California Water and Environmental Modeling Forum

2024 ANNUAL MEETING PROGRAM

30 YEARS

CWEMF at 30: Looking to the Past, Recalibrating for the Future

ORGANIZATIONAL MEMBERS

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California State Water Resources Control Board

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Delta Stewardship Council

East Bay Municipal Utility District

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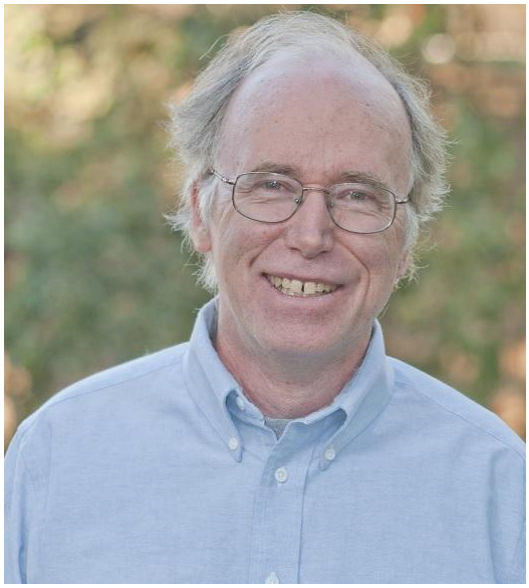
KEYNOTE ADDRESS

Jay R. Lund, Ph.D.
Distinguished Professor Emeritus, University of California, Davis



Dr. Jay Lund is a Distinguished Professor Emeritus of Civil and Environmental Engineering, Geography, Hydrology, and Environmental Policy and Management at the University of California – Davis. He has long enjoyed teaching, research, and engagement on many aspects of theory and practice for water management and policy, usually trying to integrate economics and operations research with traditional engineering. He has worked on many water problems in California with many collaborators and remains enthusiastic about the potential of system analysis and optimization to provide understanding and insights for management and policy.

He is a member of the US National Academy of Engineering. In California, he was on the Advisory Committee for the 1998 and 2005 California Water Plan Updates and has served as Convenor of the California Water and Environment Modeling Forum and Chair of California's Delta Independent Science Board. He has long been involved in applying economic and optimization ideas to provide insights on California's water problems, including the development and use of the CALVIN model of California's water supply system.

Dr. Lund has a B.A. in International Relations and Regional Planning from the University of Delaware (1979) and a BS in Civil Engineering, MA in Geography, and PhD in Civil Engineering from the University of Washington (Seattle) (1986). He has advised and learned much from over 150 graduate student advisees, including 14 who are faculty at research universities globally and has over 400 publications and reports.

A Brief History of the California Water & Environmental Modeling Forum

Water is key to the economy and environment of the State of California. In the late 1980s to the early 1990s, coincident with the advancement of the personal computer, water resource managers, policy makers, and stakeholders increasingly needed to rely upon more detailed, complex, quantitative information to perform their work. Stakeholder experts were becoming entrenched on the scientific methods and data used to form their opinions. As a result, competing models and conflicting results presented in water rights hearings and other regulatory proceedings became increasingly difficult to resolve.

The Bay-Delta Coordination Group was established in 1993 because of a growing need to resolve technical disagreements in a non-adversarial setting, allow an open exchange of technical information, and help ensure that technical analyses were focused on addressing the challenges facing California's resource managers as well as stakeholder groups. On March 11, 1994, the Bay-Delta Modeling Forum (BDMF) was formally established. BDMF was the direct precursor to the California Water and Environmental Modeling Forum (CWEMF). BDMF members adopted organizational bylaws, established the steering committee and rules governing membership, elected the first set of organization officers, and established the first of many standing and ad hoc committees. BDMF formulated its mission statement that has remained largely unchanged since adoption, "to increase the usefulness of models for analyzing California's water and environment related problems." BDMF also formulated the tagline, "Promoting Excellence and Consensus in Water and Environmental Modeling."

In 2004, BDMF celebrated 10 years since its founding and agreed upon a name change to CWEMF along with adoption of a new logo that reflected a broadened geographic focus of the organization to encompass efforts throughout all of California with emphasis on the San Francisco Bay, Sacramento-San Joaquin Delta, and the Central Valley.

One of CWEMF's most important functions is dissemination of modeling-related information through workshops and annual meetings. There is a wide range in workshop topics. They generally fall into two general categories: educational workshops where the audience learns from subject matter experts and training workshops where the audience uses computers to learn a new modeling-related skill. Even before BDMF was officially formed, the Bay-Delta Coordination group organized a salinity-outflow technical workshop in February 1994. Soon after, additional workshops were held to start addressing complex Bay-Delta challenges. Since then, CWEMF has conducted over 100 educational and training workshops, often partnering with other organizations.

From 1995 through 2011, annual meetings were held at the Asilomar Conference Center near Pacific Grove, California. CWEMF annual meetings have been held in Folsom, California since 2012, with growing attendance each year.

CWEMF recognizes achievement through several awards. In 1994, the Hugo B. Fischer Award, named in honor of Dr. Fischer's pioneering work on water quality modeling, was established to honor outstanding use or development of water/environmental models to understand or solve California water problems. Then, in 2004, CWEMF established the Career Achievement Award to honor members that made significant contributions over their career in developing, using, or promoting computer modeling to analyze California's water-related issues. In 2010, the Distinguished Life Member Award was established

to honor the service of active or past members who, through long and distinguished service made a major contribution to CWEMF and to the California water and environmental modeling profession.

Peer reviews have been another important function of CWEMF. In 1996, BDMF published guidance for organizations that would like to partner with BDMF to conduct peer reviews of models or modeling approaches. Consistent with the organizational mission, peer review efforts are framed not for providing strict approval or disapproval of a model or technical approach, rather they document strengths and weaknesses, suggest improvements, and assess model suitability for a range of potential intended uses or applications. Several peer reviews of models, modeling approaches, and/or model applications in California were completed in 2001. In 2006, CWEMF oversaw the formation of a peer review panel that produced a consequential report documenting their review of the San Joaquin River Valley CalSim II Model. In July 2013 CWEMF partnered with USBR to complete a peer review of three integrated surface water-ground water models.

In addition to conducting workshops and peer reviews, CWEMF has published reports to provide guidance and share expertise related to professional practices. In 2000, BDMF developed a best practices document titled, "Protocols for Water and Environmental Modeling" that provides guidance in the development and application of complex computer-based modeling tools used to address California's water and environmental problems. This document was updated in 2021. In 2005, CWEMF published, "A Strategic Analysis Framework for Managing Water in California" to provide integrated, broad-based guidance to support a variety of policy, planning, and management applications.

Throughout the years, CWEMF has facilitated various peer reviews, provided modeling guidance, awarded distinguished individuals, and conducted workshops and annual meetings to ensure a high standard of professional modeling practices for water and environmental management in California. The formation and development of BDMF and CWEMF have been shaped by ever-evolving volunteer engagement on behalf of its members and member organizations representing water project, regulatory, consulting, academic, and non-governmental institutions. CWEMF has improved modeling and modeling discussions by providing an informal discussion forum for “mixing and dispersion” of ideas and methods, and supporting development, testing, and acceptance of many modeling innovations for California water problems. In addition, CWEMF has established a safe, educational environment for modelers and model users within the community to share ideas, demonstrate their technical approaches, and share their insights as policy and science continue to evolve symbiotically.

SUMMARY OF SESSIONS

Monday, September 23

Time	Session	Moderator	Room
8:00 – 8:30	Registration		Sierra Hallway
8:30 – 10:15	1. Connecting Physical & Fishery Modeling	James Gilbert	Sierra 1
	2. Overview of DWR's Basin Characterization Program	Mesut Cayar	Folsom/Natoma
10:15 - 10:30	Break		
10:30 - 12:15	3. CWEMF 30th Anniversary Celebration	Paul Hutton	Sierra 1
12:15 – 1:00	Lunch - Included in registration fee		
1:00 – 2:00	4. CWEMF Awards Ceremony	Jesse Jankowski	Sierra 1
2:00 – 2:05	Break		
2:05 – 3:15	5. Pop-up Talks	Stacy Tanaka	Pavilion
3:15 – 3:30	Break		
3:30 – 5:15	6. Colorado River Basin Modeling	Rich Juricich	Sierra 1
	7. CVP Water Temperature Platform, Chapter 3	Yung-Hsin Sun	Folsom/Natoma
5:30 - 8:00	8. Social		Sierra 1

SUMMARY OF SESSIONS

Tuesday, September 24

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 – 9:45	9. Delta Salinity Management in Drought: Surrogate Development under Drought, Landscape Change and Sea Level Rise	Eli Ateljevich	Sierra 1
	10. Improved Groundwater-Surface Water and Water Allocation Models and Data to Support Water Management in the Scott River and Shasta River Watersheds	Shahab Araghinejad	Folsom/Natoma
9:45 - 10:00	Break		
10:00 – 11:45	11. Consultation on the Coordinated Long-Term Operation of the CVP and SWP	Lauren Thatch	Sierra 1
	12. History of Modeling Tools	Vivek Bedekar	Folsom/Natoma
11:45 - 12:30	Lunch - Included in registration fee		
12:30 - 1:10	13. Keynote Address – Dr. Jay Lund	Jesse Jankowski	Sierra 1
1:10 - 1:15	Break		
1:15 – 3:00	14. CalSim3 Changelog (Live)	Zachary Roy	Sierra 1
	15. Water Quality, Emerging Contaminants and PFAS Modeling	Reza Namvar & Vivek Bedekar	Folsom/Natoma
3:00 - 3:15	Break		
3:15 - 5:00	16. Hydrology/Climate Change	Ryan Lucas	Sierra 1
	17. Advancing Aquifer Recharge Modeling: Integrating Process-Based Models for Enhanced Representation of Water Quantity and Quality	Menberu Meles	Folsom/Natoma
5:00 - 7:00	18. Poster Session * & Social	Stacy Tanaka	Sierra 1

* Posters will be set up by 10:00 am and available for viewing all day. Presenters will be available from 5:00 to 7:00 pm.

SUMMARY OF SESSIONS

Wednesday, September 25

Time	Session	Moderator	Room
7:30 - 8:00	Registration		Sierra Hallway
8:00 – 9:45	19. Reclamation specific LTO Analyses	Drew Allan Loney	Sierra 1
	20. California Aqueduct Subsidence Program (CASP) Modeling: Panel Discussion	Jeff Weaver	Folsom/Natoma
9:45 - 10:00	Break		
10:00 – 11:45	21. Shasta Operations	Ryan Lucas	Sierra 1
	22. Innovative Approaches to Water Mgt. & Ecosystem Sustainability in the California Central Valley & Delta	Nicole Osorio	Folsom/Natoma
11:45 - 1:15	Lunch at area restaurants		
1:15 - 3:00	23. Integrated Modeling for the Central Valley Project Improvement Act (CVPIA) Structured Decision-Making Process	Mark Tompkins & Rod Wittler	Sierra 1
	24. Groundwater Grab Bag	Abdul Khan	Folsom/Natoma
3:00 - 3:15	Break		
3:15 – 5:00	25. The Collaboratory Starts Now	Lisamarie Windham-Myers	Sierra 1
	26. Reclamation Grab Bag	Maribeth Kniffin	Folsom/Natoma

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MONDAY EVENING SOCIAL

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California Water and Environmental Modeling Forum
Promoting Excellence and Consensus in Water and Environmental Modeling
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Dear CWEMF Membership,

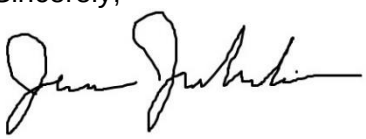
I am delighted to welcome you to CWEMF's 30th Annual Meeting! This year we look to our organization's past and consider how we may recalibrate to face the challenges of the future. Just as a well-established model undergoes improvements as additional data becomes available and new techniques are developed, so must we evolve to better meet the diverse needs of our community and our state. This year (for the first time in 9 years) we revisited our Strategic Plan with the goal of more effectively aligning our activities with our mission. We also dug through the CWEMF archives and compiled a history of our organization; the compilation includes a document that will be posted on our website, a poster session exhibit, and various photographs that you will see throughout the meeting this year.

I am grateful for your understanding as we've navigated the impacts of an uncertain state budget on our organization, which has highlighted the vital importance of our members. From individuals to private firms to large agencies, graduate students to retired professionals, CWEMF would be nothing without the experience and support that all of you bring. The conversations had, connections made, and knowledge shared are what truly helps build consensus in our field.

This year we have another fantastic program lined up. We welcome Dr. Jay Lund as our keynote speaker and are fortunate to have someone so vital to our organization and profession's history to offer a unique outlook on CWEMF's mission, past, and future. Our technical sessions will touch on many key issues of the moment: understanding habitat needs for critical species, planning for and responding to drought throughout the state, managing the effects of climate change on our water management infrastructure and operations, understanding water quality contaminants of emerging concern, and implementing groundwater sustainability in critical basins. And I hope you will join us for our plenary session celebrating CWEMF's anniversary, the presentation of our annual awards, evening socials, poster session, and pop-up talks.

I am tremendously grateful for your participation this year, whether this is your 30th time attending or your first. CWEMF has personally brought me so many opportunities, both technical and social, so it is a great honor to serve as its Convener this year. My sincere thanks to our sponsors for their generous contributions, some over multiple decades, to support our refreshments, lunches, and social events. I am confident that the continued hard work of our Executive Director, officers, Steering Committee, and individual CWEMF members will help carry forward our organization's relevance and value in the future, for another 30 years and beyond. Please fill out the Annual Meeting follow-up survey so we can continue to provide a great experience, and I encourage you to get involved with the Steering Committee if you are able.

Sincerely,



Jesse Jankowski, MS, PE
CWEMF Convener

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AGENDA

Monday, September 23

8:00 – 8:30 a.m. – Registration in Sierra Hallway

Refreshments sponsored by Sunzi Consulting LLC

8:30 – 10:15 a.m.

Session 1. Connecting Physical & Fishery Modeling

Moderator: James Gilbert (UC Santa Cruz / NMFS)
Location: Sierra 1

1. The Winter Run Lifecycle Model for Scenario Analysis in the Central Valley – Ann-Marie Osterback (UC Santa Cruz)

2. Connecting managed water operations with salmon disease in Central Valley rivers – Miles Daniels (UC Santa Cruz / NMFS)

3. Hydrological Modeling and Climate Change Analysis to Support Pajaro Valley Ecological Floodplain Inundation Potential (EcoFIP) – Tapash Das & Syed Azhar Ali (Jacobs)

4. Exploring beyond the historical sequence to understand how multi-year drought characteristics affect Winter Run salmon in California – James Gilbert (UC Santa Cruz / NMFS)

Session 2. Overview of DWR's Basin Characterization Program

Moderator: Mesut Cayar (Woodard & Curran)
Location: Folsom/Natoma

1. An Introduction to DWR's Basin Characterization Program – Katherine Dlubac & Steven Springhorn (DWR)

2. DWR's Basin Characterization Program: Data Access, Management, and Visualization – Benjamin Brezing (DWR)

3. Geophysical and hydrogeologic investigations to characterize the subsurface near the Upper San Joaquin River – Timothy Parker (Ramboll)

4. Developing Conceptual Models and Parameterizing Numerical Models using AEM and Other Hydrogeologic Data Types – Mesut Cayar (Woodard & Curran), Sercan Ceyhan (Woodard & Curran), and Vivek Bedekar (SSP&A)

10:30 a.m. – 12:15 p.m.

Session 3. CWEMF 30th Anniversary Celebration

Moderator: Paul Hutton (CWEMF Executive Director)
Location: Sierra 1

1. Introduction – Paul Hutton (CWEMF Executive Director)

2. Role of Models in California Water – Walter Bourez (MBK)

3. Panel Discussion: Looking Forward
   Ben Bray (EBMUD)
   Greg Gartrell (PPIC Adjunct Fellow, Independent Consultant)
   Jesse Jankowski (CWEMF Convener, SWRCB)
   Tara Smith (DWR retired)
   Stacy Tanaka (Watercourse Engineering)

12:15 – 1:00 p.m.

Lunch

Pick up a box lunch and then join us for the CWEMF Awards Ceremony in Sierra 1.

Lunch sponsored by CBEC Eco Engineering

1:00 – 2:00 p.m.

Session 4. CWEMF Awards Ceremony

Moderator: Jesse Jankowski (CWEMF/SWRCB)
Location: Sierra 1

Presentation of the Hugo B. Fischer, Career Achievement and Distinguished Life Member awards.

2:05 – 3:15 p.m.

Session 5. Pop-up Talks

Moderators: Stacy Tanaka (Watercourse Engineering)
Location: Sierra 1

Five-minute overviews summarizing modeling work using a maximum of five PowerPoint slides per speaker.

3:30 – 5:15 p.m.

Session 6. Colorado River Basin Modeling

Moderator: Rich Juricich (Woodard & Curran)
Location: Sierra 1

1. The Role of Modeling in Planning and Management of the Colorado River for California in a Changing World – David Rheinheimer and Angela Rashid (Colorado River Board of California)

2. Drought Mitigation Planning in the Colorado River Basin in Utah – Betsy Morgan (Colorado River Authority of Utah)

3. The Use of Models by the Central Arizona Project to Support Water Supply Planning in an Uncertain Future – Nolie Templeton (Central Arizona Water Conservation District)

4. Overview of Colorado River System Models and the Update of the Operating Guidelines for Lakes Powell and Mead – Harrison Zeff (USBR)

Session 7. CVP Water Temperature Platform, Chapter 3

Moderator: Yung-Hsin Sun (Sunzi)
Location: Folsom/Natoma

1. Session Introduction and Recap – Yung-Hsin Sun (Sunzi Consulting LLC)

2. What Have We Done – Mike Deas (Watercourse Engineering), John DeGeorge (RMA), Randi Field (USBR)

3. The End is the Beginning (Panel Discussion) – Thomas Patton, Michel Pacheco, Randi Field, David Mooney, and Levi Johnson (USBR)

5:30 – 8:00 p.m.

