

ATTACHMENT A3
RESUMES FOR PROJECT MANAGER AND KEY PROJECT STAFF

Resumes for the following project staff are provided in this attachment:

1. William Brownlie, Ph.D., P.E.
2. Sujoy B. Roy, Ph.D.
3. Kevin C. Torres, M.S.
4. Philip A.M. Bachand, PhD.
5. Stuart W. Siegel, Ph.D.
6. Theodore E. Donn, Jr., Ph.D.
7. Gary G. Wortham
8. Colleena R. Perez
9. Karen L. Dikeman

EDUCATION

Ph.D., Civil Engineering, Hydraulics, California Institute of Technology, 1981
M.S., Civil Engineering, Hydraulics and Water Resources, State University of New York, Buffalo, 1976
B.S., Civil Engineering, State University of New York, Buffalo, 1975
Cold Climate Engineering Training
Training in the Princeton Transport Groundwater Code
Continuing Education (90+ PDHs) in Sedimentation, Hydraulics and Hydrology, Treatment Wetlands, Culvert Design, Shore Protection, Program Management, and Ethics

Years of Experience / Years with Tetra Tech: 31 / 31

REGISTRATIONS/CERTIFICATIONS

1983, Professional Engineer, California (36192)
1989, Professional Engineer, Oregon (14557)
1989, Professional Engineer, Alaska (7909)
1990, Professional Engineer, Kansas (1747)
1991, Professional Engineer, Washington (28026)
1992, Professional Engineer, Virginia (23533)
1995, Professional Engineer, New Mexico (12935)
1996, Professional Engineer, Illinois (062-050997)
2009, Professional Engineer, Delaware (16173)
2009, Professional Engineer, Florida (70052)
2009, Professional Engineer, Louisiana (34525)

HONORS

Winner of the Alfred Noble Prize, awarded by the American Society of Civil Engineering (ASCE) for his technical paper, *Flow Depth in Sand-Bed Channels*, published in the ASCE Journal of Hydraulic Engineering
Delegate at the U.S.-Pakistan Binational Symposium on Mechanics of Alluvial Channels, held in Lahore, Pakistan

CLEARANCES

DoD Top Secret and DOE Q

QUALIFICATIONS

Dr. Brownlie is senior floodplain management expert and Tetra Tech's Chief Engineer. Dr. Brownlie joined Tetra Tech in 1981, and has extensive experience in engineering and program management for environmental and water resource projects. His specific technical area of expertise is river mechanics and sediment transport and hydraulics in open channels. He has been working on projects related to Salton Sea restoration since 1998, for the Salton Sea Authority and the Bureau of Reclamation. He was also Program Manager for the New and Alamo River Wetlands Master Plan Project that was funded by the State Wildlife Conservation Board. Dr. Brownlie has familiarity with Salton Sea area issues and stakeholders through his regular attendance and participation in public meetings throughout the region related to the Salton Sea including Salton Sea Authority Board meetings. He will bring that knowledge

and experience to this project. He recently oversaw the Salton Sea shallow habitat demonstration project to demonstrate the feasibility of developing shallow saline habitat near the Salton Sea, next to the Alamo River. Through multiple contracts and more than 75 different individual projects related to Salton Sea restoration, Dr. Brownlie has demonstrated his ability to manage multidisciplinary teams and to complete projects on schedule and within budget. Dr. Brownlie's research has included development of methods for determining flow depth and sediment transport in channels that have been widely cited in engineering literature and included in design manuals and flood control analysis and design computer models. These methods are published in the 2008 ASCE Sedimentation Engineering Manual 110.

PROGRAM MANAGEMENT EXPERIENCE

Salton Sea Restoration Program: Development of a Preferred Project for the Salton Sea Authority and Bureau of Reclamation—Serves as Project Manager, providing support functions including logistical services and preparation of presentation materials for meetings, including meetings with the Congressional Salton Sea Task Force and other key federal and state legislators. The project includes a feasibility assessment report, engineering/geotechnical support, public involvement, dust control/habitat planning, and planning/landscape design services.

