant.

Operations will clearly reduce flows in the lower Sacramento River. Flows will be reduced in all seasons and at most flow rates (data presented in Chapter 3), even when flows are relatively low. Therefore, several basic questions need to be addressed in an adaptive management process:

1. What are the current flow requirements established by State agencies, and do the proposed operations meet those requirements under all conditions?
2. What are specifics of the adaptive management framework for flow volume diversion, should ecological issues arise?
3. What specifically will be used as a performance measure or decision threshold for fishes?

4. Will the adaptive management framework focus ONLY on species of concern or other species as well?
5. Is there an established decision-tree process?
6. What happens if an impact exceeds some (unstated) threshold? and,
7. Have all ecologically important species been identified?

As well, it would be reassuring to see realistic plans to provide adaptive capacity in response to unexpected events and outcomes, in both construction and operating phases of the project.

The EIR should provide a basic summary of adaptive management goals, measures, monitoring, and process to evaluate the robustness of an adaptive management framework. We illustrate with two examples from the near-field and far-field fish impacts:

Near-field. An adaptive management framework for near-field effects seems feasible. Although some monitoring techniques are mentioned, the framework could have been more thoroughly outlined. For instance, a clear management goal already in use within the Delta is to minimize impingement on specific species at the intakes. A performance measure is the number of fish species entrained per unit time, and a decision threshold is not to exceed "X fish" entrained per month or per day. Monitoring would include measuring entrainment, intake flows, river flows, and a variety of environmental conditions such as turbidity, water temperature, season, and other appropriate environmental parameters. Such efforts would produce a variety of correlations that show entrainment as a function of operations. If the threshold is exceeded, one could adjust operations or reconfigure entrainment screens to reduce impingement.

Far-field. In contrast to the adaptive management currently used to modify intake operations in response to quantitative metrics of fish entrainment at water intakes (CDFW 2020), some proposed adaptive management approaches for far-field (downriver) effects seem difficult to implement and may not be credible without further explanation of methods. In this instance, a measurable performance indicator (e.g., change in biological abundance) is needed to monitor effects. The draft EIR describes an approach of measuring fish abundances and modifying flow intake rates, as needed. However, the expected impact on fishes is roughly 5% or less, which is likely to be difficult to measure, given the natural variability of fish populations and the stated high variability in measures of abundances that far exceed 5%. An effective adaptive management plan could suggest an amount of change, sustained over a specific period of time, that would trigger a change in flow intake or other operations. The uncertainty of measuring variable ecological effects and the overall uncertainty in estimates need to be a part of any initial adaptive management plan.

Mitigation

The draft EIR notes some significant impacts related to operations. The presentation of aquatic system impacts should separate the magnitude of initial ecological effects from the likely mitigation effectiveness. Further, the types of mitigation outcomes being used to offset impacts, and the performance risk of the mitigation efforts should also be clearly presented and discussed. Compensatory mitigation was invoked in the draft EIR in response to projected project impacts on certain species. The overall findings of less than significant impacts for many ecological outcomes are based on combining anticipated ecological impacts with offsetting mitigation effects. It was only with great effort that the Delta ISB was able to assess which mitigation actions were used to offset which effects, and we see that some aquatic system mitigations substitute different ecological functions or species to offset impacted ones. We recommend continued discussion of the tradeoffs associated with creating ecological structures and functions that differ from the impacts on fish populations, such as using tidal wetland restoration to mitigate loss of flows.

Most concerning is that the uncertainty of mitigation effectiveness is not discussed, addressed, or prepared for in the draft EIR, despite ample scientific evidence that mitigation is often less than fully effective at replacing lost ecological structures and functions (NRC 2001; Hough and Harrington 2019). A variety of methods are described in the draft EIR to minimize or mitigate project impacts, including avoidance, on-site mitigation, and off-site (and out of kind) mitigation, sometimes achieved using mitigation credits. Even if uncertainty of mitigation cannot be well characterized, readers should be provided with impacts prior to mitigation so as to be given the opportunity to qualitatively weigh uncertainty. Treating mitigation outcomes as certain to offset losses is inconsistent with the available scientific evidence and, more importantly, obscures the equivalency of species losses and gains. Uncertain mitigation performance and impact outcomes should be discussed and prepared for, such as outlining methods for confirming whether target species occupy new habitat as well as compensating for delays in achieving comparable functional equivalency.

Although the analysis using CEQA criteria suggests that, with mitigation, fish impacts will be less than significant, the siphoning of up to ~30% of some river flows seasonally into a tunnel (calculation based on Figure 3-37 and Tables 3-14 and 3-15 of the draft EIR) will have ecological consequences. In particular, high discharges are needed as cues for migration, reproduction, and other life stages and cannot be directly replaced through the proposed mitigation. Seasonal water availability is a key driver in maintaining (and retaining) the Delta's overall ecological structure, productivity, and resilience. The CEQA criteria further fail to consider the additive effects (summed across stressors and space) and cumulative effects (summed across time and species) of these impacts and how they could accumulate to influence fish populations as well as their foods and habitats.

The finding of a less than significant impact on riparian habitat (Impact BIO-3: Impacts of the Project on Valley/Foothill Riparian Habitat) appears inconsistent with "a substantial adverse effect on a sensitive natural community is defined as a net loss of habitat function, including a net loss of acreage" (page13-74, lines 10-11). Riparian habitat is scarce throughout the Delta, and riparian habitat's influences extend well beyond their footprint. An impact to 2.7% of the riparian areas, or 23–75 acres (Table 13-0), can be ecologically significant. Riparian habitat supports a wide variety of wildlife species, as documented in the report. It is also important for the spatial position in the landscape and for additional ecological effects (Naiman et al. 2005).

<u>Uncertainty</u>

Multiple sources of uncertainty should be fully embraced and discussed uniformly by stating assumptions and by differentiating scientifically supportable conclusions from inferences, expert opinion, and hypotheses. In the draft EIR, many types of uncertainty in the analyses are undisclosed and/or unevaluated. Often models are not used effectively to bracket a range of uncertainties or to explore how uncertainties may propagate through the system. Other uncertainties arise because understanding of the mechanistic relationships is insufficient. For example, there is not a full mechanistic understanding of all the impacts of flows on fishes (Delta ISB 2015) and population persistence; yet management and mitigation approaches seem to assume such relationships are well established. Similarly, understanding is limited for species interactions related to food webs, predator-prey interactions, and how a change at one species level can influence other species. This limitation may be particularly important for those species not considered in the draft EIR (e.g., aquatic invertebrates). The potential for thresholds in system or species responses is also not fully acknowledged. It is well-established in the scientific literature that biological responses to changes in drivers can often be precipitous.

Multiple sources of uncertainty are raised in the draft EIR, and their implications could be more completely explored. First, the project alternatives would have negative hydrodynamic impacts on designated juvenile winter-run Chinook salmon critical habitat and other habitat in the north Delta (page 12-125), including increases in flow reversals in the Sacramento River below Georgiana Slough and increases in the proportion of flow entering the interior Delta through Georgiana Slough (a relatively low-survival migration pathway compared to the main stem Sacramento River and Sutter/Steamboat Sloughs; Perry et al. 2018). Second is that lumping 'food resources', as well as combining phytoplankton and zooplankton, into single categories or exemplified by a single species clearly increases the level of uncertainty since fish are often highly selective in their choice of food. As well, individual species have specific nutritional requirements and species interactions. It would be a challenge to address the above issues, but clear recognition of ecological relationships that are not well understood (or highly complex) would be useful to help address Delta ISB concerns related to assumptions. Third, the effect of operations on a hatchery-based stock of Delta smelt is stated to be 'low' (page 12-155, line 13), but sources of uncertainty in this finding are not explored. Many more sources of uncertainty are present.

It also seems that the relationships between instream flows and temperatures might be improved by considering daily ranges and relative influences of different temperature drivers. Given the large effect that temperature can have on fish physiological functions (e.g., metabolic and growth rates) and the sensitivity to duration and threshold effects, the use of monthly mean temperatures needs to be readdressed for this important variable. In addition, the draft EIR assumes that stream temperatures are largely driven by atmospheric temperatures and not flow. The report bases this assumption, in part, on correlations of monthly temperatures and atmospheric temperatures in the San Francisco estuary (Kimmerer 2004). But other papers clearly demonstrate a relationship between flows (and residence times) and temperatures based on shorter (e.g., daily) time steps (e.g., Wagner et al. 2011, Vroom et al. 2017). A daily time-step model of how flow decisions affect downstream temperatures, residence times, and stratification is warranted.

Other Important Issues and Questions

1. A stated potential benefit of this project is to reduce fish entrainment losses by shifting intakes between the (new) North Delta intakes and the existing south Delta intakes. Has this benefit been quantitatively estimated?
2. The EIR needs to identify the studies to be conducted before operations commence, especially those intended to assess the impact of flows on selected species. Will integrated, mechanistic biophysical models be developed? What will happen if 'optimal' flows differ across species? The wide range of species impacted by the project will also have a wide range of tolerances and metabolic requirements; therefore, impacts would not be similar across species, as assumptions indicate. Overall, few details are provided on studies and monitoring, or whether they would adequately address emerging uncertainties or hypothesized relationships that underpin informed flow operations.
3. One potential impact (low risk but high impact) is the transport of invasive species from the Sacramento River to the lower Delta and beyond. Although the screening process will eliminate larger animals from transport, will the tunnel be able to transport smaller, invasive larvae, veligers, or seeds to the lower Delta and beyond? Would Zebra mussel veligers survive in the tunnel transport system and beyond? What would happen to project operations if they are discovered in the Sacramento River?
4. It would seem prudent to more fully evaluate the project's effects on HAB occurrence and severity. HABs are becoming increasingly common in the Delta with warmer temperatures, reduced flow, high residence time, and more concentrated nutrients likely to exacerbate the problem. HAB issues were mentioned in impacts under the "no-project" alternative but only assessed for drinking water quality impacts rather than being recognized for potentially broad effects on ecosystems, wild and domestic animals, human health, and recreational activities. The conclusion that since impacts on HABs would be "less that significant" (as defined by the draft EIR) then the impacts on fish would also be less than significant needs additional justification.
5. It is important to provide supporting evidence that effects on hatchery stock of Delta smelt 'would be low' (page12-155, line 13).

Final Considerations

The proposed tunnel construction, operation, and maintenance will have environmental impacts on some species and habitats, and the mitigation actions may or may not fully compensate for these impacts. One could argue that there is insufficient data or understanding to make justifiable conclusions. This makes a sound adaptive management plan essential. More importantly, while the project may be considered as a relatively minor incremental alteration in a Delta that already has been substantially altered, the siphoning of up to ~30% of the river flow into a tunnel will have some ecological consequences. Organisms and the physical habitat often depend on high water flows for a myriad of ecological functions, including determining the physical structure of the ecosystem. The cumulative impacts of the project's activities along with the long history of human-alterations to the Delta are impossible to measure precisely. Historically, seasonal water availability is a key driver in maintaining (and retaining) the Delta's overall ecological structure, productivity, and resilience. While the authors of Chapter 12 have assembled an impressive amount of information, the scientific scope of the analyses needs to be expanded to better determine if the project will, or will not, have significant effects on the Delta's aquatic resources. Consideration should be given to a more comprehensive evaluation of environmental flows as defined by the Brisbane Declaration (2007) where environmental flows describe quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Arthington 2012).

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Chapter 13: Terrestrial Biological Resources

The draft EIR assesses how the Delta Conveyance Project may impact Terrestrial Biological Resources. The draft EIR provides various descriptions of possible project effects during construction, operation, and maintenance on major species associated with the wetlands, the riparian zones, and the uplands within the project area, as well as conclusions as to whether or not the project's impacts will be ecologically significant. Notably, using the species-by-species approach (with mitigation), no project effects are deemed significant.