Session 8. Social

Location: Sierra 1

Social sponsored by Jacobs, MBK, RMA, S.S. Papadopulos & Associates, and Tetra Tech

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE IF YOU WILL NOT BE COMING BACK TO THE ANNUAL MEETING.

AGENDA

Tuesday, September 24

7:30 – 8:00 a.m. – Registration in Sierra Hallway

Refreshments sponsored by LimnoTech

8:00 – 9:45 a.m.

Session 9. Delta Salinity Management in Drought: Surrogate Development under Drought, Landscape Change and Sea Level Rise

Moderator: Eli Ateljevich (DWR)
Location: Sierra 1

1. Increasing Transparency and Flexibility of the CalSIM Delta Salinity Surrogate Process – Eli Ateljevich (DWR)

2. Representative Hydrology and Salinity Conditions for Machine Learning – Lily Tomkovic (DWR)

3. ANN Architecture, memorization and overfit – Ryan Ripkin (RMA)

4. Restoration designs and early results – Stacie Grinbergs (RMA)

Session 10. Improved Groundwater-Surface Water and Water Allocation Models and Data to Support Water Management in the Scott River and Shasta River Watersheds

Moderator: Shahab Araghinejad (SWRCB)
Location: Folsom/Natoma

1. Scott Valley Airborne Electromagnetic Data Interpretation and Assimilation into a Groundwater-Surface Water Model – Leland Scantlebury (UC Davis)

2. Updated Precipitation-Runoff Modeling System in Scott Valley – Katrina Arredondo (Larry Walker Associates)

3. Shasta Watershed Groundwater Model (SWGM): Challenges and Updates Enlightened by New Datasets – Laura Foglia (Larry Walker Associates and the University of California, Davis) and Jose Tomas Diaz Casanueva (Larry Walker Associates)

4. Organizing Adjudicated Water Right Decree Data in the Scott River – Doug Chalmers (Stockholm Environment Institute)

10:00 – 11:45 a.m.

Session 11. Consultation on the Coordinated Long-Term Operation of the CVP and SWP

Moderator: Lauren Thatch (USBR)
Location: Sierra 1

1. LTO Background and Updating the LTO No Action Alternative – Ryan Lucas (USBR), Derya Sumer (USBR), Thomas Fitzugh (Stantec), Chad Whittington (Jacobs)

2. Modified OMR – Cameron Koizumi (USBR)

3. Model Development for State Water Project Long Term Operations – Yiwei Cheng & Nicole Osorio (DWR)

4. LTO Alternative 3 – Chad Whittington (Jacobs)

5. Simulating the Voluntary Agreements – Thomas FitzHugh (Stantec)

Session 12. History of Modeling Tools

Moderator: Vivek Bedekar (SSP&A)
Location: Folsom/Natoma

1. The Story of IWFM: A Journey Through Time – Saquib Najmus (Woodard & Curran)

2. The History of MODFLOW – Richard Winston (USGS)

3. The Present and Future Role of the Loading Simulation Program C++ (LSPC) in Watershed Modeling and Water Management – John Riverson (Paradigm Environmental)

4. The History of Solute Transport Modeling Codes – Vivek Bedekar (S.S. Papadopulos and Associates, Inc.)

11:45 a.m. – 12:30 p.m. – Lunch

Pick up a box lunch and then join us for the keynote address in Sierra 1.

12:30 – 1:10 p.m.

Session 13. Keynote Address: Dr. Jay Lund (UC Davis)

Moderator: Jesse Jankowski (CWEMF/SWRCB)
Location: Sierra 1

1:15 – 3:00 p.m.

Session 14. CalSim3 Changelog (Live)

Moderator: Zachary Roy (DWR)
Location: Sierra 1

1. 2023 Delivery Capability Report Updates – Nicole Osorio & Yiwei Cheng (DWR)

2. CalSim Allocation Module (CAM) – Thomas FitzHugh (Stantec)

3. CalSim3 Artificial Neural Network Architecture Updates – Hamed Zamanisabzi, Malinda Wimalarante & Yiwei Cheng (DWR)

4. Pseudo-Hydrologic Forecast for Climate Change and Other Alternative Hydrology – Kunxuan Wang (USBR) & Mohammad Hasan (DWR)

Session 15. Water Quality, Emerging Contaminants and PFAS Modeling

Moderator: Reza Namvar (Woodard & Curran) & Vivek Bedekar (SSP&A)
Location: Folsom/Natoma

1. Comparison of PFAS Fate and Transport Modeling Tools and Data Needs for Site-scale and Regional-scale Models – Raghu Suribhatla, Jake Smith & Jacob Chu (Haley Aldrich)

2. Prediction of 35 Target PFAS in California Groundwater Using Multilabel Semi-Supervised Machine Learning – Jialin Dong (University of California, Irvine)

3. De-Risking Groundwater Investments in the Age of PFAS – Dan Haddock (INTERA)

3:15 – 5:00 p.m.

Session 16. Hydrology/Climate Change

Moderator: Ryan Lucas (USBR)
Location: Sierra 1

1. Risk-Informed Climate Change Development – Andrew Schwarz (DWR)

2. USBR 2022MED Hydrology Development: Detrending Methodology – Drew Loney (USBR) & Tapash Das (Jacobs)

3. A New Normal: Adjusted Historical Hydrology – Richard Chen (DWR)

4. A New Normal: Climate Change Adaptation – Andrew Schwarz (DWR)

5. Climate Change Development: BOR and DWR Approaches – Drew Loney (USBR) and Andrew Schwarz (DWR)

Session 17. Advancing Aquifer Recharge Modeling: Integrating Process-Based Models for Enhanced Representation of Water Quantity and Quality

Moderator: Menberu Meles (USDA)
Location: Folsom/Natoma

1. A new externally coupled physically-based multi-model framework for simulating subsurface and overland flow hydrological processes – ATM Sakiur Rahman (UC Riverside)

2. Investigating Managed Aquifer Recharge Impacts on Redox Potential: A HYDRUS 2D Modeling Approach. Alessandra Bonazzi (UC Davis)

3. CalSim (WRIMS): CoSANA (IWFM) Integration for Sacramento Regional Water Bank Modeling – Puneet Khatavkar (Stantec)

4. Distributed Recharge, Groundwater Flow Modeling, and Scenario Analysis in an Over-Exploited Aquifer: Coupling HYDRUS-1D and 3D Groundwater Flow Modeling in the Central Valley, California – Menberu Meles (USDA)

5:00 – 7:00 p.m.

Session 18. Poster Session & Social

Location: Sierra 1

Posters will be set up by 10:00 a.m. and available for viewing all day. Presenters will be available from 5:00 p.m. to 7:00 p.m.

Social sponsored by HDR, ICF, Stantec, Watercourse Engineering, and Woodard & Curran

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE IF YOU WILL NOT BE COMING BACK TOMORROW.

AGENDA

Wednesday, September 25

7:30 – 8:00 a.m. – Registration in Sierra Hallway

Refreshments sponsored by Pacific Agroecology

8:00 – 9:45 a.m.

Session 19. Reclamation specific LTO Analyses

Moderator: Drew Allan Loney (USBR)
Location: Sierra 1

1. SCHISM use in the LTO – Ben Abban (USBR)
2. PTM and ECO-PTM simulations for LTO – Samaneh Saadat (Jacobs) & Victor Huang (USBR)
3. Trinity Operations – Kunxuan Wang (USBR)
4. Trinity Temperature Operations – Drew Allan Loney & Mussie Beyene (USBR)

Session 20. California Aqueduct Subsidence Program (CASP) Modeling: Panel Discussion

Moderator: Jeff Weaver (HDR)
Location: Folsom/Natoma

1. CASP Hydraulic Modeling – Charles Lintz (HDR)
2. CASP Water Supply Modeling – Rafael Herrera (Stantec)
3. CASP Power Use Modeling – Megan Lionberger (HDR)
4. CASP Flood Hazards Modeling – Chakri Malakpet (HDR)

10:00 – 11:45 a.m.

Session 21. Shasta Operations

Moderator: Ryan Lucas (USBR)
Location: Sierra 1

1. Shasta Action in CalSim – Nancy Parker (USBR)

2. An Optimization Approach for Shasta Temperature Management – Drew Allan Loney (USBR)

3. A Comparison of Shasta Temperature Management Processes – Drew Allan Loney (USBR)

4. Impacts of TUCPs – Ryan Lucas (USBR)

Session 22. Innovative Approaches to Water Management & Ecosystem Sustainability in the California Central Valley & Delta

Moderator: Nicole Osorio (DWR)
Location: Folsom/Natoma

1. Using a Simplified Reservoir Simulator for Exploring Climate Change Adaptation in California's Central Valley – John Rath (Tetra Tech)

2. Estimating Freshwater Inflow to San Francisco Estuary During the First Six Decades Following the California Gold Rush: WY 1851 – 1911 Reconstruction Based on Legacy Hydrologic Data – Paul Hutton (Tetra Tech)

3. Forecasting Central Valley Runoff and water Availability Using NMME 7-Month Forecasts – Chuck Young (SEI)

4. Quantifying the Contribution of Marsh Plants and Aquatic Vegetation to the Detrital Food Web in the California Delta – Ed Gross (RMA)

5. Little Egbert Tract Multi-Benefit Project Hydrodynamic Modeling – Anna Hamilton (CBEC)

11:45 a.m. – 1:15 p.m. - Lunch

Lunch at area restaurants

1:15 – 3:00 p.m.

Session 23. Integrated Modeling for the Central Valley Project Improvement Act (CVPIA) Structured Decision Making (SDM) Process

Moderator: Mark Tompkins (Flow West) & Rod Wittler (USBR)
Location: Sierra 1

1. An overview of SDM for the Bay Delta Office and the Service regarding CVPIA Authorities - Management & Science – Rod Wittler (USBR) & Mike Urkov (Urkov Group)

2. The Fall Run Chinook Salmon Life Cycle Decision Support Model (DSM) – Rod Wittler (USBR) & Mike Urkov (Urkov Group)

3. A Streamlined Approach to Modeling Salmon Habitat in The Central Valley – Mark Tompkins & Emanual Rodriguez (FlowWest)

4. Modeling Chinook Salmon Spawning Habitat Decay – Emanuel Rodriguez (FlowWest) & Rod Wittler (USBR)

5. Updating Sacramento River Hydraulic and Habitat Modeling Data – Rod Whittler (USBR)

Session 24. Groundwater Grab Bag

Moderator: Abdul Khan (DWR)
Location: Folsom/Natoma

1. Groundwater extraction and agricultural demands: Insights from Kern County's Semitropic Water Storage District – Azad Heidari (GEI)

2. Hydroeconomic Modeling of Perennial Crop Dynamics and GSP Demand Management Under SGMA – Duncan MacEwan (ERA Economics)

3. Modeling Multi-benefit Groundwater Smart Markets: Open Water Trade – Brooks Ronspies (ERA Economics)

4. Remote Sensing Estimates of Groundwater Extraction using the GEEEO Process – Jacob Winslow (Davids Engineering)

5. The Pendulum Swings: California's Attempts to Find a Balance Between Fish and Feathers and Folks and Farms Through the Sustainable Groundwater Management Act (SGMA) – Brandon Ertis (Davids Engineering)

3:15 – 5:00 p.m.

Session 25. The Collaboratory Starts Now: Panel Discussion

Moderator: Lisamarie Windham-Myers (Delta Stewardship Council)
Location: Sierra 1

1. An Overview of Collaborative Approaches for Integrated Modeling: What We have Learned – Josue Medellin-Azuara (UC Merced)

2. Delta Science Program Collaboratory Vision 2025: Strategic Advances to Launch Collaborative Science – Lisamarie Windham-Myers (Delta Stewardship Council)

3. 'Use case' approach for the Collaboratory: How did we get here? – Ben Geske (Delta Stewardship Council)

4. Panel Discussion with Lighting Talks
    a. Envisioning Just Transitions in Salinity Management through Collaborative Modeling and Open Science - Laurel Larsen (UC Berkeley)
    b. Opportunities and Challenges in Predicting Harmful Algal Blooms (HABs) - Rusty Holleman (RMA)
    c. Hydrologic Remote Sensing for Ecosystem Models – Lisamarie Windham-Myers (DSC)
    d. Water Management and Salmon - Eric Danner (NOAA)
    e. Developing Food Web Models for Benefits of Tidal Wetland Restoration - Denise Colombano (DSC)
    f. The Collaboration behind CASCaDE: Computational Assessments of Scenarios of Change in the Delta Ecosystem - Lisa Lucas (USGS)
    g. Q&A – App-based real-time online survey & in-person Q&A (additional panel members include Derya Sumer (USBR) & Eli Ateljevich (DWR)

Session 26. Reclamation Grab Bag

Moderator: Maribeth Kniffin (USBR)
Location: Folsom/Natoma

1. Improvements to CalSim Reference Evapotranspiration – Lauren Thatch (USBR)

2. Updates to Forecast-Informed Reservoir Operations (FIRO) at Folsom and Klamath Dams – Drew Allan Loney (USBR)

3. Evaluating the Role of Leakage Efficiency and Release Elevations on Release Water Temperatures at Folsom Dam – Mussie Beyene & Drew Allan Loney (USBR)

4. Allocation Iteration Tool – Dan Easton (MBK) & Sam Waers (USBR)

PLEASE RETURN YOUR NAME BADGE TO THE REGISTRATION TABLE.

ABSTRACTS

Session 1: Connecting Physical & Fishery Modeling
Moderator: James Gilbert (UC Santa Cruz / NFMS)
Moderator Email: james.gilbert@ucsc.edu

1. The Winter Run Lifecycle Model for Scenario Analysis in the Central Valley

Presenter(s): Ann-Marie K. Osterback (UC Santa Cruz)
Presenter email address: annmarie.osterback@noaa.gov
Collaborators: Noble Hendrix (QEDA Consulting, LLC), Eric Danner (NMFS)
Permission to post pdf of presentation: Yes

Water management in California's Central Valley requires balancing the needs of consumptive water use and habitat for sensitive aquatic species. In the Sacramento River system, this balance has become more challenging to achieve as environmental conditions and water availability become increasingly variable and uncertain, and imperiled populations such as federally endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) continue to decline. Therefore, understanding the effects of proposed water operations on winter-run is critical to inform decision-making. The winter-run Chinook salmon life cycle model (WRLCM) can inform decisions by providing a powerful tool to evaluate how changes in water operations affect the long-term population dynamics of Sacramento River winter-run Chinook salmon. By integrating data from water planning models (e.g., CALSIM), physical models (e.g., DSM2, HEC-5Q), habitat capacity models, and lifestage-specific survival models, the WRLCM is able to capitalize on finer resolution data from these models to provide a mechanistic understanding of how individuals interact with their environment, yet still scale up to provide the vital rates needed to inform the WRLCM population model. Recent applications of the WRLCM highlight the importance of using lifecycle models and integrating data sources to better understand how changes to water management decisions in the Central Valley affect the population dynamics.

2. Connecting managed river conditions with salmon disease in the Central Valley

Presenter: Miles Daniels (UC Santa Cruz/NMFS)
Presenter Email Address: miedanie@ucsc.edu
Collaborators: Benjamin Atenctio (UCSC/NOAA)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Outmigrating juvenile Chinook salmon in the Sacramento Watershed are sensitive to the potentially deadly pathogen *Ceratonova shasta*, with the severity of an individual's health outcome linked to environmental conditions, such as temperature and exposure duration. To gain a deeper understanding of the relationship between *C. shasta* infection risk and environmental factors, we conducted field exposure studies using juvenile Chinook salmon at four locations along the Sacramento and Feather rivers, California. Following exposure, pathogen prevalence was estimated and was combined with environmental conditions specific to each exposure group to build a dose-response model of pathogen infection. This presentation will share findings from the dose-response model and discuss how this quantitative approach can be used to predict health outcomes for various fish cohorts with distinct

outmigration exposure histories. These findings will then be placed into the context of river management on the Sacramento and Feather rivers.

3. Hydrological Modeling and Climate Change Analysis to Support Pajaro Valley Ecological Floodplain Inundation Potential (EcoFIP)

Presenter(s): Tapash Das & Syed Azhar Ali (Jacobs)
Presenter(s) email(s): tapash.das@jacobs.com; syed.ali2@jacobs.com
Collaborator(s): Jeremy Thomas (Jacobs), Michael Founds (cbec), Jennifer Marr (DWR), Romain Maendly (DWR), Mark Strudley (Pajaro Regional Flood Management Agency)
Permission for CWEMF to post pdf of presentation: yes

Jacobs and cbec, in collaboration with DWR, deployed Ecological Floodplain Inundation Potential (EcoFIP) ecohydraulic modeling framework to the Pajaro River, Corralitos Creek, and Salsipuedes Creek to identify and quantify opportunities for floodplain reconnection to enhance native fish rearing habitat and augment naturally occurring floodplain recharge. EcoFIP comprehensively assesses physical floodplain restoration opportunities for habitat creation and aquifer recharge at the watershed scale, while providing conceptual design analysis at the project scale. The Jacobs and cbec team provided extensive model development for this project by integrating multiple models to evaluate existing system hydraulics, hydrology under a changing climate, and potential opportunities for multi-benefit flood projects using EcoFIP. To better understand and quantify the potential impacts of climate change on floodplain reconnection opportunities along the Pajaro River, a hydrologic model was developed for the Pajaro River Watershed, and future climate scenarios were then simulated using the data from a weather generator. Working alongside the DWR, the Jacobs and cbec team exhibited the application of weather generator developed climate change scenarios to demonstrate how floodplain inundation might change under future climate conditions, and to quantify resulting impacts to floodplain recharge and suitable habitat. To analyze the potential effects of climate change, 30 decision scaling scenarios were developed and implemented into a hydrologic model to yield long-term, climate-impacted streamflow records. This presentation will summarize hydrological model development and climate change analysis and results to support evaluating multi-benefit floodplain restoration and expansion projects in Pajaro Valley.

