# 1 Introduction

Over the past 13 years, the Delta Modeling Section of the California Department of Water Resources' Bay-Delta Office has been developing and enhancing the Delta Simulation Model Version 2 (DSM2), the tools used to support DSM2 modeling, and other Delta flow and water quality estimation tools. The following are brief summaries of work that was conducted during the past year. The names of contributing authors are in parentheses.

## *Chapter 2 – Sacramento Deep Water Ship Channel Flow Monitoring*

In support of the Sacramento Deep Water Ship Channel Fish Passage Facilities Project, the Department's Division of Planning and Local Assistance Central District Special Studies Section conducted a series of flow measurement studies near the boat lock of the Sacramento Deep Water Ship Channel in order to determine the flow of water leaking through the closed and opened boat locks. Although at present DSM2 does not simulate a lock structure at the end of the Sacramento Deep Water Ship Channel, this chapter represents the findings of the field studies in order to document the significance of the flows through the locks and to serve as a starting point for any future modeling effort concerning this particular area. (*Shawn Mayr*)

## *Chapter 3 – Developing a Residence Time Index to Study Changes in 1990 – 2004 Delta Circulation Patterns*

In order to address questions related to the 2001-2004 decline in pelagic organism populations in the Delta, DSM2-PTM was used to calculate a daily residence time index. This index is based on the length of time groups of particles take to travel from the Delta inflow boundaries to various exit locations. Each daily resident time index is unique to a specific injection location and represents the cumulative hydrologic influences during the entire time it takes for these particles to exit Delta channels. This chapter focuses on the methodology used to create these indexes. (*Michael Mierzwa, Jim Wilde, Bob Suits, and Ted Sommer*)

## *Chapter 4 – Using Volumetric Fingerprinting to Study Sources of Salinity in the South Delta*

In order to study the sources of water at locations in the south Delta for which SWRCB water quality standards exist to protect agriculture, a series of fingerprint simulations were conducted using hypothetical variations on historical hydrology and operations. This investigation examines the extent the San Joaquin River has historically been a source of water at these locations and how this contribution may be affected by State Water Project (SWP) operations and the installation of temporary barriers. (*Bob Suits*)

## *Chapter 5 –A Relationship between Vernalis and Brandt Bridge Electrical Conductivity*

A relationship between the measured electrical conductivity in the San Joaquin River (SJR) at Vernalis and Brandt Bridge has been developed to estimate maximum allowable San Joaquin River electrical conductivity (EC) at Vernalis to ensure meeting the Brandt Bridge EC standard. The relationship was based on monthly-averaged EC data measured by the Department of Water Resources and the US Bureau of Reclamation at Vernalis, Mossdale, and Brandt Bridge over the period of 1994 through 2002. This analysis also focuses on establishing confidence intervals for these predictions. (*Bijaya Shrestha and Parviz Nader-Tehrani*)

## *Chapter 6 – Using DSM2 to Develop Operation Strategies for South Delta Improvements Program's Proposed Permanent Gates*

An important component of the South Delta Improvement Plan (SDIP) is the proposed installation and management of several permanent operable gates. Designed to replace the current South Delta temporary rock barriers, these new structures can provide the operational flexibility to both improve conditions in the south Delta for irrigation and protect fish in the San Joaquin River. In order to evaluate the possible effects of the operation of the proposed gates, a reasonable strategy for gate operation needed to be developed for use in DSM2 simulations of Delta conditions. This chapter discusses the development of such strategies that are based on Delta hydrology, target minimum water levels, and average flows in key south Delta channels. (*Bijaya Shrestha and Parviz Nader-Tehrani*)

## *Chapter 7 – Estimates for Consumptive Water Demands in the Delta Using DETAW*

DWR's Modeling Support Branch currently uses two models to estimate consumptive use in the Delta. These models both estimate land use acreage and calculate crop water needs in the Delta based upon crop types and meteorological data. However, due to differences in level of detail and independent formulation of water needs, the two models may not agree on estimates of historical conditions. The results of the Consumptive Use model, the more coarser of the models, are used by CALSIM II and consist of the total net water use for the Delta broken down by Delta uplands and lowlands. The Consumptive Use model is used to estimate both historical and projected conditions for planning studies. The Delta Island Consumptive Use model is used by DSM2 and first calculates water use and agricultural drainage for each island, then distributes these flows to individual DSM2 nodes. A third model, the Adjusted Delta Island Consumptive Use model, distributes net Delta water use estimated by the Consumptive Use model to DSM2 nodes for use in CALSIM-based DSM2 long-term planning studies. In order to unify estimates of Delta consumptive use, add important enhancements, and improve documentation, DWR and UC Davis have collaboratively developed a new model, DETAW. This chapter summarizes the key features of DETAW. (*Tariq Khadir*)

## *Chapter 8 – Priority 3 Clifton Court Forebay Gate Operations for Extended Planning Studies*

DSM2 is being used to simulate hydrodynamics and water quality in the Delta as part of CALFED Common Assumptions. Hydrology from water years 1922-2003 output from the statewide planning model CALSIM is being used as the input in DSM2 for simulations of Delta conditions over the 82-year planning period. To perform such simulations, an operation schedule for the Clifton Court Forebay gates is needed. The Clifton Court Forebay gates can operate under a number of different schedules, but for the Common Assumptions simulations an operation known as "priority 3" is used to allow sufficient inflow into the Forebay while minimizing the impacts on water levels in adjacent channels. This chapter details the methodology used to generate a priority 3 operation schedule for the Forebay gates and discusses the effect of using the new extended schedule in DSM2. (*Jim Wilde*)

## *Chapter 9 – DSM2 Simulation of Historical Delta Conditions over the 1975 – 1990 Period*

DSM2 can be used to simulate both synthetic and historical flows in the Delta. Historical simulations are important because, in addition to being used in the calibration and validation of models, they can provide estimates of Delta hydrodynamics and water quality to complement limited field data. Currently DSM2 historical simulations have been used to explain circulation patterns, hydrodynamics, and water quality in the Delta for the recent State Water Resources Control Board hearings and the Pelagic Organism Decline work for the period between 1990 and the present. This chapter describes the ongoing work to extend the DSM2 historical simulation of the Delta back to 1975. *(Myint Thein and Parviz Nader-Tehrani)*

## *Chapter 10 – Using Particle Tracking to Generate Indexes of Fish Entrainment Potential*

The particle tracking module of DSM2, DSM2-PTM, was used to study the sensitivity of injection location and operation of the temporary south Delta barriers on the portion of injected particles ending up in Clifton Court Forebay. The DSM2 simulation of historical 2005 Delta hydrodynamics provided the foundation for the particle tracking simulations. The results of this work were incorporated into the 2005 temporary barrier report and are presented in more detail in this chapter. *(Bob Suits)*

## *Chapter 11 – DSM2 Users Group Update*

The DSM2 Users Group is one of three model users groups sponsored by the Bay-Delta Office and California Water and Environmental Modeling forum. Created to bring together the users of DSM2 and DSM2-generated results, the quarterly DSM2 Users Group meetings are well attended. This chapter reviews some of the topics that have been presented to the group the past year, including many topics that have been included in this or previous annual methodology reports. *(Min Yu)*