TETRA TECH

Paul H. Hutton, Ph.D., P.E.
Principal Engineer

EXPERIENCE SUMMARY

Dr. Paul Hutton joined Tetra Tech in 2017 following a 27-year career with the Metropolitan Water District of Southern California and the California Department of Water Resources. A significant focus of Dr. Hutton's career has been on modeling and operations-regulatory analysis related to water quantity, water quality, and water supply reliability in California's Sacramento-San Joaquin Delta and Central Valley. In his role at Metropolitan (2002-2016), Dr. Hutton has led technical teams of in-house and inter-agency staff, university experts, NGOs and external consultants in providing support to ongoing regulatory processes related to State Water and Central Valley project operations. This included model development and applied research studies on various aspects of Delta flow and water quality. In his work at DWR (1990-2002), Dr. Hutton led a team of 17 engineers in the development and application of a range of Delta water quality, hydrodynamic and biological models. Dr. Hutton is familiar with the development, application, and evaluation of a range of modeling tools employed for planning and operational studies in the Delta and Central Valley. As a principal engineer with Tetra Tech, Dr. Hutton has continued to apply his expertise to a variety of projects related to the Delta and Central Valley and has also assumed the role of Executive Director for the California Water & Environmental Modeling Forum (CWEMF).

EDUCATION

Ph.D., Civil and Environ. Engineering, University of California, Davis (Dec. 1994)

M.S., Environ. Engineering, W.E. Deuchler Fellow, University of Illinois, Urbana (Jan. 1985)

B.S., Civil Engineering, Highest Honors, University of Illinois, Urbana (May 1983)

AREA OF EXPERTISE

Water quality modeling

Water supply reliability

Delta hydrodynamics and water quality

TRAINING/ CERTIFICATIONS

Calif. Professional Engineer Registration #C040795.

OFFICE

Lafayette, CA

YEARS OF EXPERIENCE

33

CONTACT

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RELEVANT EXPERIENCE

Executive Director, California Water & Environmental Modeling Forum (CWEMF) (September 2017 – present). In this part-time position, Dr. Hutton leads CWEMF through collaborating with its steering committee to conduct business and representing the organization in its interactions with stakeholders. Key duties include i) coordinating and supervising all aspects of CWEMF's Annual Meeting, ii) organizing and attending bi-monthly steering committee meetings, and iii) performing other duties such as outreach, fundraising, workshop logistics assistance, and coordinating peer reviews of scientific models.

Bay-Delta Historical Data Analysis, Data Reconstruction & Modeling (January 2017 – present). As project technical lead, collaborating with Tetra Tech, university and external consulting experts on several projects related to analysis, reconstruction and modeling of Bay-Delta historical hydrodynamic and salinity transport. Employed a variety of statistical and modeling techniques to evaluate trends and change attribution in the system. To date, these projects have produced five peer-reviewed publications with two additional manuscripts currently under review.

Delta Channel Depletion Study (October 2017 – present). As project technical lead, initiating design of a modeling approach for estimating net channel depletions from Delta islands. The modeling approach is utilizing DWR's IWFM model. In the first phase of this study, a pilot application is being developed on two Delta islands at which siphon flow data are currently being collected (Bacon and Bouldin islands). These and other data will be used to support the refinement, testing and calibration of the model, and following initial development, the model framework will be used to

evaluate net channel depletions over a water year from the study islands. The model will be compared with other available estimates of Delta island net channel depletions.

Principal Engineer, Metropolitan Water District of Southern California, Sacramento (June 2002 – December 2016). Provide specialized technical support to multi-disciplinary, in-house teams for strategic negotiations and lawsuits related to the Bay-Delta and State Water Project. Evaluate alternative approaches and costs to improve water quality and supply reliability, monitor and work with state and federal agencies to implement operational changes to existing facilities and solutions identified in a variety of Bay-Delta planning processes. Provide leadership to technical teams of water users in developing and evaluating solutions. Represent Metropolitan, the State Water Contractors and Federal Central Valley Project water contractors in public processes concerning the Bay-Delta and State Water Project. Represented Metropolitan and the State Water Contractors as an expert witness in a federal court case and several State Water Resources Control Board (SWRCB) hearings.

