FOREWORD

This is the nineteenth annual progress report of the California Department of Water Resources' San Francisco Bay-Delta Evaluation Program (Work Authority 1463), which is carried out by the Delta Modeling Section. It documents progress in the development and enhancement of the Delta Modeling Section's computer models and reports the latest findings of studies conducted as part of the program.

For the last five years, the Section has been developing the new Delta Simulation Model (DSM2). The model was recently made public through the Section's World Wide Web home page: http://wwwdelmod.water.ca.gov. This report contains a description of the theory behind the model and information on how to run the model and its support programs.

CONTENTS

Foreword.

Chapter 1—Introduction.....1-1
Chapter Summaries.....1-1

Chapter 2—DSM2-Hydro.....2-1

Chapter 3—DSM2-Qual.....3-1
Water Quality.....3-1
DSM2 Equations for Non-Conservative Constituents.....3-5

Chapter 4—DSM2 PTM.....4-1
Background.....4-1
Summary.....4-1
Particle Movement.....4-2
Capabilities.....4-2
Future Directions.....4-3
Theory.....4-4

Chapter 5— DSM2 Input and Output.....5-1
Fixed Input.....5-1
Time-Varying Input.....5-6
Time-Varying Output.....5-8
Time-Varying Input and Output.....5-21
Running the DSM2 Modules.....5-29
Examining DSM2 Output.....5-30
DSM2 on the Internet.....5-33
Planning Studies.....5-33
Hints for Organizing Runs.....5-34

Chapter 6—Cross-section Development Program.....6-1
Introduction.....6-1
Bathymetry Data.....6-1
Using the CSDP.....6-2

Chapter 7—Artificial Neural Networks and MEC Estimates.....7-1
Introduction.....7-1
Response of ANN-Generated Salinity to Varying SAC Flows and Exports.....7-1
Marginal Export Cost (MEC) Estimates Using ANNs.....7-1
Effects of a 500 cfs Reduction in SWP Pumping.....7-2
Estimate of Carriage Water for 1991 Drought Water Bank (DWB) Pumping.....7-3
Synthetic ANN Development.....7-4

Chapter 8—VISTA (Visualization Tool and Analyzer).....8-1
Introduction.....8-1
Implementation.....8-2
Future.....8-2

Chapter 9—DSM2 Calibration/Verification.....9-1
Calibration-Validation Scheme.....9-1
DWR/Delta Modeling Section.....9-2

List of Figures

Figure 3.1 Interaction Among Constituents.....3-4

Figure 4.1 Defining Each Particle's Location.....4-8
Figure 4.2 Dispersion.....4-9
Figure 4.3 Longitudinal Dispersion.....4-10
Figure 4.4 Longitudinal Dispersion (Coefficient K).....4-11
Figure 4.5 Experimental Measurements of Longitudinal Dispersion in Open Channels.....4-12
Figure 4.6 Longitudinal Movement.....4-13
Figure 4.7 DSM2-PTM Transverse Velocity Profile.....4-14
Figure 4.8 Vertical and Transverse Displacements Due to Mixing.....4-16
Figure 4.9 Vertical Mixing.....4-18
Figure 4.10 Transverse Mixing.....4-19
Figure 4.11 Mixing.....4-20
Figure 4.12 Derived Dispersion Coefficient K.....4-21

Figure 6.1 CSDP Used to Convert #D Bathymetry Data.....6-10
Figure 6.2 Delta Bathymetry Data Locations.....6-10
Figure 6.3 Three-dimensional Bathymetry Data.....6-11
Figure 6.4 CSDP Bathymetry Data Plan View.....6-11
Figure 6.5 Rectangular Region.....6-12
Figure 6.6a Centerline Created by *create DSM Chan* Feature.....6-12
Figure 6.6b Centerline with Inserted Points.....6-12
Figure 6.7a Bathymetry Data—Cross-section View.....6-13
Figure 6.7b Bathymetry Data—Cross-section View with Drawing.....6-13
Figure 6.8 Cross-section Line Measurements.....6-13
Figure 6.9a "W" Shaped Cross-sections.....6-14
Figure 6.9b "J" Shaped Cross-sections.....6-14
Figure 6.10 Cross-section Plot.....6-14
Figure 6.11 Using Station and Elevation Coordinates to Make a Network File.....6-15
Figure 6.12 Change the Pathname in the FILENAME Field.....6-15
Figure 6.13 IRREG_GEOM Input Section.....6-16
Figure 6.14 IRREG_GEOM Input Section (cross sections/filenames).....6-16
Figure 6.15 Table of Cross-section Properties.....6-17
Figure 6.16 DSM Channel.....6-17
Figure 6.17 Irregular Cross-sections.....6-18
Figure 6.18 Node to Cross-section Distance.....6-18
Figure 6.19 Interpolation from Adjacent Channels.....6-18
Figure 6.20 Virtual Cross-section Look-up Table for Channel 1.....6-19
Figure 6.21 Negative dConveyance and Slope of Line Segment.....6-19
Figure 6.22 Output from Hydro.....6-19
Figure 6.23a Cross-sections Before Subtracting Bottom Elevations.....6-20
Figure 6.23b Cross-sections After Subtracting Bottom Elevations.....6-20
Figure 6.24a Cross-section Before Subtracting Bottom Elevation (with shaded area).....6-21
Figure 6.24b Cross-sections Before Subtracting Bottom Elevation (shaded area removed).....6-21