4. ***Exploring beyond the historical sequence to understand how multi-year drought characteristics affect Winter Run salmon in California***

Presenter(s): James Gilbert (UC Santa Cruz /NMFS)
Presenter(s) email(s): james.gilbert@ucsc.edu
Collaborator(s): Miles Daniels (UC Santa Cruz/NMFS), Ann-Marie Osterback (UC Santa Cruz/NMFS), Rob Sherrick (California Department of Fish and Wildlife)
Permission for CWEMF to post pdf of presentation: yes

CalSim models are commonly used as the basis for evaluating the long-term effect of reservoir operations on endangered winter-run Chinook salmon in the Sacramento River. The conventional historical time sequence used with CalSim provides substantial inter-annual variability, but contains only a small set of possible multi-year drought sequences. This limits the ability to assess the impact of the sequence and severity of drought years on salmonids with multi-year life cycles, such as winter-run. To address this, we developed a bootstrap resampling scheme to generate novel CalSim3-compatible hydrologic time series conditioned on drought characteristics derived from the historic record. Running these time series through CalSim3 yields an ensemble of reservoir storage, delivery, and flow time series that reflect the uncertainty introduced by relaxing the single hydrologic sequence assumption while converging to the historical mean. Additionally, the reservoir storage and release results can be extended to the analysis of winter-run early life stage survival below Shasta and Keswick dams using temperature models and assumptions about temperature management strategies. We present the modeling process and initial results connecting novel drought sequences to variability in winter-run habitat and survival outcomes.

Session 2: Overview of DWR's Basin Characterization Program
Moderator: Mesut Cayar (Woodard & Curran)
Moderator Email: mcayar@woodardcurran.com

The California Water Code Section 12924(a) requires the Department of Water Resources (DWR) to conduct investigation of the state's groundwater basins, in conjunction with other public agencies, and identify the state's groundwater basins on the basis of geological and hydrological conditions. It also requires that the DWR investigate existing general patterns of groundwater extraction and groundwater recharge within those basins, which characterizes the water budget components of the groundwater basins. The characterization of groundwater basins of California is a key element of the implementation of the Sustainable Groundwater Management Act (SGMA). The data obtained by the basin characterization effort will be used by Groundwater Sustainability Agencies (GSAs) in enhancing their hydrogeologic conceptual models and analytical tools for evaluation of projects and management actions.

This session will provide an overview of DWR's Basin Characterization Program. The session will showcase activities that are being conducted as part of the Basin Characterization program such as data access, management, and visualization efforts; geophysical, hydrologic, and hydrogeologic investigations; and tools that are being developed to use the geophysical, hydrologic, and hydrogeologic data as model input data for planning, management, and evaluation of progress towards sustainability.

1. An Introduction to DWR's Basin Characterization Program

Presenter(s): Katherine Dlubac & Steven Springhorn (DWR)
Presenter(s) Email Address(es): Katherine.dlubac@water.ca.gov; Steven.Springhorn@water.ca.gov
Collaborators: Benjamin Brezing (DWR), Tim Godwin (DWR), Craig Altare (DWR), Saquib Najmus (Woodard & Curran), Mesut Cayar (Woodard & Curran), Paul Thorn (Ramboll), Ian Gottschalk (Ramboll)
Permission to Post pdf of Presentation on CWEMF Website: Yes

DWR has a long history of studying and characterizing California's groundwater aquifers as a part of California's Groundwater (Bulletin 118). The Basin Characterization Program provides the latest data and information about California's groundwater basins to help local communities better understand their aquifer systems and support local and statewide groundwater management. DWR's historic Basin Characterization efforts include providing technical assistance through the collection, analysis, and sharing of various datasets, including CASGEM, OSWCR, the Statewide AEM Surveys, and more. DWR is now moving into the next phase of Basin Characterization where new and existing data will be integrated to create three-dimensional models that identify aquifer structures and conditions more clearly than ever before. We are expanding data collection efforts and developing new data visualization tools to make the data more accessible to a broad audience. As part of the Basin Characterization Program, DWR will integrate new and existing data into three-dimensional models that describe the grain size and hydrostratigraphic properties of the aquifers. These models help groundwater managers understand how groundwater is stored and moves within the aquifer. The models will be regularly updated, as new data becomes available, to ensure that up-to-date information is used for groundwater management activities. To develop the texture and hydrostratigraphic models, new tools will be created to integrate and analyze a wide range of data, including geologic, geophysical, and hydrogeologic information. By combining and assessing various datasets, these tools will help create a more complete picture of California's groundwater basins.

2. DWR's Basin Characterization Program: Data Access, Management, and Visualization

Presenter(s): Benjamin Brezing (DWR)
Presenter(s) Email Address(es): Benjamin.brezing@water.ca.gov
Collaborators: Katherine Dlubac (DWR), Steven Springhorn (DWR), Amanda Ott (DWR), Michelle Zhang (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

DWR is committed to ensuring that all data collected or compiled is made accessible to the public. All data collected as a part of the Basin Characterization Program will be available to download from the California Natural Resources Agency Open Data Portal. DWR is also committed to data access equity by ensuring data can be viewed online, eliminating the need for costly software. As a part of the Basin Characterization Program, new online GIS-based visualization tools will be developed to serve as a central hub for accessing and exploring the data. These tools will enable both the public and technical users to interact with the data in a three-dimensional space, providing a more immersive and informative experience. The Statewide AEM Survey data and digitized lithology logs can be viewed in a three-dimensional space or as profiles through DWR's innovative AEM Data Viewers.

3. Geophysical and hydrogeologic investigations to characterize the subsurface near the Upper San Joaquin River

Presenter(s): Timothy Parker (Ramboll)
Presenter(s) Email Address(es): tparker@ramboli.com
Collaborators: Ian Gottschalk (Ramboll), Frederik Christensen (Ramboll), Javier Peralta (Ramboll), Elyse Smith (Ramboll), Paul Thorn (Ramboll), Saquib Najmus (Woodard & Curran), Mesut Cayar (Woodard & Curran), Katherine Dlubac (DWR), Steven Springhorn (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The California Department of Water Resources (DWR) is conducting investigations of the state's groundwater basins to refine the understanding of groundwater basins based on geological and hydrogeological conditions. Increasing water demands and decreasing supplies caused by growth and climate variability have heightened the existing need to characterize California's groundwater basins, especially in areas where managed aquifer recharge projects could provide resilience to water supply. Data acquired in boreholes can provide information with excellent vertical resolution, and measurements can be repeated over time. However, these borehole data do not provide the lateral resolution necessary to understand horizontal variation in the subsurface. Geophysical methods can supplement invasive subsurface investigations of the shallow subsurface, providing a cost-effective approach compared to drilling boreholes and installing wells, which laterally only provide information at a single point. We present results from an ongoing pilot survey, in collaboration with DWR and Woodard and Curran, to characterize the subsurface along the Upper San Joaquin River, CA. A primary focus of the effort is to evaluate the groundwater recharge potential in the area and the connection to the larger groundwater system. We present the joint hydrogeologic and geophysical approach to data acquisition, survey design considerations, integration of newly acquired data with existing geophysical data from the DWR Statewide Airborne Electromagnetic Surveys, and an overview of upcoming pilot surveys.

4. Developing Conceptual Models and Parameterizing Numerical Models using AEM and Other Hydrogeologic Data Types

Presenter(s): Matt Tonkin (SSP&A), Mesut Cayar (Woodard & Curran)
Presenter(s) Email Address(es): matt@sspa.com; mcayar@woodardcurran.com
Collaborators: Vivek Bedekar (SSP&A), Michael Ou (SSP&A), Leland Scantlebury (SSP&A), Jack Baer (Woodard & Curran), Sercan Ceyhan (Woodard & Curran), Saquib Najmus (Woodard & Curran), Nicole Koerth (Woodard & Curran)
Permission to Post pdf of Presentation on CWEMF Website: Yes

California DWR has embarked on a multi-year program to characterize the State's groundwater basins and support of water resource management, driven in part by the SGMA. In concert with wide-ranging data collection activities, foremost among which is the acquisition of AEM survey data, DWR is supporting the development of a freeware "basin characterization and modeling" toolset. Building on previous work, the two main components of this toolset – AEM2HCM and AEM2PAR - are being linked to facilitate rapid processing, integration, and codification of disparate data types in the development and parameterization of water resource models. The first part of this presentation focuses on the AEM2HCM tool, which uses unsupervised machine learning algorithms and visualization functions to process and display the data provided by the AEM surveys to streamline HCM creation and to incorporate data uncertainty to come up with alternate HCMs. The second part provides updates on AEM2PAR, the second major element of the basin characterization and modeling toolset, which is being expanded to incorporate interpretive information – such as geologic sections – together with previously supported data types such as borehole logs and AEM survey data. By doing so, it is hoped that the toolset will enable the discretization, parameterization, calibration, and analysis of uncertainty of not just one, but multiple, model realizations reflecting alternate HCMs. This presentation shares progress updates on AEM2HCM and AEM2PAR and seeks input on appropriate development directions to ensure that when completed, the entire toolset offers the most beneficial capabilities to the wider modeling community.

Session 6: Colorado River Basin Modeling
Moderator: Rich Juricich [Woodard & Curran]
Moderator Email: rjuricich@woodwardcurran.com

This session will describe several modeling activities that are supporting decisions in the Colorado River Basin. The session brings together technical staff located in both the Upper and Lower Basin States and the U.S. Bureau of Reclamation. The Basin States and stakeholders in the Basin are striving to reach consensus on long-term operating criteria that will guide the operations of Lakes Powell and Mead for decades to come. The parties are under pressure to complete negotiations before the existing operating guidelines expire at the end of 2026.

1. ***The Role of Modeling in Planning and Management of the Colorado River for California in a Changing World***

Presenter(s): David Rheinheimer & Angela Rashid [Colorado River Board of California]
Presenter(s) email(s): drheinheimer@crb.ca.gov; arashid@crb.ca.gov
Permission for CWEMF to post pdf of presentation: yes

The Colorado River is a vital lifeline to California's people, economy, and environment, providing both urban and agricultural water supply and supporting critical natural habitats. Modeling provides a key tool in planning and managing the river as both the river and the demands that are placed on it change. This talk reviews the specific role of modeling to support California's decision-making processes for planning the Colorado River in the context of changes in hydrologic conditions due to climate change and water demand due to changing socioeconomic conditions. Modeling to support the ongoing process to develop operational policies for Lakes Powell and Mead after 2026, when current reservoir operational guidelines are set to expire, is discussed as an example, with representative modeling and analytical examples. Technical collaboration modes are also discussed, from a modelling perspective. A broad overview of other water system modeling efforts related to Colorado River use in California will also be provided.

2. ***Drought Mitigation Planning in the Colorado River Basin in Utah***

Presenter(s): Betsy Morgan [Colorado River Authority of Utah]
Presenter(s) email(s): bdmorgan@utah.gov
Permission for CWEMF to post pdf of presentation: yes

The recently established Colorado River Authority of Utah, whose mission is to "protect, conserve, use, and develop Utah's waters of the Colorado River System," has identified a need for technical tools to enable drought mitigation planning within the Colorado River Basin of Utah. In response to this need, the Utah Colorado River Accounting and Forecasting (UCRAF) project was commissioned with an associated Decision Support Tool (DST). The UCRAF-DST modeling system combines a Diversion-Runoff Calculator (DRC), a RiverWare© rule-based and accounting simulation model, geospatial datasets, OpenET data, and internet/web services. Two models are currently being developed—one for the Duchesne Basin in northeastern Utah and one for the Price and San Rafael Basins in central Utah. UCRAF will be used to develop a comprehensive understanding of the current water budget and water rights within the basin and will ultimately be used as a planning tool to evaluate how drought mitigation measures (e.g., fallowing fields, changing irrigation measures) affect water availability and water rights at the location implemented and for downstream users. This presentation will highlight the application of UCRAF to drought mitigation planning in Utah and will include preliminary modeling results for the Duchesne Basin.

3. ***The Use of Models by the Central Arizona Project to Support Water Supply Planning in an Uncertain Future***

Presenter(s): Nolie Templeton [Central Arizona Water Conservation District]
Presenter(s) email(s): ntempleton@cap-az.com
Permission for CWEMF to post pdf of presentation: yes

Central Arizona Project (CAP) delivers Colorado River water to central Arizona, where about 82% of the state's population resides. To plan for a highly uncertain future, CAP applies models at various spatial and temporal scales to support policymakers and water managers. These models simulate a broad range of future conditions and provide insights based on hydrology, demands and operational proposals, including the supply impacts to Arizona water users. This presentation will explain how the Bureau of Reclamation's Colorado River Mid-term Modeling System (CRMMS) and the Colorado River Simulation System (CRSS) are used to analyze alternative operational conditions under various hydrological futures and how impacts are analyzed. The presentation will also detail how CRMMS/CRSS outputs are visualized to further evaluate the implications for consumers. These modeling and visualization tools advance CAP's analytical capacity and provide critical insights and planning support for Arizona's water users.

4. ***Overview of Colorado River System Models and the Update of the Operating Guidelines for Lakes Powell and Mead***

Presenter(s): Harrison Zeff [U.S. Bureau of Reclamation]
Presenter(s) email(s): hzeff@usbr.gov
Permission for CWEMF to post pdf of presentation: yes

The Bureau of Reclamation's Upper and Lower Colorado regions use multiple models for mid- to long-term operations and planning. This talk will provide an overview of the different models used by Reclamation to support management of the Colorado River, including the applications of models to support update of the operating guidelines for Lakes Powell and Mead. The key inputs and assumptions of the three models will be compared and their typical uses discussed with a focus on addressing uncertainties in long term planning.

Session 7: Central Valley Project Water Temperature Modeling Platform, Chapter 3
Moderator: Yung-Hsin Sun (Sunzi Consulting LLC)
Moderator Email: sun.yunghsin@sunziconsulting.com

The session is the third installment of the Central Valley Project (CVP) Water Temperature Modeling Platform (WTMP) project at the CWEMF Annual Meeting, following the introductory session in 2022 and the progress update session 2023. The CVP WTMP by Reclamation aims to modernize the analytical tools that Reclamation uses to support activities and decision-making for water temperature management in CVP reservoirs in Sacramento-Trinity, American, and Stanislaus River watersheds to protect fishery species in downstream river reaches. The initial development of the WTMP was completed for internal deployment within U.S. Department of the Interior, Bureau of Reclamation (Reclamation) in March 2024. The geographic scope includes (1) the northern system: Shasta Lake, Keswick Reservoir, and Sacramento River from Keswick Dam to Red Bluff, Trinity Lake, Lewiston Lake, and Trinity River to North Fork Trinity River, and Whiskeytown Reservoir and Clear Creek from Whiskeytown Dam to Sacramento River; (2) the American River system: Folsom Reservoir, Lake Natoma, and American River downstream from Nimbus Dam to Sacramento River; and (3) the Stanislaus River system: New Melones Lake, Tulloch Lake, Goodwin Dam, and Stanislaus River from Tulloch Dam to San Joaquin River. Taking advantage of improved technology, the WTMP improved capacity to provide more efficient and reliable tools to assess strategies for managing CVP facilities for authorized purposes including water temperature management with a finite cold-water resource. The WTMP Project also provided significant opportunities for organization capacity building at Reclamation. In this session, two rounds of facilitated panel discussion/presentation will provide (1) a conclusive summary of the implemented WTMP components and functionalities, (2) the project approach and ongoing activities within Reclamation for successful long-term WTMP implementation, and (3) a review of the realized and anticipated impacts of this approach and resulting tools on operation, Reclamation as an organization, and modeling practices. Each panel segment will include a question-and-answer (Q&A) period to provide the audience an opportunity to clarify and further explore topics of interest related to the WTMP and water temperature management in the CVP system in general.

1. Session Introduction and Recap

Presenter(s): Yung-Hsin Sun (Sunzi Consulting LLC)
Presenter(s) email(s): sun.yunghsin@sunziconsulting.com
Permission for CWEMF to post pdf of presentation: yes

The Central Valley Project (CVP) Water Temperature Modeling Platform (WTMP) Project is an important undertaking by Reclamation supported by the Bay Delta Office, Central Valley Project Operations Office, and Planning Office of the California-Great Basin Region. Reclamation's goal for this project is to address the need to modernize water temperature models for continued CVP operation in the Sacramento-Trinity, American, and Stanislaus River systems, and associated fishery species protection. This introductory presentation provides a brief recap of the WTMP Project, previous CWEMF sessions in 2022 and 2023 (a.k.a. Chapters 1 & 2), and a session introduction to establish a common understanding for the remaining discussions.

2. What We Have Done

Presenter(s): Mike Deas (Watercourse Engineering, Inc.), John DeGeorge (Resource Management Associates), Yung-Hsin Sun (Sunzi Consulting LLC), Randi Field (USBR)
Presenter(s) email(s): mike.deas@watercourseinc.com; jfdegeorge@rmanet.com; sun.yunghsin@sunziconsulting.com; RField@usbr.gov
Permission for CWEMF to post pdf of presentation: yes

The Central Valley Project (CVP) Water Temperature Modeling Platform (WTMP) is a suite of software tools that will facilitate Reclamation's temperature modeling activities for the Sacramento-Trinity, American, and Stanislaus River systems. Primary design objectives for the WTMP are to (1) conform to professional standards of care in analytical tool development, applications, documentation and testing for reservoir-river system water temperature management; (2) be used consistently for both CVP real-time operations and seasonal and long-term planning purposes; and (3) be flexible to accommodate future technologic advancements in analytical modeling for reservoir-river system water temperature management and characterization of uncertainty. Initial development of the WTMP was completed in March 2024 and additional fine tuning for the public release (Rollout) is ongoing. This panel presentation is to provide a summary of the WTMP from the initial implementation and the anticipated public release of the WTMP (WTMP Rollout). Mike Deas and John DeGeorge will highlight the implemented WTMP based on the above principles, as well as an overview of the resulting temperature models with their features, data management system, modeling framework structure and reporting functions, and standardized workflows with options for customization. Mike Deas will focus on the overall platform design and accomplishments of the WTMP, which is a rigorous and yet flexible toolbox for housing and implementing different temperature management modeling tools and utilities for consistent high-quality applications with confidence. John DeGeorge will focus on the innovation and technological advancements embodied in the WTMP. Yung-Hsin Sun will focus on the successful implementation of a community-supported model development process, and institutional knowledge development for Reclamation to own the knowledge and experience for the platform and its sustainable application. Randi Field will provide a summary of an independent peer review conducted by the Delta Science Program, ongoing activities for preparing internal and external WTMP implementation, and finally a preview of the upcoming WTMP Rollout.