Supervising Engineer, Calif. Dept. of Water Resources, Sacramento (July 1997 – June 2002).
Delta Modeling Section – As the program manager, directed a staff of 17 engineers in the development and application of Delta water quality, hydrodynamic and biological models. The staff provides program support to a number of Department and non-Department clients, including: SWP Planning, Planning and Local Assistance, Operation and Maintenance, Flood Management, CALFED, SWRCB, and the Interagency Ecological Program. Lead the multi-disciplinary In-Delta Storage Water Quality Investigations Team. Participated in a multi-agency work team tasked to develop a carriage water estimate for the SWRCB. Acted as the Department representative on the Bay-Delta Modeling Forum Steering Committee.

CALFED Bay-Delta Program, Drinking Water Quality Branch – As the program manager, directed a multi-disciplinary Branch staff, CALFED consultants, and three multi-agency stakeholder work groups in developing actions and studies for implementing CALFED's Drinking Water Quality Improvement Strategy. Provided Program support to the Delta Drinking Water Council, a Bay-Delta Advisory Council (BDAC) subcommittee. Cooperated with policy-level agency and stakeholder staff on drinking water quality issues. Represented CALFED at public meetings.

CALFED Bay-Delta Program, Water Management Planning Branch – Directed a team of six staff engineers and CALFED consultants in planning activities for CALFED's water management strategy, including system, engineering and economic analysis. Managed technical support, text development, and response to public comments for the program's programmatic EIS/EIR. Coordinated a multi-disciplinary effort with CALFED agencies and stakeholders to evaluate (through systems modeling and operation studies) potential drinking water quality improvements through the construction of new facilities and re-operation of existing facilities.

Statewide Planning Branch – As the program manager for the Department's Statewide Planning Program, provided direct supervision for five senior engineers, provided direction to other Department staff that participate in the Program, and oversaw a $3.5 million annual budget. Coordinated with management staff of key federal, State and local agencies to develop and implement Department policies related to the California Water Plan Update. Coordinated the development of Bulletin 160-98 with Program participants and outside agencies, including development of statewide water budgets and economic analysis of regional water management options. Conducted public meetings and incorporated public comments into the final document. Represented the Department, made presentations at various public meetings, and provided water demand and supply information to the public.

Senior Engineer, Modeling Support Branch, Calif. Dept. of Water Resources, Sacramento (May 1994 – July 1997).
Hydrology & Operations Section – Directed a team of five engineers in the application of DWRSIM to evaluate State Water Project and Central Valley Project operations under a variety of facility planning and water right scenarios. Designed planning scenarios through interaction with program managers and other State and Federal agencies, including the SWRCB.

Delta Modeling Section – Directed a team of four engineers in the development and application of Delta water quality, hydrodynamic and biological models. Provided technical advice and modeling services to the Department's Municipal

Water Quality Investigations Program. Represented the Department in the Bay-Delta Modeling Forum. Specific activities included: (i) development of a new one-dimensional finite difference hydrodynamics and water quality model of the Delta (DSM2), (ii) enhancement of the Delta Island Consumptive Use (DICU) model, (iii) application of the Particle Tracking Model to study fate and movement of biological resources under various Bay-Delta management alternatives, and (iv) application of artificial neural network technology to disinfection by-product formation prediction.

Associate Engineer, Modeling Support Branch, Calif. Dept. of Water Resources, Sacramento (August 1990 – May 1994). Developed an approach to evaluate disinfection by-product formation precursor transport in the Delta using DSM1. Developed a model to predict trihalomethane formation and speciation as a function of precursor transport and assumed water treatment conditions. Applied DSM1 to evaluate Delta hydrodynamics and water quality under a variety of planning scenarios. Provided technical advice and modeling services to the Department's Municipal Water Quality Investigations Program.

