ATTACHMENT 1-6 DELTA PARTICLE TRACKING MODELING

Particle tracking models (PTM) are excellent tools to visualize and summarize the impacts of modified hydrodynamics in the Delta. These tools can simulate the movement of passive particles or particles with behavior representing either larval or adult fish through the Delta. The PTM tools can provide important information relating hydrodynamic results to the analysis needs of biologists that are essential in assessing the impacts to the habitat in the Delta.

1.1 DSM2 - PTM

DSM2-PTM simulates pseudo 3-D transport of neutrally buoyant particles based on the flow field simulated by HYDRO. The PTM module simulates the transport and fate of individual particles traveling throughout the Delta. The model uses geometry files, velocity, flow, and stage output from the HYDRO module to monitor the location of each individual particle using assumed vertical and lateral velocity profiles and specified random movement to simulate mixing. The location of a particle in a channel is determined as the distance from the downstream end of the channel segment (x), the distance from the centerline of the channel (y), and the distance above the channel bottom (z). PTM has multiple applications ranging from visualization of flow patterns to simulation of discrete organisms such as fish eggs and larvae.

The longitudinal distance traveled by a particle is determined from a combination of the lateral and vertical velocity profiles in each channel. The transverse velocity profile simulates the effects of channel shear that occurs along the sides of a channel. The result is varying velocities across the width of the channel. The average cross-sectional velocity is multiplied by a factor based on the particle's transverse location in the channel. The model uses a fourth order polynomial to represent the velocity profile. The vertical velocity profile shows that particles located near the bottom of the channel move more slowly than particles located near the surface. The model uses the Von Karman logarithmic profile to create the velocity profile. Particles also move because of random mixing. The mixing rates (i.e., distances) are a function of the water depth and the velocity in the channel. High velocities and deeper water result in greater mixing.

At a junction the path of a particle is determined randomly based on the proportion of flow. The proportion of flow determines the probability of movement into each reach. A random number based on this determined probability then determines where the particle will go. A particle that moves into an open water area, such as a reservoir, no longer retains its position information. A DSM2 open water area is considered a fully mixed reactor. The path out of the open water area is a decision based on the volume in the open water area, the time step, and the flow out of the area. At the beginning of a time step the volume of the open water area the volume of water leaving at each opening of the open water area is determined. From that the probability of the particle leaving the open water area is calculated. Particles entering exports or agricultural diversions are considered "lost" from the system. Their final destination is recorded. Once particles pass the Martinez boundary, they have no opportunity to return to the Delta. (Smith, 1998, Wilbur, 2001, Miller, 2002)

1.2 DSM2 – PTM METRICS

Fate Mapping – an indicator of entrainment. It is the percent of particles that go past various exit points in the system at the end of a given number of days after insertion.

1.3 PTM PERIOD SELECTION

PTM simulation periods for the fate computations were in December through June of the entire 82-year planning simulation period.

1.4 PTM SIMULATIONS

PTM simulations are performed to derive the metrics described above. The particles are inserted at the 39 locations listed in Table 1. The locations were identified based on the 20mm Delta Smelt Survey Stations. 20 mm Deta Smelt Survey Stations and particle insertion locations are display in Figure 1.

A total of 39 PTM simulations are performed in a batch mode for each insertion period. For each insertion period, 4000 particles are inserted at the identified locations over a 24.75-hour period, starting on the 1st of the selected month. The fate of the inserted particles is tracked continuously over a 120-day simulation period. The particle flux is tracked at the key exit locations – exports, Delta agricultural intakes, past Chipps Island, to Suisun Marsh and past Martinez and at several internal tracking locations. Generally, the fate of particles at the end of 30 days, 60 days, 90 days and 120 days after insertion is computed for the fate mapping analysis.

