CONTENTS

SESSION CW-1
WATER MANAGEMENT IN CALIFORNIA
Moderator: WILLIAM GIANELLI, Consultant

California Water Issues Bay-Delta Hearings Impacts on State Water Project
EDWARD F. HUNTELEY, and EDWARD D. WINKLER, Division of Planning, California Department of Water Resources .......................... 1

Issues in Balancing Environmental Costs and Benefits in Water Resources Planning
M. MCRAE, J. HASHEM and E. HAITES, Barakat & Chamberlin, Inc. .......................................................... 8

Establishing a Drought Reserve Policy for the Monterey Peninsula Water Management District
J.R. COFER and DARBY W. FUERST, Monterey Peninsula Water Management District ............................................... 15

SESSION GW-1
GROUND WATER I
Moderator: Y.C. KIM, California State University, Los Angeles, and R.G. QUIMPHO, University of Pittsburgh

Well Response in a Leaky Aquifer and Computational Interpretation of Pumping Tests
ZBIGNIEW J. KABALA, Dept. of Soil and Environmental Science, University of California, Riverside ................................. 21

Concentration History During Pumping from a Leaky Aquifer with Stratified Initial Concentration

Parameter Estimates for a Groundwater Model
M.R. CONDON, ROBERT G. TRAVER, and W.B. FERGUSSON, Dept. of Civil Engineering, Villanova University .............................. 36

Simulation of Buoyant, Miscible Liquid Plumes in Heterogeneous Aquifers
SALWA RASHAD, JOHN HOOPES, DAVID OLSON and TSWN-SYAU TSY, Civil and Envir. Engineering Dept., University of Wisconsin .................................................. 42
An Overview of Methods of Delineate Capture Zones of Pumping Wells
BENJAMIN LEVY, KIM HENRY, and CHRISTIAN HILLER, ENSR Consulting and Engineering ................................................................. 48

SESSION HR-1
HAZARD REDUCTION I
Moderator: M.T. TSENG, U.S. Army Corps of Engineers, and S.S. FAN, FERC

Regulatory Constraints on Vegetation Control in Channels—A Case Study of the Santa Ynez River, Santa Barbara County, California
RUDOLF OHLEMTUTZ, Santa Barbara County Flood Control and Water Conservation District .......................................................... 54

Regulatory Obstacles to Emergency Response—A Case Study of the Paint Fire, June 1990, Santa Barbara, California
RUDOLF OHLEMTUTZ, Santa Barbara County Flood Control and Water Conservation District .......................................................... 59

A Semi-Discrete Element Approach to the River Ice Breakup and Jamming Process
QIZHONG GUO and CHARLES C.S. SONG, Dept. of Civil and Envir. Engineering, Rutgers University .................................................. 65

Adaptive Control of Unavoidable Hazardous Releases
NIKOLAOS D. KATOPODES and M. PIASECKI, Dept. of Civil and Envir. Engineering, University of Michigan ............................................. 70

SESSION HS-1
DAM DESIGN, SAFETY, AND OPERATION
Moderator: J. RUFT, Colorado State University, and W. MIH, Washington State University

Mechanism of Air Entrainment in Spillway Aerators
AMIR REZA ZARRATI, Dept. of Civil Engineering, AmirKabir University of Technology ................................................................. 75

Simulation of Rapid Reservoir Drawdown for Flood Control, Cowlitz Falls Project
ROBERT H.A. JANSSEN and FREDERICK A. LOCHER, Bechtel Corporation ................................................................. 81

The Influence of Slope and Surface Roughness on Trapezoidal Free Overfall Characteristics
R.J. KELLER and DARYL F. WALTERS, Dept. of Civil Engineering, Monash University ................................................................. 87

Nonlinear Hydrodynamic Pressures on Dam Faces with Arbitrary Reservoir Shapes
BANG-FUH CHEN, Dept. of Marine Environment, National Sun Yat-Sen University ................................................................. 93

Performance of Prototype Aerating Weirs Downstream From TVA Hydropower Dams
GARY E. HAUSER, WILLIAM D. PROCTOR and TONY A. RIZK, TVA Engineering Laboratory ................................................................. 99
SESSION ST-1
WATERSHEDS AND RESERVOIRS
Moderator: H. CHANG, San Diego State University, and J.B. BRADLEY, WEST Consultants

Watershed Erosion
RAÚL PACHECO-CEBALLOS, Ingenieros Consultores Ltda. ............... 104

Sediment Yields from a Watershed in Taiwan
WEN C. WANG, CHANG-TAI TSAI and H.W. SHEN, Multech Engineering Consultants, Inc. .......................................................... 111

Hydraulic Desiltation for Noncohesive Sediment
HSIEH WEN SHEN, JIHN-SUNG LAI and DIHUA ZHAO, Dept. of Civil Engineering, University of California, Berkeley ...................... 119

Optimization Modeling for Sedimentation in Alluvial Rivers Considering Uncertainties
CARLOS CARRIAGE and LARRY W. MAYS, Dept. of Civil Engineering, Arizona State University .................................................. 125

SESSION WL-1
PHYSICAL PROCESSES IN COASTAL WETLANDS
Moderator: P. GOODWIN, Philip Williams & Associates, Ltd., and C EVERTS, Moffat & Nochol Engineers

Flow Patterns in Constructed Wetlands
ROBERT H. KADLEC, Dept. of Chemical Engineering, University of Michigan ................................................................. 131

Fundamental Principles of Tidal Wetland Restoration
R.B. KRONE, Dept. of Civil and Environmental Engineering, University of California, Davis ......................................................... 137

Integrated Description of Wetland Hydrology and Ecology by Mathematical Models
KARSTEN HAVNØ, and JESPER DØRGE, Danish Hydraulic Institute ................................................................. 143