Engineering Consultant, Pacific Gas & Electric, Sacramento Region (October 1989 – August 1990). Evaluated existing natural gas distribution facilities. Forecasted utility demands and made recommendations for facility expansions. Prepared reports and supervised the work of student assistants.

Project Engineer, Los Angeles County Sanitation District (February 1986 – July 1989). Performed duties of assistant resident engineer on the construction and start-up of a $60 million wastewater sludge dehydration, combustion and energy recovery facility in Carson, Calif. Acted as liaison between Districts and City of Los Angeles in administering multi-million dollar wastewater disposal contracts for services in the City's regional system, representing the Districts in various public forums. Developed user fee rates.

Associate Engineer, James M. Montgomery Engineers, Pasadena (October 1984 – February 1986). Designed and supervised the sampling of industrial wastewaters from a large Midwest defense contractor, using the results to select and size appropriate treatment process trains. Designed sludge thickener for an industrial client. Assisted in the development of facility plans for wastewater sludge disposal and wastewater collection. Assisted in the preparation of proposals for potential studies and design projects.

AWARDS & PROFESSIONAL AFFILIATIONS

- Executive Director, California Water & Environmental Modeling Forum, 2017-present
- Convener, California Water & Environmental Modeling Forum, 2009-10.
- Vice Convener, California Water & Environmental Modeling Forum, 2007-08.
- California Water & Environmental Modeling Forum, Hugo B. Fischer Award, 2006.
- MWDSC, Innovation/Creativity Award, 2006.
- MWDSC, Leadership Award, 2006.
- Calif. Dept. of Water Resources, Meritorious Service Award, 1999.
- CALFED, Draft PEIS/EIR Superior Accomplishment Team Award, 1999.
- Calif. Dept. of Water Resources, DSM2 Development Team Unit Citation, 1998.
- ASCE Water Resources Plng. and Mgmt. Div. Outstanding Journal Paper Award, 1994.
- Calif. Dept. of Water Resources, Outstanding Professional Accomplishment Award, 1994.

MANAGEMENT DEVELOPMENT

- U.S. Executive Development Seminar, Denver (Feb. 2000)
- U.C. Davis Management Development Program (Nov. 1998)

REFEREED PUBLICATIONS

Chen, L., S. B. Roy, and P.H. Hutton (2018). Emulation of a Process-Based Estuarine Hydrodynamic Model, *Hydrological Sciences Journal*, http://doi.org/10.1080/02626667.2018.1447112.

Hutton, P.H., J.S. Rath, and S.B. Roy (2017). Freshwater Flow to the San Francisco Bay-Delta Estuary Over Nine Decades; Part 1- Trend Evaluation, *Hydrological Processes*, http://onlinelibrary.wiley.com/doi/10.1002/hyp.11201/full.

Hutton, P.H., J.S. Rath, and S.B. Roy (2017). Freshwater Flow to the San Francisco Bay-Delta Estuary Over Nine Decades Part 2-Change Attribution, *Hydrological Processes*, http://onlinelibrary.wiley.com/doi/10.1002/hyp.11195/full.

Andrews, S., Gross, E., and Hutton, P.H. (2017). Modeling Salt Intrusion in the San Francisco Estuary Prior to Anthropogenic Influence, *Continental Shelf Research*, http://dx.doi.org/10.1016/j.csr.2017.07.010

Rath, J. S., Hutton, P. H., L. Chen, and S. B. Roy (2017). Modeling Salinity in the San Francisco Bay-Delta Estuary using Artificial Neural Networks, *Environmental Modelling and Software*, http://doi.org/10.1016/j.envsoft.2017.03.022.

Andrews, S., Gross, E. and Hutton, P.H., (2016). A Water Balance Model to Estimate Flow through the Old and Middle River Corridor, *San Francisco Estuary & Watershed Science J.*, 14(2), DOI: http://dx.doi.org/10.15447/sfews.2016v14iss2art2.

Hutton, P.H., Rath, J.S., Chen, L., Ungs, M.J., and Roy, S.B. (2015). Nine Decades of Salinity Observations in the San Francisco Bay and Delta: Modeling and Trend Evaluation. *J. Water Resour. Plng. Mgmt.*, American Society of Civil Engineers, DOI: 10.1061/(ASCE)WR.1943-5452.0000617.