3. The End is the Beginning – USBR Panel Discussion

Panelists: Thomas Patton, tpatton@usbr.gov; Mechele Pacheco, mpacheco@usbr.gov; Ryan Lucas, rlucas@usbr.gov; David Mooney, dmmooney@usbr.gov; Levi Johnson, lejohnson@usbr.gov
Permission for CWEMF to post pdf of presentation: yes

For the development of the Central Valley Project (CVP) Water Temperature Modeling Platform (WTMP), Reclamation has identified the following principles: (1) focusing on technical improvement to advance water temperature modeling tools and analytical methods; (2) using a collaborative model development approach with stakeholders and interested parties; and (3) building trust and confidence with independent scientific peer review. The resulting WTMP Project and its products, as well as the prospect of continued development and implementation by Reclamation, present a unique case study in model development for California's water and environmental management. The collaborative model development reflects the intent and emphasis on transparency and community engagement. The design and execution of the WTMP has resulted in an ambitious platform and models with rigor for conforming modern modeling standards and flexibility for accommodating additional models and technology advancement. Reclamation's organizational commitments are also critical for the success to date in tool development with expanded organizational capacity. This panel, consisting of modelers, operators, and managers within Reclamation, will share their experience and perspectives on WTMP development, implementation, and long-term business cases for fulfilling Reclamation's mission.

Session 9: Delta Salinity Management in Drought: Surrogate Development under Drought, Landscape Change and Sea Level Rise
Moderator: Eli.Ateljevich@water.ca.gov (DWR)
Moderator Email: Eli.Ateljevich@water.ca.gov

Recent droughts, emergency barriers, restoration proposals and climate concerns have brought to light new challenges in modeling the salinity-outflow relationship of the Delta and describing the implications of the changes for California water management. In this session we bring first round results from a collaboration between Resource Management Associates (RMA), Department of Water Resources (DWR) and the Delta Science Program (DSP) to improve the connections between high resolution multidimensional modeling results and CalSIM. We address and improve the surrogate methodology in which a simplified representation of the Delta plays a central/controlling role in statewide water management.

1. Increasing Transparency and Flexibility of the CalSIM Delta Salinity Surrogate Process

Presenter: Eli Ateljevich (DWR)
Presenter Email: Eli.Ateljevich@water.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

Surrogates are used in the state operations model CalSIM to represent complex hydrodynamic relationships and formulate constraints. As it is a very early application of neural networks, the CalSIM surrogate methodology has been bogged down in older technology. Here we describe a transition to the ubiquitous TensorFlow platform, some improvements that make it easier for a non-CalSIM developer to access and use, and modifications to embrace new ANN architectures and even non-ANN surrogates.

2. *Representative Hydrology and Salinity Conditions for Machine Learning*

Presenter: Lily Tomkovic (DWR)
Presenter Email: Lily.Tomkovic@water.ca.gov
Collaborators: Eli Ateljevich (DWR), Ryan Ripken (RMA)
Permission for CWEMF to post pdf of presentation: Yes

Traditionally, CalSIM surrogates have been trained with long hydrologies together with results from the 1D hydrodynamic and transport model DSM2. As we contemplate using expensive multi-dimensional models for training, it is natural to ask whether there might be a more compact and partially synthetic dataset that represents important axes of variability much more efficiently. In this talk we discuss the use of cluster analysis to derive 4-6 “canonical” years from the point of view of salinity control. We also describe the use of perturbations and ideas from statistical study design to add variability and avoid rote memorization.

3. ANN Architecture, memorization and overfit

Presenter: Ryan Ripkin (RMA)
Presenter Email: ryan @rmanet.com
Collaborators: Edward Gross (RMA)
Permission for CWEMF to post pdf of presentation: Yes

This talk discusses in more detail the overfitting and memorization issues inherent to some ANN architectures that have been proposed for the Delta. Extending from the previous talk, we discuss architectures and training methodologies that are compact, avoid overfit and preserve sensitivities.

4. *Restoration designs and early results*

Presenter(s): Stacie Grinbergs (RMA)
Presenter Email(s): stacie@rmanet.com
Permission for CWEMF to post pdf of presentation: Yes

In this presentation we describe scenario choices, early results on implications for salinity management, as well as strategies for surrogates. The designs are inspired by the Delta Adapts program and other restoration efforts.

Session 10: Improved Groundwater-Surface Water and Water Allocation Models and Data to Support Water Management in the Scott River and Shasta River Watersheds
Moderator: Shahab Araghinejad (SWRCB)
Moderator Email: Shahab.Araghinejad@Waterboards.ca.gov

Water year 2021 was one of the most severe droughts on record in California. On April 21, May 10, and October 19, 2021, Governor Gavin Newsom issued proclamations declaring drought states of emergency in different parts of the state, providing authorizations and directing state agencies to take expedited actions during the drought emergency. Among other things, the proclamations directed the State Water Resources Control Board (State Water Board) to consider emergency regulations in multiple watersheds throughout the State of California to curtail water diversions when water is not available at a water right holder's priority of right. The presentations in this session summarize modeling efforts used to inform the State Water Board actions under drought emergency regulation and other efforts (such as Sustainable Groundwater Management Act) to evaluate and support potential actions that may be taken to enhance and establish instream flow for anadromous fish in the Scott River and Shasta River watersheds with considerations for other beneficial uses of water (e.g., municipal, agricultural). The modeling efforts in the Scott River and Shasta River watersheds include a range of surface water, groundwater, and water allocation models. Presentations will cover the technical aspects of developing the modeling, challenges encountered, and the benefits of using new conceptual models and data sets to improve the models. New conceptual models and data sets used to improve the models include incorporating the Department of Water Resources' Airborne Electromagnetic Survey (AEM) and high-resolution Light Detection and Ranging (LiDAR) data, replacing statistical-based surface water estimation with a physically-based precipitation-runoff model, incorporating continuous groundwater level and streamflow records to enhance model calibration , refining agricultural water demand and deep percolation parameterization, and organizing water rights, allocation priorities, and places of use through a water allocation algorithm.

1. *Scott Valley Airborne Electromagnetic Data Interpretation and Assimilation into a Groundwater-Surface Water Model*

Presenter(s): Leland Scantlebury (UC Davis)
Presenter(s) Email Address(es): lscantle@ucdavis.edu
Collaborators: Thomas Harter (UC Davis), Claire Kouba (UC Davis)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The California Department of Water Resources (DWR) has been collecting airborne electromagnetic (AEM) data for overdrafted groundwater basins across the state. The hope is these data will lead to better knowledge about the important water resources in these basins. However, the data is not readily able to be incorporated into existing groundwater models or other decision-making tools. Here a method introduced in Knight et al. (2018) is applied to a basin with a very different hydrogeology in Northern California, the Scott Valley watershed. The method is used to identify texture-resistivity distributions that can be used to probabilistically classify the AEM data. These classifications are then combined with existing borehole log texture data, using the hydrogeologic modeling tool Texture2Par. The hydraulic property estimates are then inserted into a MODFLOW-NWT model of the watershed, known as the Scott Valley Integrated Hydrologic Model (SVIHM). SVIHM includes a coupled soil water model that calculates irrigation demands and incorporates water management decisions like the recent curtailment orders during California's recent drought. Ideally, the assimilation of the AEM data into the existing model will result in improved predictions of spatial groundwater-surface water relationships and a better understanding of the basin flow dynamics. The primary purpose of the model is as a

decision support tool for water management in Scott Valley – a primarily agricultural basin but also a habitat for endangered salmon. Many of the predictions of interest are controlled by spatial differences in stream-aquifer connectivity, thus the model stands to gain much from the added heterogeneity of the AEM data.

2. Updated Precipitation-Runoff Modeling System in Scott Valley

Presenter(s): Katrina Arredondo (Larry Walker Associates)
Presenter(s) Email Address(es): katrinaa@lwa.com
Collaborators: Laura Foglia (Larry Walker Associates)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Scott Valley is a tributary of the Klamath River and provides important habitat for endangered salmon species. To better understand streamflow in the valley, a Precipitation-Runoff Modeling System (PRMS) was constructed to estimate runoff and streamflow in the entire Scott Valley Watershed. The PRMS model was designed to provide improved modeled streamflow into the Scott Valley Integrated Hydrologic Model (SVIHM), a MODFLOW-based groundwater model. SVIHM is used by the local groundwater sustainability agency (GSA) of the Scott Valley groundwater basin for groundwater sustainability plan (GSP) implementation. The Scott Valley PRMS model provides daily streamflow timeseries of the Scott River and tributaries from water year 1991 to 2023. The PRMS model was used to develop an unimpaired flow scenario and has been recalibrated with updated estimated diversions from SVIHM.

3. Shasta Watershed Groundwater Model (SWGM) – Challenges and Updates Enlightened by New Datasets

Presenters: Laura Foglia and Jose Tomas Diaz Casanueva (Larry Walker Associates)
Presenter(s) Email Address(es): lauraf@lwa.com, josed@lwa.com
Collaborators: Andrew Calderwood & Paula Rueda-Villamil (Larry Walker Associates)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The presence of lava tubes within basaltic formations and springs emerging from Quaternary and Tertiary High Cascade volcanic materials constitute a challenging geological setting for the development of the Shasta Watershed Groundwater Model (SWGM). This geological complexity, enhanced by limited data availability and intricate groundwater-surface water interaction dynamics, have historically contributed to a poor understanding of Shasta's groundwater system. During the WY2023 Groundwater Sustainability Plan (GSP) annual reporting process, we significantly improved the performance of the SWGM. We filled data gaps by incorporating continuous groundwater level and streamflow records. We refined our hydrogeologic conceptual model by incorporating DWR's Airborne Electromagnetic Survey (AEM) and high-resolution Light Detection and Ranging (LiDAR) data. Agricultural water demand and deep percolation were parameterized using the soil water budget approach developed by Foglia et al. (2013) in conjunction with recently published land use data. Our groundwater model was recalibrated using an updated dataset of observations. The performance of our updated model was assessed by performing sensitivity and uncertainty analyses. We used our updated model to identify critical hydrological conditions and develop future scenarios. Our updated model represents a valuable tool for decision makers to quantify the effects of management strategies on groundwater levels, groundwater dependent ecosystems, ecological flows in streams, and agriculture. Our results provide key guidance to the Shasta Valley Groundwater Sustainability Agency (GSA) to achieve their goal of

maintaining groundwater resources in ways that best support the continued and long-term health of the people, the environment, and the economy.

4. Organizing adjudicated water right decree data in the Scott River

Presenter: Doug Chalmers (Stockholm Environment Institute)
Presenter(s) Email Address(es): doug.chalmers@sei.org
Collaborators: Chuck Young (Stockholm Environment Institute)
Permission to Post pdf of Presentation on CWEMF Website: Yes

How can the water rights data for the Scott River watershed- with 3 adjudicated decrees, appropriative water rights in eWRIMS, and overlying groundwater rights- be organized to use as model inputs? Water rights have been adjudicated under the Scott River decree in 1980, the Shackleford Creek decree in 1958, and the French & Miners Creek decree in 1950. Further complicating the picture is that overlying groundwater pumping is not reported, and an uncertain amount of water rights are cross-listed between the decrees and eWRIMS. How can we extract the place of use, point of diversion, allocation priority, and allowed water diversion information for all these rights? This talk will discuss:

(1) What challenges and discoveries were there in organizing the water rights data?
(2) How were the allocation priorities modeled, considering the detailed rules within each decree as well as the seniority across the different types of water rights?
(3) How were the places of use for decreed rights aligned with modern irrigation field imagery?
(4) How was the eWRIMS Analyzer tool applied to organize water rights data from eWRIMS?

The resulting dataset is being applied in a WEAP water allocation model of the Scott River watershed, connecting with imagery-based irrigation demand and surface-groundwater interactions from SVIHM (Scott Valley Integrated Hydrologic Model) (UC-Davis) and surface runoff from PRMS (Larry Walker Associates).

Session 11. Consultation on the Coordinated Long-Term Operation of the CVP and SWP
Moderator: Lauren Thatch [USBR]
Moderator Email: lthatch@usbr.gov

1. LTO Background and Updating the LTO No Action Alternative

Presenter(s): Ryan Lucas [USBR], Derya Sumer [USBR], Thomas Fitzugh [Stantec], Chad Whittington [Jacobs]
Presenter(s) email(s): rlucas@usbr.gov
Collaborator(s): Andy Draper [Stantec], Rob Leaf [Jacobs]
Permission for CWEMF to post pdf of presentation: yes

On Sept. 30, 2021, Reclamation and the California Department of Water Resources requested reinitiation of consultation on the Long-Term Operation of the CVP and SWP. with the U.S. Fish and Wildlife Service and National Marine Fisheries Service due to anticipated modifications to the proposed action that may cause effects to ESA-listed species and/or designated critical habitat not analyzed in the 2019 biological opinions. This reinitiation of consultation of the LTO resulted in both major and minor upgrades to the LTO No Action Alternative. Major upgrades included extending the simulation period, development of new climate change input data and many evapotranspiration and CalSimHydro updates. Updating the LTO NAA for the reinitiation of consultation required an immense undertaking by multiple Reclamation offices (BDO, CVO, TSC), DWR, and the consulting community, as well as collaboration with our fish agencies (NMFS, USFS, CDFW). This talk discusses the coordination and collaboration, and the technical challenges that went into updating the LTO NAA.

2. Modified OMR

Presenter(s): Cameron Koizumi [USBR]
Presenter(s) email(s): ckoizumi@usbr.gov
Permission for CWEMF to post pdf of presentation: yes

For both the 2019 BiOps and the Proposed Action under Reclamation's new LTO, there are a collection of actions that limit reverse Old and Middle River flows toward the CVP and SWP pumping facilities. The triggers for these actions are often based on fish behavior which cannot be directly modeled in CalSim, and there were no apparent correlations of those triggers to hydrodynamic conditions. During the LTO process, Reclamation and DWR worked together to develop a new implementation of the OMR actions which relied on the historical presence of fish and salvage.

3. Model Development for State Water Project Long Term Operations

Presenter(s): Yiwei Cheng & Nicole Osorio (DWR)
Presenter(s) email(s): yiwei.cheng@water.ca.gov; nicole.osorio@water.ca.gov
Collaborator(s): Erik Reyes (DWR), Nazrul Islam (DWR), Raymond Hoang (DWR), Aaron Miller (DWR), Devinder Dhillon (DWR), Nancy Parker (USBR), Cameron Koizumi (USBR), Tom FitzHugh (Stantec), Puneet Khatavkar (Stantec), Jeffrey Weaver (HDR)
Permission for CWEMF to post pdf of presentation: no

The California Department of Water Resources released the draft Environmental Impact Report (EIR) for Long Term Operation (LTO) of the State Water Project (SWP) in the Sacramento-San Joaquin Delta, Suisun

Marsh and Suisun Bay in May 2024. This presentation will provide a high-level overview of CalSim3 model development for SWP LTO as discussed in the draft EIR. There are two main components of development: (1) extended hydrology update and (2) updates to the baseline and proposed project CalSim3 models.

4. LTO Alternative 3

Presenter(s): Chad Whittington [Jacobs]
Presenter(s) email(s): Chad.Whittington@jacobs.com
Collaborator(s): Rob Leaf [Jacobs], Derya Sumer [USBR]
Permission for CWEMF to post pdf of presentation: yes

As part of the US Bureau of Reclamation's 2021 Long-Term Operations (LTO) of the CVP and SWP, Alternative 3 represents a water resources operational strategy informed by environmental NGOs involved in state-wide water projects. Also referred to as the Modified Natural Hydrology scenario, Alternative 3 includes unimpaired flow, Delta outflow, and reservoir carryover measures to improve drought protection and temperature management. As modeled in CalSim 3, the alternative applies a unique prioritization of operational criteria for meeting downstream demands while maintaining prescribed storage and flow targets. CVP and SWP deliveries are determined by forecasting upstream storage conditions and the quantity of water needed from the Shasta, Oroville, and Folsom reservoirs to meet delivery and regulatory requirements. Allocations for each contract type are adjusted based on rules developed in collaboration with the NGOs. In general, Alternative 3 yields higher levels of upstream carryover storage and Delta outflow than other 2021 LTO Alternatives.

5. Simulating the Voluntary Agreements

Presenter(s): Thomas FitzHugh [Stantec]
Presenter(s) email(s): thomas.fitzhugh@stantec.com
Collaborator(s): Roja Kaveh Garna & Puneet Khatavkar [Stantec]
Permission for CWEMF to post pdf of presentation: yes

Voluntary Agreements are related to the State Water Board's efforts to update and implement the Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (Bay-Delta Plan). A Memorandum of Understanding (MOU) was signed in March 2022 which committed water agencies to providing additional flows through upstream tributaries and the Delta through a series of VAs. These VAs were implemented in the CalSim 3 model used to simulate Alternative 2 in Reclamation's LTO modeling. The VAs implemented in the model cover the Delta (CVP and SWP); the Sacramento, Feather, Yuba, American, Upper San Joaquin (Friant VA), and Mokelumne Rivers; and also Putah Creek. This presentation will cover the assumptions implemented for each VA, the modeling approach used, and results. The VA code implementation was derived from earlier DWR modeling efforts, but certain modifications were made to these earlier models and also to assumptions in the MOU, so these changes will be highlighted. An overview will be provided on the outflow changes due to each VA and due to all VAs combined, as well as the Delta export and CVP/SWP delivery changes associated with the Delta VA. VA performance will be compared to stated goals in the MOU. Lastly, effects on other parts of the system (i.e. upstream storages) will also be summarized.