Table 1: List of Particle Insertion Locations for Residence Time and Fate Computations

Location	DSM2 Node
San Joaquin River at Vernalis	1
San Joaquin River at Mossdale	7
San Joaquin River D/S of Rough and Ready Island	21
San Joaquin River at Buckley Cove	25
San Joaquin River near Medford Island	34
San Joaquin River at Potato Slough	39
San Joaquin River at Twitchell Island	41
Old River near Victoria Canal	75
Old River at Railroad Cut	86
Old River near Quimby Island	99
Middle River at Victoria Canal	113
Middle River u/s of Mildred Island	145
Grant Line Canal	174
Frank's Tract East	232
Threemile Slough	240
Little Potato Slough	249
Mokelumne River d/s of Cosumnes confluence	258
South Fork Mokelumne	261

Location	DSM2 Node
Mokelumne River d/s of Georgiana confluence	272
North Fork Mokelumne	281
Georgiana Slough	291
Miner Slough	307
Sacramento Deep Water Ship Channel	314
Cache Slough at Shag Slough	321
Cache Slough at Liberty Island	323
Lindsey slough at Barker Slough	322
Sacramento River at Sacramento	330
Sacramento River at Sutter Slough	339
Sacramento River at Ryde	344
Sacramento River near Cache Slough confluence	350
Sacramento River at Rio Vista	351
Sacramento River d/s of Decker Island	353
Sacramento River at Sherman Lake	354
Sacramento River at Port Chicago	359
Montezuma Slough at Head	418
Montezuma Slough at Suisun Slough	428
San Joaquin River d/s of Dutch Slough	461
Sacramento River at Pittsburg	465
San Joaquin River near Jersey Point	469

1.5 OUTPUT PARAMETERS

The particle tracking models can be used to assist in understanding passive fate and transport, or through consideration of behavior or residence time. In, general the following outputs are generated:

- Fate of particles and cut lines or regions
- Time of travel breakthrough curves
- Residence time

For the purposes of this EIR, only particle fate outputs were assessed.