Fox P., Hutton, P.H., Howes, D.J., Draper, A.J., and Sears, L. (2015). Reconstructing the Natural Hydrology of the San Francisco Bay-Delta Watershed. *Hydro. & Earth System Sciences* 19:4257–4274.

Howes, D.J., Fox, P., Hutton, P.H. (2015). Evapotranspiration from Natural Vegetation in the Central Valley of California: Monthly Grass Reference-Based Vegetation Coefficients and the Dual Crop Coefficient Approach. *J Hydrol. Eng.*, American Society of Civil Engineers, DOI: 10.1061/(ASCE)HE.1943-5584.0001162.

Hutton, P.H. and Chung, F.I. (1994). Bromine Distribution Factors in THM Formation. *J. Water Resour. Plng. Mgmt.*, American Society of Civil Engineers, 120(1), 1-16.

Hutton, P.H. and Chung, F.I. (1994). Correlating Trihalomethane Data. *J. Environ. Eng.*, American Society of Civil Engineers, 120(1), 219-241.

Hutton, P.H. and Chung, F.I. (1992). Simulating THM Formation Potential in Sacramento Delta: Part I. *J. Water Resour. Plng. Mgmt.*, American Society of Civil Engineers, 118(5), 513-529.

Hutton, P.H. and Chung, F.I. (1992). Simulating THM Formation Potential in Sacramento Delta: Part II. *J. Water Resour. Plng. Mgmt.*, American Society of Civil Engineers, 118(5), 530-542.

CONFERENCE PROCEEDINGS & OTHER PUBLICATIONS

CALFED (1999). Bay-Delta Program Programmatic EIS/EIR. June Draft.

Calif. DWR (1991). Trihalomethane Formation Potential in the Sacramento-San Joaquin Delta: Mathematical Model Development. Division of Planning.

Calif. DWR (1995). Representative Delta Island Return Flow Quality for Use in DSM2. Division of Planning, Modeling Support Branch.

Calif. DWR (1995). Estimation of Delta Island Diversions and Return Flows. Division of Planning, Feb.

Calif. DWR (1998). Calif. Water Plan Update, Bulletin 160-98.

Enright, C., Hutton, P.H. and Chung, F.I. (1996). Transport of Dormant Spray Pesticides in the San Francisco Bay-Delta. Proceedings 1996 North American Water and Environment Congress, ASCE, Anaheim, Calif., C.T. Bathala, Ed.

Enright, C., Mahadevan, N. and Hutton, P.H. (1996). Simulation of Dormant Spray Pesticide and Dissolved Organic Carbon Transport during 1993. IEP Newsletter, Interagency Ecological Program for the Sacramento-San Joaquin Estuary, 9(2), 27-31.

Hutton, P.H. and Enright, C. (1993). Simulating THM Precursors Transport with DWRDSM. Proceedings 1993 Hydraulic Div. National Conf., ASCE, San Francisco, Calif., H.W. Shen, Ed. 821-826.

Hutton, P.H. (1994). Bay-Delta THM Formation Potential: Data Collection and Mathematical Modeling. IEP Newsletter, Interagency Ecological Program for the Sacramento-San Joaquin Estuary, 7(4), 12.

Hutton, P.H., Sandhu, N. and Chung, F.I. (1996). Predicting THM Formation with Artificial Neural Networks. Proceedings 1996 North American Water and Environment Congress, ASCE, Anaheim, Calif., C.T. Bathala, Ed.

Hutton, P.H., Mahadevan, N. and Chung, F.I. (1996). Simulating DBP Precursor Transport in Sacramento Delta. Proceedings 1996 North American Water and Environment Congress, ASCE, C.T. Bathala, Ed.

Metro. Water Dist. So. Cal. (2008). A Model to Estimate Combined Old & Middle River Flows, Apr.