Strengths

1. The draft EIR assembles an extensive species-by-species analysis of possible impacts from project construction, operation, and maintenance. The literature review and the habitat suitability modeling are adequate, if limited. If there are project impacts on an individual species, the draft EIR considers if the mitigation and the overall impact is less than significant.
2. It is encouraging to see that wildlife and habitat connectivity are considered in project designs. The draft EIR relies on The California Essential Habitat Connectivity (CEHC) Project: A Strategy for Conserving a Connected California, which is designed to support land-use planning and transportation (Spencer et al. 2010).
3. The protocols set in place to minimize species impacts include having one or more qualified biologists on site making regular inspections and with the authority to halt construction or operations if an issue arises.

Concerns and Potential Weaknesses

1. The draft EIR overlooks two significant strategies or approaches that, even though difficult to fully quantify, are environmentally essential: 1) cumulative effects at the community/ecosystem levels and 2) impacts on primary and secondary productivity, decomposition and biogeochemical processes, and environmental resiliency associated with water moving down the Sacramento River rather than being diverted into the tunnel. The draft EIR considers if past, present, or reasonably foreseeable activities might indirectly affect natural communities in the study area (page 13-466), providing a list of plans, policies, and programs in Table 13-106. Unfortunately, there are no quantitative analyses of how the project might affect the ability of other plans, policies, and programs to improve conditions for individual species. More importantly, the draft EIR does not consider

cumulative impacts occurring among the species (community-scale impacts) from incremental changes, which could be considerable.

2. Productivity, decomposition, and resilience are inadequately addressed. Water diverted into the tunnel ceases to provide many of environmental goods and services that occur when water remains in the channel. When water moves through the Sacramento River ecosystem, it supports primary and secondary productivity that helps maintain the environment's support for organisms. As well, decomposition and biogeochemical processes regulating nutrient availability and underpinning ecological productivity are denied to the ecological system. Altogether, characteristics of productivity and decomposition are essential in establishing environmental resiliency.
3. An equally important weakness of the draft EIR is the absence of an adaptive management plan. The draft EIR recognizes that adaptive management is essential, but the details are insufficient to assess net potential impacts.
4. The mitigation plan does not reflect the reality that restoration is not an exact science. Some mitigation activities are associated with the I-5 ponds and the tract of land on Bouldin Island; all of which are to be reconfigured/restored to compensate for losses of terrestrial biological resources. One would expect that the re-configuration and/or restoration of these sites would be already included in one or more of the numerous Habitat Conservation Plans (HCPs) of the agencies and counties. While the restoration goal may be to establish environmental conditions favorable to target species, the reality is that it may or may not occur in a reasonable time frame (~5 to 8 years, if ever), and it often requires remedial actions and maintenance for many years thereafter at considerable costs (millions of dollars).
5. Overall, it is difficult to determine the true magnitude and effectiveness of the proposed Compensatory Mitigation Plan (CMP; Appendix 3F). Mitigation ratios are a tool used to standardize the area restored to compensate for habitat losses; ratios are presented as area restored through mitigation to area lost from impacts (Iadanza 2000). Increasing the ratio well above 1:1 can reduce uncertainty about the success of the compensation. It was difficult to see a clear acre-to-acre comparison of habitat lost versus habitat mitigated, especially because habitat type between the text and tables are sometimes inconsistent, even within the same section. For example, in Table 3F-1, the "habitat descriptions" for species are defined differently than the "aquatic resources and species habitats" in the same table or habitat impacts in Table 13C-9, which makes it nearly impossible to determine the magnitude and

effectiveness of the proposed CMPs. In addition to the uncertainty of successful mitigation occurring on Bouldin Island and the I-5 ponds, there is also the uncertainty of site protection instruments or conservation credits and future proposed mitigation under the Tidal Habitat Mitigation Framework that cannot currently be accounted for.

6. Cumulative impacts (Section 13.3.4.3) are discussed qualitatively but do not reflect the best available science. Section 13.3.4.3 serves more as an account of current restoration programs as opposed to a true cumulative effects assessment (CEA) that analyzes potential synergistic or antagonistic interactions between the proposed alternatives and the landscape. There are existing methods of CEA suitable for complex projects with varying degrees of qualitative and quantitative data such as species-stressor models (Hodgson and Halpern 2019), network analysis (Harker et al. 2021), and scenario-building (Mahon and Pelech 2021). The EIR should explain why these methods are employed or use any number of frameworks available to structure a more thorough CEA (Stelzenmüller et al. 2020, Sutherland et al. 2022) to provide the public with a fair understanding of "the short- and medium-term environmental costs." As it is, the current CEA approach does not seem to serve CEQA's informational purpose (Section 3C.2.1).
7. The draft EIR presents compensatory mitigation plans with some ambiguity, presumably assuming that mitigation will show 100% success. In reality, it is unlikely that mitigation is always completely successful (note that "success", as used in the draft EIR, is also highly plan-specific). Turner et al. (2001) found that mitigation led to a net loss of wetlands when considered by acreage or ecosystem function. They found that across nine studies (including programs in four different states), the average area of wetland mitigation implemented to compensate for that lost was 0.69:1. When functional equivalency in mitigated wetlands was examined, Turner et al. (2001) found that only 21% of the mitigation sites examined met ecological equivalency to the functions lost (e.g., replacement wetlands ranged from 0-67% functionality, 6-100% compliance with permitting).
8. The explanation is inadequate for the determination of less than significant impact on Impact BIO-3: Impacts of the Project on Valley/Foothill Riparian Habitat. Riparian habitat is already in very short supply throughout the Delta. Riparian habitat tends to be long and narrow but has influences well beyond its footprint of 2.7% of the study area, impacting 23–75 acres may be ecologically significant (Table 13-0). Riparian habitat supports a wide variety of wildlife species. It provides structure and function for places where

organisms live; provides cover, food, and water resources; and serves to facilitates dispersal and movement for a wide range of taxonomic groups ranging from invertebrates to birds to large mammals. Habitats are also important because of their spatial positions in the landscape and for a number of ecological reasons (see Naiman et al. 2005).

9. The uncertainty of vernal pool restoration is not well described, particularly given known issues in the Delta and San Francisco Bay region (DeWeese et al. 1994). The draft EIR should make clear that between 1988 and 1994, only 5% of constructed mitigation occurred in the same year as the impact and only 44% of pools were constructed within 2 years of project impacts. Allen and Feddema (1996) examined multiple types of sites in southern California and found a disproportionate loss of freshwater wetland habitat, as most mitigation was from creating riparian woodland wetlands (out of kind mitigation). As well, using hydrological characteristics, Sueltenfuss and Cooper (2019) found that vernal pools only achieved hydrological similarity to reference pools after nine years, indicating that the length of monitoring should be based on ecosystem status rather than set time frames (see following concern about the use of ecosystem indicators).

10. The criteria used to assess wetland mitigation performance appear weak. While vegetation is commonly used as a criterion for evaluating the ecosystem function of a mitigated wetland, it has been recognized for over three decades that it is not often the best indicator for ecological function (Reinartz and Warne 1993). Importantly, flood storage and water quality improvement are two key wetland functions but were required to be replaced in <10% of California wetland mitigation permits examined in 2001 (Turner et al. 2001). Additionally, multiple criteria should be used to determine success and suitability. For instance, California coastal wetlands require a combination of soil, nutrient, and vegetation metrics, in addition to nesting requirements, to predict if a mitigated site would be (or not) suitable for clapper rail nesting (Zedler and Callaway 1999).

11. It is not clear if environmental monitoring will be adequate? Appendix 3F states that the DWR would prepare and implement a long-term monitoring plan for each mitigation site (Bouldin Island, I-5 ponds). Monitoring would be structured under an adaptive management plan (Section 3F.6.4), but no details are given about how the plan would be developed (e.g., decision triggers, and so forth). Several performance standard categories are outlined but only "examples of potential metrics" and not exact metrics are defined (Section 3F.7.1; page 3F-74). These include hydrologic, vegetation, water

quality, invasive species, and physical categories. Of note, "Performance standards are not included for special-status species directly since the objective of the project mitigation is to establish compensatory suitable habitat rather than to ensure occupancy" (Section 3F.7.1; p 3F-74). While there are some examples of specific (physical or hydrologic) criteria for some species, except for invasive species monitoring, no biological performance standards are proposed.

12. Timelines for monitoring and site management should be created based on ecological status (e.g., ecosystem function, suitable conditions) instead of the set periods (e.g., yearly for 3-5 years) identified in Section 3F.7.2. Ecosystem indicators are useful tools to assess ecosystem condition, monitor trends in these conditions, provide early warning signs of environmental change, hypothesize the cause of changes, and target management activities (Cairns et al. 1993). Ecosystem indicators that could be used to assess mitigation success are already established for estuaries and tidal estuarine wetlands (EPA 2008, Weilhoefer 2011).
13. The draft EIR states that monitoring is the basis for determining "potential remedial actions after project implementation," evaluating successful establishment of aquatic, wetland, and upland habitats, and complying with regulatory obligations (Sections 3F.7.1; 3F.7.2). Yet, the source and extent of funding for monitoring "would dictate the scale and sampling frequency of monitoring" (Section 3F.7.2). There could be situations where lack of funds might constrain effective monitoring to maintain mitigation. Examples or projections are needed of how funding would be allocated during project operation since the DWR has committed to providing funding for these mitigation sites using water supply contracts and revenue bonds (Section 3F.5.1).
14. It is not clear if environmental connectivity will be adequate. Draft EIR Figure 13E-2 depicts the project alternatives on a map of California Essential Habitat Connectivity and shows that all of the alternatives will effectively bisect potential riparian connections and disturb and/or impact designated essential connectivity areas. Additionally, Figure 3F-1 indicates that Mitigation Site B1 on Bouldin Island and I-5 Ponds 7 and 8 border with CA Hwy 12 and near I-5 experience heavy vehicle traffic. Sections of the draft EIR that address connectivity can be improved by including additional information on the impacts of severing riparian corridors as well as how wildlife is expected to populate and move into these mitigation sites, which are not adjacent to any of the mapped connectivity areas (particularly the I-5 Ponds).

15. While impact assessments were completed for many species native to the area (see tables in EIR Appendix 13C), mitigation was almost entirely established for a set of species-of-interest. For terrestrial species-of-concern, mitigation measures are described for only species that are either federal or state species-of-concern (endangered or threatened) except for the burrowing owl. While a focus on such species may fulfill CEQA requirements, it also establishes a “if we build it, they will come” attitude towards mitigation that is not always borne out (Turner et al. 2001). It is important to consider mitigation from an ecosystem perspective, as impacts to soil invertebrates or other lower trophic-level species provide foundational support for a range of species of concern to support long-term ecological functioning and species persistence.

    The probability that construction activities could promote the spread of invasive species with potentially adverse effects on the remaining natural communities in the project area should be assessed. Invasive species can threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat (CDFG 2008). Invasive plants can change the invaded habitat by altering fire regimes, hydrology (e.g., sedimentation and erosion), light availability, nutrient cycling, and soil chemistry (California Invasive Plant Council 2006). The six counties that overlap with the project study area contain 242 plant species identified as invasive by Cal-IPC. While some invasive species risks are discussed, treating all invasive species as equals does not characterize their individual abilities, life histories, or potential impacts.