Structural and Ice Effects on Salt Water Marsh Hydrology
THOMAS P. BALLESTERO, JOSEPH P. MARRONE and DEBORAH M. TROTTIER, Dept. of Civil Engineering, University of New Hampshire ......................................................... 150

SESSION PD-1
RESEARCH NEEDS IN HYDRAULIC ENGINEERING
(PANEL DISCUSSION)
Moderator: JEFFERY P. HOLLAND, U.S. Army Corps of Engineers

Research Needs in Hydraulic Engineering
ASCE HYDRAULICS DIVISION RESEARCH COMMITTEE ................. 156
SESSION CW-2
BAY DELTA DECISION
Moderator: B.J. MILLER, Consultant

Is There a Future for Desalting in Meeting California’s Water Needs?
E.O. KARTINEN JR., Boyle Engineering Corporation ........................... 162

Coping with Agricultural Shortages
J.S. JENKS, Consulting Engineer .................................................. 168

Economic Costs to the State Water Project of Environmental Protection
and Mitigation Measures
RANDALL BROWN and RAYMOND HOAGLAND, California
Department of Water Resources ..................................................... 174

SESSION GW-2
GROUND WATER II
Moderator: H. NOURI, California Institute of Technology, and Z.J. KABALA,
University of California, Riverside

Designing Self-Cleaning Wet Wells for Wastewater Pumping
ROBERT L. SANKS, GARR M. JONES and CHARLES E. SWEENEY,
Dept. of Civil and Agricultural Engineering, Montana State University .. 180

Real Time Forecast of Landfill Leachate Flow
THOMAS P. BALLESTERO and M.A. HOLANDA DE CASTRO,
Water Resources Research Center, University of New Hampshire ....... 186

Nonlinear Flow in Embankments
NAZEER AHMED, Dept. of Civil and Environmental Engineering,
University of Nevada-Las Vegas .................................................. 192

Modeling Ground Water Mounding in a Heterogeneous
Unconfined Aquifer
TSWN-SYAU TSAY, JOHN HOOPES, DAVID OLSON,
SALWA RASHAD, and M.Y. JIANG, Civil and Environmental
Engineering Dept., University of Wisconsin ................................. 198

SESSION HR-2
HAZARD REDUCTION II
Moderator: C.B. CECILIO, PG&E, and R. KRONE, University of California, Davis

Reducing the Potential Downstream Impacts of a Dam Failure
PETER W. SOLTYS, Water Resources Group, Woolpert Consultants ... 204

Assessment Procedures for Lahars, Mudflows, Debris Flow and
Debris Torrents
ROBERT MACARTHUR, DOUGLAS L. HAMILTON and
WILLIAM E. BRANCH, Resource Consultants and Engineers, Inc. .... 210

Disaster Reduction in Dam and Reservoir Design
K.P. SINGH, Office of Surface Water Resources and Systems Analysis,
Illinois State Water Survey ......................................................... 216
The Coyote Dam Outlet Works Replacement Project: Hazard Reduction  
D.E. HOOK, Santa Clara Valley Water District ............................................. 222

SESSION HS-2  
OUTLET AND INTAKE STRUCTURE  
Moderator: F. LOCHER, Bechtel, and E. CARTER, Harza

Velocity Reduction at a Submerged Pipe Outlet  
CHARLES E. RICE and KEM C. KADAVY, USDA, ARS ................................. 228

Hydraulic Performance of Culvert End Sections Designed for  
Collision Safety  
JEFFERY A. BARTLEY, and BRUCE M. MCENROE, Dept. of Civil  
Engineering, University of Kansas .......................................................... 234

Compacted Spillway  
ABDELKAWI KHALIFA, Civil Engineering Dept., United Arab  
Emirates University .................................................................................. 240

Equations to Predict Critical Submergence at Horizontal  
Hydraulic Intakes  
JOHN E. HITE, JR. and WALTER C. MIH, Locks and Conduits  
Branch, Hydraulic Structures Div., US Army Engr. Waterways  
Experiment Station .................................................................................. 247

Hydraulic Analysis of the McCook Outlet Manifold  
RICHARD L. STOCKSTILL, US Army Engr. Waterways  
Experiment Station .................................................................................. 253

SESSION ST-2  
RIVER SEDIMENT CASE STUDIES  
Moderator: D.L. HAMILTON, Resource Consultants and Engineers, and  
G.D. GLYSSON, U.S. Geological Survey

Total Sediment Loads of Tropical Rivers  
L. POSADA G. and C.F. NORDIN JR., Dept. of Civil Engineering,  
Universidad Nacional de Columbia .......................................................... 258

Sedimentation and Flood Protection for the Lower Yellow River  
TA WEI SOONG, Office of Hydraulics and River Mechanics, Illinois  
State Water Survey .................................................................................. 263

Sacramento River Environmental Requirements  
W.C. GAINES, U.S. Army Engineers District, Sacramento .....................