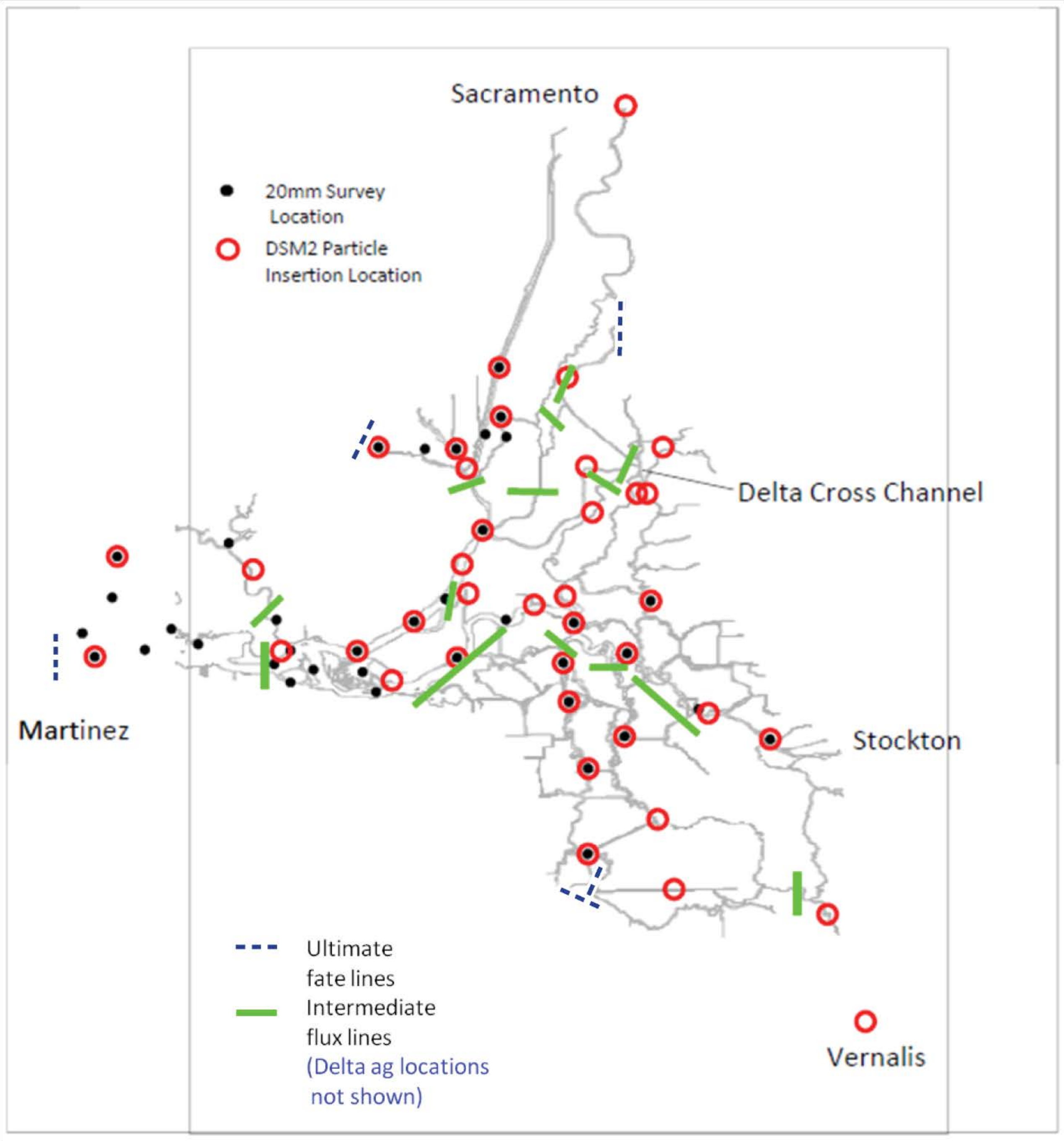

Figure 1. Particle insertion locations for fate computations

Attachment 1-7 Model Limitations

1 Introduction

Models are commonly used to evaluate changes in the management and operations of water resources systems. These models are computer based and use mathematical expressions, methods and input data to represent hydrologic, physical, environmental, operational, and institutional aspects of the water resources systems. As complex as water resources systems are, the representation of the water resources system in input data, calculations and model outputs is understood to be simplified and generalized in comparison to what is observed in the historical records and documents that describe the real-world water resources system. Even so, models are useful tools in assessing historical, current and future projected conditions of the water resources system. These conditions are described by models based on assumptions that are captured in the data and calculations used.

Even though the models used in this document are the best available tools, because the representation of the water resources system in models is understood to be simplified and generalized in comparison to what is observed in the historical records and documents, the use of model results should be subject to a set of agreed upon limitations and subsequent analysis of results is thereby limited. The developers and expert users of the models in question should be consulted in regard to these limitations. The following is a presentation of information that the team of modelers relevant to the limitations of the models. This information should be considered in use of the model results and any subsequent analysis derived from these model results.

2 General Limitations of Models Used

2.1 CalSim II

CalSim II is a monthly model developed for planning level analyses. The model is run for an 82-year historical hydrologic period, at a projected level of hydrology and demands; and under an assumed framework of regulations. Therefore the 82-year simulation does not provide information about historical conditions, but it does provide information about variability of conditions that would occur at the assumed level of hydrology and demand with the assumed operations, under the same historical hydrologic sequence. Because it is not a physically based model, CalSim II is not calibrated and cannot be used in a predictive manner. CalSim II is intended to be used in a comparative manner; which is appropriate for CESA analysis.

In CalSim II, operational decisions are made on a monthly basis, based on a set of pre-defined rules that represent the assumed regulations. Modifications by the model user would be required to allow for variation in these rules based on a sequence of hydrologic events such as a prolonged drought, or statistical performance criteria such as meeting a storage target in an assumed percentage of years.

While there are certain components in the model that are downscaled to a daily time step (simulated or approximated hydrology), such as an air-temperature based trigger for a fisheries action, the results of those daily conditions are always averaged to a monthly time step. For example, a certain number of days with and without the action is calculated and the monthly result is calculated using a day-weighted average based on the total number of days in that month. Operational decisions based on those components are again made on a monthly basis. Any reporting or use of sub-monthly results from CalSim II should include disaggregation methods that are appropriate for the given application, report, or subsequent model.

Appropriate use of model results is important. Despite detailed model inputs and assumptions, the CalSim II results differ from real-time operations under stressed water supply conditions. Such model results occur due to the inability of the model to make unique real-time policy decisions under extreme circumstances, as the actual (human) operators must do. Therefore, results which indicate severely low storage, or inability to meet flow requirements or senior water rights should only be considered an indicator of stressed water supply conditions under that alternative, and should not necessarily be understood to reflect literally what would occur in the future under that alternative. These conditions, in real-time operations, would be avoided by making policy decisions on other requirements in prior months. In actual future operations, as has always been the case in the past, the project operators would work in real time to satisfy legal and contractual obligations given then current conditions and hydrologic constraints.