16. The analysis of project effects on special-status plant and wildlife species (page 13-55) considers the direct effects of project construction for each of the alternatives. Direct effects were assessed both quantitatively and qualitatively, but no quantitative consideration is given to indirect effects. The draft EIR notes that possible indirect impacts on special-status plants and special-status wildlife habitat could occur from construction activities that alter hydrology and erosion or degrades habitat, or ground disturbance that facilitates the establishment of invasive plants that compete with native vegetation, and thereby alter the vegetative community in ways that can make it unsuitable for wildlife species.

17. There is a statement (page 13-88) that project operations would not substantially alter river flows on the Sacramento and San Joaquin Rivers.

Therefore (according to the draft EIR), project operations would not substantially affect valley/foothill riparian habitats. This statement requires more complete justification since sometimes up to ~30% of the flow would be diverted into the tunnel (See EIR Appendix 3F).

Suggestions for Improvement

1. In addition to addressing the environmental concerns outlined above, the draft EIR should add explicit details about mitigation plans (e.g., performance standards, timelines, and so forth) and adaptive management plans (e.g., decision triggers, identifying stakeholders, and so forth); without those details, it is challenging to know if mitigation/adaptive management plans are sufficient.
2. At a minimum, the EIR should provide a working "blueprint" of how adaptive management would be implemented, how it would function in helping achieve the objectives for Terrestrial Biological Resources, and how the monitoring would inform the adaptive management process. Clear principles should be established and communicated for a functioning adaptive management process that helps guide the project from the beginning. Thresholds of Probable Concern could be established for species before the project begins as an aid to adaptive management.
3. The draft EIR also could be greatly improved by actively applying contemporary approaches for quantifying the cumulative effects. The EIR should consider using approaches outlined in recent scientific articles (e.g., Mahon et al. 2021, Harker et al. 2021; Pirotta et al. 2022; Simmons et al. 2021). To promote successful mitigation, potential construction impacts on individual species, and the mitigation measures employed should be reviewed by subject matter experts and use well-established indicators such as those that exist for wetland performance (EPA 2008, Weilhoefer 2011). A statistically valid monitoring strategy, and its implementation, should also be carefully examined by experts familiar with contemporary scientific strategies. Some useful references are: Allen and Feddema (1996), DeWeese (1998), EPA 2008, Hodson and Halpern (2019), Iadanza (2000), Reinartz and Warne (1993), Stelzenmüller et al. (2020), Sueltenfuss and Cooper (2019), Sutherland et al. (2022), Turner et al. (2018), and Weilhoefer et al. (2019).
4. We recommend that additional concerns raised above also be addressed.

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Chapter 14: Land Use

Strengths

1. This chapter provides thorough descriptions of the study area and land uses. The discussion of potential land-use effects is relatively extensive, and the potential land-use effects relevant to other chapters are explained well. The chapter provides a summary of acreages affected in terms of deviations from permitted land uses.
2. The comparison of different types of land-use designations inside the water conveyance footprints in Table 14-4 is useful for comparisons of potential impacts. The county-level analysis of the various land-use impacts is also useful.

Concerns and Potential Weaknesses

1. The chapter could draw a clearer connection between the study area description and the types of possible impacts that could affect land uses in those specific locations. The chapter gives the impression that all land-use impact types are relatively similar or comparable, that is, by the severity or physical extent of the impact. Yet, some land-use impacts are likely to be more sensitive or important to affected communities than others. For instance, removal of residences or structures that house migrant farm laborers might have a more serious impact than removal of structures for less vulnerable populations. Additionally, recreation impacts that prohibit access to resources might be more problematic than those that may require more time or alternative routes to access. Similarly, when considering acreage as the unit of comparison, the effects on an acre of farmland (which the report highlights is the majority of temporary land used) may not be comparable to the effects on an acre of housing or recreational land use.
2. The cumulative effects analysis is weak since the draft EIR does not estimate quantities of land conversion from other known planned projects. Substantial agricultural and recreational lands are being converted (from a local perspective) to other uses, and hence there is unclear support for the following conclusion (quote below):

   "*Therefore, because the incremental changes in land use associated with construction of the project alternatives and the potential conflicts with land use plans, policies, and regulations adopted to avoid or mitigate environmental impacts would not result in physical effects on the* *environment, none of the alternatives would have cumulatively considerable contribution to impacts on land use*" (page 14-45).

Land-use mitigation is used to claim that these conversions have less than significant effect. But, given the finite quantity of land, one would expect land-use conversion to have some kind of cumulative effect(s).

3. Some consideration of where there may be more sensitivity of particular types of land uses and affected communities within the study area would be useful information. Regardless of the CEQA criteria that evaluate impacts as a function of conflicts with local land-use plans, the land use chapter lacks a local perspective on the impact of land-use changes. For example, impacts to communities or populations were deemed to be no impact or less than significant using CEQA criteria but could still represent significant concerns to particular communities within the Delta. The land-use effect "Impact LU-1: Displacement of Existing Structures and Residences and Effects on Population and Housing" has an no impact rating, despite that "Between 61 and 93 permanent structures would be removed within the water conveyance facility footprint" (page 14-22). The EIR claims no impacts from the removal of structures because locations are zoned in open space/agricultural areas. (Section 14.3.3.2 Impacts of the Project Alternatives on Land Use; lines 32-36). Furthermore, there will be less than significant impacts because any impacts on agricultural land will be a small proportion of total land and mitigated by preserving existing agricultural land and compensating owners for less than significant impacts.

4. Similarly, the conclusion that none of the alternatives would result in a physical division of existing community, depends on how a community is defined. As such, the chapter needs to provide a definition of a "community" when discussing Impact LU-3 and effects on existing communities. The conclusion that "*most of the structures to be removed are not located in existing communities but are in open space and agricultural areas*" (page 14-23) also requires a clear definition of community.

   As these examples clarify, the local perspective can be relevant to understanding impacts. More explicit connections with the Recreation Chapter, Agricultural, Cultural Resources, and Environmental Justice chapters could help tease out potentially important localized effects of land use changes.

5. In the discussion of impacts by county, the report notes that temporary project features would be in place for "*13 or more years*" and land would be

"*temporarily converted to nonagricultural use.*" That seems to stretch the definition of "temporary." The discussion of temporary land-use effects on structures/residences in the study area from construction (page 14-22) is vague. What specifically would be the temporary effects?

Further explanation is needed of the claim that "*The construction of the project's water conveyance infrastructure would result in temporary and permanent changes in land use in the study area, which may be incompatible with the general land uses presently designated in these areas*" (page14-35). The impact(s) of this change need to be discussed.

6. The discussion of future land use conditions under the No Project Alternative (page 14-19) seems to assume that changes to land use will occur due to "seismic events, levee failure, and inundation of Delta lands." Why are these risks only assumed under the No Project Alternative? Are they not also relevant under project alternatives? Seismic events and levee failures do not disappear with the implementation of projects. Furthermore, water efficiency projects are presented as another alternative (page 14-21, lines 17-21), but such effects should be a part of all future scenarios.
7. At the beginning of the methods section (14.3.1), it would help to define or operationalize the concept of compatibility (or incompatibility) up front.
8. Additionally, more clarity on how conflicts with existing land-use regulations were determined would be valuable.
9. Table 14-1 can be challenging to interpret on the first pass as the description of the land-use impact mechanisms sometimes use "if" phrasings (others use "could be" or just simply state a mechanism). Is it a potential impact that is uncertain, or is the impact contingent upon a particular condition (or a given condition)? More consistency in how the mechanisms are described would help.
10. More explanation is needed regarding the claim that, "*The compensatory mitigation is designed to compensate for several types of wetlands, other waters, and upland habitats that may be affected by the project*" (page 14-36).
11. Combined impacts such as associated with climate change and land-use change are not addressed: "*Those effects typically associated with land use relate to conflicts with existing or designated uses that do not necessarily, by themselves, equate to an adverse effect on the physical environment*" (page 14-17, lines 34-35). Yet Paine et al. (1998) show that when two disturbances occur concurrently, the impacts are more than the sum of the two expected

effects. Even though Section 14.3.4 is supposedly on "Cumulative Analysis," the cumulative impacts are not discussed. The draft EIR reports that there are many such effects, "*The cumulative projects include flood protection projects, habitat and ecosystem restoration projects, and water conveyance projects proposed in various areas within and adjacent to the Delta*."

Suggestions for Improvement

1. Make clear the relationship between the study area and types of possible impacts that could affect land uses in specific locations.
2. Cumulative and combined impacts of changes that can affect land use need to be carefully considered.
3. Land-use mitigation activities and effects should be specified by mitigation practices, land use types, and effects.
4. The effects on land use should be described that violate existing land-use regulations, even though they are not considered a significant impact on the environment. This information is necessary for a thorough scientific assessment.
5. Sensitivities of particular types of land uses and affected communities need to be discussed. Differences between specific CEQA criteria that define when a change becomes a significant impact and what a local community may perceive as an impact need to be acknowledged more clearly.
6. The report needs to make clear the connections between local land-use changes and information in other chapters (e.g., Recreation, Agricultural, and Cultural Resources). This connection is critical for interpretation of "Delta as a Place."
7. Terms should be clearly defined and used consistently throughout the report (e.g., community, temporary, compatibility, etc.).
8. Changes to land use due to "seismic events, levee failure, and inundation of Delta lands" and water use efficiency should be considered for all alternatives.
9. Consistent use of uncertainly terms (such as if, could, and would) is required to know whether an activity is expected, likely, or conditional on other activities. Consistency in descriptions of mechanisms is needed.
10. We recommend that additional concerns raised above also be addressed.

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Chapter 15: Agricultural Resources

Strengths

1. The chapter provides useful descriptions and data on Delta agriculture. Figure 15-1 is especially useful, as are some of the tabular data that combine acreages lost from direct conversion, loss of ability to farm, and mitigation activities.
2. The identified and quantified impacts of alternatives on various designations of valued farmland seem generally reasonable.
3. The chapter appropriately characterizes total agricultural land loss as a function of area and parcel qualities that reflect yield and local interest. Furthermore, the draft EIR links agricultural land to habitat loss and makes a conservative assumption to identify land as lost from agriculture if it had compacted soils or if the parcels were reduced in size.
4. The draft EIR makes general connections between loss of annual crops and potential effects on bird habitat (page 15-10) and considers mitigation sites in farm acreage impacts, which both suggest a thorough analysis. The report is thorough in noting that “temporary” construction impacts to infrastructure that support agriculture could persist for 7 to15 years, which may be significant for local landowners and farmers.

Concerns and Potential Weaknesses

1. While the description of Delta agriculture and salinity tolerances is good overall, it would be useful to discuss the importance of local irrigation water supply and drainage networks on individual islands. The local water distribution and drainage infrastructure helps shape the ability of farmers to respond to changes in salinity by altering diversion locations or timing, as documented in grey and refereed journal literatures.
2. The Agricultural Resources 2040 Analysis does not generate clear conclusions about how the analysis could be used to evaluate, avoid, or mitigate impacts.
3. Appendix (Agricultural Land Stewardship 15B) is potentially important but does not effectively communicate issues or opportunities.
4. The agricultural mitigation plans do not discuss how they will ensure additionality of their mitigation efforts. To compensate for land that will be converted for the project, the EIR proposes to protect existing agricultural land. However, such efforts will not stabilize the amount of agricultural land

unless the land being protected has a reasonable expectation of being developed. The method for identifying agricultural land for preservation and the use of any mitigation ratios to reflect different degrees of development risk is not discussed.

5. The report does not make it clear how conflicts by designation and contract type are addressed. Farmland designation and contract types affect impacts. Conversion of farmland under Williamson Act contract or under contract within a Farmland Security 4 Zone can occur even though there is not much farmland under these contracts in the Delta, for much of the agricultural land within the study area is Important Farmland (page 15-2, lines 1-8). Project activities in the Farmland Security Zones are more likely to create compatible use conflicts.