Dune Profiles Before and After Storm Events in Coastal Massachusetts  
LISA J. WOLF, JAMES D. BOWEN, and KENNETH A. HICKEY,  
ENSR Consulting and Engineering ......................................................... 269

SESSION WL-2  
SIMULATIONS OF WATER QUALITY IN WETLANDS  
Moderator: J. OBEYSEKERA, South Florida Water Management District,  
and S. TU, PG&E

Refined Modelling of Water Quality Constituents in a Semi-Enclosed  
Coastal Wetland Basin  
ROGER A. FALCONER and LIU SUIQING, Dept. of Civil Engineering,  
University of Bradford ............................................................................. 275

Development of the Lake Okeechobee Watershed Phosphorus  
Transport Model  
RICHARDSON A. WAGNER and LARRY A. ROESNER, Camp  
Dresser & McKee Inc. .............................................................................. 281
Orange County Florida Landfill Dilute Leachate Wetland Treatment and Restoration System

LARRY N. SCHWARTZ, J.G. LADNER and S.J. KEELY, Camp Dresser & McKee Inc ........................................ 287

Environmental Control of Wetland Plant Communities

MICHAEL DUEVER, Ecosystem Research Unit, National Audubon Society ........................................ 293

Surface Flows over Intertidal Marshes

FLORA C. WANG, Dept. of Oceanography and Coastal Sciences, Louisiana State University ................. 299

SESSION GW-3
GROUND WATER II
Moderator: W. WALDROP, TVA, and D. PETERSON, CH2M HILL

Development of a Two-Layered Groundwater Model for the Taipei Basin

N.S. HSU, M.J. HORNG, C.M. WU, and WILLIAM YEH, Civil Engineering Dept., National Taiwan University 305

Development of San Gorgonio Pass Groundwater Flow Model

ALADDIN SHAIKH and R. B. BELL, Boyle Engineering Corporation ........................................ 311

Modelling Saltwater Intrusion Control Measures in the West Coast Basin

DONALD SCHROEDER and BRUCE JACOBS, Camp Dresser & McKee, Inc ........................................ 317

SESSION HR-3
HAZARD ASSESSMENT
Moderator: M.A. FODA, University of California, Berkeley, and F. TSAI, FEMA

A Model for Low-Drag Landslides

DAGANG ZHANG and M.A. FODA, Civil Engineering Dept., University of California, Berkeley ............ 322

Uncertainties of Tailwater in an Inundation Study: Dam Upgrade Optimization for Hazard Reduction

S. SAMUEL LIN and RICHARD O. DAMERON, Commonwealth of Virginia, Dept. of Conservation and Recreation, Division of Soil and Water Conservation ........................................ 328

Debris Flow Velocity Estimation Methods for Natural Hazard Assessment

DOUGLAS HAMILTON, ZHANG SHUCHENG and ROBERT C. MACARTHUR, Resource Consultants and Engineers 334

Federal Levee Effects on Flood Heights Near St. Louis

GARY R. DYHOUSE, Hydrologic Engineering Section, Corps of Engineers, St. Louis District ................. 340
Case History: 100 Year Flood in San Francisco
JAMES WALSH, Bureau of Engineering, City and County of San Francisco ...................................................... 347

SESSION HS-3
ANALYSIS AND MODIFICATIONS TO AVERT DAM FAILURES
Moderator: H. COPP, Washington State University, and J. GEORGE, Water Experiment Station

Analysis of Cabinet Gorge Dam
JOHN Z. GIBSON, Washington Water Power Company .................................................. 353

Dam Safety Modification for Clear Creek Dam
J. TROJANOWSKI, Concrete Dams Branch, Bureau of Reclamation .... 359

New Austrian Dam Side-Channel Spillway
MICHAEL A. STEVENS and SAL A. TODARO, Consultant ............... 365

Bartlett Dam Fuseplug Auxiliary Spillway
BRUCE C. MULLER, JR., Concrete Dams Branch, Bureau of Reclamation .................................................. 372

SESSION ST-3
ASCE MANUAL 54 EXPANSION
Moderator: R.C. MACARTHUR, Resource Consultants and Engineers, Inc. and P.C. KLINGEMAN, Oregon State University

Current Legal Issues in Sedimentation
JAMES E. SLOSSON, Gerard Shuirmann Slosson & Associates ............... 378

Updating Chapter II—Sediment Transportation Mechanics
HASAN NOURI, ROBERT C. MACARTHUR and VITO A. VANONI, Rivertech Inc. .................................................. 383

Computational Modeling of Sedimentation Processes
COMMITTEE ON COMPUTER MODELING .................................................. 388

Engineering Geomorphology
S.A. SCHUMM and M.D. HARVEY, Resource Consultants & Engineers, Inc. .................................................. 394

Scour Analysis at Highway Structures
E.V. RICHARDSON and J. R. RICHARDSON, Resource Consultants & Engineers, Inc. .................................................. 400

SESSION WL-3
WETLANDS—MANAGEMENT

Variability of Hydraulic Response of Constructed Wetlands
M. T. WATERS, D.H. PILGRIM, T.J. SCHULZ and I.D. PILGRIM, Centre for Wastewater Treatment, The University of New South Wales .... 406

Multi-Disciplinary Strategies for Flood-Plain Restoration at the River Rhine
R. ROETTCHER, E. RITTERBACH and G. ROUVE, Inst. fur Wasserban und Wasserwirtschaft .................................................. 412
Development Strategies for Botswana's Okavango Delta
T. SCUDDER, Dept. of Anthropology, California Institute of Technology ........................................... 418

Wetland Management in Britain: a Comparative Approach
J.S. PETHICK, Institute of Estuarine & Coastal Studies, University of Hull ........................................... 424

The Florida Everglades Nutrient Removal Project
S. NEWMAN, J. ROY and J. OBEYSEKERA, Dept. of Research, South Florida Water Management District ........................................... 430

Establishing Environmental Standards for Water Projects Based on Limited Data
DAVE VOGEL, Vogel Environmental Services ........................................... *

SESSION CW-4
COPING WITH PROBLEMS
Moderator: ROBERT POTTER, California Department of Water Resources

Mathematical Modeling of the Sacramento-San Joaquin Delta
MOHAMMAD RAYEJ and FRANCIS CHUNG, California Dept. of Water Resources ........................................... 436

Application of Four Point Model to the Sacramento-San Joaquin Delta
PARVIZ NADER, California Dept. of Water Resources ........................................... 442