Session 12: History of Modeling Tools
Moderator: Vivek Bedekar
Moderator Email: vivekb@sspa.com

Modeling codes are important tools to understand water systems in California. On the occasion of the 30th anniversary of CWEMF, this session looks back at the development of a few modeling codes that are widely used by the modeling community in California. The session aims to capture the long history, both technical and non-technical, of the codes and the presenters will provide the motivation, challenges, anecdotes, and trivia associated with the development of IGSM/IWFM, MODFLOW, LSPC, and groundwater solute transport codes.

1. The Story of IWFM: A Journey Through Time

Presenter(s): Saquib Najmus (Woodard & Curran) and Can Dogrul (DWR)
Presenter(s) Email Address(es): snajmus@woodardcurran.com; can.dogrul@water.ca.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

Integrated Water Flow Model (IWFM) has been developed and maintained by the California Department of Water Resources since the early 2000s. IWFM and its companion software, IWFM Demand Calculator (IDC), have become an important tool for Groundwater Sustainability Agencies (GSAs) to develop their Groundwater Sustainability Plans (GSPs) as part of the implementation of the Sustainable Groundwater Management Act (SGMA). Today, about 70% of the GSPs developed in the Central Valley utilize IWFM for evaluating projects and management actions. Although IWFM has become a "household" name in the GSP development circles in the last decade, its origins go back to 1970s. This presentation will take the audience back to those days and walk them through IWFM's gradual evolution to simulate more and more complex hydrologic processes to address emerging needs of the groundwater managers concomitant with increased availability of data and computational power.

2. The History of MODFLOW

Presenter(s): Richard B. Winston (USGS)
Presenter(s) Email Address(es): rbwinst@usgs.gov
Permission to Post pdf of Presentation on CWEMF Website: Yes

This history of MODFLOW is presented using audio recordings of interviews with its developers extending from electrical analog models through MODFLOW 6. In 1980, a committee of eight was assigned to create MODFLOW, but half of the original members left the USGS early in the project. Michael McDonald was then added to the committee. He recruited Arlen Harbaugh, and together, the two of them created the first version of MODFLOW. More than two dozen additional packages were added to MODFLOW through the release of MODFLOW-2005. Some of these packages were developed in partnership with external collaborators such as Sorab Panday from AMEC Geomatrix Inc. (MODFLOW-NWT). Many of the new packages were developed by hydrologists in the field offices to address modeling challenges not addressed by the first version of MODFLOW. For example, the Stream package was developed by David Prudic in the Carson City, Nevada office with advice by McDonald. MODFLOW 6 was a redesign of MODFLOW. While it retains some of the original design features of earlier versions of MODFLOW, internally, it was rewritten from scratch using object-oriented programming patterns, and thus, the source code does not resemble previous versions. In addition, some of the packages have been dropped, others have been merged, and new capabilities have been added. MODFLOW 6 is being developed in conjunction with Flopy. This close collaboration ensures that Flopy supports the latest features

in MODFLOW when those new features are released. The widespread adoption of MODFLOW was not inevitable. Numerous factors contributed to its success:

- It met societal and a USGS needs.
- It was free.
- It was easy to use.
- The input structure was clearly described.
- It was thoroughly documented including documentation of how the program related to the conceptual model and hydrology.
- It made good use of computer memory.
- It was virtually free of bugs.
- Source code was available.
- It had the imprimatur of the USGS which was advantageous in litigation.
- MODPATH, ZONEBUDGET, and MT3D extended its simulation capabilities.
- Graphical User Interfaces for it were developed which made it easier to use.

3. The Present and Future Role of the Loading Simulation Program C++ (LSPC) in Watershed Modeling and Water Management

Presenter(s): John Riverson (Paradigm Environmental)
Presenter(s) Email Address(es): john.riverson@paradigmh2o.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

The Loading Simulation Program C++ (LSPC) is a watershed modeling tool that traces its roots to early advancements in watershed hydrological and water quality modeling, including the Stanford Watershed Model and the Hydrological Simulation Program FORTRAN (HSPF). From 2000-2010, LSPC evolved as it was being applied to help federal, state, and local agencies address hundreds of Total Maximum Daily Load (TMDL) efforts. Since then, it has become a robust, widely used model for quantifying sources for stormwater management, watershed analyses, and environmental flows. LSPC offers unique advantages over other models through its data management structures, streamlined organization of physical watershed characteristics and model process parameters, and convenient spatial and temporal rollup summaries of model outputs. Through its flexible architecture and sophisticated algorithms, LSPC empowers researchers and practitioners to efficiently organize, process, and analyze vast amounts of hydrological data, paving the way for informed decision-making in water resource management. Over time, LSPC model enhancements have been driven by project needs through various applications. These include a robust snow and irrigation module, reservoir diversions, and linkage to other modeling systems such as the MODFLOW groundwater model. The Shasta River Watershed Model, developed for the State Water Resources Control Board, is an example LSPC application that applied all those enhancements. This presentation will illuminate the impact of LSPC and its contributions in shaping the future of hydrological science and sustainable water resource stewardship through a comprehensive exploration of its history, data management capabilities, and practical applications in water management.

4. The History of Solute Transport Modeling Codes

Presenter(s): Vivek Bedekar (S.S. Papadopulos and Associates, Inc.)
Presenter(s) Email Address(es): vivekb@sspa.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

Solute transport modeling in groundwater has a long history, but large-scale numerical modeling of fate and transport of contaminants advanced in the 1980s with the availability of computing resources. Several generic solute transport simulation codes were published during that time. A diverse set of capabilities were incorporated in the different codes from simple advective-dispersive transport to codes with multi-component multi-phase transport capabilities and geochemical modeling capabilities. This presentation summarizes the progress of solute transport modeling codes over the last few decades.

Session 14: CalSim3 Changelog (Live)
Moderator: Zachary Roy (DWR)
Moderator Email: zachary.roy@water.ca.gov

1. 2023 Delivery Capability Report Updates

Presenter(s): Nicole Osorio & Yiwei Cheng (DWR)
Presenter(s) Email Addresses: yiwei.cheng@water.ca.gov; nicole.osorio@water.ca.gov
Collaborators: Erik Reyes, Nazrul Islam, Andrew Schwarz, Romain Maendly, Wyatt Arnold, Alejandro Perez, Richard Chen, Hongbing Yin, James Polsinelli, Mohammad Hasan, Jianzhong Wang, Raymond Hoang, Yiwei Cheng, Nicole Osorio, Zachary Roy, Jonathan Byers, Chris Quan, Devinder Dhillon, Malinda Wimalaratne, Hamed Zamanisabzi, Auhona Zaki (DWR): Kunxuan Wang, Nancy Parker, Drew Loney, Kevin Thielen (USBR); Tom FitzHugh, Andy Draper, Bridget Childs (Stantec); Chakri Malakpet & Jeffrey Weaver (HDR); Dan Easton & Shankar Parvathinathan (MBK), Tapash Das (Jacobs)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The California Department of Water Resources released the Final State Water Project Delivery Capability Report (DCR) for 2023. The DCR is used widely both within and outside the SWP for water supply planning. This presentation will provide a high-level overview of DCR results comparing with the previous 2021 DCR. There are four main updates: extended hydrology update, baseline code updates, historical hydrology adjustment, and system risk-informed climate change scenarios. The CalSim 3 simulation period and corresponding hydrology was extended through water year (WY) 2021 which now provides 100 years of simulated water operations. Next, code fixes and updates to the baseline CS3 model include, but are not limited to, improved inflow forecasts, dynamic Yuba transfer logic, OMR implementation, and Delta Cross Channel operations. The baseline adjusted historical hydrology represents a "climate-adjusted current conditions" simulation that accounts for climate changes that have already occurred. Lastly, DWR implemented system risk-informed climate change scenarios that use the best available science and enabled alignment of climate change modeling strategies across the Department.

2. CalSim Allocation Module (CAM)

Presenter(s): Thomas FitzHugh (Stantec)
Presenter(s) Email Address: thomas.fitzhugh@stantec.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

The CalSim Allocation Module (CAM) for defining SWP Table A allocations has been integrated into the CalSim 3 model. CAM is a multi-timestep optimization module which is currently used by DWR's SWP Operations Control Office (OCO) to help define annual Table A allocations. Integration into CalSim 3 will provide for greater consistency in how allocations are defined between CalSim 3 and OCO. CAM represents the SWP/CVP system in an aggregated manner, which allows for an efficient model solution while still representing the key components of the system. Inflows are represented by forecasts, and reservoirs are operated to meet certain storage targets which mimic rules used in actual SWP operations. CAM has been previously integrated into CalSim II and CalLite, but this new version for CalSim 3 includes numerous updates in order to improve consistency with CalSim 3 and better represent system operations across a range of hydrologic conditions. CAM has been tested using historical and climate change hydrology. CalSim 3 results using the CAM module will be presented and contrasted with results from models using the prior allocation method which has been standard in CalSim 3 for many years (WSI-DI).

3. CalSim 3 ANN Architecture Updates

Presenter(s): Malinda Wimalarante (DWR), Hamed Zamanisabzi (DWR), Yiwei Cheng (DWR)
Presenter(s) Email Addresses: yiwei.cheng@water.ca.gov; hamed.zamanisabzi@water.ca.gov; malinda.wimalaratne@water.ca.gov
Collaborators: Nicky Sandhu (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

CalSim 3 uses flow salinity relationships developed using artificial neural networks (ANNs) to calculate the salinity at select compliance locations in the Delta and X2. X2 is the distance from the Golden Gate to the point where daily average salinity is 2 parts per thousand (2000 ppm) at 1 meter off the bottom of the waterbed. This presentation discusses updates to components of the ANN module. One update involves the development and application of an open-source Python based package (TensorFlow) as an alternative method to a previous Matlab package in ANN model training.

4. Pseudo-Hydrologic Forecast for Climate Change and Other Alternative Hydrology

Presenters: Kunxuan Wang (USBR), Mohammad Hasan (DWR)
Presenters Email Addresses: kwang@usbr.gov; mohammad.hasan@water.ca.gov
Collaborators: Hongbing Yin, Francis Chung, Andrew Schwarz, Jianzhong Wang, James Polsinelli (DWR)
Permission to Post pdf of Presentation on CWEMF Website: Yes

CalSim 3 is a water resources planning model used to simulate the forecast-based operations of the State Water Project (SWP) and the Central Valley Project (CVP), as well as much of the water resources infrastructure in the Central Valley of California and the Sacramento-San Joaquin Delta region. DWR MSO recently revised the inflow forecast equations to include air temperature and vapor pressure deficit (VPD) in addition to precipitation and streamflow used in the original hydrologic forecast from 20 years ago. The forecast equations were implemented using Fortran as a Dynamic Link Library (DLL) and used in CalSim 3. To apply CalSim 3 under climate change and other alternative hydrologic conditions and overcome the limitations of applying the forecast equations developed based on the historical data, MSO developed an alternative (Pseudo-forecast) method. The method and the forecast DLL were tested with the 2040 hydrology developed by Reclamation's Long-Term Operations (LTO) consultation and acceptable results were obtained. This presentation will highlight the development of the Pseudo-forecast under future climate change and alternative hydrologic conditions as well as the evaluation of revised hydrologic forecasts.

Session 15: Water Quality, Emerging Contaminants and PFAS Modeling
Moderator: Reza Namvar (Woodard & Curran) & Vivek Bedekar (SSP&A)
Moderator Email: rnamvar@woodardcurran.com; vivekb@sspa.com

The emerging groundwater contaminants and recent data on per- and polyfluoroalkyl substances known as PFAS or forever chemicals indicate wide distribution of PFAS in groundwater. Many drinking water supply wells may be contaminated by PFAS and require treatment of groundwater before it is added to the drinking water supply. Understanding of distribution and movement of PFAS in an aquifer requires development of transport and water quality models. This session presents a set of presentations covering a range of PFAS related subjects from developing the conceptual model of a site for use in PFAS transport model development, available tools and transport models for simulation of PFAS, groundwater investments and PFAS and prediction of PFAS in California.

1. ***Comparison of PFAS Fate and Transport Modeling Tools and Data Needs for Site-scale and Regional-scale Models***

Presenter(s): Raghu Suribhatla, Jake Smith & Jacob Chu (Haley Aldrich)
Presenter(s) email(s): *rsuribhatla@haleyaldrich.com; jchu@haleyaldrich.com*
Permission for CWEMF to post pdf of presentation: Yes

PFAS fate and transport in the subsurface is currently an active area of research, with limited modeling tools that can simulate all the key processes. These processes include advection/dispersion in the vadose zone, advection/dispersion in the saturated zone, adsorption and accumulation at the air-water interface, sorption to the solids, and precursor transformations to terminal PFAS. We present an overview of the different 1-D, 2-D and 3-D modeling tools, and compare the conceptual representation of key sorption processes. We discuss data requirements for the specialized vadose-zone PFAS modeling tools and applicability of traditional groundwater modeling tools such as MODFLOW-MT3D for the regional-scale PFAS fate and transport modeling.

2. ***Prediction of 35 Target PFAS in California Groundwater Using Multilabel Semi-Supervised Machine Learning***

Presenter(s): Jialin Dong (UC Irvine)
Presenter(s) email(s): *jialind2@uci.edu*
Collaborators: Christopher I Olivares Martinez (UC Irvine)
Permission for CWEMF to post pdf of presentation: Yes

Comprehensive monitoring of PFAS is challenging because of the high analytical cost and an increasing number of analytes. We developed a machine learning pipeline to understand environmental features influencing PFAS profiles in groundwater. By examining 23 public data sets (2016–2022) in California, we built a state-wide groundwater database (25,000 observations across 4200 wells) encompassing contamination sources, weather, air quality, soil, hydrology, and groundwater quality (PFASs and cocontaminants). We used supervised learning to prescreen total PFAS concentrations above 70 ng/L and multilabel semi supervised learning to predict 35 individual PFAS concentrations above 2 ng/L. Random forest with ADASYN oversampling performed the best for total PFASs (AUROC 99%). XGBoost with SMOTE oversampling achieved the AUROC of 73–100% for individual PFAS prediction. Contamination sources and soil variables contributed the most to accuracy. Individual PFASs were strongly correlated within each PFAS's subfamily (i.e., short- vs long-chain PFCAs, sulfonamides). These associations improved prediction

performance using classifier chains, which predicts a PFAS based on previously predicted species. We applied the model to reconstruct PFAS profiles in groundwater wells with missing data in previous years. Our approach can complement monitoring programs of environmental agencies to validate previous investigation results and prioritize sites for future PFAS sampling.

3. De-Risking Groundwater Investments in the Age of PFAS

Presenter(s): Dan Haddock (INTERA)
Presenter(s) email(s): *dhaddock@intera.com*
Collaborators: Nathan Hatch, Beronica LeeBrand, Ryan Alward, Melanie Beck (INTERA)
Permission for CWEMF to post pdf of presentation: Yes

In April 2024, the USEPA finalized maximum contaminant levels (MCL's) for PFOA, PFOS, and other PFAS. Data on the occurrence and sources of PFAS is still limited. Transport of PFAS is complex and highly variable and soils can act as reservoirs for PFAS precursors, releasing regulated end-products over long periods of time. Utilities need to continue to invest in water supply infrastructure, despite evolving regulations and uncertainty with respect to the sources of PFAS. De-risking these infrastructure investments is critical to preserving the affordability of water service. Creative solutions are needed to effectively mitigate risks using currently available data. We will present an innovative, systematic approach to evaluating PFAS risks using currently available hydrogeologic, water quality, and environmental site data. Existing models were used to delineate areas of concern. To assess the potential for surface releases to reach groundwater, we developed an analytical vadose-zone tool based on Guo (2022) to predict leaching and discharge of PFAS to groundwater including adsorption at solid-water and air-water interfaces. To identify potential historical sources, we reviewed water quality data for PFAS and common co-contaminants and records on facilities with operations commonly associated with PFAS use. This information was synthesized to assess the relative risk to existing and potential well sites and to develop recommendations to mitigate currently observed and potential future contamination, including treatment, changes to pumping operations, and location of new wells. In this presentation, we will describe the approach and its results, including data visualization used to communicate recommendations.

Session 16: Hydrology/Climate Change Development

Moderator: Ryan Lucas [USBR]
Moderator Email: rlucas@usbr.gov

DWR and Reclamation have produced input data sets for CalSim3 reflecting a range of hydrologies that include multiple future climate scenarios. Individual study needs, according to agency guidelines and mandates, play a role in development of such scenarios. This session will provide an overview of dataset development approaches and study applications.

1. *Risk-Informed Climate Change Development*

Presenter(s): Andrew Schwartz [DWR]
Presenter(s) email(s): Andrew.schwarz@water.ca.gov
Collaborator(s): Erik Reyes [DWR], Nazrul Islam [DWR], Wyatt Arnold [DWR], Romain Maendly [DWR], Jeff Weaver [HDR]
Permission for CWEMF to post pdf of presentation: yes

The 2023 biennial edition of the State Water Project Delivery Capability Report features three risk informed climate change projections for 2043 conditions. These risk informed scenarios have been developed using a new approach and new tools including CMIP6 climate models, LOCA2 downscaling, a next generation statistical weather generator, and new 2023 sea level guidance. The scenarios span the SWP climate risk space from a median climate risk outcome, to the 95th percentile worst outcome. This talk will present briefly on the methodology and reasoning behind the development of these scenarios and focus on what the scenarios show and how they should be used in future planning activities.