6. The report states that, "*Table 15-1 provides the acreages of crops grown in the study area by county in 2018. The acreages presented in Table 15-1 are used as estimates because annual and semiannual crop rotation and long-term crop change are based on a variety of outside influences including economic and climatic conditions*" (page 15-6, line 18-20). To interpret this information, it is important to know if 2018 was a typical year for this area. How is variation in crop production captured? Was 2020 a typical year for weather (noting that an average year does not necessarily have meaning – see Appendix 4A)? Furthermore, Figure 15-1 (page 15-7) does not include variability in land uses.

Suggestions for Improvement

1. The issues discussed above regarding how significance is defined and how impacts are presented should be addressed, particularly when summarizing project impacts in the Executive Summary, to better characterize land-use impacts from a local perspective.

2. The importance of local irrigation water supply and drainage networks on individual islands should be discussed, for local water distribution and drainage infrastructure help shape the ability of farmers to respond to changes in salinity by altering diversion locations and timing.

3. The agriculture appendix Agricultural Resources 2040 Analysis needs to address the implications of that analysis by making changes to page 6 and the following pages.

4. Table 15-12 needs to be corrected, for the city of Antioch's brackish desalination plant is now under construction, requiring a change in status from planning to ongoing (although this is not an agricultural water supply).
5. Appendix 15B (Agricultural Land Stewardship) is potentially important but should be changed to effectively communicate issues and opportunities.
6. The tables in the text and appendices present a lot of details that would be more useful if they were summarized to reveal impacts that would be substantial from a local perspective or that vary by alternative.
7. The section on agricultural mitigation plans should discuss how those plans will ensure additionality of the mitigation efforts. Furthermore, efforts to protect existing agricultural land will not stabilize the amount of agricultural land unless the land being protected has a reasonable expectation of not being developed. The draft EIR should discuss the method for identifying agricultural land for preservation and the use of any mitigation ratios to reflect different degrees of development risk.
8. It would be helpful to know if 2018 is a typical year for the area and to report variation in crop production over time. Also, it would be useful to show how the weather in 2020 relates to the long-term average and recent trends. Furthermore, Figure 15-1 (page 15-7) should include the variability in land uses.
9. We recommend that additional concerns raised above also be addressed.

Chapter 16: Recreation

This chapter offers a complete summary of key recreational activities and locations in the Delta as well as a consideration of whether existing recreational activities would be displaced or impaired by the proposed project alternatives.

Strengths

1. The chapter recognizes the importance of recreation to people in the Delta and the connection to environmental justice issues.
2. The chapter provides reasonable assessment methods and conclusions about recreational use changes for the two CEQA criteria. Thresholds of significance are laid out clearly.
3. The Recreation Resources Inventory and Data Collection Documentation (Appendix 16A) provides some useful details to supplement the background information in the chapter.

Concerns and Potential Weaknesses

1. The two summary criteria described in the Executive summary do not appear to reflect some of the lost local benefits that can be inferred from the detailed analyses. The first indicator evaluates potential for congestion at parks and the second is concerned with environmental effects of recreation facilities that might be created. Neither CEQA recreation criterion addresses onsite disruption to specific users and the impacts from lost use or inability to make nearby (low cost) substitutes for a lost recreation type. For example, a portion of a long bikeway will be closed during construction (page16-27). The text does not describe the duration of impact, the user days affected, or whether other long bikeways are available as substitutes. It says that a bridge will need to be built to reconnect the bikeway after construction but gives no indication of urgency for such an effort.
2. The excuse for not including visitation statistics was that Covid-19 caused unusual recreation patterns. Unusual use seems like a poor reason not to measure usage, since measurements could have been adjusted if evidence of a systematic bias (overcount, undercount) was found.
3. Physical alteration of recreation areas appears to be the primary focus of the assessment of impacts on recreation. Less attention is given to the impacts of changes to water supply in Delta waterways and water quality changes. The treatment of changes to flows and quality feels somewhat superficial and lacking data to support conclusions.

4. Overall, the chapter is descriptive, and largely devoid of analyses that would aid in comparisons of alternatives.

Suggestions for Improvement

1. A summary of potential recreation effects in the Executive Summary chapter that reflect concerns described above (number of users affected, loss of unique recreation types) would improve representation of local impacts.
2. The list of Developed Recreation Areas in Table 16-1 appears fairly comprehensive, but it would help to know how the list of recreation areas was developed and what criteria were used for selecting those “nearest” to proposed project features.
3. The 2008 statewide survey of boaters is a bit out of date. Are there other sources that might be more recent?
4. Key highlights from the Recreation 2040 analysis (Appendix 16B) could be mentioned more directly in the main chapter.
5. We recommend that additional concerns raised above also be addressed.

Chapter 17: Socio-Economics

Strengths

1. Overall, the chapter presents a complete summary of economic and employment impacts. It uses fairly standard methods for estimating economic impacts, and the results seem to be reasonable in magnitude.
2. The assumptions and limitations of the IMPLAN modeling are also laid out reasonably well. The inclusion of qualitative assessments of social and community effects for those communities most directly affected by project activities is important.
3. The descriptions and data on economic and agricultural structure and values, such as crop acreages, yields, prices, and values, as well as recreation expenditures (about $200 million/year and 1,700 direct jobs), are useful.
4. The data on housing, employment, income, government revenue, recreation, and agricultural economics provide valuable context on socioeconomic conditions in the study area. Additionally, the county and area profiles provide useful context on the populations living in the study area, including regions south of the Delta SWP/CVP export areas who benefit from the project.
5. The overview of the Delta Region Community draws important connections to the concept of Delta as a Place.
6. The assessment of potential project benefits in this chapter is more explicit than in other chapters.
7. Table 17-26 provides a valuable summary of estimated effects on crop acres and values and connects well to the chapter on Agricultural Resources.
8. The methods used to assess agricultural job losses are reasonable and use somewhat conservative assumptions (e.g., full footprint effects are assumed to occur throughout the construction period) and include appropriate discussion of analytic caveats. For the construction, operations and maintenance economic effects, the authors used some conservative analytic choices such as not including Alameda County in the economic region, which likely would have increased the indirect and induced jobs.

Concerns and Potential Weaknesses

1. The economic input-output modeling description omits some important information. Most importantly, the methods for (or the source of) the initial direct jobs (construction, operation, maintenance) that serve as input to the economic model are not documented. Since all economic model results are highly sensitive to this initial input, this omission is a major oversight. The methods for mitigation job impacts are briefly explained although they similarly fail to document the source of the base estimates, which is equipment-days needed to conduct the restoration activities.
2. The analytic methods do not consider potential future changes in agricultural prices that could increase economic losses above the estimates provided, especially if crop prices or land prices increase substantially.
3. Although the front end of this chapter references key Delta communities considered important in the concept of "Delta as a Place," the analysis of socioeconomic effects does not provide a localized understanding of many of the socioeconomic effects.
4. In Section 17.3, the chapter notes that *"Project alternatives are not anticipated to cause changes in water deliveries in areas upstream of the Delta. There could be some effects in the south-of-Delta SWP/CVP export service areas as a result of improvements in water delivery reliability occurring under each project alternative*." What seems to be missing is consideration of whether there could be effects from changes to within-Delta water users, if any. A more explicit assessment of the in-Delta effects would be more informative for readers concerned about in-Delta effects of proposed conveyance tunnels.

Suggestions for Improvement

1. The methods used to generate the initial jobs input to the IMPLAN model need to be described to allow this important step of the methods to be evaluated.
2. The summary table for economic impacts needs a better explanation of units; for instance, it does not specify how 'employment' is measured (annual jobs, person-years of jobs, or full-time equivalents (FTEs)). 'Jobs' is an ambiguous metric since the default output from IMPLAN counts part-time and full-time jobs as "jobs". The mitigation section of the Socio-economic chapter has clearly labeled information. Employment is labeled as FTEs and the columns in the results table are labeled as annual FTEs or a sum of job-

years. On the positive side, the summary table includes annual jobs, which tends to be more representative of employment effects than summing jobs over many years.

3. The discussion of future socioeconomic conditions is very general and assumes past trends will predict the future (e.g., see page 17-48). Are data on socioeconomic projections available to validate some of these assumptions?
4. It is important to provide the rationale for the estimate that 15% of workers would relocate to the region and affect population and housing (on page 17-61).
5. The following finding of minimal effects would benefit from citations or stronger justification: "*Although project construction could result in some effects that enhance the economic welfare of a community, other social effects could arise as a result of declining economic stability in other communities, although these are expected to be minimal*" (pages 17-65).
6. The report finds that "*undesirable social effects could linger in communities closest to potential character changing effects and in those most heavily influenced by agricultural and recreational activities. However, these effects would be minimal*" (page 17-66). Clarify which communities these are and whether people in these communities perceive the effects to be minimal.
7. The chapter should consider a more explicit adaptive management plan for addressing unanticipated effects on recreation or socioeconomic conditions in communities resulting from construction, operations, and maintenance.
8. References could be added to the section on community cohesion and community characteristics of the statutory Delta (at the bottom of page 17-43).
9. We recommend that additional concerns raised above also be addressed.

Chapter 18: Aesthetics and Visual Resources

Strengths

1. The background description of the Delta area is thorough and helpful for judging effects, although somewhat repetitive. The draft EIR demonstrates the authors' firm knowledge of the concepts and methods of aesthetic analyses by considering the visual dominance of proposed changes, given the existing natural and cultural character of the landscape, effects on scenic visits, and sensitivity of viewers.
2. The analyses follow relevant and commonly used federal guidance for aesthetic impacts (Federal Highway Administration – highway impacts, page 18-16).
3. The draft EIR uses a thorough range of visual impacts including multiple aspects of visual compatibility, viewer sensitivity, number of viewers (qualitatively), and nighttime glare.
4. The chapter frequently mentions stakeholder perceptions gathered as part of the analyses.

Concerns and Potential Weaknesses

1. Although the summary criteria suggest that many visual impacts are substantial and unavoidable, the detailed place-based analyses in the chapter find a diversity of effects. From the methods provided, it is difficult to discern if these judgment calls are representative of the community preferences. An example is the assessment of the discharge structure at the Bethany Reservoir State Recreation Area, which would be highly visible to water and shoreline users who have high sensitivity. The discharge units will add the only tall industrial feature visible from the banks of the reservoir, which otherwise lack prominent vertical built features. Degradation in visual aesthetic qualities is generally understood to reduce recreational enjoyment for many activities, but the conclusion of the draft EIR is that the change "would not constitute a substantial change in visual quality" (page 18-88, lines 28-29) because the feature is consistent with the other industrial features, even though these features are not visible from the water nor dominant when viewed from the shoreline. The potential for visual effects is also judged to be negligible in the recreation chapter (page 16-28, lines 31-33).
2. Mitigation measures appear thoughtful in terms of using native vegetation and colors that blend with the landscape. However, there is no commitment

to co-design mitigation plans and actions with communities, nor are there firm assurances that mitigation, as proposed, will be required. A co-design process would provide an opportunity to discuss whether the proposed visual barriers are preferred by the community.

3. Evaluation of the aesthetic impacts of the full project mitigation plan are much less thorough than the project effects, even though these activities still involve putting features (e.g., new gravel roads and vehicle crossings) into landscapes where they could have low visual compatibility, such as Bouldin Island.

Suggestions for Improvements

1. The methods should clearly distinguish when expert judgement versus community perspective was used to determine significance.
2. Co-designing aesthetic mitigation measures with the local community will promote effective incorporation of local aesthetic preferences.
3. We recommend that additional concerns raised above also be addressed.