Accounting for Antecedent Conditions in Seawater Intrusion Modeling—Applications for the San Francisco Bay-Delta
RICHARD A. DENTON, Contra Costa Water District ........................................... 448

The DWR Delta Assembly Project
ARTHUR HINOJOSA and RALPH FINCH, Division of Planning, California Dept. of Water Resources ........................................... 454

SESSION GW-4
GROUNDWATER IV
Moderator: W. YEH, University of California, Los Angeles, and T. BALLESTERO, University of New Hampshire

Removal of Tidal Fluctuations from Pumping Test Data
B.S. LEVY, ENSR Consulting and Engineering ........................................... 460

A Unified Optimization-Simulation Aquifer Management Model
B.T. REELY and A.K. TYAGI, Envirotech Services Inc. ........................................... 466

An Optimal Parameter Estimation Model for Groundwater Resource Management
Y.S. TSAO, K.L. HWANG, and S.C. LIN, National I-Lan Institute of Agriculture and Technology ........................................... 471

Field-Scale Research at the TVA Columbus Groundwater Research Test Site
W.R. WALDROP and J.M. BOGGS, TVA Engineering Laboratory ........................................... 477

*Manuscript not available at time of printing
Simulation of Subsurface Drainage of Highway Pavements
B.M. MCENROE and S. ZOU, Dept. of Civil Engineering, University of Kansas ............... 483

SESSION BS-1
NATIONAL BRIDGE SCOUR EVALUATION PROGRAM I
Moderator: D. HALVERSON, Minnesota DOT, and A. WADDOUPS, Federal Highway Administration

Quality-Control & Quality-Assurance Plan for Bridge Channel-Stability Assessments in Massachusetts
GENE W. PARKER and HARLOW PINSON, USGS Water Resource Division, Massachusetts-Rhode Island District .................... 489

Screening of Bridges in New Jersey Bridge for Scour
SALIM M. BAIG, New Jersey DOT, ANELLO F. MONACO and JITENDRA C. PATEL, New Jersey Dept. of Transportation .............. 495

Quality Control in Evaluating Scour at Bridges
EDWARD J. KENT, Whitman & Howard Inc. ........................................ 501

New Jersey Bridge Scour Evaluation Program
PAUL WOJCIK, TAMS Consultants .......................... 507

An Efficient Method for Assessing Channel Instability Near Bridges

Bridge Scour Analysis in New Jersey: Which Scour Factors Matter Most?
THOMAS W. ANELLA and GEORGE OLIGER, Parsons Brinckerhoff, Inc. ................. 519

In-Depth Scour Evaluations for Bridges in Pennsylvania
EREZ SELA and GEORGE R. OLIGER, Parsons Brinckerhoff, Inc. ... 525

SESSION HR-4
HURRICANE ANDREW
Moderator: A. MILLEDGE, South Florida Water Management District, and J. OBEYSEKERA, South Florida Management District

Hurricane Andrew
ALLEN MILLEDGE, South Florida Water Management District ................. *

Hurricane Andrew in South Florida: Preparing a Water Management System for Disaster
VINIO FLORIS and CATHLEEN ANCLADE, South Florida Water Management District .................... 531

Hurricane Andrew in South Florida: Steps to Recovery and Lessons Learned
VINIO FLORIS and CATHLEEN ANCLADE, South Florida Water Management District ........ 537

*Manuscript not available at time of printing
Protecting the Boca Raton Outfall Before and After Hurricane Andrew
JONATHAN A. FRENCH, W.A. JOHNSON, J.A. MILLS and
G.S. MARSH, Camp Dresser & McKee International Inc. 543

SESSION HS-4
ASPECTS OF RECLAMATION'S DAM SAFETY PROGRAM—PART I
Moderator: S. HIGINBOTHAM, Bureau of Reclamation, and D SCHREIBER,
Grant, Schreiber & Associates

Reclamation’s Review of Operation and Maintenance
Examination Program
V. A. HOFFMAN and D.E. KRAUSE, U.S. Bureau of Reclamation 549

The Dam Safety Process
C.J. VEESAERT, U.S. Bureau of Reclamation 556

SESSION WL-4
WETLANDS—TIDAL CHARACTERISTICS OF WETLANDS
Moderator: R.E. NECE, University of Washington, and K. NG, Bechtel

The Tidal Inlet Characteristics of a Small Californian Estuary
PETER GOODWIN, J. NIELSON and C. KELLY CUFFE, Philip
Williams & Associates, Ltd. 562

Wetland Restoration In the Dutch Dune Area
B. H. TANGENA and B. KORF, N.V. PWN Water Supply Company of
North-Holland 568

A Hydrodynamic Model for a Tidal Wetland
JEFF A. LEWANDOWSKI, R.J. SOBEY and PETER GOODWIN,
Black & Veatch 574

Mechanics of Riprap Movement in Tidal Flow
C. GALVIN, Coastal Engineer 580

Annual Oscillation of Mean Monthly Water Levels at U.S. Ports
TASK COMMITTEE ON EFFECTS OF ANNUAL TIDES, TIDAL
HYDRAULICS COMMITTEE, C. GALVIN, Coastal Engineer 584

SESSION BS-2
NATIONAL BRIDGE SCOUR EVALUATION PROGRAM II
Moderator: C. HARRIS, CALTRANS, and C. DUNN,
Federal Highway Administration

Comparison of Two Methods of Screening Bridges for Scour
DAVID S. HUNTER, EBASCO Services, Inc., M.K. HIXSON and
SALIM M. BAIG, New Jersey DOT 586

Case Studies of Bridge Scour in Western New York
KENNETH R. AVERY and M.A. HIXSON, Bergmann Associates 592