Salton Sea Shallow Habitat Project, Bureau of Reclamation and the USGS Salton Sea Science Office—Principal-In-Charge for the design, construction, and operation and maintenance of a 100-acre saline, shallow habitat project, consisting of four ponds located near the Alamo River where it discharges into the Salton Sea.

Engineering Support Services for the Salton Sea Restoration Project for the Salton Sea Authority and US Bureau of Reclamation—Project Manager for a program to restore California's largest lake, a 370-square mile saline lake located in Riverside and Imperial Counties. The program has involved extensive hydraulic, hydrologic and water quality modeling, including application of the EPA EFDC Model that was developed by Tetra Tech. Other investigations have included management support, environmental compliance services, environmental and civil conceptual analysis and design, geotechnical surveys, cultural and biological resource surveys, public involvement, and alternatives assessments. *Received three letters of commendation citing "outstanding" performance.*

Salton Sea Restoration Project Alternatives Document for the Bureau of Reclamation—Project Manager to provide conceptual design and environmental engineering services in support of the Salton Sea Restoration Project and preparation of the Department of Interior's Status Report to Congress in January 2003. Alternatives included a 200-km pipeline to the Gulf of California which had numerous water quality and invasive species issues. The project also involved completion of a cultural resource Phase 1 Survey that included compilation of a site database of 1,250 archaeological sites.

Salton Sea Restoration Project EIS/EIR, CA—Program Manager for preparation of a combined Environmental Impact Statement/Report (EIS/EIR) and subsequent work to develop a preferred project to restore the Salton Sea. The main goals of the program are to control salinity and water surface elevation and improve water quality and wildlife habitat at this 370 square mile salt-water body in southern California. In addition to document preparation, the program includes alternative assessment and screening, finance analysis and planning and extensive public outreach. Alternatives assessed included several alternatives involving pipelines and tunnels (total pipeline lengths of 100-220 km) for conveying salty water to either the Gulf of California or the Pacific Ocean.

Project Management Plan and Framework Document for the Central Valley Integrated Flood Management Study (CVIFMS), US Army Corps of Engineers Sacramento District—Project Manager for the development a Project Management Plan and Companion Watershed Planning Document

for a long-term, comprehensive program to reduce flooding risk along the Sacramento and San Joaquin Rivers in Central California.

Pacoima Reservoir Sediment Removal Feasibility Study, Los Angeles County Department of Public Works—Program Manager, providing technical support to the County for the development of a plan for removal and disposition of 5.2 million cubic yards of sediment from Pacoima Reservoir in Los Angeles, CA. Involved analysis and screening of sediment management alternatives and development of conceptual designs.

Long-Term Sediment Management Plan for Los Angeles County, Los Angeles County Department of Public Works—Program Manager, providing technical support to the County for the development of a plan for long-term, sustainable management of sediment in the County. Involved analysis and screening of sediment management alternatives, modeling of sluicing at Pacoima Reservoir, and development and operation of a pilot project for processing of sediment for multiple uses.

Santa Fe Regional Water Supply, City of Santa Fe, NM—Program Manager responsible for development and screening of long-term water supply alternatives for the City and County of Santa Fe and for preparation of an EIS related to those water supply options. The project included evaluation of the following categories of alternatives: six surface water diversion options, all would include construction of new water conveyance pipelines varying in length from 15 to 40 km; four groundwater options; and five methods of using reclaimed water.

Buckman Water Diversion EIS, US Forest Service—Program Manager responsible for preparation of an EIS to identify potential environmental impacts of a new water diversion from the Rio Grande in northern New Mexico. The project involved evaluation of the construction and operation of a direct diversion structure, a 15-mile pipeline, three pumping stations and a new water treatment plant. The project involved detailed Phase III cultural resource surveys, biological surveys, and visual analyses. *Received letter of commendation citing “outstanding service.”*

Santa Fe Supplemental Wells EA, City of Santa Fe, NM—Principal-In-Charge responsible for overseeing preparation of an EA related to water supply enhancements for the City of Santa Fe involving installation of four new water supply wells.