Metro. Water Dist. So. Cal. (2014). Delta Salinity (DSG) Model: Version 1.0 Model Documentation, Sept.

CONFERENCE PRESENTATIONS

Application of SANMAN: A San Joaquin River Salinity Management Spreadsheet Model, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Mar. 2005.

Delta and Aqueduct Taste and Odor Precursors: Modeling Status, presented at the CWEMF Workshop on Overview of Delta Nutrient Water Quality Problems: Nutrient Load – Water Quality Impact Modeling, Sacramento, Calif., Mar. 2008.

Delta Island Consumptive Use Model, presented at the Annual Interagency Ecological Program Workshop & Bay-Delta Modeling Forum, Pacific Grove, Calif., Mar. 1995.

Delta Island Diversions and Returns, presented at the Bay-Delta Modeling Forum Workshop on Delta Modeling for End Users, Sausalito, Calif., Nov. 1995.

Delta Outflow & Salinity: Trends & Change Attribution, presented at the CWEMF Annual Meeting, Folsom, Calif., Apr. 2018.

Delta Salinity Gradient (DSG) Model, presented at the 8th Biennial Bay-Delta Science Conference, Sacramento, Calif., Oct. 2014.

DWR's Delta Model on DBP Precursors, presented at the American Water Works Association Calif.-Nevada Section Spring Conference, San Jose, Calif., Apr. 1992.

Estimating Combined Old and Middle River Flow, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Feb. 2008.

Forecasting Delta Turbidity Conditions, presented at the 7th Biennial Bay-Delta Science Conference, Sacramento, Calif., Oct. 2012.

Life after Bulletin 160-98: Ongoing DWR Statewide Planning Program Elements, presented at the Bay-Delta Modeling Forum Workshop on Approaches and Problems for Long-Term Regional Water Planning, Sacramento, Calif., Feb. 1999.

Metropolitan’s Evaluation of the 2003 Colorado River Contingency Transfer, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Feb. 2003.

Metropolitan's Policy Principles on Long-Term Delta Actions, presented at the Bay Planning Coalition's 19th Annual Decisionmakers Conference, Oakland, Calif., Mar. 2006.

Metropolitan's 2003 Colorado River Contingency Transfer in Retrospect, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Feb. 2004.

Modeling Delta Flow-Turbidity Relationships with Artificial Neural Networks, presented at the CWEMF Annual Meeting, Folsom, Calif., Apr. 2012.

Modeling of Delta Standards Using ANN Approach in the Joint CALSIM Model, presented at the Annual Interagency Ecological Program Workshop & Bay-Delta Modeling Forum, Pacific Grove, Calif., Feb. 2001.

Natural Delta Outflow Water Balance, presented at the CWEMF Annual Meeting, Folsom, Calif., Feb. 2014.

Neural Networks and THM Prediction, presented at the Bay-Delta Modeling Forum Workshop on Drinking Water Quality, Sacramento, Calif., Oct. 1995.

New Empirical Bay-Delta Salinity Model, presented at the CWEMF Annual Meeting, Folsom, Calif., Apr. 2013.

Nine Decades of Salinity Observations in Suisun Bay & Western Delta, presented at the CWEMF Annual Meeting, Folsom, Calif., Apr. 2013.

Overview of Recent Efforts to Characterize Natural Delta Outflow, presented at the CWEMF Annual Meeting, Joint Session with the Interagency Ecological Program, Folsom, Calif., Feb. 2014.

San Joaquin River Salinity Management Model, SANMAN, presented at the CWEMF Technical Workshop on San Joaquin River Valley Modeling, Sacramento, Calif., Nov. 2005.

SANMAN: Decision Support for the DIP's San Joaquin River Salinity Management Plan, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Mar. 2005.

Simulating DBP Precursor Transport, presented at the Bay-Delta Modeling Forum Workshop on Drinking Water Quality, Sacramento, Calif., Oct. 1995.

Validation of DSM2 Volumetric Fingerprints Using Grab Sample Mineral Data, presented at the CWEMF Annual Meeting, Pacific Grove, Calif., Mar. 2006.