State of California
California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

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

33rd Annual Progress Report to the
State Water Resources Control Board in
Accordance with Water Right Decisions 1485 and 1641

June 2012

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Foreword

This is the 33rd 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 the Bay-Delta Office's Delta Modeling Section's computer models and 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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Preface

Chapter 1 Monitoring Station Locations

The authors compared several lists of purported accurate measurement station locations and conducted field measurements of some sites. The lists were analyzed using ESRI products and a script in ArcPython. This chapter describes and summarizes the analysis.

Chapter 2 Improved Geometry Interpolation in DSM2-Hydro

This chapter documents modifications to the DSM2 Delta modeling program that improve the model's internal representation of bathymetry under conditions typical of the Sacramento-San Joaquin River Delta. The authors implemented a more accurate channel cross-sectional calculation scheme based on absolute elevation and also increased the density of geometry samples (number of quadrature points) used when calculating integral quantities such as volume.

Chapter 3 DSM2 Version 8.1 Recalibration

Modifications to the DSM2 program source code that improve channel geometry representation described in Chapter 2 of this report affects results both in DSM2-Hydro and DSM2-Qual. The model has been recalibrated by adjusting Manning's coefficient values in DSM2-Hydro. The recalibrated Hydro results (flow and stage) are very close to the Bay Delta Conservation Plan (BDCP) 2009 Calibration results, although there are significant changes in Manning's coefficient values. Qual was recalibrated in 2011 after changes to improve DSM2-Qual model convergence. Using the recently recalibrated Hydro, we reran the Qual module to check the impacts of the Hydro source code changes and the Hydro recalibration on EC results. The electrical conductivity results are compared with field data and also the 2009 BDCP Calibration results.

Chapter 4 South Delta Null Zone Study

The State Water Resources Control Board (SWRCB) is in the process of reviewing and updating the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan). The review may result in the potential amendments to the South Delta salinity objectives in the Bay-Delta Plan. Under the review process, SWRCB states that poor water circulation (null zones) contributes to bad water quality in the South Delta, and that the Central Valley Project (CVP) and State Water Project (SWP) are responsible for improving the water circulation conditions while raising water stage so that the farmers are able to divert water.

The purpose of this study is to analyze through hydrodynamic modeling whether and to what extent CVP and SWP exports and the agricultural temporary barrier actually influence the water levels (stage) and water circulation in South Delta.

Chapter 5 Estimating Delta-wide Bromide Using DSM2-Simulated EC Fingerprints

This chapter compares 6 methods to determine bromide concentrations at select locations in the Sacramento-San Joaquin River Delta (the Delta). The results of the methods are compared to observed grab sample bromide data at those Delta locations. The analysis confirms MWH's conclusion that direct simulation of bromide with DSM2 and the current version of dispersion coefficients is equivalent to estimating bromide based on DSM2-simulated electrical conductivity (EC) and applying multiple linear regressions based on simulated EC fingerprints. However, using observed EC and multiple linear regressions provides significantly better estimates of bromide. Multiple linear regressions based on

Delta regions perform nearly as well as site-specific regressions and allow for converting from EC to bromide at nearly any location in the Delta.

Chapter 6 A Continuous Surface Elevation Map for Modeling

This chapter documents the development of an elevation data set for multidimensional modeling developed under the REALM project, synthesizing LiDAR, single- and multibeam sonar soundings and surveys and integrating them with existing integrated maps that themselves were collated from multiple sources. The result is a continuous surface—terrestrial and water—in meters using the NAVD88 vertical datum. The initial release of this map was in the form of a 10 m Digital Elevation Map (DEM) for the entire Bay-Delta and parts of the coast to the Farallones, supplemented by a 2 m model of the South Delta in a region where the channel features are poorly resolved at 10 m.

Chapter 7 DSM2-PTM Simulations of Particle Movement

The National Marine Fisheries Service requested the California Department of Water Resources Modeling Support Branch perform a DSM2-PTM modeling study to investigate the impact of various factors on salmon/steelhead migration behaviors in the Sacramento-San Joaquin River Delta. Those factors include San Joaquin River flows, exports from the State Water Project and Central Valley Project, and the Head of Old River Barrier (HORB). The report documents the assumptions, model setups, and simulation results and could be used to help studies on HORB installation/operation and export adaptive management for salmonid outmigration protections.

Acronyms and Abbreviations

Bay-Delta Plan	2006 Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary
BDCP	Bay Delta Conservation Plan
BNSF	Burlington Northern Santa Fe Railway
Br	bromide
CDEC	California Data Exchange Center
cfs	cubic feet per second
CLFCT	Clifton Court Forebay Gates
CVP	Central Valley Project
DC	dispersion coefficient
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin River Delta
DEM	Digital Elevation Map
DSM2	Delta Simulation Model 2
DWR	California Department of Water Resources
EC	electrical conductivity
GIS	Geographical Information System
GLCB	Grant Line Canal Barrier
HORB	Head of Old River Barrier
IE ratio	inflow/export ratio
Marsh	Suisun Marsh
MIDB	Middle River Barrier
MTZSL	Montezuma Salinity Control Structure
NED	National Elevation Dataset
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
N-S	Nash-Suttcliffe
OMR	Old and Middle River
ORTB	Old River Barrier at Tracy
PTM	Particle Tracking Model
RPA	Reasonable Prudent Alternative
SAC R.	Sacramento River
SJR	San Joaquin River
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
USBR	US Bureau of Reclamation
USGS	US Geological Survey
WDL	Water Data Library

Metric Conversion Table

Quantity	*To Convert from Metric Unit*	*To Customary Unit*	*Multiply Metric Unit By*	*To Convert to Metric Unit Multiply Customary Unit By*
Length	millimeters (mm)	inches (in)	0.03937	25.4
	centimeters (cm) for snow depth	inches (in)	0.3937	2.54
	meters (m)	feet (ft)	3.2808	0.3048
	kilometers (km)	miles (mi)	0.62139	1.6093
Area	square millimeters (mm^2)	square inches (in^2)	0.00155	645.16
	square meters (m^2)	square feet (ft^2)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometers (km^2)	square miles (mi^2)	0.3861	2.590
Volume	liters (L)	gallons (gal)	0.26417	3.7854
	megaliters (ML)	million gallons (10*)	0.26417	3.7854
	cubic meters (m^3)	cubic feet (ft^3)	35.315	0.028317
	cubic meters (m^3)	cubic yards (yd^3)	1.308	0.76455
	cubic dekameters (dam^3)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic meters per second (m^3/s)	cubic feet per second (ft^3/s)	35.315	0.028317
	liters per minute (L/mn)	gallons per minute (gal/mn)	0.26417	3.7854
	liters per day (L/day)	gallons per day (gal/day)	0.26417	3.7854
	megaliters per day (ML/day)	million gallons per day (mgd)	0.26417	3.7854
	cubic dekameters per day (dam^3/day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lbs)	2.2046	0.45359
	megagrams (Mg)	tons (short, 2,000 lb.)	1.1023	0.90718
Velocity	meters per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (kW)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	feet head of water	0.32456	2.989
Specific capacity	liters per minute per meter drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per liter (mg/L)	parts per million (ppm)	1.0	1.0
Electrical conductivity	microsiemens per centimeter (µS/cm)	micromhos per centimeter (µmhos/cm)	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(1.8X°C)+32	0.56(°F-32)