Mid-Pacific Services IDIQ, US Bureau of Reclamation—Program Manager for the program that involves a broad range of environmental, planning, engineering and water resources projects.

Environmental Restoration and Compliance Support for the Air Force—Program Manager for successful completion of \$50 million nationwide environmental restoration and other environmental support including RI/FS and groundwater monitoring at March ARS; and RI/FS at Vandenberg AFB, as well as environmental compliance activities such as Base Reuse EISs and EBSs at Bergstrom, England, Griffiss, and Plattsburgh AFBs. Efforts included 30 delivery orders at 25 DoD installations in 10 states, involving hundreds of sites. *Received “excellent” ACASS ratings.*

Tennessee Valley Authority Reservoir Optimization Management Plan, Knoxville, TN. Project Manager for the development management plan for a program to optimize the operation of TVA reservoirs to improve flood control, while maximizing power generation, navigation and recreational opportunities. Work closely withal involved TVA departments to identify criteria and goals and prepare a consolidated management plan document.

CALFED Bay-Delta Programmatic Environmental Impact Statement/Report (EIS/EIR), CA—Principal-In-Charge for technical and production support for a programmatic EIS/EIR addressing the

effects of a 30-year water resources management program for California. The project involved analysis of alternatives that included an isolated facility (canal or pipeline) that would convey water from the north end of the Delta, approximately 50-miles to the pumping plants in the south of the Delta.

CALFED Bay-Delta Program Riverine Hydraulics and Delta Hydrodynamics, CA—Project Manager for a technical evaluation of the effects of the development of a large water resources management program on the hydraulic flow characteristics of the Sacramento and San Joaquin rivers and the hydrodynamics of the Bay-Delta.

CALFED Bay-Delta Watershed Management Program Assessment, CA—Principal-In-Charge for an evaluation of the effects of a coordinated watershed management program in the Sacramento and San Joaquin river basins.

CALFED Bay-Delta Water Storage Program Assessment, CA—Principal-In-Charge for an evaluation of the effects of potential development of new water storage facilities in the Sacramento and San Joaquin river basins.

National-Scope Programmatic Environmental Impact Statement and Other Environmental Support Services for Nuclear Weapons Complex DOE—Program Manager for one of the largest environmental programs ever undertaken by the DOE. This 6-year, \$75 million program involved preparation of environmental documents addressing realignment and consolidation of missions at 13 weapons complex locations throughout the country. *Received several letters of commendation.*

NEPA Documentation for Air Force BRAC II—Program Manager for \$3.5 million fast-tracked project to prepare four concurrent EISs involving bases in nine states, for possible closure of eight bases and realignment of missions to seven alternative installations. Completed project under budget and within an accelerated schedule. *Received “excellent” ACASS rating.*

National-Scope Programmatic Environmental Impact Statement and Siting Support for Air Force ICBM Modernization Program—Deputy Program Manager and later Program Manager for \$27 million program to prepare a national-scope programmatic EIS and other environmental documents and GIS to support siting of missile programs at candidate bases nationwide. Environmental analyses were conducted at: Barksdale AFB, Davis-Monthan AFB, Eaker AFB, Edwards AFB, Ellsworth AFB, Eglin AFB, F.E. Warren AFB, Gila Bend AFAF, Grand Forks AFB, Holloman AFB, Indian Springs AFAF, Little Rock AFB, Luke AFR, Nellis AFB & AFR, Malmstrom AFB, Minot AFB, and Whiteman AFB. *Received letter of commendation from the Air Force Regional Civil Engineer Commanding Officer... “The high quality characterization and environmental analysis of such a diverse group of locations within the short period allowed was outstanding.”*

Commencement Bay Environmental Restoration Feasibility Study for the Washington State Department of Ecology—Program Director for the preparation of a feasibility study for the cleanup of Commencement Bay in Tacoma, WA.