Reclamation’s 2008 BA on the coordinated long-term operations Appendix W (Reclamation 2008) included a comprehensive sensitivity and uncertainty analysis of CalSim II results relative to the uncertainty in the inputs. This appendix provides a good summary of the key inputs that are critical to the largest changes in several operational outputs. Understanding the findings from this appendix may help in better understanding of the alternatives.

2.2 DSM2

DSM2 is a one-dimensional model with inherent limitations in simulating hydrodynamic and transport processes in a complex estuarine environment such as the Sacramento – San Joaquin Delta. DSM2 assumes that velocity in a channel can be adequately represented by a single average velocity over the channel cross-section, meaning that variations both across the width of the channel and through the water column are negligible. DSM2 does not have the ability to model short-circuiting of flow through a reach, where a majority of the flow in a cross-section is confined to a small portion of the cross-section. DSM2 does not conserve momentum at the channel junctions and does not model the secondary currents in a channel. DSM2 also does not explicitly account for dispersion due to flow accelerating through channel bends. It cannot model the vertical salinity stratification in the channels.

It has inherent limitations in simulating the hydrodynamics related to the open water areas. Since an open water surface area (represented with a reservoir in the model) is constant in DSM2, it impacts the stage in the reservoir and thereby impacts the flow exchange with the adjoining channel. Due to the inability to change the cross-sectional area of the reservoir inlets with changing water surface elevation, the final entrance and exit coefficients were fine tuned to match a median flow range. This causes errors in the flow exchange at breaches (levee openings) during the extreme spring and neap tides. Using an arbitrary bottom elevation value for the reservoirs representing the proposed marsh areas to get around the wetting-drying limitation of DSM2 may increase the dilution of salinity in the reservoirs.

For open water bodies DSM2 assumes uniform and instantaneous mixing over entire open water area. Thus it does not account for the any salinity gradients that may exist within the open water bodies. Significant uncertainty exists in flow and EC input data related to in-Delta agriculture, which leads to uncertainty in the simulated EC values. Caution needs to be exercised when using EC outputs on a sub-monthly scale, and therefore results are only presented at the monthly scale. Water quality results inside the water bodies representing the tidal marsh areas were not validated specifically and because of the bottom elevation assumptions, preferably should not be used for analysis.

3 Appropriate Use of CalSim II and DSM2 Model Results

The modeling conducted to evaluate Existing Conditions and Proposed Project scenarios is a planning analysis. A planning analysis is conducted to understand long-term changes in the Central Valley Project (CVP) and State Water Project (SWP) system due to a proposed change. The models developed and applied in planning analysis are generalized and simplified representations of a complex water resources system. Even so, the models used are informative and helpful in understanding the performance and potential effects (both positive and negative) of the operation of a project and its interaction with the water resources system under consideration. Even though some of the models used in this planning analysis such as DSM2 are calibrated and validated to represent physical processes, given the nature of the boundary conditions used (derived from CalSim II, a generalized system model), DSM2 results would only tend to represent generalized long-term trends. Note that level of confidence, in the results of any well calibrated predictive model is only as good as the level of confidence in the input boundary conditions used. Given the limitations of the planning analysis, a brief description of appropriate use of the model results to compare two scenarios or to compare against threshold values or standards is presented below.

3.1 Absolute Versus Relative Use of the Model Results

The CalSim II and DSM2 results in a planning analysis are appropriately used as “comparative tools” to assess relative changes between Existing Conditions and Proposed Project. In a planning analysis, models used are not predictive models and therefore the results cannot be considered as absolute with a quantifiable confidence interval. The model results are only useful in a comparative analysis and can only serve as an indicator of condition (e.g. compliance with a standard) and of trend or tendency (e.g. generalized impacts). Because CalSim II relies on generalized rules, a coarse representation of project operations, adjusted hydrologic conditions to reflect future demands and land use, and no specific operations in response to extreme events, results should not be expected to reflect what operators might do in real time operations on a specific day, month or year within the simulation period. In reality, the operators would be informed by numerous real-time considerations such as salinity monitoring.