Chapter 21: Public Services and Utilities

This is a descriptive chapter with some fairly coarse analyses of potential impacts on public services and utilities.

Strengths

1. While coarse, this discussion and analysis seems fairly representative of the range of public services and utilities that could be affected.

Concerns and Potential Weaknesses

1. The analysis seems fairly preliminary and coarse, perhaps appropriate for this stage, but lacks much discussion of how the project or its management might react to unexpectedly serious impacts that might not be foreseen at this stage.
2. The chapter seems to have little comparison of project alternatives.
3. The inventories of water and wastewater utilities and services seem to omit private companies and smaller community systems providing these utility services.
4. For solid waste, gross square feet (gsf) (page 21-44) seems unusual as an indicator of solid waste volume. Units of mass or volume seem more reliable.
5. Table 21A-7 – Correction: Rio Vista is in Solano County, not Sacramento County.
6. Table 21A-8 – Isleton's Wastewater Treatment Plant seems to be missing but this might be because of the narrow radius of impacts considered from the new facilities. Still, we would expect nearby towns further than those considered in this chapter to see increases in activities and utility demands from the influx of construction work.

Suggestions for Improvement

1. Assess potential issues identified by local interests and service providers.
2. Improve discussion of how project managers plan to address unanticipated issues that arise over the course of construction and operation (i.e., adaptive management).
3. We recommend that additional concerns raised above also be addressed.

Chapter 22: Energy

Strengths

1. Effects of project construction and operation on energy resources are evaluated by considering (i) wasteful, inefficient, or unnecessary energy use, and (ii) conflicts with or obstruction to a state or local plan for renewable energy or energy efficiency.
2. Environmental impacts akin to energy usage also are assessed (Appendix F).

Concerns and Potential Weaknesses

1. The chapter deals with "wasteful, inefficient, or unnecessary energy use'; while this purpose is repeated often, how it is achieved is not substantially addressed. There are several plots and comparisons of alternatives; however, abruptly the text goes on to say that there is no "wasteful……" A similar criticism is applicable to two appendixes. As such, this chapter differs from many other chapters where extensive discussions and calculations are given in appendixes.
2. Another purpose is to ensure that the project will not 'conflict with or obstruct a state or local plan' but this aspect is not even discussed briefly. Are there published local energy plans? Curiously there is no mention of the Delta Conveyance Project in the California Energy Commission data and reports inventory (https://www.energy.ca.gov/resources/all-publications).
3. The chapter states (pages 22-40) that project alternatives would not affect energy use, and pumping will be offset by extra hydroelectric energy produced by increased water availability. It also mentions that electricity is supplied from existing facilities or new facilities satisfying Senate Bill 100 and would not result in "considerable wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation." This statement needs clarification, mentioning what sources of energy will be available for the Delta Conveyance Project. Currently the information is scattered.
4. The increase of power consumption for the Delta Conveyance Project from the existing conditions is 28% (Alternative 1) to 35% (Alternative 5). This is an annual increase of ~ 1000 GWh from existing conditions, representing ~ 25% SWP generation (4100 GWh) with Alternative 5. The projected SWP net energy consumption for no project (2,457 GWh), existing (2,819 GWh) and Alternative 5 (3,539) conditions indicate that the project is energy intensive,

mainly due to south of the Delta pumping plants. Given the energy intensive nature of the project, local energy impacts of Delta Conveyance Project need to be carefully discussed, for at least Alternative 5.

5. Page 22-14 states "The following impacts were assessed by evaluating an alternative's potential to: (i) Result in wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation or (ii) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency." While many other impacts are covered in other chapters (water supply, air quality & greenhouse gases, climate change, environmental justice etc.), energy that could have been used for other activities is not discussed. What if there are changes to the state or local plans for renewable energy or energy efficiency (e.g., shut down of the Diablo Canyon nuclear plant)?
6. Under the topic of cumulative impacts, Table 22-17 lists plans for the future and their impacts on energy. This table, however, does not discuss impacts on energy demand and use but rather describes additional impacts that could occur. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis.
7. Based on Gov. Gavin Newsom's 2020 executive order, "The CARB [California Air Resources Board] established a ban on the sale of gasoline-powered cars by 2035," 35% of new vehicles will be required to produce zero emissions by 2026, increasing to 68% by 2030, and then 100% by 2035. Yet the report does not mention this ban and instead states the project will rely on vehicles (including worker vehicles) that use diesel and gasoline (page 27) even though the project goes to 2040. Later in the report, the EIR states "renewable features have also been incorporated into project construction including the installation of solar panels at the park-and-ride lots to power electric vans to move employees to construction sites and requiring the use of commercially available electric or hybrid vehicles." Information about how the Delta Conveyance Project will meet this executive order should be included.

Suggestions for Improvement

1. The planned desalination plants appear to be outside the Delta Conveyance Project area. This point should be made on page 22-26.
2. We recommend that additional concerns raised above also be addressed.

Chapter 23: Air Quality and Greenhouse Gas Emissions

Strengths

This chapter addresses construction, operations, and maintenance impacts of the project on local air quality and GHG for the construction period (~12 years) and the period of long-term operations and maintenance. Compensatory mitigation and additional measures for pollution control are discussed in the context of federal and state environmental standards (National Ambient Air Quality Standards and California Ambient Air Quality Standards). Obviously, the project generates additional air pollutants, and the challenge is to keep them at less than significant levels. Mitigation measures are proposed to achieve net zero GHG emissions, and calculations show GHG increase after mitigation would be less than significant. Appendixes 1-2 presents pollution inventories. A health risk analysis is presented in Appendix 3-4 Comparative evaluation of alternatives is well done.

A rigorous health impact assessment is made for extended operational periods, mainly for cancer risks. For the worst-case scenarios of continuous exposure during a person's lifetime at the South Delta Outlet and Control Structure, the health risks are reckoned to be less than significant (Tables 23-86/87). GHG impacts are also less than significant given expected emergence of new technologies.

Concerns and Potential Weaknesses

The GHG from cement manufacturing are sizable, and a discussion/analysis in this context seems missing. The Executive Summary (page ES-99, lines 32-33) states that project construction will generate 453,412 to 794,150 MT of CO_2 but does not provide a supporting table that details the sources. Roughly 132,611 metric tons of CO_2 (based on 400 pounds of CO_2 from cement per ton of batched concrete) will be generated by cement manufacturing to create the 45-mile-long 18-inch-thick concrete wall of the tunnel (Chapter 10, page 55, gives wall thickness). Much more GHG emission would occur because DWR plans to grout outside the concrete walls, and the grout may be cement/bentonite. (Table 3-2 indicates a 3-foot thick-wall, which would more than double the GHG estimates. A 3-foot-wall thickness presumably includes the concrete liner and surrounding grout).

PM10 (fugitive dust) would be significant at the construction sites, and PM2.5 will increase during construction and long-term operation of pumps and increased vehicular traffic. The San Joaquin Valley Air Pollution Control District is particularly sensitive to extra PM2.5 emissions because of its current non-compliance (both daily and annually) of Federal standards and is under an EPA-Approved State Implementation Plan. Alternative 5 involves construction of two launch shafts over a decade, and sustained impacts of particulate matter can be substantial. Similarly, 8-hour ozone levels are seriously exceeding the San Joaquin Valley Air Pollution Control District although the district has been compliant with 1-hour ozone standard since 2016. Tables 23-4 and 23-5 identify their degree of violations, but the mitigation actions are not convincing. Presenting large numbers of actions to address air quality issues are welcome, but a definitive plan would be better. Cumulative effect of additional precursor emissions would nonlinearly increase ozone, PM10, and PM2.5 and may lead to new violations or exacerbate noncompliance in the San Joaquin Valley Air Basin.

Additional precursors will impact criteria pollutants disproportionately, and hence impact assessments are to be conducted using reliable air quality models and emission inventories (California Air Resources Board maintains and regularly updates inventories). DWR has developed project-specific inventories; given they are conservative, there is a plan to reanalyze the data and revise the inventory. A MOU with the air quality district to reduce the emissions will be completed, after a full evaluation is made. These actions should have been done a priori.

If an agreement cannot be reached between DWR and the Sacramento Metropolitan Air Quality Management District, alternative mitigation strategies need to be developed by DWR. In the past such an approach has been successful (pages 23-77/78, AQ-1), but there is a possibility that refinements to pollution mitigation strategies are forgotten after the construction. Hence, it would be useful to know about the monitoring protocol.

The Weather Research and Forecasting model with the Sparse Matrix Operator Kernel Emissions modeling extension (Appendix 23D.2.2) and photochemical grid model (CAMx) have been used in pollutant calculations, which is a standard procedure. However, in this case the project emissions are highly concentrated in certain areas, and it is of concern whether a 4 km grid model is the best strategy for calculations. A plume-in-grid calculation (e.g., Karamchandani et al. 2006) or a plume model (Wang et al. 2018) may be more accurate.

Some of the receptors in the Sacramento Metropolitan Air Quality Management District would continue to violate PM2.5 standard, and mitigation measure calls for retrofitting homes and relocation of area residents. If the residents do not agree, then there would be significant pollutant impacts.

Uncertainty calculations leave much to be desired. In Appendix 2B, it is simply said that there will be uncertainty, but no further actions are taken to estimate/reduce them.

Suggestions for Improvement

Concerns noted in the section above should be addressed.

References

Karamchandani, P., Vijayaraghavan, K., Chen, S.Y., Seigneur, C. and Edgerton, E.S., 2006. Plume-in-grid modeling for particulate matter. Atmospheric Environment 40(38): 7280-7297.

Wang, B.Z., Zhu, Z.H., Yang, E., Chen, Z., and Wang, X.H. 2018. Assessment and management of air emissions and environmental impacts from the construction industry. Journal of Environmental Planning and Management 61(14): 2421-2444.

Chapter 24: Noise and Vibration

Strengths

1. This chapter and its six appendixes analyze noise and vibration impacts from project construction (12–14-year time frame), operations, and maintenance and supporting projects (levee improvements). There are many health impacts of noise and vibrations, and, in some countries (e.g., Canada), noise is considered a contaminant. A thorough engineering acoustics analysis is presented using standard models. Noise level contours are presented (Appendix 24A) where exceedances of the standards (5, 60 dBA) are indicated. The project would cause exceedances of noise pollution and vibration criteria; however, mitigation measures are suggested to reduce severity of noise to acceptable levels. Impacts after all CEQA mitigation measures are applied may be less than significant.
2. Some sound level monitoring (type 11) also has been done in preparation of the draft EIR. Field investigations (geotechnical, penetration testing and geophysical testing) will be done to test sheet pile installation methods, if the Delta Conveyance Project moves forward.
3. Construction impacts are based on standard Federal Transit Administration (2018) methods. The worst-case scenario estimates operate all equipment simultaneously, so the estimates presented are conservative. Noise and vibrations from traffic, construction trucks, rail, tugboats, barges, etc. are all accounted for, as are vibrations from numerous construction equipment. Most impacts will be on construction crews, as sites are somewhat removed from populated urban areas.

Concerns and Potential Weaknesses

1. CEQA conclusions are that all alternatives of the project would entail significant noise and vibration impacts, which can be made less than significant using mitigation measures. For mitigations to be successful, however, voluntary participation of residents is required, which DWR cannot guarantee. As such, the impacts (NOI-1) are listed as significant and unavoidable for alternatives for various activities. Alternative 5 has the most noise and vibration exceedances at the receptor locations.
2. Noise and vibrations are discussed for the No Project Alternative in Appendix 3C and Appendix 24A, but insufficient quantitative information and details are available in these chapters to assess the results tabulated in appendices.