Diamond Valley Reservoir Project EIR—Quality Assurance Manager for the Eastside Reservoir EIR for the Metropolitan Water District. The EIR addressed the impacts of construction and operation of a proposed new water storage facility in the Diamond Valley in Riverside County, CA.

Erosion Analysis along Salton Sea Tributaries—Performed an engineering analysis of erosion at transmission tower footings along the San Geronio and Whitewater Rivers in California. Provided specifications for footing designs.

Expert Testimony Involving Flooding in Talbert Channel, Huntington Beach, CA—Provided expert testimony in support of legal action involving flooding in the Talbert Channel in Huntington Beach, CA.

Evaluation of Flood Hazards Associated with Naval Hospital, San Diego, CA—Evaluated impacts of flooding and flood plain management from construction of the Navy Hospital in San Diego, CA.

Design of Pumping Stations for Contaminated Runoff from Mission Bay, CA—Project Manager for the design of a network of pumping stations to collect contaminated runoff in storm drains and flood control channels and divert it into the City of San Diego (CA) sanitary system. Project was designed and constructed in three phases. The network has been in successful operation since 1985 and has a pilot for a more extensive system for the entire bay.

Tecolote Creek Sedimentation Basin Design, CA—Project Manager for Tecolote Creek (CA) sedimentation basin design, which included all aspects of design for a sedimentation basin on a creek with a drainage area of approximately 8 mi².

Talbert Channel Design Studies, CA—Project manager for design studies for improvements to Talbert Channel in Huntington Beach, California.

Master Plan for Shoreline Improvement of Bass Lake, CA—Prepared master plan for shoreline improvements of Bass Lake in California. This project included wave studies, analysis of shoreline erosion, development of conceptual design alternatives for shoreline improvements, and prioritization of shoreline segments.

Analysis of Design Flood Elevations of Debris Flood Events, Big Tujunga Canyon, CA—Project Manager for an analysis of design flood elevations of debris flood events in Big Tujunga Canyon, California. Provided specifications for levee design.

Shoreline Erosion Studies, Mission Bay, CA—Principal Investigator for shoreline erosion studies in Mission Bay, San Diego (CA). Prepared conceptual designs for shoreline improvement alternatives.

North Carolina Flood Hazard Studies for FEMA—Project Manager for the largest coastal and riverine flood hazard study ever conducted by the Federal Emergency Management Agency at the time (17 counties and 45 communities in NC).

South Carolina Flood Hazard Studies for FEMA—Project Manager for a riverine and coastal flood hazard study of Georgetown and Horry Counties and seven communities in S. Carolina for the Federal Emergency Management Agency.

Florida Flood Hazard Studies for FEMA—Project Manager for a \$600,000 flood hazard study of Flagler and St. Johns Counties (FL) for the Federal Emergency Management Agency.

Sabine River Flood Hazard Study for FEMA, in Calcasieu Parish, LA—Project Manager for a study of flood levels along the Sabine River in Louisiana and Texas to evaluate the effects of dam construction on flood elevations for the Federal Emergency Management Agency.

Public Hearing Support for Flood Insurance Program for FEMA—Presented the results of flood hazard studies at more than 50 public meetings in four states.

Analysis of Rock Trap and Drain System for Southern California Edison—Performed analysis of the rock trap and drain system in Southern California Edison Tunnel No. 3 on Big Creek.

Evaluation of Sedimentation Effects of Hydroelectric Development, North Fork of Kings River, CA—Evaluated the effects of hydroelectric development on sedimentation in North Fork of the Kings River (CA) for Pacific Gas and Electric.

FERC Permit Application for Susitna Hydroelectric Project, AK—a consultant to U.S. EPA for evaluation of water quantity, water quality, and sedimentation aspects of the FERC permit application and EISs for the Susitna Hydroelectric Project (AK).