2. USBR 2022MED Hydrology Development: Detrending Methodology

Presenter(s): Drew Loney [USBR] and Tapash Das [Jacobs]
Presenter(s) email(s): dloney@usbr.gov, tapash.das@jacobs.com
Collaborator(s): Syed Azhar Ali [Jacobs], Steve Micko [MWD], Solmaz Rasoulzadeh [Jacobs]
Permission for CWEMF to post pdf of presentation: yes

CalSim 3 meteorologic and hydrologic boundary conditions are developed to represent 2022±15 climate condition for Long Term Operations (LTO) of Central Valley Project (CVP) and State Water Project (SWP). The 2022±15 climate condition is developed with 20 Coupled Model Intercomparison Project Phase 5 (CMIP5) global climate projections, selected for LTO. A set of different scenarios to review range of uncertainty are also developed, representing 2022±15 hot-dry, 2022±15 warm-wet, and 2040±15 median climate conditions. Future climate change analysis for the LTO is mainly based on the 2022±15 median climate change scenario. Various parameters such as precipitation, rim inflows, reservoir evaporation, valley floor flows, water demand, groundwater are perturbed to develop the boundary conditions for CalSim 3 representing future climate change conditions. This presentation will summarize climate change data development and results to support the LTO.

3. A New Normal: Adjusted Historical Hydrology

Presenter(s): Richard Chen [DWR]
Presenter(s) email(s): zhiqiang.chen@water.ca.gov
Collaborator(s): Hongbing Yin, Francis Chung [DWR], Andrew Schwarz [DWR], Jianzhong Wang [DWR], James Polsinelli [DWR], and Hasan Mohammad [DWR]
Permission for CWEMF to post pdf of presentation: yes

Adjusted Historical Hydrology (AHH) is being added to the 2023 State Water Project Delivery Capability Report (DCR) as the hydroclimate hydrology representing the current hydroclimate and watershed condition for CalSim 3 modeling. This AHH is our first attempt to adjust the historical observationally based hydrology to reflect the shifts in historical hydrologic conditions due to climate changes. To develop AHH datasets, historical precipitation timeseries were adjusted first so that the standard deviation of the annual precipitation in the early 70-year period (WY1922-1991) were matched to the standard deviation of the annual precipitation in the recent 30-year period (WY1992-2021). Second, the stream flows from rim watersheds were adjusted based on annual precipitation runoff curves and monthly stream flow distribution derived from historical precipitation and historical stream flow records observed in the recent 30-year period. Third, other adjusted hydrological input datasets to CalSim 3 under the adjusted historical conditions were also derived by feeding the adjusted historical precipitation into the 4 CalSim3's Valley Floor Models, i.e., CalSimHydro, CalSimHydroEE, Small Watershed, and Delta Channel Depletion. The combination of adjusted historical precipitation and adjusted historical rim inflow, and the derived hydrological datasets is called "adjusted historical hydrology". This presentation will describe the difference between the historical observationally based hydrology that has been used in DCR before and the new adjusted historical hydrology (AHH) in terms of the hydrologic conditions in CalSim 3's rim watersheds, valley floor WBAs, and groundwater aquifers, and discuss impacts of AHH on DCR analysis.

4. A New Normal: Climate Change Adaptation

Presenter(s): Andrew Schwartz [DWR]
Presenter(s) email(s): Andrew.schwarz@water.ca.gov
Collaborator(s): Thomas Fitzugh [Stantec], Puneet Khatavkar [Stantec]
Permission for CWEMF to post pdf of presentation: yes

This talk will summarize the SWP Climate Adaptation Analysis, which is analyzing the climate change adaptation benefits to the SWP of the following projects under a range of climate change hydrology scenarios using CalSim 3: Delta Conveyance Project, California Aqueduct subsidence correction, Oroville flood control manual update and forecasted informed reservoir operations, and SWP enhance asset management. The SWP Climate Adaptation Analysis is part of DWR's on going and continuous climate action planning efforts and will inform future strategic investments for the SWP.

5. **Climate Change Development: BOR and DWR Approaches: Panel Discussion**

Panel Moderators(s): Drew Loney [USBR], Andrew Schwartz [DWR]
Moderator(s) email(s): dloney@usbr.gov, andrew.schwarz@water.ca.gov
Permission for CWEMF to post pdf of presentation: yes

Reclamation and DWR have worked together to improve the understanding and modeling of how climate change affects hydrology within California. For the 2021 LTO and DCR analyses, a shared climate change workflow was utilized to help understand the response of the CVP/SWP projects to future conditions. This panel discussion will highlight lessons learned in developing climate information for these studies, current climate related activities, and areas of future research.

Session 17: Advancing Aquifer Recharge Modeling: Integrating Process-Based Models for Enhanced Representation of Water Quantity and Quality
Moderator: Menberu Meles
Moderator Email: Menberu.Meles@usda.gov

Hydrological models are crucial for understanding the complex interactions between surface and subsurface water systems. This session will delve into innovative modeling approaches that integrate specialized, cutting-edge models to simulate distinct hydrological processes across various scales. Presentations will explore the computationally efficient external coupling of models like HYDRUS-1D, KINEROS2, and MODFLOW, focusing on water flux, solute transport, and sediment dynamics. Additionally, the session will highlight large-scale 3D groundwater modeling in California's Central Valley, examining the role of these coupled models in addressing Managed Aquifer Recharge (MAR) challenges and assessing the impact of MAR on redox potential and geogenic pollutant mobilization. We will also investigate the development of the Sacramento Regional Water Bank (SRWB) for assessing the potential benefits recharge water banking through the integration of the CoSANA and CalSim models.

1. *A new externally coupled physically-based multi-model framework for simulating subsurface and overland flow hydrological processes*

Presenter(s): ATM Sakiur Rahman (UC Riverside)
Presenter(s) email(s): atmsakir@ucr.edu
Collaborator(s): Jiří Šimůnek, Scott A. Bradford, Hoori Ajami, Menberu B. Meles, Lin Chen, Adam Szymkiewicz, Mateusz Pawlowicz, Alberto Casillas-Trasvina, and Sahila Beegum
Permission for CWEMF to post pdf of presentation: yes

Physically based watershed models are essential for understanding surface and subsurface hydrological processes and informing water resources management and climate change impact assessments. This study presents an innovative modeling framework that externally couples three widely used hydrological models: HYDRUS-1D (H1D), KINEROS-2 (K2), and MODFLOW-2005 (MF5), resulting in a new simulation code, H1D-K2-MF5. This new coupled approach allows for the simultaneous simulation of overland flow, infiltration, soil water movement, groundwater flow, and their interactions within a single modeling framework, addressing individual model limitations by harnessing synergies through integration. The accuracy and robustness of the H1D-K2-MF5 model are investigated for several benchmark cases, including overland flow, recharge, and groundwater flow simulations. The model accurately reproduces analytical solutions for overland flow, including cases of excess infiltration and saturation runoff and a number of cases of groundwater flow (increasing and decreasing groundwater heads and variable recharge) simulations for homogenous and heterogeneous surface and subsurface conditions. Furthermore, simulated overland flow, soil water movement, recharge, groundwater hydrographs, and water balance for different scenarios show almost identical agreement with the recently developed H1D-K2 and HMSE models. An inherent advantage of this new simulation code is its versatility and computational efficiency. It allows for the simulation of complex domains and the coupling of various models, such as H1D-K2 and H1D-MF5. This flexibility enhances its applicability across various hydrological studies and management practices. Further development will delve into the implementation of solute fate and transport modules.

2. *Investigating Managed Aquifer Recharge Impacts on Redox Potential: A HYDRUS 2D Modeling Approach*

Presenter(s): Alessandra Bonazzi (UC Davis)
Presenter(s) email(s): **abonazzi@ucdavis.edu**
Collaborator(s): Kyounglim Kang, Salini Sasidharan, Jasquelin Peña, Scott Bradford, Veronica Morales
Permission for CWEMF to post pdf of presentation: yes

Managed aquifer recharge (MAR) strategies hold promise for increasing groundwater availability, yet they also present potential risks to groundwater quality. The introduction of exogenous source water to the subsurface, whether by flooding or well injection, creates geochemical gradients in redox potential, pH, and major ion compositions. In turn, these gradients can induce dissolution reactions in the aquifer matrix that mobilize geogenic pollutants (e.g., arsenic and uranium) with the infiltrating groundwater. This work aims to better understand the impact of MAR on local redox shifts within an aquifer, understanding that this change is at the heart of both arsenic and uranium mobilization. We hypothesize that shifts in redox potential are principally driven by the combined delivery of oxygen with the infiltrating water and its consumption by microbial activity. We employ a HYDRUS 2D model to simulate water infiltration dynamics and geochemical gradients from a drywell at various injection and interruption frequencies. The model's hydrogeology is based on the conditions of the Terranova Ranch (Helm, CA), where MAR operations are in progress, and where arsenic/uranium mobilization has been detected. Simulation results are used to estimate 1) the water residence times within the different soil profile layers that make up our site, and 2) the expected oxygen consumption by microbial activity in depth. Together, these data will be used to infer the magnitude and persistence of redox potential shifts induced by MAR. By integrating HYDRUS 2D modeling with geochemical assessments, we will elucidate the complex interplay between MAR activities, redox dynamics, and geogenic contaminant mobilization. This research contributes to a deeper understanding of the environmental implications of MAR practices, ultimately informing strategies for sustainable water management and contaminant mitigation.

3. *CalSim (WRIMS) – CoSANA (IWFM) Integration for Sacramento Regional Water Bank Modeling*

Presenter(s): Puneet Khatavkar (Stantec)
Presenter(s) email(s): Puneet.Khatavkar@stantec.com
Collaborator(s): Jingnan Zhou (Woodard and Curran), Ibrahim Khadam (Khadam Consulting), Trevor Joseph (RWA)
Permission for CWEMF to post pdf of presentation: yes

The Sacramento Regional Water Bank (SRWB) is a proposed project that formalizes regional conjunctive use into a framework for establishment of a Federally acknowledged water bank. The SRWB will utilize predominately in-lieu recharge and some direct recharge to store water by diverting additional surface water during wet periods and will allow use of that stored water during future dry periods. An interface has been developed between the CoSANA model (the Cosumnes-South American-North American, modeled in Integrated Water Resources Model, IWFM) and the CalSim model (modeled in Water Resources Integrated Modeling System, WRIMS) that are being used to assess potential benefits of the SRWB and support regulatory compliance (e.g., CEQA and SGMA). The primary purpose of CalSim is to evaluate CVP and SWP operations at current or future levels of development, with and without various assumed future facilities, under various regulatory requirements, and with different facility management options. One of the principal outputs of the model is the estimate of CVP and SWP exports at project facilities south of the Sacramento-San Joaquin Delta and corresponding delivery reliability of the two

projects. CalSim has become a widely accepted modeling tool for water resources planning in the Central Valley. CoSANA is an integrated hydrological model that simulates water resources in the greater Sacramento region and is built on an IWFM framework and tailored to support regional efforts for SGMA compliance. CoSANA simulates details not included in CalSim, such as well-by-well pumping and provides detailed hydrogeological information as an output. This model interface between CalSim and CoSANA allows for detailed representation of surface water- groundwater interactions to simulate the operations of GW bank at a finer resolution. CalSim is utilized for its sophisticated simulation of CVP and SWP water supplies, and environmental compliance, as well as providing the formulation of SRWB operations. CoSANA is utilized to provide information on surface water-groundwater interaction, detailed water budgets, and assessment of benefits and potential impacts. Together, the interface between CalSim and CoSANA allows for a robust quantitative assessment of the SRWB and will provide key information needed for regulatory compliance and public support.

4. Distributed Recharge, Groundwater Flow Modeling, and Scenario Analysis in an Over-Exploited Aquifer: Coupling HYDRUS-1D and 3D Groundwater Flow Modeling in the Central Valley, California

Presenter(s): Menberu Meles (USDA)
Presenter(s) email(s): **Menberu.Meles@usda.gov**
Collaborator(s): Cui, Wenyi, Meles, Menberu, Bradford, Scott, Harter, Thomas
Permission for CWEMF to post pdf of presentation: yes

The California Central Valley (CCV) has experienced significant aquifer and surface water depletion due to extensive groundwater withdrawals and prolonged droughts. To address the consequences of groundwater over-exploitation and adapt to future climatic changes, initiatives including water conservation and Managed Aquifer Recharge (MAR) strategies have been explored. However, the accurate assessment of MAR feasibility, effectiveness, and economic impacts remains challenging due to the need for improved subsurface representation. Accurately estimating groundwater recharge distribution, influenced by subsurface heterogeneity, remains a hydro(geo)logical challenge. This study employs land cover, crop type maps, the soil survey database (SSURGO), and lithological borehole logs to develop a series of HYDRUS-1D (*Šimůnek et al., 1998*) models for the Turlock and Modesto (TM) subbasins. These models are integrated with a transient 3D groundwater MODFLOW (*Harbaugh, 2005*) model. Comprehensive analysis explores spatial and temporal recharge variations, driven by intensive groundwater pumping for irrigation. The study examines implications for water budget, streamflows, flow systems, and groundwater head distribution at the catchment scale for the current state of the aquifer. In addition, MAR scenarios (e.g., dry wells, ASR, Ag-MAR, Flood-MAR) are explored with the aim of mitigating the observed cone of depression. This research represents a significant step in advancing hydro(geo)logical modeling techniques and assessing the complex interplay between groundwater recharge, subsurface heterogeneity, and potential MAR strategies in an over-exploited aquifer.

Session 19: Reclamation specific LTO Analyses
Moderator: Drew Allan Loney [USBR]
Moderator Email: dloney@usbr.gov

1. SCHISM use in the LTO

Presenter(s): Ben Abban (USBR)
Presenter(s) email(s): babban@usbr.gov
Collaborator(s): Steve Micko (MWDSC), Kristen Arend (USBR)
Permission for CWEMF to post pdf of presentation: YES

The 2021 LTO required extensive modeling of the Sacramento/San Joaquin Delta to meet flow and salinity compliance targets under new operations scenarios. This presentation discusses the SCHISM modeling of the Delta that was done to investigate how the effect of the proposed 2021 LTO CVP/SWP operations scenarios on environmental compliance targets.

2. PTM and ECO-PTM simulations for LTO

Presenter(s): Samaneh Saadat [Jacobs], Victor Huang (USBR)
Presenter(s) email(s): Samaneh.Saadat@jacobs.com; VHUANG@usbr.gov
Collaborator(s): Steve Micko (MWDSC)
Permission for CWEMF to post pdf of presentation: YES

DSM2 HYDRO and PTM models were used to study the fate of Delta and Longfin Smelt under varying flow scenarios. DSM2 was used to simulate hydraulic conditions under a range of operational alternatives. Under the range of hydraulic conditions, PTM was used to simulate the fate of particles with two types of behaviors: neutrally buoyant particles (representing larval Delta Smelt) and surface-oriented particles (representing larval Longfin Smelt). Particles were inserted throughout the Sacramento – San Joaquin River Delta. At various time-intervals after insertion, the number of particles remaining in the delta, entrained at CVP and SWP exports, crossing SJR to South Delta, passing east of Chipps were evaluated to understand the effect of varying operational conditions.

3. Trinity Operations

Presenter(s): Kunxuan Wang (USBR)
Presenter(s) email(s): kwang@usbr.gov
Collaborator(s): Amanda Becker (USBR)
Permission for CWEMF to post pdf of presentation: YES

As part of the Consultation of Long-Term Operation (LTO) for the Trinity River Division of the Central Valley Project (CVP), several alternatives were developed for consideration. This presentation provides details on the alternatives and discusses operations modeling development to represent these alternative operations of the Trinity River Division.

4. Trinity Temperature Operations

Presenter(s): Drew Allan Loney & Mussie Beyene (USBR)
Presenter(s) email(s): dloney@usbr.gov; mbeyene@usbr.gov
Collaborator(s): Amanda Becker & Machele Pacheco (USBR)
Permission for CWEMF to post pdf of presentation: YES

As part of the Consultation of Long-Term Operation (LTO) for the Trinity River Division of the Central Valley Project (CVP), several alternatives were developed for consideration. This presentation discusses the temperature model development and scenario results to represent these alternative operations of the Trinity River Division.

Session 20: California Aqueduct Subsidence Program (CASP) Modeling Panel
Moderator: Jeff Weaver (HDR)
Moderator Email: Jeffrey.Weaver@hdrinc.com

Since the construction of the California Aqueduct in the 1960s, portions of land near the aqueduct have dropped between 20 and 30 feet due to subsidence, largely attributable to groundwater over draft. In fact, during the 2013-2016 drought, portions of the aqueduct sank nearly three feet. In an effort to understand how subsidence has affected operations of the aqueduct, the California Aqueduct Subsidence Program (CASP) was initiated by DWR. Technical analysis under CASP required the development of new modeling tools to (1) understand current effects of subsidence on water deliveries and O&M costs and (2) project future effects of subsidence under both climate change and continued subsidence. Following characterization of effects of subsidence on the current aqueduct construction, the tools will be used to identify potential future remediation measures. Some of these modeling tools are new, and others include substantial modifications to existing models. The HDR-Stantec panel will include presentations on several of the tools developed to support the CASP analyses:

1. ***CASP Hydraulic Modeling***

Presenter(s): Charles Lintz (HDR)
Presenter(s) email(s): charles.lintz@hdrinc.com
Collaborator(s): Renato Espinoza-Torres, Gary Brunner, Pavanni Chukkapalli (HDR)
Permission for CWEMF to post pdf of presentation: no

HDR developed a HEC-RAS hydraulic model of the California Aqueduct which extends from Dos Amigos Pumping Plant to Edmonston Pumping Plant, approximately 200 miles. The purpose of the Aqueduct hydraulic model is to help DWR understand the hydraulic effects of land subsidence in the California Central Valley, simulate varying scenarios to explore the operational limits of the Aqueduct, and to develop the measures that will address the impacts of subsidence. The California Aqueduct unsteady HEC-RAS hydraulic model includes a detailed geometry, complex gate rules to operate the Aqueduct's check structure gates, versatile turnout operations, adaptable pumping plants, and real operational criteria. These features are combined to produce simulations which can mimic a vast range of intricate field conditions and water delivery configurations. The Aqueduct hydraulic model is a crucial tool which will help DWR plan for the future of the State Water Project; California's critical water lifeline which has "fueled California's population boom and economic prosperity since its initial construction" (DWR). HDR will provide an overview of the model development, key inputs, typical outputs and unique set of rules which allow for the creative, unconventional use of HEC-RAS.