3.2 Appropriate Reporting Time-Step

Due to the assumptions involved in the input data sets and model logic, care must be taken to select the most appropriate time-step for the reporting of model results. Sub-monthly (e.g. weekly or daily) reporting of model results are generally inappropriate for both models and the results should be presented on a monthly basis. There may be exceptions to this, and selected model results can be reported on a sub-monthly basis with adequate caution. An understanding of validity of the underlying operational conditions is critical in interpreting a sub-monthly result.

3.3 Appropriate Reporting Locations

Due to the assumptions involved in the input data sets and model logic, care must be taken to select the most appropriate reference locations (and/or boundaries) for the reporting of model results. Each model assumes a simplified spatial representation of the water resource system and sub-systems. Reporting of model results inconsistent with the spatial representation of the model is inappropriate. Care must be taken in selecting the locations desired for reporting model results and whether or not the models are adequate for that purpose.

3.4 Statistical Comparisons are Preferred

Absolute differences computed at a point in time between model results from an alternative and a baseline to evaluate impacts is an inappropriate use of model results (e.g. computing differences between the results from a baseline and an alternative for a particular day or month and year within the period of record of simulation). Likewise, computing absolute differences between an alternative (or a baseline) and a specific threshold value or standard is an inappropriate use of model results. Statistics based on the absolute differences at a point in time (e.g. maximum of monthly differences) are an inappropriate use of model results. By computing the absolute differences in this way, an analysis disregards the changes in antecedent conditions between individual scenarios and distorts the evaluation of impacts of a specific action (e.g. project).

Reporting seasonal patterns from long-term averages and water year type averages is appropriate. Statistics based on long-term and water year type averages are an appropriate use of model results. Computing differences between long-term or water year type averages of model results from two scenarios is appropriate. Care should be taken to use the appropriate water year type for presenting water year type average statistics of model results (e.g. D1641 Sacramento River 40-30-30 or San Joaquin River 60-20-20, and with or without climate modified conditions).

The most appropriate presentation of monthly and annual model results is in the form of probability distributions and comparisons of probability distributions (e.g. cumulative probabilities). If necessary, comparisons of model results against threshold or standard values should be limited to comparisons based on cumulative probability distributions. Information specific to a model calibration (should be considered in using these types of comparisons.

3.5 Suggested Formats for Presentation of Model Results

The most appropriate format to present model results is:

- Long term average summary and year type based summary tables and graphics showing monthly and/or annual statistics derived from the model results

- Cumulative exceedance probability monthly and/or annual model results shown only by rank/order or only by probability statistic

Comparative statistics based on these two types of presentations are generally acceptable.

4 Model Specific Considerations

As stated earlier, the models developed and applied in planning analysis are generalized and simplified representations of a complex water resources system, which means they are limited in some way. The following is a description of considerations specific to each model.

4.1 CalSim II

CalSim II is a monthly time-step model. It represents projected conditions under current or future regulatory and operational regimes. The operational decisions in CalSim II (e.g. determining the flow needed to meet a salinity standard in the Delta) are on a monthly time-step which does not consider operational responses to changes that are on a sub-monthly timescale. Results for an individual parameter are either a monthly average or an end-of-month condition.

A few specific concerns regarding CalSim II model results include the following:

- Storage results from CalSim II reflect end-of-month conditions and not monthly-average conditions. Therefore, any attributes derived from storage results such as littoral area or water surface elevation in the reservoir reflect end-of-month values.
- CalSim II operates to a monthly approximation of compliance to selected Delta standards. CalSim II monthly average salinity and X2 location outputs are ANN-based. (note that ANN outputs are lagged by one month). Following are some more details on CalSim II D1641 compliance limitations:
    - Even though additional standards are identified in SWRCB D-1641, CalSim II only recognizes five stations for compliance with a salinity standard:
        - Sacramento River at Emmaton
        - San Joaquin River at Jersey Point
        - Old River at Rock Slough
        - Sacramento River at Collinsville
        - Sacramento River at Chipps Island
    - Some standards in SWRCB D-1641 require compliance for a specified number of days in a year (e.g. CCWD 150mg/L Chloride Standard). In such cases, CalSim II does not have any discretion on which days the standards are met, but rather depends on a predetermined schedule, which cannot be altered dynamically.
    - Some of the standards modeled in CalSim II may not match exactly with the values specified in the SWRCB D-1641. Modeled standards may be more constrained (“ramped”) to make operations more responsive to comply with a standard over the season.
    - Under extreme operational conditions, CalSim II may fail to comply with D1641 and other standards. This situation occurs rarely and is needed to maintain feasibility of the model solution.
- San Luis Storage operations in CalSim II are simplified compared to real time operations. The results are uncertain and prone to reflect how CalSim II represents CVP and SWP operations. This is due to the relatively coarse SWP/CVP allocation decisions (e.g. no updates after May) used in the model and uncertainty in the model’s capability to forecast export capabilities.