Environmental Impact Analysis Services, Nevada Test Site and Offsite Areas—Corporate Sponsor for preparation of an Environmental Impact Statement on environmental restoration and waste management activities at four DOE sites in Nevada.

Southern California Sediment Management Project—Principal Investigator to evaluate the sediment yield of nine major rivers in southern California. Participated in studies of upland sediment yield, including debris flow investigations and a field program to monitor hill slope erosion after a brush fire.

Sediment Transport Research and Model Development—Conducted research on sediment transport and determination of friction factors in open channels. Developed an implicit finite difference numerical model.

Evaluation of Effects of Harbor Jetties on the Sodus Bay Shoreline, NY—Conducted research on the effects of harbor jetties on the shoreline in the vicinity of Sodus Bay, NY. Project included field tracer studies of beach material movement, an analysis of historical shorelines, numerical modeling of wave hindcasting and refraction, and sediment budget analysis.

Study of Dredging Effects—Conducted research on the effects of dredging at a creek mouth through the use of numerical models.

PROFESSIONAL ORGANIZATIONS/ASSOCIATIONS

Member, American Society of Civil Engineers

Former Vice Chairman, Hydraulics Committee, Los Angeles Chapter, ASCE

Reviewer for American Society of Civil Engineers, National Academy of Sciences, National Science Foundations, and Water Resources Research

Control Group Member of the ASCE Task Committee on Analysis of Laboratory and Field Sediment Data Accuracy and Availability

Member, Tau Beta Pi and Sigma Xi

PUBLICATIONS

Selected References to Brownlie Hydraulic Methods in Literature

Marcelo Garcia (Editor), Sedimentation Engineering: Processes, Measurements, Modeling, and Practice, American Society of Civil Engineers Sedimentation Manual 110, 2008, *Brownlie Sediment Transport and Flow Methods*. Includes presentation of Brownlie Methods for (1) initiation of motion, (2) sediment transport, and (3) friction factor/flow depth.

Floodplain Mapping Using HEC-RAS, Bentley Publications, 2005 *Section 11.11 Stable Channel Design Using HEC-RAS*. Option for using the Brownlie Method for roughness determination in the Corps of Engineers HEC-RAS computer program for channel analysis and design.

US Army Corps of Engineers, Engineer Manuals, EM 1110-2-4000, Sedimentation Investigations of Rivers and Reservoirs, ENG 1787, October 1995, *Section 9-11 Brownlie Approach*. A presentation of the Brownlie Approach for determining flow depth in open channels in a Corps of Engineers Design Manual.

Publications by Brownlie

1983 and 1985 ASCE Engineering Workshops. Presented papers at 1983 and 1985 ASCE Engineering Workshops at California State University at Long Beach.

1982 USGS Conference, Living with Landslides. Presented paper entitled “Living with landslides” at the 1982 U.S. Geological Survey conference in Menlo Park (CA) on landslides and flooding in the San Francisco Bay region.

Coastal Zone 1981, Unsteady Sediment Transport Modeling. Presented paper entitled “Unsteady sediment transport modeling” at Water Forum 1981 conference in San Francisco, sponsored by the American Society of Civil Engineers.

Coastal Zone 1978, Effects of Dams on Beach Sand Supply. Presented paper entitled “Effects of dams on beach sand supply” at Coastal Zone 1978 conference in San Francisco, sponsored by the American Society of Civil Engineers.

Brownlie, W.R. 1985. *Compilation of alluvial channel data*. J. Hydraul, Eng. ASCE 111(7).

Brownlie, W.R., and J. Weckmann. 1985. *Water quality control in Mission Bay, California*. In: Proceedings of Engineering Workshop on Hydraulic Modeling, ASCE, Long Beach, CA. 22 pp.