Scour Analysis For Bridges Over Missouri and Mississippi Rivers
S.L. MCCASKIE, C.C. CHANG and R.G. CHANTOME,
Sverdrup Corp. 598

Risk Analysis of Bridge Failure
GEORGE W. ANNANDALE, HDR Engineering, Inc. 604

Stream Stability and Scour Training in Support of the NBIS
P.F. LAGASSE, J.D. SCHALL and E.V. RICHARDSON, Resource
Consultants & Engineers, Inc. 611
Implementation of the NBIS Scour Evaluation Program
District 2, Florida
P.F. LAGASSE, E.V. RICHARDSON and NIZAR JETHA, Resource Consultants & Engineers, Inc. ................................................................. 617

SESSION CW-5
MODELING THE EFFECTS OF PROJECT OPERATIONS ON BAY DELTA
Moderator: JACK CASSIDY, Hydraulics/Hydrology, Betchel Corporation
Modeling the Operation of a Water Quality Reservoir and Its Effect on the Sacramento-San Joaquin Delta
RICHARD A. DENTON, G. GARTRELL and A. W. NELSON, Contra Costa Water District ................................................................. 623
Quantification of Uncertainties in Water Quality Model with Application to the Sacramento-San Joaquin Delta
GREGORY GARTRELL, Contra Costa Water District ........................................ 629
San Francisco Bay and Delta Oil Spill Fate Studies, Part I:
Hydrodynamic Simulation
PARMESHWAR L. SHRESTHA, CAMILLA M. SAVIZ, GERALD T. ORLOB, IAN P. KING, RODNEY J. SOBEY and R. GLENN FORD, Dept. of Civil Engineering, Virginia Tech. ................. 635
San Francisco Bay and Delta Oil Spill Fate Studies, Part II:
Oil Spill Simulation
R. GLENN FORD, RODNEY J. SOBEY, PARMESHWAR L. SHRESTHA, CAMILLA M. SAVIZ, GERALD T. ORLOB and IAN P. KING, Ecological Consulting, Inc. ................................. 641

SESSION EH-1
SAN FRANCISCO BAY AREA
Modeling the Fate and Transport of Toxic Heavy Metals in South San Francisco Bay
PARMESHWAR L. SHRESTHA and G. T. ORLOB, Dept. of Civil And Environmental Engineering, University of California, Davis ................. 647
New Methodology for Optimization of Freshwater Inflows to Estuaries
YIXING BAO and LARRY W. MAYS, Department of Civil Engineering, College of Engineering and Applied Sciences, Arizona State University ......................................................... 653
Relationships Between Flow and Benthic Communities
DAVID A. COBB, Bechtel Co. ................................................................. 659
Tidal Propagation in a Distorted Model
JIANGLU XU and R.J. SOBEY, Dept. of Civil Engineering, University of California, Berkeley ................................................................. 665

SESSION HS-5
ASPECTS OF RECLAMATION'S DAM SAFETY PROGRAM—PART II
Moderator: S. HIGINBOTHAM, Bureau of Reclamation, and G. PICKERING, Waterways Experiment Station
Bureau of Reclamation Downstream Hazard Classification
DOUGLAS J. TRIESTE, U.S. Bureau of Reclamation ................................. 671
Using Threat to Life Studies to Guide Dam Safety Decisions
WAYNE J. GRAHAM, Surface Water Branch, Bureau of Reclamation ............. 678
Economic Aspects of the Bureau of Reclamation Safety of Dams Program
ROBERT W. WALKER, Surface Water Branch, Bureau of Reclamation ............................ 684
Reclamation's Design Process of Early Warning Systems for Dam Safety
DAVID B. FISHER, Surface Water Branch, Bureau of Reclamation .................... 690
Emergency Action Plan
PATRICIA HAGAN-CHAGNON, Surface Water Branch, Bureau of Reclamation ........ 696

SESSION ST-4
GRAVEL-BED RIVERS

U.S. Geological Survey Bed Load Sampling Policy
G. DOUGLAS GLYSSON, U.S. Geological Survey ................................. 701

Incipient Motion in Gravel-Bed Rivers
PETER C. KLINGEMAN and HABIB MATIN, Dept. of Civil Engineering, Oregon State University ...................... 707

Sediment Budgets in Gravel Bed Streams
JEFFREY B. BRADLEY and DAVID T. WILLIAMS, WEST Consultants, Inc. ..................... 713

SESSION WL-5
WETLANDS
Moderator: J. PETHICK, University of Hull, and F. WEN, University of California, Berkeley

Extreme Events and Coastal Wetlands
JEFFERY HALTINER, Philip Williams & Associates, Ltd. ......................... 719

A Model of Mixing in a Stratified Tidal Flow
STEPHEN MONISMITH, DEREK FONG and MARK STACEY, Environmental Fluid Mechanics Laboratory, Stanford University .................. 725

Yolo Bypass Wetlands—Impact Investigation
MICHAEL K. DEERING, U.S. Army Corps of Engineers, Sacramento District .................. 731

Weaver Bottoms Backwater Rehabilitation
JON S. HENDRICKSON and DENNIS D. ANDERSON, U.S. Army Corps of Engineers, St. Paul District .................. 737

SESSION BS-3
UNCERTAINTIES IN QUANTIFYING STREAM STABILITY AND SCOUR I

Flow and Scour Near an Abutment
HSIEH WEN SHEN, CHRISTIAN T. CHAN, JIHN-SUNG LAI, and DIHUA ZHAO, Dept. of Civil Engineering, University of California, Berkeley .................. 743

The Fallacy of Local Abutment Scour Equations
J.R. RICHARDSON and E.V. RICHARDSON, Resource Consultants & Engineers, Inc. .................. 749
Scour Prediction Model at Bridge Abutments
G.K. YOUNG, GKY and Assoc., M. PALAVICINI, Catholic
University of America, and R.T. KILGORE, GKY and Assoc. 755