Figure 7.1 Contra Costa Canal EC (Sac, CVP).....7-5
Figure 7.2 Contra Costa Canal EC (Sac, SWP).....7-5
Figure 7.3 Jersey Point EC (Sac, CVP).....7-6
Figure 7.4 Jersey Point EC (Sac, SWP).....7-6
Figure 7.5 Estimated SAC (CIMEC method assuming Jersey Point EC Controlling).....7-7
Figure 7.6 Monthly Carriage Water Estimate for a 500 cfs Reduction in Exports (CIMEC method with Jersey Point EC Controlling).....7-8

Figure 7.7 Estimated SAC with Historic Exports vs. Estimated SAC when Historic Exports Reduced by 500 cfs CCC EC controlling)....7-9
Figure 7.8 Monthly Carriage Water Estimate for a 500cfs Reduction in Exports (CIMEC method with CCC EC controlling)....7-10
Figure 7.9 Carriage Water Estimate 1991 DWB Pumping (Jersey Point EC controlling)....7-11
Figure 7.10 Carriage Water Estimate 1991 DWB Pumping (CCC EC controlling)....7-1

Figure 8.1 Data Sessions....8-4
Figure 8.2 Data Reference Groups....8-4
Figure 8.3 Two-dimensional Plots....8-5
Figure 8.4 Data Displayed in Tabular Format....8-6

Figure 9.1 Martinez/Mallard Island....9-5
Figure 9.2 Antioch/Three Mile Slough....9-6
Figure 9.3 Collinsville/Rio Vista....9-7
Figure 9.4 San Joaquin R. at Hwy 4/Old R. blw Tracy Road....9-8
Figure 9.5 Old R. at Bacon Island/Middle R. at Bacon Island....9-9
Figure 9.6 Columbia Cut/Turner Cut....9-10
Figure 9.7 Grantline Canal/Old R. near Clifton Court Forebay....9-11
Figure 9.8 Piper Slough/Dutch Slough....9-12
Figure 9.9 Three Mile Slough/San Joaquin R. at Jersey Point....9-13
Figure 9.10 Potato Slough/Honker Cut....9-14
Figure 9.11 North Fork Mokelumne R. blw Snograss Slough/South Fork Mokelumne R....9-15
Figure 9.12 Georgiana Slough near Sacramento R....9-16
Figure 9.13 Miner Slough/Steamboat Slough....9-17
Figure 9.14 Sacramento R. South of Decker Island....9-18
Figure 9.15 Sacramento R. above DXC/ below Georgiana Slough (resid)....9-19
Figure 9,16 Delta Cross-Channel Residual Flow....9-20
Figure 9.17 Steamboat +Sutter Slough/Cross Delta (resid)....9-21
Figure 9.18 Sacramento R. at Freeport/Sacramento R. at Delta Cross-Channel....9-22
Figure 9.19 Sacramento R. below Georgiana Slough....9-23
Figure 9.20 Sacramento R. at Freeport/Sacramento R. at Delta Cross-Channel(resid)....9-24
Figure 9.21 Sacramento R. below Georgiana Slough (resid)....9-25
Figure 9.22 Sacramento R. above DXC/ Sacramento R. below Georgiana Slough....9-26
Figure 9.23 Sacramento R. above DXC/Sacramento R. below Georgiana Slough (resid)....9-27
Figure 9.24 Three Mile Slough/San Joaquin R.at Jersey Point (May)....9-28
Figure 9.25 Three Mile Slough/ San Joaquin R. at Jersey Point (May/residual)....9-29
Figure 9.26 Three Mile Slough/San Joaquin R. at Jersey Point (October)....9-30
Figure 9.27 Three Mile Slough/San Joaquin R. at Jersey Point (October/residual)....9-31
Figure 9.28 Central Delta Residual Flow (Old +Middle R.)....9-32
Figure 9.29 Old R. at Bacon Island/Middle R. at Bacon Island (January)....9-33
Figure 9.30 Old R, at Bacon Island/ Middle R. at Bacon Island (January/residual)....9-34
Figure 9.31 Time-value plots— Mallard/Collins (1992)....9-35
Figure 9.32 Time-value plots— Emmaton/Rio Vista (1992)....9-36
Figure 9,33 Time-value plots— Antioch/Jersey Point (1992)....9-37
Figure 9.34 Time-value plots—CCC/Holland (1992)....9-38
Figure 9.35 Time-value plots—Victoria/Union (1992)....9-39
Figure 9.36 Time-value plots—Stockchan/Mossdale (1992)....9-40
Figure 9-37 Time-value plots—Pittsburg/Collins (1969-1989)....9-41
Figure 9-38 Time-value plots—Emmaton/Rio Vista (1969-1989)....9-42
Figure 9-39 Time-value plots—Antioch/Jersey Point (1969-1989)....9-43
Figure 9-40 Time-value plots—CCC/Holland (1969-1989)....9-44
Figure 9-41 Time-value plots—Victoria/Union (1969-1989)....9-45
Figure 9-42 Time-value plots—Stockchan/Mossdale (1969-1989)....9-46
Figure 9-43 Time-value plots—Pittsburg/Collins (1985-1991)....9-47
Figure 9-44 Time-value plots—Emmaton/Rio Vista (1985-1991)....9-48
Figure 9-45 Time-value plots—Antioch/Jersey Point (1985-1991)....9-49
Figure 9-46 Time-value plots—CCC/Holland (1985-1991)....9-50
Figure 9-47 Time-value plots—Victoria/Union (1985-1991)....9-51
Figure 9-48 Time-value plots—Stockchan/Mossdale (1985-1991)....9-52