3. The nighttime criteria are deemed significant for all alternatives, but the magnitudes may not be accurate for the purposes of designing mitigation strategies. The noise levels may be higher than estimated because calculations do not consider temperature stratification effects occurring at night, which may cause more extensive noise impacts (Ovenden et al. 2009; Shaffer et al. 2015). Without accounting for stratification, the impacts may be underpredicted in terms of the magnitude (A-weighted dB level) and spatial extent. Models used such as the Federal Highway Administration Traffic Noise Model Version 2.5 and SoundPLAN Noise 8.2 do not rigorously account for stratification effects, and use averaged favorable meteorological conditions. Temperature inversion conditions are mentioned (page 24-17) but not reckoned in evaluations. This gap is applicable to both construction and operational periods.
4. Ambient sound level monitoring in two places in Sacramento County (Appendix 24D) is not representative because of the strong spatial variation of noise intensity. Monitoring in San Joaquin County is representative for about nine stations.

Suggestions for Improvement

1. More robust calculation methods are available for operations such as pile driving on nearby infrastructure and foundations (Colaco et al. 2021). The United States Environmental Protection Agency provides guidance based on its “Levels Document” (EPA 1974), which may provide additional (federal) guidance. Ground-borne vibration from heavy equipment such as pile drivers or tunnel boring machines would cause a significant impact if PPV exceeds the Federal Transit Administration’s construction vibration damage criteria. This draft EIR uses canonical values of ground-borne vibration levels, which may be adequate.
2. We recommend that additional concerns raised above also be addressed.

References

Colaco, A., Costa, P.A., Parente, C.M.A. and Cardoso, A.S. 2021. Ground-borne noise and vibrations in buildings induced by pile driving: An integrated approach. Applied Acoustics 179: 108059.

[EPA] United States Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (Report No. 550/9-74-004).

Federal Transit Administration. 2018. Transit Noise and Vibration Impact Assessment Manual. FTA 1 Report No. 0123. September. Washington, D.C.: Office of Planning and Environment.

Ovenden, N.C., Shaffer, S.R. and Fernando, H.J.S. 2009. Impact of meteorological conditions on noise propagation from freeway corridors. The Journal of the Acoustical Society of America 126(1): 25-35.

Shaffer, S.R., Fernando, H.J.S., Ovenden, N.C., Moustaoui, M., and Mahalov, A. 2015. Simulating meteorological profiles to study noise propagation from freeways. Applied Acoustics 92: 102-114.

Chapter 25: Hazards, Hazardous Materials, and Wildfire

This chapter concerns hazards, hazardous material, and wildfires related to construction, operation, and maintenance of the project as well as those related to compensatory mitigation measures and additional mitigation measures needed to reduce the impacts of mitigation measures. Considerations include hazardous material encountered through reusable tunnel material (and their beneficial uses), excavation, construction near oil and natural gas facilities and fields that pose hazards to workers and receptors at schools (located within 0.25 miles from schools).

Strengths

1. Sites of hazardous material emissions (natural and anthropogenic; above and below ground), contaminated soils, mining residues, potential release areas of wastewater and pollutants, utility lines, transportation, fire hazard, areas, and mineral resource and transportation risks sites are carefully identified and presented in terms of seven risk categories HAZ-1 to HAZ-7. Hazards, hazardous material, and wildfire impacts for each category are described for the nine alternatives, and the most (negatively) impactful alternative in each category is identified.
2. An exhaustive discussion of project hazards is given (which sometimes appears to be too elementary and repetitive). The draft EIR concludes that with proposed mitigation strategies all HAZ categories for all alternatives can be ameliorated to less than significant levels. Limited tests for evaluation (e.g., soil tests for hazardous materials) have been completed. Some of the hazards (e.g., air quality) are discussed in other chapters, and the reader is directed toward them when needed.
3. Thresholds of significance have been identified.

Concerns and Potential Weaknesses

1. A major weakness is the lopsidedness of the discussions; there is too much discussion of hazards and too little discussion of remediation/mitigation. It is concluded that all HAZ categories are less than significant because of the mitigation measured to be adopted based on applicable laws, regulations, and programs (e.g., by Certified Unified Program Agencies, California Division of Occupational Safety and Health). Action plans would be developed concurrent with project development, prompting the reader to feel that 65 pages are an overkill for Chapter 25.

2. Unlike in many other chapters, the No Project Alternative is barely discussed and relegated to half a page (page 25-27). The planned changes of land use and climate change will impact the risks of wildfires, which ought to be considered alongside project alternatives.
3. Figure 25-4 presents the fire hazard severity zones identified by the California Department of Forestry and Fire Protection (CALFIRE). The southwest part of the project is in a moderate fire hazard area served by CALFIRE. Most of the study area is not in a fire hazard region nor is it served by CALFIRE under a State Responsibility Area (SRA) or Local Responsibility Area (LRA). Identification of CALFIRE, SRA, and LRA covered areas in the map is recommended, considering situations such as the August 2021 brush fire and June 2022 grassfire in Stockton; they were not covered by any of the agencies, thus exacerbating the impacts. Also, fire maps may change considerably in 2040 and 2070 timeframes due to climate and land-use change, which should be considered in discussions.
4. The Alternative 5 project area is close to a school, and it is not clear that the risks to those attending the school (air quality and other hazards) have been fully assessed.

Suggestions for Improvement

Concerns noted in the section above should be addressed.

Chapter 26: Public Health

Strengths

1. The Public Health chapter offers in-depth discussions of several potentially negative public health effects from the project alternatives. It explicitly connects to analyses from other chapters.
2. The assessment of potential electromagnetic fields (EMF) exposure is appreciated, despite uncertainty in the nature and extent of EMF-related public health risks.

Concerns and Potential Weaknesses

1. The chapter lacks an explicit discussion of why the specific set of public health effects (which are largely water-quality related) were selected for analysis over others. The project could produce other effects to public health (e.g., related to air quality, noise, hazardous materials), as identified as in other chapters, which are not discussed in this chapter.
2. Most of the analyses of significance rely on qualitative interpretations of potential impacts (and not on quantitative models of population exposure or risk assessments), or they rely upon inferences from modeling or assessments in other chapters of the draft EIR that themselves have uncertainties.
3. The chapter lacks an adaptive management plan for monitoring public health effects and whether identified mitigation measures and best practices (as described in Appendix 3B) are effective at reducing key risks such as mosquito vectors and cyanoHABs. This gap is particularly important given the finding of the potential for significant cumulative public health effects when considering other relevant projects in the study area.

Suggestions for Improvement

1. More attention to potential uncertainties in the significance determinations in this chapter is advised. Such uncertainties could be addressed in an adaptive management plan.
2. The comparison of 2040 conditions for project alternatives to the No Project Alternative in the Appendix is useful and could be mentioned briefly in the body of the chapter. The chapter acknowledges that changes in public health effects could result due to climate change under the No Project Alternative

discussion but lacks this attention to this topic in the discussion of project alternative effects.

3. The discussion of cumulative impacts (highlighted in Table 26-9) could be more nuanced. The findings suggest potentially significant impacts from the various plans and programs identified, but some of these effects appear to potentially reduce public health risks (e.g., exposure to pesticides), while others may increase risks.
4. HABs pose a risk to human health that extends beyond drinking water quality.

Chapter 29: Environmental Justice

Strengths

1. The chapter does a good job of defining key terms related to environmental justice, using a clear and justifiable definition of environmental justice (EJ) concerns (disproportionate impacts on EJ communities), and defining communities and people that would be affected by environmental justice issues. It also uses a more inclusive threshold for defining low-income communities than is typical to adjust for California's high cost of living.
2. The early summary of all socially relevant impacts across the draft EIR chapters is a helpful feature of this chapter. The analysis draws from both an assessment of the effects of physical changes (as identified in other chapters of the draft EIR) from project alternatives on environmental justice using Census and other demographic data of communities in the study area, and from a community outreach process and survey data of relevant communities in the Delta.
3. Some of the demographic data by census tract and county are useful and interesting.
4. The chapter considers the positive effects or benefits for environmental justice communities, as well as potentially negative effects.
5. The survey results in Appendix are informative (e.g., people who live in the Delta generally have good things to say about it). The concerns noted on page 29-35 are reasonable.

Concerns and Potential Weaknesses

1. The description of methods in the EJ chapter has contradictory and unclear statements. First, the draft EIR says that they do not carry forward, for in-depth analysis, any impacts that were fully mitigated (page 29-2, lines 11-13 and again on 29-31, line 42). However, the draft EIR also says that significant impacts prior to mitigation are analyzed (page 29-3, line 3). This may seem like a minor point, but these inconsistencies make it more difficult to interpret the analysis.
2. Additionally, the treatment of Tribes in this chapter is somewhat vague and contradictory at times. In Section 29.2, the definition of environmental justice used by DWR includes Tribal populations, but the summary of comparisons (page 29-2) notes that assessment of significant impacts on Tribal cultural resources cannot be analyzed with the methods applied to environmental

justice due to a lack of comparison group (and notes this assessment is examined in Chapter 32). Some assessments in this chapter include Tribal populations, but in a limited or general way.

3. The chapter lacks an explanation of the rationale behind many statements that effects were not disproportionate on EJ communities throughout Section 29.4 (e.g., flood risk, page 29-32, lines 20-21; aesthetic impacts page 29-38, lines 15-16). Many of these statements do not seem supportable since the analysis shows a high proportion of EJ communities near project activities (minority and Hispanic distributions shown in Figure 29-2, p. 29-13; low-income distribution shown in Fig. 29-3, page 29-19), which suggests the potential for a disproportionate impact.
4. Additionally, the use of CEQA to exclude impacts from EJ consideration (page 29-27, lines 36-39) is inconsistent with the initial methods description, where the draft EIR authors said that EJ was not required for CEQA (page 29-1, Line 7) and that they were aiming to be consistent with the National Environmental Policy Act framework for the EJ analysis (page 29-1, lines 12-16).
5. When considering EJ effects, it can be important to account for uncertainties around whether mitigation measures (as noted on page 29-2, lines 9-12) will be effective over time, and whether there are potentially localized effects where mitigation measures may not be adequate for particularly sensitive EJ communities. The chapter fails to acknowledge such uncertainties.
6. The approach taken for EJ outreach appears reasonable, but it is unclear in that process (and the survey that ensued) if there was a direct assessment of perceived risks and benefits from the proposed conveyance projects. The survey methods appear to focus more on identifying key values and priorities for the Delta and would be more informative -for generating ideas for the Community Benefits Program described in Chapter 34.
7. Overall, the chapter is mostly descriptive. Analyses that would aid in comparing alternatives are limited.

Suggestions for Improvement

1. A plan for adaptively managing the environmental commitments and mitigation measures that would reduce potentially significant impacts is advised, given the uncertainty around the likely effects of alternatives on EJ communities. Additionally, the effects may not be evenly distributed across all communities, and some communities might be more sensitive to

cumulative effects across multiple projects. An adaptive management approach to monitoring, assessing, and managing such localized effects is needed.

2. The chapter needs to provide a sharper explanation of how Tribal populations are considered in the analysis of environmental justice.
3. It would be valuable to analyze the survey results with more of an eye toward connecting the priorities and comments to potential impacts of the project, if possible.
4. The survey report in the Appendix 29A is thorough and accessible. Some of the data from the results could be integrated more directly into the body of the chapter, at least those findings that might speak directly to how the priorities of disadvantaged communities (DACs/EJ) communities tie into the potential effects or impacts identified throughout the draft EIR.
5. Avoid or rephrase the following statement: "If the project was not approved and constructed, climate change and other natural processes and ongoing human activities would continue" (page 29-2, lines 32-33). This sounds like climate change and these ongoing processes continue only if the project is not approved.
6. We recommend that additional concerns raised above also be addressed.