Bridge Abutment Scour in a Floodplain
TERRY W. STURM, Georgia Institute of Technology, and
NAZER JANJUA, Pakistan Council of Research in Water Resources 761

Bridge Abutment Scour in Compound Channels
B.W. MELVILLE, Dept. of Civil Engineering, Auckland University,
R. ETTEMA, University of Iowa 767

Plans for a Sensitivity Analysis of Bridge-Scour Computations
DAVID D. DUNN, and P.N. SMITH, U.S. Geological Survey 773

SESSION CA-1
COMPUTER APPLICATION I
Moderator: E.R. HOLLEY, University of Texas, Austin, and F.T. WATTS, Idaho State University

Computational Hydraulics—the Systems Approach
GERALD J. BARIL and GLEN DROGIN, Civil & Highway Engineering, Gannett Fleming Engineers 779

Computer Aided Design and Cost Estimation of Gabion Lined Channel
DAVID T. WILLIAMS and GRAY R. OSENDORF, WEST Consultants, Inc. 785

Water Surface Profile Computations—How Many Sections Do I Need?
DAVID B. THOMPSON and T.D. ROGERS, Dept. of Civil Engineering, Texas Tech University 791

Simulation of River Bed Evolution Below Tsenwen Reservoir in Taiwan
CHANG TAI TSAI and BOR-CHYI TSAI, Dept. of Hydraulics and Ocean Engineering, National Cheng-Kung University 797

On the Applicable Ranges of Kinematic and Diffusion Models in Open Channels
GYE-WOON CHOI, G.H. KIM and S.J. AHN, Water Resources Research Institute, Korea Water Resources Corporation 803

SESSION CW-6
WATER QUALITY MODELING I
Moderator: GERALD T. ORLOB, University of California, Davis

Predicting Water Quality at Municipal Water Intakes—Part 1:
Application to the Contra Costa Canal Intake
RICHARD A. DENTON, Contra Costa Water District 809

Predicting Water Quality at Municipal Water Intakes—Part 2:
Application to the Southern Sacramento-San Joaquin Delta
GREGORY GARTRELL, Contra Costa Water District 815

Simulating THM Precursors Transport with DWRDSM
PAUL H. HUTTON and CHRISTOPHER ENRIGHT, Division of Planning, Dept. of Water Resources 821

Particle Tracking Model for the Sacramento-San Joaquin Delta
GILBERT V. BOGLE, TARA A. SMITH and FRANCIS I. CHUNG, Water Engineering and Modeling 827
Levee Breach Inundation Study, Sacramento County, California
DAVE PETERSON, Municipal Services Department, CH2M Hill ........ 833

SESSION EH-2
DENSITY CURRENTS
Moderator: V. ALAVIAN, TVA Engineering Laboratory, and S. MONISMITH, Stanford University

Density Currents in Pollutant Transport and Mixing
GERHARD H. JIRKA and P.J. AKAR, DeFrees Hydraulics Laboratory, School of Civil and Environmental Engineering, Cornell University ........ 838

Criticality of Density Intrusions
STEVEN J. WRIGHT and DIANA RAEZ-RIVADENERIA, Department of Civil and Environmental Engineering, University of Michigan ........ 845

Hydraulic Performance of a Flexible Curtain Used for Selective Withdrawal—A Physical Model and Prototype Comparison
TRACY VERMEYEN and PERRY JOHNSON, U.S. Department of the Interior, Bureau of Reclamation ............................................ 2371

A Flexible Curtain Structure for Control of Vertical Reservoir Mixing Generated by Plunging Inflows
PERRY JOHNSON and TRACY VERMEYEN, U.S. Department of the Interior, Bureau of Reclamation ............................................ 2377

SESSION HS-6
PLUNGE POOLS—DESIGN AND ANALYSIS CONCEPTS
Moderator: R. WITTLER, Bureau of Reclamation, and M. SKINNER, Colorado State University

Plunge-Pool Aeration Due to Inclined Jets
ASSEM AFIFY and GILBERTO E. URROZ, Hydraulics and Sediment Research Institute ....................................................... 851

Design of Pre-Excavated Scour Hole Below Flip-Bucket Spillways
NOSRATOLLAH AMANIAN and GILBERTO E. URROZ, Utah Water Research Laboratory, College of Engineering, Utah State University .... 856

Design of Riprap Stilling Basin for Overhanging Pipe
M. SHAFAI-BAJESTAN and M.L. ALBERTSON, Shahid-Chamran University ................................................................. 861

SESSION ST-5
CHANNEL PROCESSES
Moderator: R.R. COPELAND, U.S. Army Corps of Engineers

Bed Sediments Size Changes, Atchafalaya Rivers

A Study of Lateral Bed Slopes Developed at Bend
DIANA YU MA and H.W. SHEN, Dept. of Civil Engineering, University of California, Berkeley ............................................. 875

Bank Stability Analyses verses Field Observations
DANIEL E. MARCH, STEVEN R. ABT, and COLIN R. THORNE, Dept. of Civil Engineering, Colorado State University ....................... 881
Effect of Grain Size on Sediment Transport Calculations
D. GESSLER, C.C. WASTSON and N. RAPHELT, Dept. of Civil Engineering, Colorado State University .............................. 887

Nonuniform Transient Sediment Transport Modeling
KEH-CHIA YEH, CHIAN-MIN WU, JINN-CHUANG YANG and SHIAN-JANG LI, Dept. of Civil Engineering, National Chiao Tung University .......................................................... 893

SESSION BS-4
UNCERTAINTIES IN QUANTIFYING STREAM STABILITY AND SCOUR II
Moderator: D. POTTER, Arkansas DOT, and R.E. TRENT, Federal Highway Administration