4.2 DSM2

In a planning analysis, the flow boundary conditions that drive DSM2 are obtained from the monthly CalSim II model. The agricultural diversions, return flows and associated salinities used in DSM2 are on a monthly time step. The implementation of Delta Cross Channel gate operations in DSM2 assumes that the gates are open from the beginning of a given month, irrespective of the water quality needs in the South Delta.

A few specific concerns regarding DSM2 model results include the following:

- Even though CalSim II releases sufficient flow to meet the standards on a monthly average basis, the resulting EC from DSM2 may exceed the standard for part of a month while complying with the standard for the remainder of the month, depending on the spring/neap tide and other factors (e.g. simplification of operations). It is appropriate to present the results on a monthly basis. Frequency of compliance with a criterion should be computed based on monthly average results. Averaging on a sub-monthly (14-day or more) scale may be appropriate as long as the limitations with respect to the compliance of the baseline model are described in detail and the alternative results are presented as an incremental change from the baseline model.

- In general, it is appropriate to present DSM2 QUAL results including EC, DOC, volumetric fingerprinting and constituent fingerprinting on a monthly time step. When comparing results from two scenarios, computing differences based on these mean monthly statistics would be appropriate.

5 Extreme Operational Conditions under Regulatory Uncertainty

Continuing uncertainty in the regulatory environment makes the long-term planning of CVP and SWP operations challenging. The Existing Conditions CalSim II model used to establish the modeling of the Proposed Project scenario assumes the full implementation of the operational actions of the 2008 USFWS and 2009 NMFS BiOp. However, under full implementation of the BiOps, not all conditions of the BiOps may be met in a given month due to competing hydrologic, operational, and regulatory requirements. As a result the simulation provides what is referred to as “extreme operational conditions”. Frequency of such conditions can increase in the future with climate change, if the hydrology is drier or occurrence of sea level rise, without changes in the existing obligations of CVP-SWP.

Extreme operational conditions are defined as simulated occurrences of storage conditions at CVP and SWP reservoirs in which storage is at “dead pool” levels. Reservoir storage at or below the elevation of the lowest outlet is considered to be at dead pool level.

Under extreme operational conditions, CalSim II will utilize a series of rules within the specified priority to reach a numerically feasible solution to allow for the continuation of the simulation. The outcome of these types of solutions in CalSim II may vary greatly depending upon the antecedent conditions from the previous time-step result. The model may reach a numerical solution, but the results of the simulation may not reflect a reasonably expected outcome (i.e. an outcome which would require negotiation). In such cases, flows may fall short of minimum flow criteria, salinities may exceed standards, diversions may fall short of allocated volumes and operating agreements may not be met, indicating a stressed water supply condition.

6 Limitations of the Delta Salinity Modeling Approach

Delta salinity changes were analyzed based on the modeling results from CalSim II and DSM2 simulations of the Existing Conditions and Proposed Project scenarios. DSM2 salinity results indicated exceedances of a few salinity requirements. This section provides background on the models and examines three types of modeling limitations that could have resulted in exceedances.

CalSim II is a water operations model that simulates Delta flows for regulatory and operational criteria assumed under the scenarios on a monthly time step. The model simulates compliance with salinity standards in the Delta. CalSim II relies on an Artificial Neural Network (ANN) for monthly averaged flow verses salinity relationships in the Delta. ANN emulates flow-salinity relationships derived from DSM2 for a given Delta channel configuration and sea level rise condition.