Chapter 30: Climate Change

Strengths

1. The draft EIR provides a concise summary of a wide range of potential implications of climate change at all scales from global to regional, and covers, conceptually, negative impacts of future changes from climate change on all alternatives. The impacts include changing seasonality of Delta inflows, potential changes in wet periods and droughts, increased wildfire risks, saltwater intrusion, and decreased water quality in estuaries during droughts.
2. Quantitative analyses using the CalSim 3 model include scenarios representing existing conditions, a No Project alternative, and a series of alternatives representing spatial conveyance options and capacities.
3. The summaries and appendices in the draft EIR and the detailed model output data provided by DWR show how the draft EIR has addressed climate change impacts.

Concerns and Potential Weaknesses

1. There are significant concerns regarding the formulation of the hydrologic drivers with future conditions. These concerns include the use of a single time series known as 2040 CT, without considering variability in future trajectories, and lack of consideration of changes to hydrologic functions. The future hydrologic scenario has been developed using a simple adjustment to the historical series informed by a "central tendency" of downscaled, climate model outputs.
2. The approach to representing future conditions by using change factors generated from one future scenario (2040 CT) to adjust historical flow (see Appendix 5A, Section B Modeling Technical Appendix B – Attachment 4-Climate Change Development for the Delta Conveyance Project) seems to preserve the inter-temporal (and perhaps spatial) structure of the historical drought sequences but may not represent the increasing variability that is documented in the draft EIR. The problem with using the same historical pattern but with adjusted magnitude is that it assumes future wet and dry cycles under climate change will be very similar to that of the historical flows used in CalSim 3 (Figures 29.1-3 below). Consequently, the multi-year drought periods for modeled 2020 and 2040 conditions are more or less identical in duration to the historical time series of 1981-2005 (see Figures 29.1-3).

3. Similarly, the 2040 future, represented by 2040 CT does not account for the future inter-annual variability of inflow patterns (described in Table 30-2, Table 3, Statewide Summary Report). It may mimic the seasonal shifts in inflow, but it will lack representation of the increased variability of wet and dry cycles.
4. It is not clear if the future modeling adequately captures potential consequences of more intense extremes of weather (e.g., atmospheric rivers) and the associated changes to the flood flows from tributaries. If upstream reservoir operations do not change, future changes in the rain-snow regimes due to warming (precipitation occurring in the form of rain early in the season) are likely to cause early and possibly large floods coming into the Delta. Such high flows coupled with higher sea levels will lead to compound hazards on the interior levees. This aspect of future climate change implications should not be ignored.

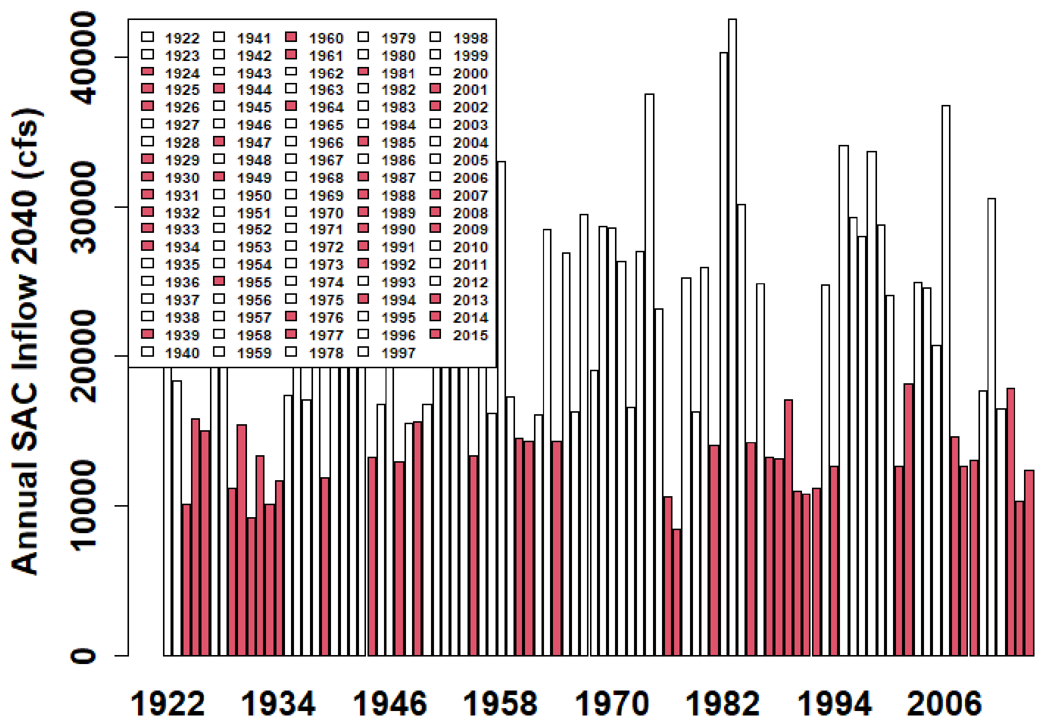

Figure 29.1. Sacramento River inflows at Freeport. The filled bars indicate water year types "Dry" and "Critical." The 2040 CT scenario pattern is simply an adjustment to this historical pattern. Data source: Spreadsheets provided by DWR.

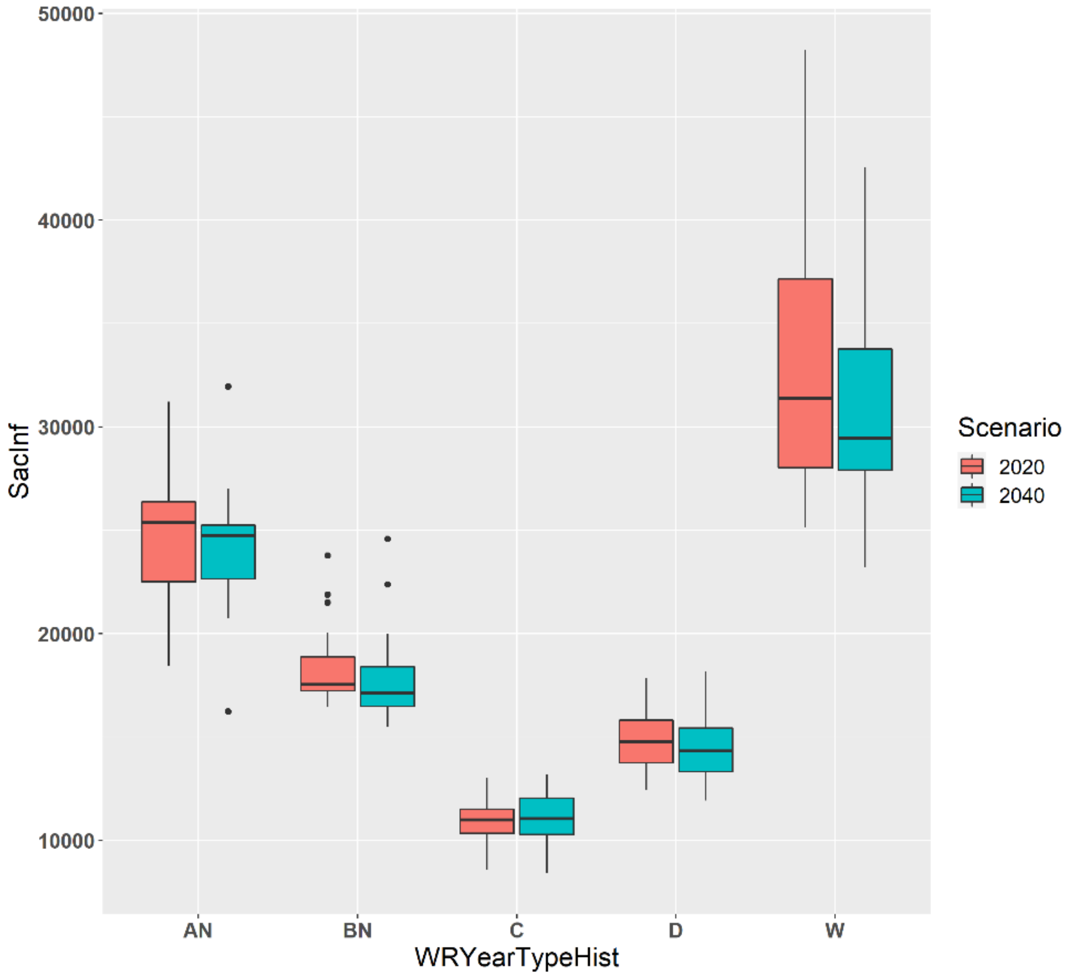

Figure 29.2 Comparison of Sacramento Inflow at Freeport (2020 and 2040). This graphic shows the similar variability of flows for the 2020 and 2040 condition. It further demonstrates that the projected 2040 CT scenario drought patterns (shown as the bottom whiskers or outlier circles of the boxes) will be similar to that of the 2020 condition. Data source: Spreadsheets provided by DWR.

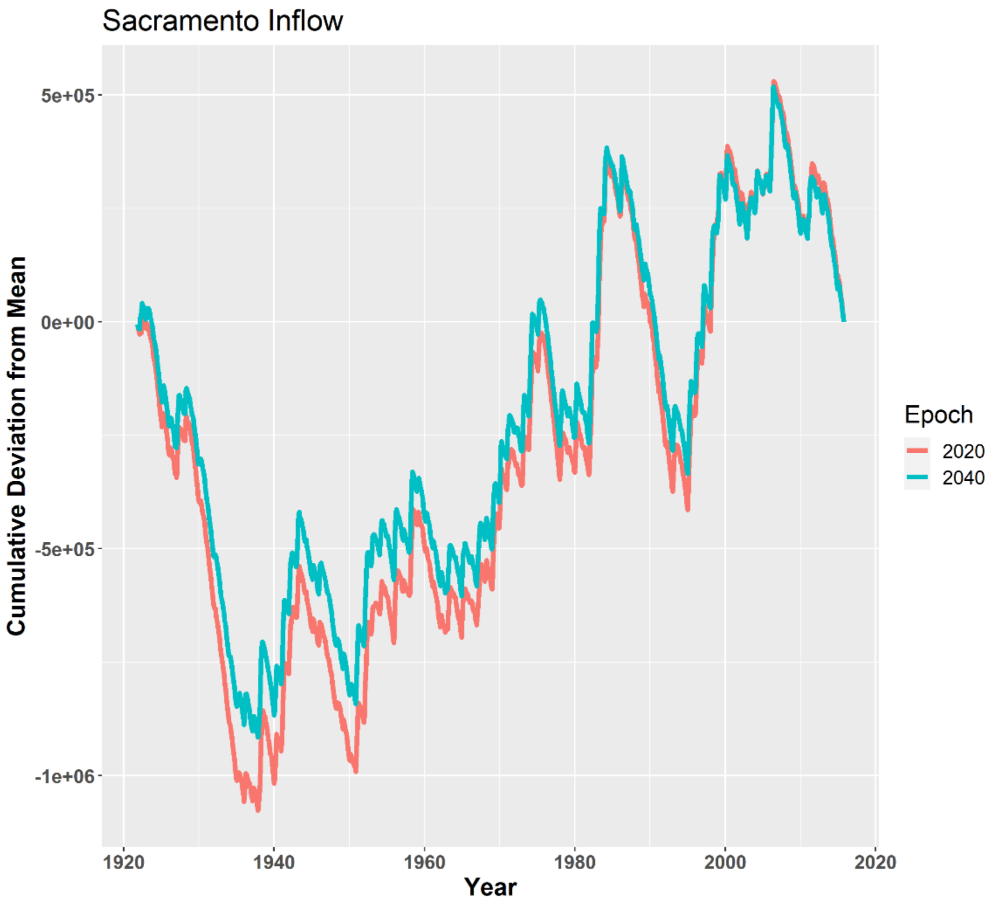

Figure 29.3. Comparison of cumulative deviations from the respective means for the Sacramento River inflow at Freeport. The two curves demonstrate that future projections estimate wetter future conditions but very similar patterns of drier and wetter periods. The modeling approach ignores the potential for different hydrologic trajectories, such as increasing extreme conditions, under climate change. Data source: Spreadsheets provided by DWR.