Computation of Flow Past a Cylinder Mounted on a Flat Plate
CESAR MENDOZA-CABRALES, Dept. of Civil Engineering, Columbia University ..................................................... 899

The Separated Flow Around a Circular Bridge Pier
F. WEN, D. SEYMOUR and H.W. SHEN, Dept. of Civil Engineering, University of California, Berkeley ......................... 905

Top Width of Pier Scour Holes in Free and Pressure Flow

Preliminary Studies of Pressure Flow Scour
J. STERLING JONES, Federal Highway Administration, DAVID BERTOLDI and ED UMBRELL, GKY and Associates .................. 916

The Influence of Exposed Footings on Pier Scour Depths
LISA M. FOTHERBY, Colorado State University, Engineering Research Center and J. STERLING JONES, Federal Highway Administration .......... 922

Economics of Floods, Scour and Bridge Failures
JENNIFER RHODES, University of Maryland and ROY TRENT, Federal Highway Administration ............................... 928

Scour Around Bridge Piers in Oklahoma Streams in 1986
A.K. TYAGI, School of Civil and Environmental Engineering, Oklahoma State University .................................................. 934

SESSION EH-3
STRATIFIED FLOW I
Moderator: A. LAW, Bechtel, and P. ROBERTS, Georgia Institute of Technology

A Model for Vertical Transport at a Sheared Density Interface
GREG D. SULLIVAN and E. JOHN LIST, Contra Costa Water District ................................................................. 939

Operational and Structural Optimization of Hydraulic Structures for Light Liquid Removal
A.J. KUCK, G. STROMBERG and G. ROUVÉ, Institute for Hydraulic Engineering and Water Resources Management, Aachen University of Technology .................................................. 945

Mixing Characteristics of a Transitional Stratified Two-Layer Flow
C. LIU and F. WEN, Dept. of Civil Engineering, University of California, Berkeley .................................................... 951
Observations of Artificial Destratification
S. G. SCHLADOW, Centre for Water Research, University of Western Australia ......................................................... 957

SESSION HS-7
EROSION PROTECTION OF HYDRAULIC STRUCTURES
Moderator: D.H. PILGRIM, University of New South Wales, B. FLETCHER, Waterways Experiment Station

Emergency Protection, San Luis Rey River Aqueducts
ERGUN BAKALL, JEFF MONCRIEF, JON WALTERS, and HOWARD CHANG, San Diego County Water Authority .................. 962

Design and Performance of Emergency Spillway Channel Erosion Protection Grenada Lake Dam, Grenada, Mississippi
PAUL BARNES and JOHN E. HITE, JR., Design Branch, Engineering, US Army Engineer District ........................................ 968

The Study of Riprap as Scour Protection for Bridge Abutments
A. TAMIM ATAYEE, J.E. PAGÁN-ORTIZ, S. JONES and R.T. KILGORE, GKY & Associates, Inc. ................................. 973

Erosion Protection at Hydraulic Structure—A Report from the Task Committee
RODNEY J. WITTLER, FRED WATTS, JOHN HITE JR. and GILBERTO URROZ, U.S. Bureau of Reclamation ....................... 979

SESSION ST-6
SEDIMENT TRANSPORT MECHANISM I
Moderator: C.T. YANG, Bureau of Reclamation

Video Analysis of Gravel Saltation
Y. NIÑO, MARCELO H. GARCÍA and LUIS AYALA, Department of Civil Engineering, University of Illinois, Urbana-Champaign .... 983

Scour Development at Isolated River-Bed Obstacles
P.C. KLINGEMAN and C-C HUANG, Dept. of Civil Engineering, Oregon State University .................................................. 989

N Values for Shallow Flow in Rough Channels
F. J. WATTS, Department of Civil Engineering, University of Idaho ................................................................. 995

Problems with Numerical Modeling of Gravel-Bed River
R.R. COPELAND and W.A. THOMAS, US Army Engineer Waterways Experiment Station .................................................. 1001

SESSION EC-1
ECOLOGICAL HYDRAULICS I
Moderator: R.T. MILHOUS, National Ecology Research Center, and A.J. ODGAARD, University of Iowa

An Experimental Study of Bivalve Siphonal Jets in a Turbulent Boundary Layer Flow
CATHERINE A. O’RIORDAN, S.G. MONISMITH and J.R. KOSEFF, Environmental Fluid Mechanics Laboratory, Department of Civil Engineering, Stanford University ...................................................... 1007

An Assessment of Fish Entrainment and Impingement Potential for an Offshore Cooling Water Intake in a Tropical Bay
ANDREW M. DASINGER and RONALD SUTTON, ENSR Consulting and Engineering .......................................................... 1013
Using a Numerical Model to Evaluate Striped Bass Management—
Scenarios in the Sacramento-San Joaquin Delta, CA
Bureau of Reclamation ........................................ 1019

Numerical Models of Phytoplankton Dynamics for Shallow Estuaries
L.L. VIDERGAR, J.R. KOSEFF, and S.G. MONISMITH,
Environmental Fluid Mechanics Laboratory, Stanford University ...... 1025

SESSION BS-5
UNCERTAINTIES IN QUANTIFYING STREAM STABILITY AND
SCOUR III
Moderator: N. BORMANN, Gonzaga University,
and STANLEY DAVIS, Consultant

Pier Scour Equations Used in China
GAO DONG GUANG, LILIAN POSADA G. and CARL F. NORDIN,
Dept. of Civil Engineering, Colorado State University ............... 1031

Local Scour at Skewed Bridge Piers
E.A. MOSTAFA, A.A. YASSAN, R. ETTEMA and B.W. MELVILLE,
Dept. of Irrigation & Hydraulics, University of Alexandria ............ 1037