DSM2 application for analyzing Existing Conditions and Proposed Project scenarios uses the monthly CalSim II Delta inflows and diversions/exports results, and simulates Delta hydrodynamics and salinity from the water year 1922 to water year 2003, on a 15-minute time step. Flow inputs assumed in DSM2 modeling are based on monthly CalSim II outputs. The DSM2 inflows do not represent any sub-monthly operational adjustments that could occur to address any potential issues with salinity control in the Delta.

Monthly CalSim II salinity outputs and daily averaged salinity outputs from DSM2 simulations were used to evaluate compliance with D-1641 salinity requirements. DSM2 salinity results indicated exceedances of a few salinity requirements. The modeling limitations that could have resulted in exceedances are listed below:

a. CalSim II is a monthly model – some salinity standards are partial month
b. CalSim II flow-salinity ANN

6.1 CalSim II is a Monthly Model – Some Salinity Standards Are Partial Month

Since CalSim II is a model with a monthly time-step and a number of daily D-1641 salinity standards are active during only portions of a month (ex: April 1 – June 20 and June 20 to August 15), D-1641 standards are calculated as a monthly weighted average in the model. The model attempts to meet these objectives on a monthly average basis, even though the objectives themselves are often transitioning within a month from one value to the other, and may start or end in the middle of a month. When the monthly weighted average standards calculated for CalSim II are less stringent than the daily D-1641 EC standards, CalSim II adjusts SWP and CVP operations to release less flow to meet monthly weighted average EC standards instead of the flow needed to meet higher daily D-1641 EC standards. Figure 1 “Sacramento River at Emmaton” below shows the difference between daily D-1641 EC standards and the monthly weighted average EC standards modeled in CalSim II, for reference. Therefore, within the months where the salinity standard is transitioning, there may be days where DSM2 inflows are less than the required flow to comply with the salinity standard, and more flow on other days. This results in a few days within such months where the modeled salinity exceeds the compliance standard. Importantly, however, in reality the CVP and SWP operations will be adjusted on day-to-day basis to meet the Delta standards.

6.2 CalSim II Flow-Salinity ANN

In CalSim II, the reservoirs and facilities of the SWP and CVP are operated to assure the flow and water quality requirements for these systems are met. Meeting regulatory requirements, including Delta water quality objectives, is the highest operational priority in CalSim II. CalSim II uses the ANN to configure system operations to meet salinity objectives. Because meeting the objectives is the highest priority in CalSim II, the model attempts to meet the applicable water quality objectives on a monthly average basis according to the ANN, unless there is no feasible way to meet the objective (i.e., upstream reservoirs at dead pool conditions). In some cases, even though the ANN predicts that the objective would be met on a monthly average basis, it can be an imperfect predictor of compliance on the time-step appropriate for a given standard (e.g daily standard) and averaging basis (e.g. 14-day running average) that these objectives need to be met. Thus when using the CalSim II results in such cases, the DSM2 results may indicate an exceedance of a salinity standard, when CalSim II does not.

6.3 Stressed CVP-SWP System Under Extreme Operational Conditions

Existing obligations on the CVP-SWP system (hydrology, water demands, biological opinions and other regulatory requirements) may result in extreme operational conditions. Under such extreme operational conditions, flows may fall short of minimum flow criteria, salinities may exceed standards, diversions may fall short of allocated volumes and operating agreements may not be met in CalSim II simulations. In some months, unavailability of the flow to meet the salinity standards in the Delta when upstream storage is at dead pool conditions can be a factor for the modeled exceedances of the standards. In such cases any salinity standard exceedances are reflections of the system operations in the CalSim II model which does not always recognize the operational flexibility, and adhere to the rigid criteria set forth in the model.

6.4 Modeling Exceedances

CalSim II and DSM2 modeling presented in this document may indicate a few modeled exceedances of the D1641 salinity standards. As noted above the exceedances are mostly a result of limitations in the modeling process. In reality, DWR and Reclamation staff constantly monitor Delta water quality conditions and adjust operations of the SWP and CVP in real time as necessary to meet water quality objectives. These decisions take into account real-time conditions and are able to account for many factors that the best available models cannot simulate. At times, under extreme conditions, negotiations with the State Water Resources Control Board occur in order to effectively maximize and balance protection of beneficial uses and water rights, which cannot be modeled.