2. ***CASP Water Supply Modeling***

Presenter(s): Rafael Herrera (Stantec)
Presenter(s) email(s): Rafael.herrera@hdrinc.com
Collaborator(s): Bill Smith & Tom FitzHugh (Stantec)
Permission for CWEMF to post pdf of presentation: no

Localized ground subsidence in the Central Valley has created changes in the slope of the California Aqueduct with potential impacts to conveyance capacity and water deliveries. Analysis of these potential impacts to water delivery was not possible with the existing representation of the Aqueduct in CalSim 3. The California Aqueduct Subsidence Program (CASP) team identified modifications to CalSim 3 found to be necessary to support evaluation of the effects of subsidence of the California Aqueduct (Aqueduct) in the San Joaquin Valley on the water delivery capability of the State Water Project (SWP) and Central Valley Project (CVP). To evaluate potential water delivery impacts, the spatial resolution and application of monthly hydraulic conveyance capacity across the Aqueduct from Dos Amigos Pumping Plant to Edmonston Pumping Plant was modified to represent the Aqueduct capacity on a pool-by-pool basis. SWP Municipal, Industrial, and Agricultural demands were redistributed to the new configuration and logic added to impose any capacity related shortages equally between the demand types at each individual pool. Using the modified version of CalSim 3, a series of scenarios will be run to incorporate multiple levels of subsidence under different hydrologic conditions.

3. ***CASP Power Use Modeling***

Presenter(s): Megan Lionberger (HDR)
Presenter(s) email(s): megan.lionberger@hdrinc.com
Collaborator(s): Jeff Weaver & Asphota Wasti (HDR)
Permission for CWEMF to post pdf of presentation: no

The CASP Power Use Model evaluates the power use associated with five aqueduct pumping plants: Dos Amigos, Buena Vista, Teerink, Chrisman, and Edmonston. By using check structures, pumping plants, and operational storage within the prism of the aqueduct, pumping loads can be "shaped" to minimize energy costs while maintaining deliveries to contractors. Regional land subsidence along the aqueduct path causes reduced hydraulic capacity and reduces operational flexibility to shape pumping load. The Power Use Model evaluates changes in power use and cost associated various levels of aqueduct subsidence. The model optimizes hourly pumping plant operations by determining the least-cost feasible operation for each day, while simultaneously solving for aqueduct pool mass balance under a set of physical constraints such as maintaining a positive head differential from one pool to the next, operating each pool within its respective storage ranges, pumping plant ramping rate limitations, and meeting pool deliveries on a daily basis. The CASP Power Use Model relies on outputs from the CASP Hydraulic Model, the CASP CalSim 3 Model, and a time series of energy prices.

4. ***CASP Flood Hazards Modeling***

Presenter(s): Chakri Malakpet (HDR)
Presenter(s) email(s): chakri.malakpet@hdrinc.com
Permission for CWEMF to post pdf of presentation: no

Localized ground subsidence along the California Aqueduct has changed the hydraulic capacity of the aqueduct, and its drainage facilities impacting the performance of these facilities to manage flood flows during the wet season. Hydrologic, hydraulic, and flood damage models were developed for two pilot study areas along the Aqueduct for evaluating the impacts of subsidence on three types of flood risks; (1) flood risk to the Aqueduct due to capacity limitations of cross drainage systems, (2) flood risk to the Aqueduct due to capacity limitations of flood flow conveyance through the Aqueduct, and (3) flood risk to adjacent communities due to embankment breaches or overtopping. HEC-HMS, HEC-RAS 1D and 2D, and HEC-FDA models were used to represent the Aqueduct pools, the drainage areas along the Aqueduct including drainage infrastructure like inlets, gates, detention basins, and the adjacent communities with damageable property. These models were applied to evaluate the flood risks under current subsided conditions and future conditions based on projections of subsidence in the region. The effects of climate change on precipitation and hydrology of the drainage basins were incorporated into the evaluations.

Session 21: Shasta Operations
Moderator: Ryan Lucas [USBR]
Moderator Email: rlucas@usbr.gov

1. Shasta Action in CalSim

Presenter(s): Nancy Parker (USBR)
Presenter(s) email(s): nparker@usbr.gov
Collaborator(s): Derya Sumer & Kristin White (USBR)
Permission for CWEMF to post pdf of presentation: Yes

A new operation of Shasta Dam was developed for the LTO, focused on maintaining cold water release capabilities by preserving carryover storage through a suite of CVP operations actions. The details and challenges in developing CalSim model mechanisms to represent these actions will be the focus of this talk.

2. An Optimization Approach for Shasta Temperature Management

Presenter(s): Drew Allan Loney (USBR)
Presenter(s) email(s): dloney@usbr.gov
Collaborator(s): Mechele Pacheco (USBR)
Permission for CWEMF to post pdf of presentation: yes

The 2021 LTO reopened temperature operations at Shasta Dam for downstream water temperature management. As part of the analysis, a optimization approach was implemented to improve understanding of potential temperature management strategies. This presentation highlights that approach and key takeaways from the analysis.

3. A Comparison of Shasta Temperature Management Processes

Presenter(s): Drew Allan Loney (USBR)
Presenter(s) email(s): dloney@usbr.gov
Collaborator(s): Mechele Pacheco (USBR)
Permission for CWEMF to post pdf of presentation: yes

The 2021 LTO reopened temperature operation at Shasta Dam for downstream water temperature management. The Shasta temperature analysis consisted of multiple operations and temperature target combinations that have distinct biologic impacts. This presentation summarizes the understanding gained from comparing operations/temperature target combinations.

4. Impacts of TUCPs

Presenter(s): Ryan Lucas (USBR)
Presenter(s) email(s): rlucas@usbr.gov
Collaborator(s): Amanda Becker (USBR), Nancy Parker [USBR], Derya Sumer [USBR], Liz Kiteck [USBR], Randi Field [USRB], Aaron Miller [DWR]
Permission for CWEMF to post pdf of presentation: yes

In extended drought periods, USBR and DWR request changes to water right requirements through Temporary Urgency Change Petitions (TUCPS). These TUCPs include changes in SWRCB D-1641 to allow management of reservoir releases on patterns that conserve upstream storage for fish and wildlife protection, Delta salinity control, and provide critical water supply needs. Reclamation included the implementation of TUCPs in select modeling efforts developed for the current consultation of the Long-Term Operations. Including TUCPs reduces some of the regulatory water cost in CalSim3 during drought conditions. We present results from CalSim3 modeling efforts that show the impact implementing TUCPs in the CVP-SWP system.

Session 22: Innovative Approaches to Water Management and Ecosystem Sustainability in the California Central Valley and Delta

Moderator: Nicole Osorio (DWR)
Moderator Email: Nicole.Osorio@water.ca.gov

1. ***Using a Simplified Reservoir Simulator for Exploring Climate Change Adaptation in California's Central Valley***

Presenter: John Rath (Tetra Tech)
Presenter Email Addresses: John.Rath@tetratech.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

Hydroclimatic changes in reservoir-regulated watersheds are expected to change reservoir performance with respect to water supply, flood control, and hydropower generation in the coming decades. Additionally, environmental considerations in the areas that these reservoirs supply will potentially apply constraints on their operation. This work develops a simplified, data-driven, and flexible model of reservoir operation that can be applied to Central Valley reservoirs to assess system responses in this context. The model is used to simulate a range of potential scenarios based on historical reservoir data and climate change-informed watershed runoff models. Different operational modes are considered, including rule curves specific to adaptation strategies such as forecast-informed reservoir operations (FIRO) and groundwater recharge banks in the valley floor. The effects of these operational modes and climate change impacts are analyzed in a hypothetical case study.

2. Estimating Freshwater Inflow to San Francisco Estuary During the First Six Decades Following the California Gold Rush: WY 1851 – 1911 Reconstruction Based on Legacy Hydrologic Data

Presenter: Paul Hutton (Tetra Tech)
Presenter Email Addresses: Paul.Hutton@tetratech.com
Collaborator: Sujoy Roy (Tetra Tech)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Freshwater inflow is vital for the ecological health, biodiversity, and productivity of estuarine ecosystems. Understanding the historical volume and timing of this flow is therefore essential for the sustainable management, conservation, and restoration of these valuable and highly productive environments. By utilizing legacy water level measurements at Sacramento, recently developed unimpaired or "virgin" watershed runoff estimates, and records of wetland reclamation, we extended an existing time series of freshwater inflow to the San Francisco Estuary (spanning eleven decades) by an additional six decades at a monthly timescale – back to California's "Gold Rush" era when significant anthropogenic modifications to the waterscape commenced. Our analysis of this extended time series, when normalized to unimpaired runoff data, shows that an increasing trend in systemwide water use was preceded by a decreasing trend during the latter half of the 19th century; we hypothesize that a systemwide reduction in evapotranspiration resulted from the removal of high water using natural vegetation and reduction in overbank flows due to levee construction. This finding, which suggests that the long-term, annual average freshwater inflow to the estuary under current conditions is consistent with inflow under natural conditions, is consistent with earlier published research comparing pre-development annual flow conditions (circa 1850) with those prevalent in the early 20th century (circa 1920) and those prevalent today. Findings related to monthly flow trends were more nuanced and reflect season-specific influences of anthropogenic modifications to the waterscape. We believe that

these findings, while somewhat limited by unusually wet hydrology associated with much of the flow reconstruction period, comprise an important contribution to ongoing dialogue on ecosystem restoration targets.

3. Forecasting Central Valley Runoff and Water Availability Using NMME 7-Month Forecasts

Presenter: Chuck Young (SEI)
Presenter Email Addresses: chuck.young@sei.org
Collaborators: John Abatzoglou (UC Merced), David Yates (NCAR), Andy Draper (Stantec)
Permission to Post pdf of Presentation on CWEMF Website: yes

Increasing climate variability is highlighting the need for improved hydrological forecasting. In this presentation we will discuss our efforts in developing procedures to automatically process meteorological forecasts from the North American Multi-Model Ensemble (NMME) for use in the SacWAM and SJWAM models. The tool will be used to study estimates of coming water-year runoff and water availability for the Sacramento and San Joaquin Valleys.

4. Quantifying the Contribution of Marsh Plants and Aquatic Vegetation to the Detrital Food Web in the California Delta

Presenter: Ed Gross (RMA)
Presenter Email Addresses: edward.s.gross@gmail.com
Permission to Post pdf of Presentation on CWEMF Website: Yes

The low food web productivity in the northern San Francisco Estuary limits the growth and fecundity of native fish species and contributes to observed long-term population declines. The bioavailable portion of dissolved organic carbon (DOC) and particulate organic carbon (POC) from freshwater inflows, wetlands and aquatic vegetation, fuels the detrital food web utilized by pelagic fish. We quantified sources of DOC using a novel tracer-based DOC prediction approach and extensive DOC samples distributed throughout the California Delta. The proposed model predicted DOC reliably during a summer-fall period and estimated credible DOC inputs to the estuary. It was validated using high-speed mapping observations of fluorescent dissolved organic matter (fDOM) collected concurrently with the DOC samples but over a larger spatial extent. DOC contributions from marsh and aquatic vegetation substantially affected surrounding regions, but far-field concentrations were primarily driven by refractory DOC from source waters.

5. Little Egbert Tract Multi-Benefit Project Hydrodynamic Modeling

Presenter: Anna Hamilton (CBEC)
Presenters Email Addresses: a.hamilton@cbecoeng.com
Collaborators: Kiernan Kelty (CBEC), Scott Wright (CBEC), Toby Stegman (CBEC), Chris Campbell (CBEC)
Permission to Post pdf of Presentation on CWEMF Website: Yes

The focus of this project is to evaluate a suite of alternatives designed to provide multiple benefits through the re-introduction of tidal action to Little Egbert Tract (LET). LET is a former tidal marsh located within the Sacramento-San Joaquin River Delta approximately one mile northeast of Rio Vista, that was previously diked and drained and used for agriculture. The tract is at the southern tip of the Cache Slough Complex, an area of particular importance for native fishes, bordered by Cache Slough to the east, Lindsey Slough to the northwest, and the Sacramento River to the southeast. The study area also includes sections of the Yolo Bypass, Sacramento River, and Deep Water Ship Channel. Four alternatives designed to provide multiple benefits, including flood protection, habitat, and agricultural benefits, have been identified for assessment and potential implementation. These alternatives include various options for re-connecting the tract to Cache Slough as well as other elements such as habitat berms along the levees and habitat islands along a meandering, sub-tidal channel through the center of the tract. To assess differences among the alternatives with respect to hydrodynamics, residence/exposure times, the wind-wave climate, and sediment transport, a suite of numerical models was developed and calibrated using the Delft3D platform. These tools were applied to simulate a range of hydrologic and meteorologic conditions, including a climate change scenario, to assess the performance of the alternatives. This presentation will cover calibration and validation efforts, modeling results, alternative scenarios, as well as modelling challenges and successes.

Session 23: Integrated Modeling for the Central Valley Project Improvement Act (CVPIA) Structured Decision Making (SDM) Process

Moderator(s): Mark Tompkins (FlowWest) & Rod Wittler (USBR)
Moderator(s) Email: mtompkins@flowwest.com; rjwittler@usbr.gov

1. *An overview of SDM for the Bay Delta Office and the Service regarding CVPIA Authorities - Management & Science.*

Presenter(s): Rod Wittler (USBR) & Mike Urkov (Urkov Group)
Presenter(s) email(s): rjwittler@usbr.gov; mike.urkov@gmail.com
Permission for CWEMF to post pdf of presentation: yes

CVPIA established the Science Integration Team (SIT) in 2015 to support Structured Decision Making (SDM) as an updated science-based framework to inform the use of CVPIA's Restoration Fund on Fish Resource Area projects. The SIT is a self-selected technical group made up of agency staff and stakeholders that follow the SDM process. Increasingly, the CVPIA SIT has become an organization focused on modeling.

2. *The Fall Run Chinook Salmon Life Cycle Decision Support Model (DSM)*

Presenter(s): Rod Wittler (USBR) & Mike Urkov (Urkov Group)
Presenter(s) email(s): rjwittler@usbr.gov; mike.urkov@gmail.com
Permission for CWEMF to post pdf of presentation: yes

The salmon life cycle model is the core analytical tool used to evaluate proposed CVPIA restoration actions. It allows the SIT to turn conceptual models of what impacts salmon to a numerical model that can evaluate various hypotheses. Model results help identify actions most likely to increase populations as well as areas requiring focused scientific investigations.

3. *A Streamlined Approach to Modeling Salmon Habitat in The Central Valley*

Presenter(s): Mark Tompkins (FlowWest) & Emanual Rodriguez (FlowWest)
Presenter(s) email(s): mtompkins@flowwest.com; erodriguez@flowwest.com
Permission for CWEMF to post pdf of presentation: yes

Habitat inputs for the CVPIA SIT Decision Support Models (DSMs) are derived from studies and models that use a variety of methods and data. The CVPIA SIT identified improved habitat quantification for the DSMs in the CVPIA Near Term Restoration Strategy. The recommended approach is "full census" habitat modeling in watersheds where suitable data and models exist, and a new remote sensing and machine learning approach for watersheds without suitable data or models. We present general methods for both approaches and illustrate implementation of both methods in selected Central Valley watersheds.

4. Modeling Chinook Salmon Spawning Habitat Decay

Presenter(s): Emanuel Rodriguez (FlowWest) & Rod Wittler (USBR)
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Permission for CWEMF to post pdf of presentation: yes

Salmonid spawning habitat is an important input to the CVPIA DSMs. Initially, spawning habitat was modeled as static through time in the twenty-year simulation period. The CVPIA SIT identified that spawning habitat, especially downstream of large dams that trap most of the spawning gravel supply, is subject to change during high flows. We used detailed sediment transport studies conducted on the Sacramento River to develop a spawning habitat decay function for the DSMs that causes spawning habitat to change in response to flow in DSM simulations. We present methods used to develop the Sacramento River decay function and to translate this function to other Central Valley watersheds. The evaluation of spawning habitat decay allows the SIT to schedule realistic management actions during the 20-year simulation period.

5. Updating Sacramento River Hydraulic and Habitat Modeling Data

Presenter(s): Rod Wittler (USBR)
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Permission for CWEMF to post pdf of presentation: yes

One of the most sensitive inputs to the SIT models is the existing amount of various types of fish habitat. Initial estimates for the first version of the model relied entirely on expert elicitation to determine how many acres of habitat existed in every watershed in the Central Valley. Since then, many of the estimates have been replaced with detailed 2-D hydrodynamic model output to provide better inputs for various watersheds. This presentation will provide a status update on new topographic and bathymetric data needed to update the hydraulics model for the largest river in the Central Valley, the Sacramento River.