Estimating Pier Scour with Artificial Neural Networks
ROY TRENT, N. GAGARIN, and JENNIFER RHODES, Federal
Highway Administration ............................................ 1043

An Artificial Neural Network for Computing Sediment Transport
ROY TRENT, ALBERT MOLINAS and N. GAGARIN, Federal
Highway Administration ............................................ 1049

Supply of Large Woody Debris in a Stream Channel
TIM DIEHL and B.A. BRYAN, U.S. Geological Survey ............... 1055

The Control and Monitoring of Local Scour at Bridge Piers
COLIN PAICE, and RICHARD HEY, Environmental Sciences,
University of East Anglia ......................................... 1061

Comparison of Theoretical and Historical Scour
M.A. HIXSON, K.R. AVERY, New York State Thruway Authority ... 1067

SESSION CA-2
COMPUTER APPLICATION II
Moderator: W.T. THOMAS, U.S. Army Corps of Engineers, and M.H. HSU,
National Taiwan University

Calibration of Manning’s Roughness for a River Reach
CASSIE C. KLUMPP and D.C. BAIRD, U.S. Bureau of Reclamation ... 1073

Hydrodynamic Modeling for Channel Barrier Design
P. L. SHRESTHA, J.J. DEVRIES and R. B. KRONE, Dept. of Civil
and Environmental Engineering, University of California, Davis .... 1079

A 2-D Numerical Model for High Velocity Channels
R.C. BERGER and RICHARD L. STOCKSTILL, U.S. Army Engr.
Waterways Experiment Station ..................................... 1085

Numerical Solution of Transient Closed-Conduit Flow Equations by the
Method of Lines Along Characteristics
NOSRAT MAGHSOUDI, HydroTel Intl. ................................ 1091
Visualization and Analysis of Multi-Dimensional Velocity Measurements in Carquinez Strait, California
D. AGOSTINI, J. EVANS, F. WEN and P. SMITH, Civil Engineering Department, University of California, Berkeley ........................................ 1096

SESSION EH-4
STRATIFIED FLOW II
Moderator: G. JIRKA, Cornell University, and L. LEE, Bechtel

* Fluid Mechanics Aspects of Ocean Outfalls
PHILIP J.W. ROBERTS, School of Civil Engineering, Georgia Institute of Technology .......................................................... 1102

A 2-D Lake Model with Artificial Destratification
S. G. SCHLADOW, Centre for Water Research, University of Western Australia ............................................................... 1108

Stratification Models Sensitivity to Solar Radiation Data
MONICA F.A. PORTO, University de São Paulo ........................................ 1113

Selective Withdrawal in a Rotating Stratified Fluid
STEPHEN G. MONISMITH, N.R. MCDONALD and JÖRG IMBERGER, Environmental Fluid Mechanics Laboratory, Stanford University .......................................................... 1119

SESSION HS-8
OUTLET AND INTAKE STRUCTURES
Moderator: L. HARRISON, PG&E, and F.J. WATTS, University of Idaho

Multi Objective Detention Outlet Control Structure
DARRELL KIM BEATLEY and JAMES N. WIGFIELD, Espey, Huston & Associates, Inc .................................................. 1125

Velocity Downstream of a Submerged Pipe Outlet
KERRY M. ROBINSON, CHARLES E. RICE and KEM C. KADAVY, Agricultural Research Service, USDA, ARS .............................. 1131

Pressure Relief Under Hydraulic Jump Stilling Basins
C.D. SMITH and Z. GUI, Department of Civil Engineering, University of Saskatchewan ........................................ 1137

General Implicit Representation of Hydraulic Structures in Numerical Flow Models
LEWIS L. DELONG and J.M. FULFORD, U.S. Geological Survey ....... 1143

LaPlace Valve Stroking to Control Water Hammer
DONALD SERPAS, Dept. of Hydraulic Engineering, University of São Paulo .......................................................... 1149

SESSION EC-2
ECOLOGICAL HYDRAULICS II
Moderator: G.M. KONDOFF, University of California, Berkeley, and T. WAKEMAN, US Army Corps of Engineers

Low-Flow Habitat in Flood Control Channels
J. CRAIG FISCHENICH, STEVEN R. ABT and CHESTER C. WATSON, US Army Engineer Waterways Experiment Station ........................................ 1155

Management of Rice Fields for Wetlands, Water, and Rice Production
ELIZABETH S. ANDREWS and PHILIP B. WILLIAMS, Philip Williams & Associates, Ltd .................................................... 1161
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeling the Impacts of Plankton Entrainment in a Tropical Bay</td>
<td>J. D. BOWEN, D.P. GALYA and M.T. VILLARS, ENSR Consulting and Engineering</td>
<td>1167</td>
</tr>
<tr>
<td>The Flushing Flow Problem on the Trinity River, CA</td>
<td>G.M. KONDOLF and P.R. WILCOCK, Department of Landscape Architecture, University of California, Berkeley</td>
<td>1172</td>
</tr>
<tr>
<td><strong>SESSION ST-7</strong></td>
<td><strong>SEDIMENT TRANSPORT MECHANISM II</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Moderator:</strong> M.E. FALTAS, Michael Baker Jr. Inc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drag Characteristics of Coarse Sediment in Clay Suspension</td>
<td>HYOSEOP WOO, and HYOUNGSUP KIM, Korea Institute of Construction Technology</td>
<td>1178</td>
</tr>
<tr>
<td>Fractal Dimension of Aggregated Sediments</td>
<td>H. S. KIM and P. D. SCARLATATOS, Dept. of Ocean Engineering, Florida Atlantic University</td>
<td>1184</td>
</tr>
</tbody>
</table>