Appendix 4A

Model Assumptions

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The appendix is presented in its entirety from the Draft Environmental Impact Report (DEIR), with revisions to text presented as a strikethrough or underline. Text shown with a strikethrough has been deleted from the DEIR. Text that has been added is presented as single underlined. Deleted figures are shown with a dashed border. Added figures do not have unique formatting.

4A.1 Introduction

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

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

4A.2 Modeled Scenarios

The following scenarios were prepared:

- Baseline Conditions (Study 1)
- Proposed Project (Study 9bv2)

The assumptions used for each scenario and each model listed above are documented in the following attachments:

- Attachment 1, "Model Assumptions"
- Attachment 2, "CalSim 3 Model Assumptions Callouts"
- Attachment 3, "DSM2 Model Assumptions Callouts"

The following attachments contain documentation of additional model assumptions and limitations:

- Attachment 4, "DSM2 PTM Documentation"
- Attachment 5, "DSM2 ecoPTM Documentation"
- Attachment 6, "Scenario Related Changes to CalSim 3 and DSM2"
- Attachment 7, "SWP Proportion"
- Attachment 8, "Model Limitations"
- Attachment 9, "Suisun Marsh Salinity Control Gate Operation Sensitivity Analysis"
- Attachment 10, "CalSim Model Updates Between DEIR and FEIR"

4A.2.1 Baseline Conditions

The Baseline Conditions represents Central Valley Project (CVP) and State Water Project (SWP) operations to comply with the "current" regulatory environment (as of June 16, 2023). The Baseline Conditions assumptions include existing facilities and ongoing programs that existed as of the June 16, 2023 publication date of the Notice of Preparation (NOP). The Baseline Conditions assumptions also include facilities and programs that received approvals and permits by June 2023 because those programs were consistent with existing management direction as of the NOP.

4A.2.2 Proposed Project

The Proposed Project is the DWR ongoing long-term operation of the SWP consistent with existing regulatory requirements that address water rights, water quality, and the protection and conservation of designated species in compliance with the California Endangered Species Act. The goal of the Proposed Project is to continue the long-term operation of the SWP for water supply and power generation, consistent with applicable laws, contractual obligations, and agreements, and to increase operational flexibility by focusing on nonoperational measures to avoid significant adverse effects. DWR proposes to store, divert, and convey water in accordance with existing water contracts and agreements up to full contract amounts and other deliveries, consistent with water rights and applicable laws and regulations.

The following model simulations were prepared for each scenario:

- CalSim 3
- DSM2

4A.3 CalSim 3

DWR and the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) have jointly developed a new version of CalSim, known as CalSim 3. CalSim 3 replaces its predecessor, CalSim II, for conducting planning studies relating to operations of SWP and CVP.

CalSim 3 contains many additions and enhancements over CalSim II, including the following:

- Expansion of model domain to dynamically simulate the mountain watersheds of the Sacramento and San Joaquin valleys using a physically based network schematic, which is available in geo-referenced form.
- Delineation of over 230 mountain and foothill (rim) watersheds and corresponding unimpaired runoff to major reservoirs and to mountain rivers and streams at points of diversion and points of measurement.
- Finer spatial resolution, whereby water demands are based on individual water districts and water agencies rather than large geographic regions and points of diversion are based on contracts and water rights.
- Updated agricultural land use, crop water demands, and irrigation efficiencies.
- Updated urban demands based on 2020 Urban Water Management Plans.

- Improved simulation of groundwater flows and storage, including stream-groundwater interaction, by linking CalSim 3 to a distributed, finite element groundwater model and improved distinction between surface water use and groundwater use.
- Extended period of simulation to include water years (WY) 2004 through 2021.

DWR and Reclamation have extensively reviewed CalSim 3 performance through comparison to CalSim II and to recent historical observed data. CalSim 3 is considered the best available tool for performing planning studies and supporting environmental review of proposed projects and programs.

4A.3.1 Groundwater Representation

To accurately represent the water resources of the Central Valley for planning and policy decisions, it is important that CalSim 3 represents the groundwater flow system in detail. CalSim 3 uses the configuration and parameters of the coarse grid version of the California Central Valley Simulation Model (C2VSim) as its basis for the groundwater flow simulation. The simulation module of the Integrated Water Flow Model (IWFM) was separated from the rest of the IWFM numerical engine and compiled into a dynamic link library (DLL). The CalSim 3 groundwater model covers only the valley floor watersheds and the Delta islands, the spatial extent of the groundwater model is the same as the spatial extent of C2VSim, covering the floor of the Central Valley below an elevation of 500 feet. Additional information of the development and representation of groundwater flow in CalSim 3 is described in the August 2022 CalSim 3 Report (California Department of Water Resources and U.S. Bureau of Reclamation 2022).

