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DEPARTMENT OF WATER RESOURCES

Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh

36th Annual Progress Report to the
State Water Resources Control Board in
Accordance with Water Right Decisions 1485 and 1641

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Foreword

This is the 36th annual progress report of the California Department of Water Resources San Francisco Bay-Delta Evaluation Program, which is carried out by the Delta Modeling Section. This report is submitted annually by the section to the California State Water Resources Control Board pursuant to its Water Right Decision 1485, Term 9, which is still active pursuant to its Water Right Decision 1641, Term 8.

This report documents progress in the development and enhancement of computer models for the Delta Modeling Section of the Bay-Delta Office. It also reports the latest findings of studies conducted as part of the program. This report was compiled under the direction of Tara Smith, program manager for the Bay-Delta Evaluation Program.

Online versions of previous annual progress reports are available at:

http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm.

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Contents

Preface

Chapter 1. PTM Fish Behavior Development Workshop

This chapter summarizes the Particle Tracking Model (PTM) Fish Behavior Development Workshop held at DWR on January 8, 2015. This workshop was attended by PTM developers from National Marine Fisheries Service (NMFS), U.S. Geological Survey (USGS), and California Department of Water Resources (DWR). The leads for the three agencies were Doug Jackson (NMFS), Russel Perry (USGS), and Xiaochun Wang (DWR).

Chapter 2. New Reservoir Implementation in DSM2 V8.1.3

This chapter describes a modification for the Delta Simulation Model 2 (DSM2) open water areas to include changing bathymetry with elevations. Previously, open water areas were treated as a constant area with a bottom elevation. This change will help to better model Liberty Island in addition to other open water areas in the Delta. The elevation-area-storage curves for reservoirs can be calculated using geographic information system (GIS) tools like ArcMap. The model has been tested and new results have been evaluated.

Chapter 3. Estimating the Impact of Groundwater on Delta Channel Depletions

This chapter describes the study that integrated the consumptive use, hydrodynamics, and water quality models and also calibrated the groundwater supply and electric conductivity together by using the correlation between Delta outflow and EC. With the estimated groundwater contribution, EC, in the summers of the critical and dry years, could be estimated close to the measured field data.

Chapter 4. Modeling Physical Barriers (Gates) as Engineering Solutions to Satisfy NMFS BiOp RPA Action IV.1.3

This chapter provides detailed modeling information on the potential impact on flow, water quality, and water level throughout the Delta of physical barriers (gates) as engineering solutions to deter fish from entering the Delta. The modeling was performed to provide information to support decision-making for engineering solutions to satisfy the National Marine Fisheries Service Biological Opinion Reasonable Prudent Alternative (NMFS-BiOp RPA) Action IV.1.3 (Action). The Action objective is to prevent emigrating salmonids from entering into the Interior of the Delta and southern Delta, and to reduce exposure to the Central Valley Project (CVP) and State Water Project (SWP) export facilities. Delta Simulation Model II (DSM2) was used to simulate gates on the Delta channels: Georgiana Slough, Head of Old River, Turner Cut, and Columbia Cut. The modeling results have been evaluated for impact analysis of flow, water quality, and water level throughout the Delta.

Chapter 5. Visualizing DSM2 Simulation Results with ArcMap

The Delta Simulation Model II has been widely used for three types of Delta simulations: historical conditions, near- and long-term forecasting, and planning studies. DSM2 simulations have been applied for various purposes. Some examples include forecasting water quality in the Delta and the California Aqueduct system, generating hydrologic information for a permit application, and providing support for litigation. Since DSM2 simulation results can be presented to members of the public coming from various backgrounds, it is vital to present simulation results tailored to meet the needs of different audiences. In the past, the visualization of DSM2 electric conductivity results was readily accepted. Even so, it takes many steps to prepare an animation, and the process relies on a program called Tecplot.

Tecplot was fairly uneconomical to purchase, especially considering that Tecplot has been rarely used by other staff in the Bay-Delta Office.

This chapter presents several ways to visualize DSM2 simulation results with ArcMap, a product of Environmental Systems Research Institute (ESRI). A programming language, Python, is used to convert DSM2 output to ArcGIS geodatabase or NetCDF files.

Chapter 6. Rating Clifton Court

With the help of staff at California Department of Water Resources (DWR) Operations and Maintenance (O&M), Delta Field Division (DFD), and North Central Region Office (NCRO), the Delta Modeling Section has developed a new rating for the Clifton Court radial gates — a formula for estimating flow into the forebay based on gate heights and water levels inside and outside the gates. The new rating is suitable for operational and modeling purposes. Clifton Court Forebay is included explicitly in our models, DSM2 and SCHISM. In addition to presenting the new rating, we describe DSM2 modeling experiments that show the role the gates play in the local balance and where modeling error tends to manifest. Although our main results are obtained with detailed gate data and pumping data, we also address situations, such as planning scenarios, where detailed time series of gate heights and exports are not available.

The main potential impact of the work presented in this chapter is on water levels in the forebay, where the Clifton Court gate characterization and modeling practices have an enormous impact on results. There are more minor impacts as well on exterior water levels in the South Delta, on high tide, on water quality, and residence time in the forebay.

Chapter 7. Calibrating the Martinez Boundary Salinity Generator using PEST

Martinez represents the stage-and-salinity boundary and the location for applying the Delta Simulation Model 2 (DSM2). The salinity at this location is estimated using the Net Delta Outflow (NDO) and stage. This chapter presents a re-calibration effort for the Martinez boundary salinity generator, with a mathematically based calibration software named PEST. This new calibration improves the performance of the model by better matching the historical salinity data, particularly at the higher value range. The performance of the current calibration has been a concern of water resources management, especially in the current drought crisis.

This chapter describes the background of the Martinez boundary salinity generator, explains the methodology and configuration of PEST for model calibration, and presents some preliminary findings.

Chapter 8. Bay-Delta SCHISM Model Developments and Applications

The Bay-Delta SCHISM project is an application of the 3D SCHISM (Semi-Implicit Cross-Scale Hydroscience Integrated System Model) that offers the capability to study cross-scale, multidimensional flow and transport in the Bay-Delta. SCHISM is an open source, 3D computational model derivative from an earlier model, SELFE. We have incorporated into SCHISM practical details needed to model the Bay-Delta, such as agricultural sources and sinks, gates and seasonal gates, and barriers. Work on the model has been collaborative with the Virginia Institute of Marine Science and other users.

The model has been deployed for studies over the full domain of two years by DWR, and we have begun offering institutional support through workshops. The model has also been used as the estuary hydrodynamic component of multidisciplinary collaborations with National Aeronautics and Space Administration (NASA), National Marine Fisheries Service/National Oceanic and Atmospheric Administration (NMFS/NOAA), and San Francisco State University, including the SESAME project, a full life cycle model for fish, and NASA-HICO, a remote sensing and nutrient modeling analysis of human impacts.

Development in the past year has emphasized a public release, drought applications, and algorithm improvements. Progress has been made towards diverse capabilities such as robust flood modeling and temperature calibration. Chapter 8 surveys some of the work, much of which is in progress.