Session 24: Groundwater Grab Bag
Moderator: Abdul Khan (DWR)
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1. ***Groundwater extraction and agricultural demands: Insights from Kern County's Semitropic Water Storage District***

Presenter(s): Azad Heidari (GEI)
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Collaborator(s): Larry Rodriguez (GEI)
Permission for CWEMF to post pdf of presentation: Yes

This study provides a detailed analysis of agricultural water use and groundwater extraction in Kern County, CA, focusing on the Semitropic Water Storage District (SWSD) from 1983 to 2022. Setting up an Integrated Water Flow Model Demand Calculator (IDC) across 1.1 million acres, we incorporated extensive data, including soil, climate, and irrigation management, with a particular focus on high-resolution data from 2010 onwards in the SWSD. We emphasized processing the intricate system of surface and groundwater import and export within the SWSD. This approach allowed for a nuanced understanding of water distribution systems and the impacts of a water banking agreement with the California Department of Water Resources. Key findings of the model include detailed crop water usage and applied water requirements representing the total water needed for municipal or agricultural needs plus losses. The net ground water extraction was defined as the difference between applied water and surface water delivery. Our results, presented through accessible monthly and annual water balance maps and charts, offer valuable insights into the region's water dynamics and are used to inform a MODFLOW model for accurate groundwater level simulations. This study provides a foundational tool for simulating future scenarios and guiding sustainable water management strategies.

2. Hydroeconomic Modeling of Perennial Crop Dynamics and GSP Demand Management Under SGMA

Presenter(s): Duncan MacEwan (ERA Economics)
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Collaborators(s): Richard Howitt, Brooks Ronspies, Steve Hatchett (ERA Economics)
Permission to Post pdf of Presentation on CWEMF Website: Yes

Perennial crops now comprise about 65% of the irrigated acres in the San Joaquin Valley (SJV) and approximately 70% of crop ETAW. As GSAs implement demand management programs it is important that integrated economic and hydrologic modeling of grower reactions to changes in water allocations reflect the difference in adjustment costs between annual and perennial crops. Orchards, vineyards, and other perennial crops are capital assets and should be modeled in a dynamic economic framework, yet this is not done in existing models. This is important because limited groundwater availability in parts of the SJV may force some growers to fallow perennial crops before the capital investment is fully recovered. We develop a field-level economic model calibrated to hydrologic data, hydrologic models (e.g., CalSim 3 and C2VSim), and orchard age data from DWR and analyze how the economic cost of a demand management program is changed by the age structure of perennial crops. We illustrate this with a case study current GSP implementation in selected SJV GSAs. In this presentation we summarize: (i) the field-level calibrated model (SWAP-RTS) incorporating these perennial crop dynamics and linkage to hydrologic data and models, (ii) acres idled and the potential costs and benefits of a demand management program that

minimizes premature land idling, and (iii) how demand management program development affects the decision to invest in supply augmentation (e.g., Flood-MAR) projects. We conclude with a summary of implications for cost-effective demand management program design in the SJV.

3. Modeling Multi-benefit Groundwater Smart Markets: Open Water Trade

Presenter(s): Brooks Ronspies (ERA Economics)
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Preliminary economic modeling shows that SGMA may result in hundreds of thousands of acres of cropland idled in the San Joaquin Valley (SJV). Agencies and affected groups agree that minimizing the economic cost of reducing the irrigated footprint in the SJV is an important consideration for GSP implementation. In areas with defined groundwater allocations, water markets can provide benefits that lessen economic impacts of land idling by increasing flexibility and allowing economic resources to move to lands that provide higher returns. However, market transactions can also create environmental harms and affect third parties, and some water users may find it difficult/costly to participate. Electronic smart markets help reduce transaction costs for participants, automate constraints to avoid third-party impacts, and automate the buyer-seller matching process. We describe a novel application of smart water markets to achieve multi-benefit outcomes by considering incremental incentive payments to achieve voluntary land idling through market transactions in areas that provide additional ecosystem, community, or other benefits. In this presentation we: (i) present a new open-source smart market water trading platform, called Open Water Trade, (ii) describe multi-benefit groundwater trading in a smart market, and (iii) show an application of Open Water Trade economic modeling to selected SJV subbasins.

4. Remote Sensing Estimates of Groundwater Extraction using the GEEEO Process

Presenter(s): Jacob Winslow (Davids Engineering)
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Permission for CWEMF to post pdf of presentation: yes

Effective groundwater management requires consistent and accurate estimates of groundwater extraction. In California, groundwater extraction estimates are critical for groundwater sustainability planning and successful implementation of the Sustainable Groundwater Management Act (SGMA). While efforts have been made to expand direct methods for groundwater monitoring, much of the groundwater extraction in California is currently unmeasured, including extraction from privately-owned wells. Recognizing this area of need, we have developed a process that leverages the many remote sensing methodologies and geospatial datasets that have become available in recent years to estimate unmeasured groundwater extraction in agricultural and managed wetland environments. In this process – referred to as the Groundwater Extraction Estimates from Earth Observations (GEEEO) process – a spatial water use analysis is computed using available geospatial data gathered from remote sensing approaches that provide an understanding of current land use, climate conditions, and crop water demands at satellite pixel-scale (typically 30 meters x 30 meters). The GEEEO process then combines this data with other locally available information about surface water supplies and water use to estimate total water use and groundwater extraction, after accounting for the use of other available water supplies. This presentation will provide an overview of the geospatial datasets and methodologies that are used in the GEEEO process to estimate groundwater extraction over large, diverse landscapes in California. This

presentation will also provide an overview of test cases where the GEEEO process has been used to support SGMA implementation and reporting in a variety of groundwater subbasins in California's Sacramento Valley.

5. The Pendulum Swings: California's Attempts to Find a Balance Between Fish and Feathers and Folks and Farms Through the Sustainable Groundwater Management Act (SGMA)

Presenter(s): Brandon Ertis (Davids Engineering)
Presenter(s) email(s): brandon@davidsengineering.com
Permission for CWEMF to post pdf of presentation: yes

California's Great Central Valley was historically teaming with fish and feathers. Starting in the mid to late 1800s, a grand pendulum swing towards folks and farms occurred. This swing included significant modifications to the way water moved through California's landscapes, including the extensive construction of surface water storage facilities, and the widespread development of groundwater resources for both folks and farms. In 2014, amidst the specter of acute drought, rapidly falling groundwater levels, and subsiding land surfaces, California passed the Sustainable Groundwater Management Act. It had been nearly a century since the state had first initiated a systematic approach towards surface water rights management via the California Water Commission Act of 1913. Since 2014, Groundwater Sustainability Agencies (GSAs) have been formed, Groundwater Sustainability Plans (GSPs) have been developed, and Projects and Management Actions (PMAs) are currently being implemented to avoid undesirable results associated with unsustainable groundwater use. In this presentation, we explore the first few years of GSP implementation in California, focusing on innovative approaches to demand management. Specifically, we provide examples of groundwater allocation frameworks, leveraging a combination of remote sensing and flowmeters to quantify consumptive groundwater use relative to sustainable groundwater supplies.

Session 25: The Collaboratory Starts Now

Moderator: Lisamarie Windham-Myers (Delta Stewardship Council)
Moderator Email: lisamarie.windham-myers@deltacouncil.ca.gov

The Delta Stewardship Council's Delta Science Program has been working with California's environmental modeling professionals, managers and decision-makers on the formation of a collaboratory. Currently, the goals are to develop a unified vision and implementation plan to catalyze, facilitate, and guide the creation of a collaborative framework and virtual space to enhance our ability to tackle complex socio-environmental challenges that require multiagency and community wide coordination and support. This effort is intended to use the community's ideas, needs, and suggestions gathered over the last few years and develop an approach to implement foundational collaboratory elements while simultaneously producing usable scientific information aimed at supporting current and long-standing socio-environmental challenges. This session is intended to convey the history and background of this effort, current vision and goals for the collaboratory, next steps, and present real-world use case examples, topics, and projects. This session will include a few short lighting talks/presentations, and a moderated panel discussion followed by an interactive Q&A session. Topics will include an overview of the importance and usefulness of collaboratory approaches, the Delta Science Programs role in facilitating and coordinating community members, and the vision and strategy for implementing the current plan. This session will explore current use cases and topic specific challenges as potential pathways to building core collaboratory elements such as cyber infrastructure, human resources, best practices, and leadership elements. Session organizers and panel participants are looking forward to interacting with the audience through real-time app-based survey tools and an in-person Q&A session.

1. ***An Overview of Collaborative Approaches for Integrated Modeling: What We have Learned***

Presenter(s): Josue Medellin-Azuara (UC Merced)
Presenter(s) email(s): jmedellin@ucmerced.edu
Permission for CWEMF to post pdf of presentation: Yes

Collaborative integrated modeling is essential for managing complex environmental systems like the Sacramento-San Joaquin Delta. By intertwining models and data across disciplines, agencies, and stakeholders, these approaches enhance decision-making, ensuring strategies are both scientifically sound and practically relevant. The concept of a Collaboratory envisions a central hub that unites expertise from government, academia, NGOs, and the private sector to promote transparency, interdisciplinary collaboration, and adaptive modeling. This approach mitigates challenges such as fragmentation and inefficiency by encouraging modular frameworks that allow for flexible simulations and more responsive models. Key to the success of this initiative are sustained funding, strong partnerships, and iterative refinement. The Collaboratory enhances knowledge sharing, data management, and alignment of diverse objectives, leading to more effective environmental management. This integrated model provides valuable insights for global environmental management and serves as a blueprint for addressing complex systems worldwide, with case studies from California illustrating the importance of collective learning throughout the process.

2. ***Delta Science Program Collaboratory Vision 2025: Strategic Advances to Launch Collaborative Science***

Presenter(s): Lisamarie Windham-Myers (Delta Stewardship Council)
Presenter(s) email(s): Lisamarie.Windham-Myers@deltacouncil.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

Development of collaborative spaces for science advances and actionability has been a line item in the Delta Science Program Action Agenda since guidance for the Delta Science Plan was established in 2015. Science literature and governance has seen a global rise in the use of cross-scale syntheses and forecasting in complex and nonstationary socio-environmental systems. Open and integrative modeling practices are worthy of the extra effort when they lead to transdisciplinary knowledge and transformative interpretation of existing data. Further, transparent modeling practices democratize understanding of alternatives, advancing both science and management goals. Among the modeling achievements of the 30 year CWEMF partnership, is recognition of the central role of models in forecasting resource management futures in California's socially-ecologically-phyiscally complex Delta. We suggest that partnerships are essential to addressing challenges in decision making under deep uncertainty, including assessment of alternatives in monitoring design and governance. DSP's current vision is deeply seeded in the visions of past Delta Lead Scientists and champions of collaboration across agencies and institutions. We use this CWEMF platform to 1) engage model users and authors in establishing the foundation of the Collaboratory, and 2) initiate facilitation of 'use cases' to simultaneously achieve project-specific goals while building a foundation that accelerates and democtratizes future project development.

3. ***'Use case' approach for the Collaboratory: How did we get here?***

Presenter(s): Ben Geske (Delta Stewardship Council)
Presenter(s) email(s): Ben.Geske@deltacouncil.ca.gov
Permission for CWEMF to post pdf of presentation: Yes

The Delta Science Program's approach to implementation of an integrated modeling framework and Collaboratory acknowledges and builds off many previous initiatives along with parallel projects currently underway in the Bay-Delta. Over the last decade, and through the guidance and leadership of collaborative partners and Delta Lead Scientists, several working groups and workshops have progressed the thinking around priority needs for a Collaboratory and feasible mechanisms by which to establish and organize its components. To establish the foundation of the Collaboratory, the Delta Science Program intends to facilitate actionable 'use cases' to simultaneously achieve project-specific goals and initiate development of the Collaboratory's foundational elements. A 'use case' will involve a diverse team of participants, including scientists, managers, academics, agency staff, and community participants, working to address high-priority management needs through collaborative development and application of data synthesis, models, and tools. This approach will help assemble and organize the necessary experts, issues, and approaches while continuing to make progress on real-world management challenges. The structures and processes established through initial 'use cases' are intended to lay the foundation for longer-term functions and organizational aspects of the Collaboratory. In parallel with 'use case' development and implementation, a strategic plan will be developed to ensure continued sustainable operations and governance of the Collaboratory and its resources.

Session 26: Reclamation Grab Bag

Moderator: Maribeth Kniffin [USBR]
Moderator Email: mkniffin@usbr.gov

1. Improvements to CalSim Reference Evapotranspiration

Presenter(s): Lauren Thatch (USBR)
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Collaborator(s): Chris Pearson & Justin Huntington (Desert Research Institute)
Permission for CWEMF to post pdf of presentation: yes

Improved estimates of crop ET and applied water demands are desired for water operations and planning simulations made using the CalSim water resources planning model. Current CalSim applications rely on simplified methodologies that are out of date with respect to current technologies and best available science. ASCE-EWRI Standardized Penman-Monteith (ASCE-PM) standardized reference ET is the gold standard for crop ET estimates and planning throughout the United States and the World. ASCE-PM provides a consistent approach for estimating reference ET using the best available inputs and data processing allowing for reproducible ET estimation in variable environments and scenarios. Adoption of a dual crop coefficient approach based on ASCE-PM reference ET will bring CalSim in line with other crop ET estimation practices throughout Reclamation. Furthermore, application of finer scale gridded climate and land use datasets will establish a consistent framework for future updates and incorporation of future climate scenario modeling. This work is currently in progress, this presentation will include an analysis of spatial reference ET datasets to update the CalSimHydro inputs to ASCE-PM reference evapotranspiration, and initial steps for development of the ET Demands model over the CalSimHydro model domain to estimate crop ET.

2. Updates to Forecast-Informed Reservoir Operations (FIRO) at Folsom and Klamath Dams

Presenter(s): Drew Allan Loney (USBR)
Presenter(s) email(s): dloney@usbr.gov
Collaborator(s): Douglas Woolridge (USBR)
Permission for CWEMF to post pdf of presentation: yes

Reclamation water management is increasingly restricted by greater human usage, larger environmental compliance demands, and accelerating climate change. These factors interact to intensify the requirements on water resources infrastructure and the scrutiny regarding how those resources are managed. Forecast Informed Reservoir Operations (FIRO) are an approach through which Reclamation can adapt to these factors. FIRO pilot studies have demonstrated the feasibility of utilizing improved meteorological/hydrological forecasts combined with better management techniques to simultaneously improve dam safety and water availability. This work summarizes the current status of a FIRO pilot studies at two Reclamation facilities -- Folsom Dam and Link River Dam (Upper Klamath Lake) -- what, if any, water management alternatives are available to increase water availability, improve environmental compliance, and adapt to a changing climate.

3. *Evaluating the Role of Leakage Efficiency and Release Elevations on Release Water Temperatures at Folsom Dam*

Presenter(s): Mussie Beyene & Drew Loney (USBR)
Presenter(s) email(s): mbeyene@usbr.gov, dloney@usbr.gov
Permission for CWEMF to post pdf of presentation: yes

Record droughts and rising annual air temperatures in northern California are increasingly challenging Folsom Dam's ability to cool downstream river water temperatures during late summer and fall, particularly under no power bypass. There is an ongoing effort to refurbish existing Temperature Control Shutters (TCS) at Folsom Dam, however, there is limited understanding about the efficacy of different TCS designs in preserving the cold-water pool into the latter part of the year. This study investigates the relationship between Folsom Dam release temperatures and TCS design parameters, including leakage efficiency and release elevations, under historical meteorological and hydrological conditions. The CE-QUAL-W2 model is employed to simulate release temperatures, with summer and fall cumulative degree days above 59°F (CDD59) used as a metric to evaluate the performance of various TCS configurations. Our findings indicate that TCS designs with higher leakage efficiency and release elevations were generally associated with cooler release summer temperatures and lower CDD 59 during summer and fall seasons. Compared to the existing TCS design at Folsom Dam, TCS designs with leakages less than 35% and/or more than three release elevations were improvement in managing the cold-water pool across a variety of meteorologic and hydrologic conditions. Notably, TCS designs with higher leakage efficiency and elevation numbers provide the greatest reduction in the CDD 59 during critically dry years. The findings in this study offers a helpful reference for the refurbishment of Folsom dam TCS.

4. *Allocation Iteration Tool*

Presenter(s): Dan Easton (MBK Engineers), Sam Waers (USBR)
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Permission for CWEMF to post pdf of presentation: yes

The CVP Allocation Iteration (AI) Tool is a WRIMS-based script for improving agricultural service allocations in CalSim 3. The AI inputs are taken from the output of an existing model (the model to be optimized). These inputs include Shasta, Folsom, and San Luis storage values, South-of-Delta (SOD) delivery shortages, Jones and Banks exports, and others. The user must define storage thresholds for Shasta, Folsom, and San Luis CVP storage, which are used by the AI tool to calculate relative shortages and the available storage at the end of September. The AI tool also determines several other quantities after each model run, including the maximum potential reduction in Jones exports from June to August and the available Jones capacity during the same interval (limited by pumping capacity, OMR regulations, EI export control, and DMC/Intertie capacity). After each model run, the AI tool calculates potential decreases and increases to North-of-Delta (NOD) and South-of-Delta (SOD) allocations. These increases and decreases are added to and subtracted from the original allocations and the model is re-run. This procedure is repeated, typically for three runs. This iterative process allows the adjustments to the allocations to be implemented and then updated based on the effects of a full CalSim3 run with adjusted allocations. The process of running the AI procedure is accomplished within WRIMS and does not require additional software.

LIST OF LOCAL RESTAURANTS

1. Sutter St. Steakhouse – 604 Sutter St.
2. Plank Craft Kitchen + Bar – 608 Sutter St.
3. Folsom Hotel – 703 Sutter St.
4. Q'Bole! Mexican Cocina & Cantina – 718 Sutter St #201
5. Gaslight Co. – 718 Sutter St. #200
6. Riley's on Sutter – 702 Sutter St Ste M
7. Hop Sing Palace – 805 Sutter St
8. Pizzeria Classico – 702 Sutter St
9. Scott's Seafood Roundhouse – 824 Sutter St.
10. Sutter Street Taqueria – 727 Sutter St
11. Fat Rabbit Public House – 825 Sutter St.
12. Mystique Dining – 611 Sutter St.
13. Samuel Horne's Tavern – 719 Sutter St.
14. The Vine Folsom – 609 Sutter St.
15. Folsom Café – 727 B Sutter St.
16. Powerhouse Pub – 614 Sutter St #D
17. Represa Grill – 703 Sutter St.

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