Robertson, A.A., W.R. Brownlie, and F.P. Gerard. 1983. *Flood hazard analysis in coastal areas-a case study in North Carolina*. pp. 172-191. In: Proceedings of Engineering Workshop on Hydraulics of Flood Works. ASCE, Long Beach, CA.

Brownlie, W.R. 1983. *Flow depth in sand-bed channels*. J. Hydraul. Eng., ASCE 109:959-990.

Brownlie, W.R., and G. Borboa. 1982. *Living with landslides*. 17 pp. In: Proceedings of Landslides and Flooding in the San Francisco Bay Region. U.S. Geological Survey Conference, Menlo Park, CA.

Brownlie, W.R. 1981. *Reexamination of Nikuradse roughness data*. J. Hydraul. Div., ASCE 107(HY1):115-119.

Brownlie, W.R., and P.E. Calkin. 1981. *Effects of jetties - Sodus Bay, New York*. Great Lakes Coastal Geology. New York Sea Grant Institute, Albany, NY. 27 pp.

Brownlie, W.R., and B.D. Taylor. 1981. *Coastal sediment delivery by major rivers of southern California*. EQL Report 17-C. California Institute of Technology, Pasadena, CA. 314 pp.

Brownlie, W.R. 1981. *Prediction of flow depth and sediment discharge in open channels*. W.M. Keck Laboratory Report No. KH-R-43A. California Institute of Technology, Pasadena, CA. 232 pp.

Brownlie, W.R. 1981. *Compilation of alluvial channel data: laboratory and field*. W.M. Keck Laboratory Report No. KH-R-43B. California Institute of Technology, Pasadena, CA. 209 pp.

Brownlie, W.R. 1981. *Discussion of total load transport in alluvial channels*. J. Hydraul. Div., ASCE 107 (HY12):1750-1751.

Brownlie, W.R. 1981. *Unsteady sediment transport modeling*. 8 pp. In: Proceedings of Water Forum '81. ASCE, San Francisco, CA.

Brownlie, W.R. 1980. *Discussion of velocity profiles and minimum stream power*. J. Hydraul. Div., ASCE 106 (HY3):473-474.

Brownlie, W.R. 1979. *Water particle motion under deep water stokes waves*. J. Waterway, Port, Coastal and Ocean Div., ASCE 105 (SS1):89-94.

Brownlie, W.R., and W.M. Brown. 1978. *Effects of dams on beach sand supply*. 15 pp. In: Proceedings of Coastal Zone '78. ASCE, San Francisco, CA.

Brownlie, W.R. 1976. *Coastline changes on Lake Ontario: the effect of the Federal Navigation Project at Great Sodus Bay, New York*. State University of New York at Buffalo. Masters thesis. 144 pp.

EDUCATION

Ph.D., Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pa, 1995
M.S., Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pa, 1992
B. Tech., Civil Engineering, Indian Institute of Technology, New Delhi, India, 1990

SPECIALTIES

Water quality and flow modeling, fate and transport of trace metals, nutrient chemistry and impacts, ecological risk assessment, TMDL model development, and drinking water quality protection.

QUALIFICATIONS

Dr. Roy is an environmental engineer with extensive experience studying water quality in aquatic systems in applied research and regulatory contexts. He has been involved in studies at the local, regional and national levels, and has participated or directed studies with significant modeling, monitoring, and pilot testing components. Dr. Roy's particular areas of interest include the modeling and development of management plans to address water quantity and quality concerns for drinking water source protection and for addressing ecological impacts. In most instances, his work is motivated by current impairment, such as the development of total maximum daily loads (TMDLs) or anticipation of future growth and climate change.