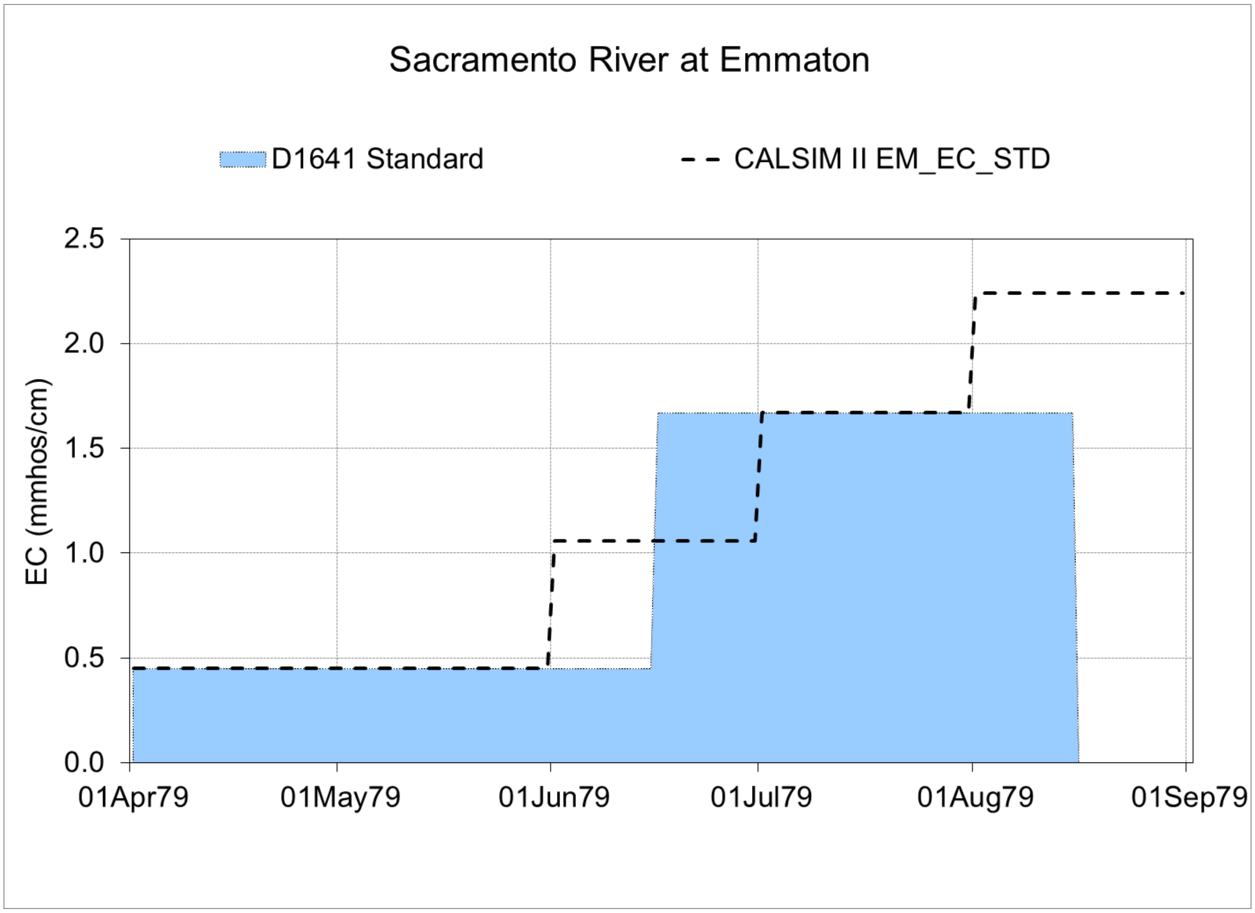

Figure 1. D-1641 Salinity Control Requirement at Emmaton as Simulated in CalSim II

7 References

U. S. Bureau of Reclamation, 2008. Biological Assessment on the Continued Long-term Operations of the Central Valley Project and State Water Project, Appendix W Sensitivity and Uncertainty Analysis, August 2008.

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