4A.4 DSM2

DSM2 is a one-dimensional hydrodynamic and water quality simulation model used to simulate hydrodynamics, water quality, and particle tracking in the Sacramento–San Joaquin Delta (California Department of Water Resources 2019). DSM2 represents the best available planning model for Delta tidal hydraulic and salinity modeling. It is appropriate for describing the existing conditions in the Delta, as well as performing simulations for the assessment of incremental environmental impacts caused by future facilities and operations (U.S. Bureau of Reclamation 2015).

4A.4.1 River Flows

For all DSM2 simulations, the river flows at the DSM2 boundaries are based on monthly flow timeseries from CalSim 3. These boundary flows are Sacramento River at Freeport, San Joaquin River at Vernalis, Calaveras River at Stockton, Cosumnes River at Michigan Bar, Mokelumne River at Woodbridge, Yolo Bypass at Lisbon, and North Bay Aqueduct diversion. To provide a warm-up period for DSM2, the flow boundaries of WY 1922 have been replicated and applied to fill the flow boundaries of WY 1921. This duplication ensures the availability of consistent data for the desired warm-up period.

4A.4.2 Model Updates

DSM2 hydrodynamics and salinity (electrical conductivity [EC]) were initially calibrated in 1997 (California Department of Water Resources 1997). In 2000, a group of agencies, water users, and ~~stakeholders~~ interested parties recalibrated and validated DSM2 in an open process, resulting in a model that could replicate the observed data more closely than the 1997 version (DSM2PWT 2001). In 2009, CH2M HILL performed a calibration and validation of DSM2 by including the flooded Liberty Island in the DSM2 grid, which allowed for an improved simulation of tidal hydrodynamics and EC transport (CH2M HILL 2009). In 2013, DWR released DSM2 version 8.1.2, which included major changes, such as updated bathymetric reference to NAVD 881 and modified representation of dispersion in DSM2-QUAL. DWR also recalibrated DSM2 with this updated version and found that the performance of the model in simulating observed hydrodynamics and salinity conditions was very close to the 2009 calibration (Liu and Sandhu 2013). Most recently, DWR released DSM2 version 8.2.0 (California Department of Water Resources 2021), modifying the way that consumptive use and net channel depletion are estimated for the legal Delta. More specifically, v8.1.2 uses the Delta Island Consumptive Use (DICU) model, while v8.2.0 employs the Delta Channel Depletion (DCD) model in deriving Delta channel depletion as well as consumptive use.

DICU is a monthly model that divides the Delta into 142 subareas and simulates the water entering, leaving, or being stored in each of these subareas. In comparison, DCD has finer temporal and spatial resolutions that provide simulations at a daily scale for 168 subareas in the Delta. DCD also incorporates several enhancements, including updated parameterization and the addition of physical processes related to Delta channel depletions (Liang and Suits 2017, 2018). More details regarding the DCD model are described in Section 4A.4.3, *Delta Channel Depletion Model*. In light of this difference, the DSM2 v8.2.0 hydrodynamics and EC were calibrated and validated using observed data up to 2021 (California Department of Water Resources 2021).

4A.4.3 Delta Channel Depletion Model

The Delta Evapotranspiration of Applied Water (DETAW) v2.0 (Liang and Suits 2017) and the DCD model v1.0 (Liang and Suits 2018) were developed to better estimate daily Delta evapotranspiration and channel depletion, respectively. These two models, when combined (termed DETAW-DCD), were calibrated concurrent with DSM2 in order to improve simulated historical patterns in salinity intrusion.

In 2020, CalSim 3 and SCHISM were tested using DETAW v2.0- and DCD v1.0-simulated channel depletions as model inputs. Results indicated that linking the models can improve overall performance.

4A.4.4 Tidal Boundary Martinez Water Level and Electrical Conductivity

For all 2020 studies, the tidal boundary condition at Martinez is based on an adjusted harmonic tide normalized for sea-level rise (Ateljevich and Yu 2007). The Martinez boundary condition has been extended to 2021 (Ferreira et al. 2018).

For all studies representing the 2020 level of development, the Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CalSim 3 and the pure astronomical tide (Ateljevich 2001a, 2001b).

4A.5 References

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