5. The use of 2040 as the future epoch for alternative assessment is a concern. The 2040 timeframe is less than 20 years from today, and in fact, the period of simulation ranges from 2026 to 2055. The rationale, as indicated, is the fact that 2040 is the expected date for the project to begin operation. Because the climate is deemed nonstationary (Milly et al. 2008), the climatic conditions (rainfall patterns, sea level rise, temperature, and water demand) will evolve continuously and an assessment using a median scenario centered around 2040 needs to be justified. Before 2050, the implications of various Greenhouse Gas Scenarios (in the form of RCPs) are not expected to deviate much from each other, and depending on the future warming scenario, conditions could deviate more significantly after 2050. The

conveyance project is expected to be operational well beyond 2040, so it would make more sense for the analysis to use 2040 as the future condition.

The time frame for evaluating the longer-term impacts of climate change appears to be inadequate. Climate change is a nonstationary environment that will affect management and performance presumably for centuries. Civil engineering developed in a more stable climate so its hydrologic analytical tools and methods and approach to problem-solving do not traditionally incorporate a changing climate. This demonstrates the need to think long-term about the consequences of actions.

6. The draft EIR has focused primarily on the changes in spatiotemporal runoff from the tributary basins due to future warming and altered precipitation patterns assessed using climate model output. However, the EIR has not adequately considered the implications of the potential increase in the frequency of future watershed disturbances that will likely occur due to climate change. The obvious example of such a disturbance is the wildfires that may drastically alter the watershed landscape and hence the rainfall-runoff response. Watersheds with steep, forested terrains, when subject to wildfire, will result in flashier hydrographs with high peak flows that are orders of magnitude greater than the pre-burn condition (Neary et al. 2011). In a study of two watersheds in north-central Arizona, Gottfried et al. (2003) demonstrated that, following fires, peak flows were on the order of 7 and 2350 times higher than the historical high flows along with increased erosion. The loss of canopy that helps moderate infiltration, and protects soil, would be expected to lead to decreased evapotranspiration and infiltration, and increased runoff (Neary et al. 2011). However, this projected response may be more complex as other factors such as watershed aridity, may moderate the magnitude of the forest fire impacts (Goeking and Tarboton 2022).

   A study that is highly relevant to the California region is the recent research by Williams et al. (2022) regarding the impact of wildfire on the western United States water supply. They demonstrated that the streamflow increased significantly by approximately 30% for six years in basins where >20% of the forest is burned. While the percentage of the percentage burned may be lower historically, this study suggested that over the next several decades, forest fire extents in the Western United States may exceed what was seen in 2020 which experienced records fires. They clearly stated that the projections of water supply and runoff-related hazards need to account for wildfires. Williams et al. (2022) also showed that conditions of increased aridity will likely be more common in the future, possibly leading to increased frequency of fire disturbances. Projected climate change and the associated increase in temperature will also influence the water budgets in tributary basins. For instance, Albano et al. (2022) have demonstrated that in the western US, the increasing water loss into the atmosphere, as quantified by the reference evapotranspiration, may be attributed to temperature increase over the 1980-2020 period exceeding the historical range of variability. The above research suggests that the hydrologic response of tributary basins will need to account for the nonstationarity that results from the altered landscapes with increasing frequency extreme events and other implications of warming attributable to climate change and not only changes in runoff response due to precipitation or other drivers.

7. The sensitivity study performed in the draft EIR may not provide adequate insights into the uncertainties in flow predictions and impacts of alternatives. For example, the effects of examined sea-level-rise levels on most reservoir levels seem small. A reasonable assumption is that rising sea levels would require additional flows from the reservoirs, particularly during drier periods leading to depletion of their storage.

Suggestions for Improvement

1. Climatic conditions representing the future epoch should use all 20 or a subset of GCM scenarios that may better represent a range of future hydrologic conditions in the tributary basins. In particular, the project evaluation metrics should be computed for a range of conditions representing diverse water years (very dry to very wet), selected based on the magnitude, duration, and frequency of both wet periods and droughts. It is not clear why the “2040 median” scenarios based on 10 climatic datasets were used only for the sensitivity analysis, which appears to be drier, but were not used for the evaluation of alternatives. At a minimum, the performance of the system under each alternative should be assessed separately for multi-year drought periods on the order of six years or more.
2. It would be useful to stress test proposals with increasing climate change effects, including hydrologic responses, and sea level rise to see under what conditions their performance diminishes. Such a stress test could be based parametrically on the 20 climate scenarios examined, perhaps varying

historical flows' monthly means and standard deviations, and/or expanding the length of drought periods until the system fails.

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Chapter 31: Growth Inducement and Other Indirect Effects

Strengths

1. Chapter 31 makes a reasoned assessment of the likelihood of growth inducement that would result from project alternatives in the Delta and SWP South-of-Delta Area. The conclusions that the increased supply of water would be used primarily for reliability and are not likely to trigger human population growth seem to be founded on solid assumptions and evidence of existing water demands and growth inducement factors.
2. The chapter includes some useful and interesting data on trends in water use and population, such as Figures 31-2 and 31-3. Sizable reductions in population growth rate and sharp reductions in average per-capita urban water use should remove some concerns for urban water suppliers. Projected increases in California population (Figure 31-4) seem minimal.

Concerns and Potential Weaknesses

Overall, this is a short, descriptive chapter largely devoid of analysis. Although it is somewhat useful for orientation, it offers limited value for comparison of alternatives.

Chapter 32: Tribal Cultural Resources

Strengths

1. It appears that the draft EIR made a thorough and good faith effort to seek input from tribal communities that could be affected by the project. Outreach efforts were multi-pronged and used diverse sources of notification and communication, along with a variety of venues to communicate with Tribes. Tribal outreach was complemented by archival and ethnographic research and historical records research.
2. The process and methods for identifying individual landscape components for California Register of Historical Resources (CRHR) evaluation as potential individual Tribal cultural resources is also described clearly. In general, the methods for identifying a "Tribal cultural resource" requires the source "…to be significant to a Tribe and eligible for listing in the CRHR to be a Tribal cultural resource" (page 32-16, line 21-22), which helps ensure that Tribal expertise is considered in the analysis of cultural resources.
3. Although details in the draft EIR are insufficient to judge the quality of the tribal interactions during the outreach process, the draft EIR finds substantial and unavoidable impacts to all CEQA criteria, which lessens concerns that the tribal perspective was not considered.
4. The chapter acknowledges the sensitivity of discussing and assessing the Tribal Cultural Landscape and acknowledges a range of defining features of the cultural landscape that could be impaired by the project alternatives.
5. The chapter explains the legal requirements that inform the analysis of potentially affected cultural resources.
6. The creation of a Tribal Cultural Resources Management Plan seems prudent to help avoid and minimize potential impacts on cultural resources.

Concerns and Potential Weaknesses

1. It is difficult to evaluate whether individual Tribes or Tribal member interests were adequately represented in the consultation and outreach process, or whether the interpretation of the input during these processes fully reflects Tribal perspectives. It would be valuable to acknowledge these potential limitations, given that any community or public outreach process conducted by public agencies is subject to potential biases that reflect the interests of people who show up and engage.

2. Related to the point above, it would be helpful to know how many individuals or Tribes who received notification letters did not respond to the letters (on page 32-11).
3. As with other chapters, the assumption that climate change will have notable impacts under the No Project Alternative, but not with others, is illogical.
4. The "Cumulative Impacts" analyses only lists other Delta projects and do not apply available quantitative analytic methods. Section 32.3.4 serves more as an account of current restoration programs as opposed to a true cumulative effects assessment (CEA) that analyzes potential synergistic or antagonistic interactions between the proposed alternatives and the landscape. There are existing methods of CEA suitable for complex projects with varying degrees of qualitative and quantitative data such as species-stressor models (Hodgson and Halpern 2019), network analysis (Harker et al. 2021), and scenario-building (Mahon and Pelech 2021). Choosing not to employ these methods or use any number of frameworks available to structure a more thorough CEA (Stelzenmüller et al. 2020, Sutherland et al. 2022) is not scientifically sound and is contrary to providing the public with a fair understanding of "the short- and medium-term environmental costs,'' which does not serve CEQA's informational purpose (draft EIR Section 3C.2.1).
5. The Delta ISB has raised a number of fundamental concerns related to the project's impacts on Fish and Aquatic Resources (Chapter 12) and Terrestrial Biological Resources (Chapter 13). These concerns are potentially significant in that they could profoundly change the Tribal Cultural Landscape and need to be clearly communicated to Tribal representatives for their consideration.

Suggestions for Improvement

1. Careful consideration of Tribal input on this draft EIR chapter, and active outreach to solicit input on the quality of the analysis, is strongly recommended as Delta ISB members are not experts on all of the Tribal Cultural Resources.
2. The amount of "apparent" redundancy in the Chapter made it difficult to follow and fully understand the impacts. Perhaps a simple summary of significant and non-significant impacts at the beginning would be helpful for reader comprehension.
3. The chapter also could be greatly improved by actively applying contemporary approaches for quantifying the cumulative effects. The EIR should consider using approaches outlined in recent scientific articles.

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Chapter 34: Community Benefits Program

Strengths

1. The process for creating the framework for a Community Benefits Program draws on community engagement and outreach with relevant groups in the Delta.
2. The initial plan does a good job of acknowledging the values underling the Delta as a Place.

Concerns and Potential Weaknesses

1. There is always a risk that community benefits programs designed to provide "goodwill" for new infrastructure projects will be perceived as disingenuous placating of communities to avoid focusing on community concerns about a project. The plan and approach for determining community benefits could be better connected to perceptions and concerns communities have about project impacts, or potential impacts identified in the draft EIR that communities may not even be aware of.
2. The draft EIR does not discuss how the Delta Community Fund will be funded, or by whom, and how much funding will be available and for how long. These details are critical for determining what community benefits are feasible.

Suggestions for Improvement

1. Acknowledging the potential for communities to perceive a Community Benefits Program as being disingenuous is advised. There is social science research, especially in the planning literature, on the limitations of community benefits programs. DWR might want to look at examples of failed efforts versus successful efforts for some further guidance.
2. More effort should be put into developing a process for prioritizing program activities going forward and described in the EIR. For instance, should there be criteria for selecting community benefit activities/projects that minimize additional environmental or cultural impacts? Given the diversity of interests in the Delta and the wide range of potential benefits of interest to people and communities in the Delta that have already been identified through outreach, it could be challenging to find agreement on initial benefits or projects to pursue. It can also be challenging to determine whose voices matter in the process of deciding on specific projects or programs.

3. Relatedly, a more explicit connection between the Community Benefits Program and tribal concerns and Environmental Justice issues identified in the draft EIR could help identify some of the top priorities for the program, especially given that impacts to Tribal resources were deemed significant and unavoidable.