RELEVANT EXPERIENCE

- **Selenium Total Maximum Daily Load (TMDL) in North San Francisco Bay.** Selenium from a variety of agricultural, industrial, and municipal sources, combined with natural loadings of the element, had led to impairment of San Francisco Bay, largely as a result of elevated concentrations in certain species of fish and birds. Dr. Roy is leading an effort to support the development of the TMDL for this water body through a combination of data collection, field measurement and fate and transport modeling. The goal of the TMDL is to better characterize the pathways of impairment in biota and to identify strategies to help minimize the causes of impairment.
- **Master Plan to Improve Water Quality in the New and Alamo Rivers.** The New and Alamo Rivers discharge approximately a million acre feet of highly polluted water into the Salton Sea, a large terminal, hypereutrophic lake in Southern California. Included in the flows are raw sewage discharges from the town of Mexicali in Mexico as well as nutrient-rich agricultural drainage. This study developed a detailed model of flow and chemistry in these rivers and developed a master plan to create a network of treatment wetlands to improve water quality with respect to nutrients and pathogens.
- **Operation and Management of Shallow Habitat Near the Salton Sea and Alamo River.** Responsible for operation and management of a 100-acre system of shallow wetlands using water from the Salton Sea and Alamo River. The wetlands contain four cells with increasing salinity and serve as a pilot system for evaluating potential ecological risks for similar habitats to be constructed in future. Tetra Tech operated this pilot shallow habitat from 2006-2011 with the assistance of a subcontractor (Agrarian Research).
- **Water Quality Treatment Evaluation and Modeling in the Salton Sea.** Managed a study to evaluate the treatment potential and costs of treating a portion of the hypolimnetic waters of the

Salton Sea. The goal of the treatment was to control sulfide build-up and emission of odors to the surrounding areas. An additional component of the study is the development and calibration of a three-dimensional hydrodynamic and water quality model of the Sea that can be used to evaluate the water quality impacts of different restoration scenarios. This model is being used to determine whether there might be potential changes in the water quality of the Sea as the surface area and inflow volumes change over the coming decades.

- **Climate Change Study on the Los Angeles Aqueduct.** Worked with the Los Angeles Department of Water and Power to analyze the impacts of climate change on water supplies from the Eastern Sierra Nevada, and to evaluate adaptation strategies to address the impacts of such changes. Climate change impacts are being assessed through a mix of modeling and analytical approaches, including dynamic and statistical downscaling of global climate models, and through evaluation of the 80-year historical record in the basin. Adaptation measures considered as part of this work, included the creation of additional groundwater/surface water storage, conservation, and new water supplies, driven runoff projections under different climate scenarios, and over different timeframes.
- **Sea Level Rise Impacts on NASA Ames Research Center in San Francisco Bay.** Ongoing study to evaluate impacts to the infrastructure at the ARC, including Those impacts include impacts due to increases in the frequency and intensity of extreme storms that could produce unprecedented flooding across the site; sea level rise; increase in extreme wind speeds that could impair aviation operations; and increases in frequency, duration and severity of heat waves over the 21st century.
- **Potential Constraints in Water Use in Response to Changing Climate.** National-scale study to evaluate water use across the U.S. by different sectors, with future projections of temperature and precipitation from a set of climate models. The goal was to identify areas that are more likely to be impacted because of the regional aspects of climate change, the existing patterns of water use, and projected growth under a business-as-usual scenario.
- **Water Resources Impacts of Hydraulic Fracturing for Natural Gas Extraction.** Ongoing study to develop reasonable high- and low-end scenarios for water withdrawals for hydraulic fracturing, and comparing these withdrawals with projected water withdrawals for all other uses over the coming two decades. The goal is to identify specific regions in the US where the growth of hydraulic fracturing could be constrained by the availability of surface water and groundwater resources.
- **TMDL for Organic Carbon and Nutrients in Suisun Marsh.** Suisun Marsh is one of the largest brackish wetlands in western North America and currently listed on the Clean Water Act (CWA) 303 (d) list for impairment by metals, nutrients, organic enrichment/low dissolved oxygen and salinity/TDS/chlorides. We developed a conceptual model/impairment assessment (CMIA) report for Suisun marsh focusing on these constituents and a set of chapters for the technical TMDL for the following constituents associated with impairment: dissolved oxygen, organic carbon, and mercury.
- **Studies to Evaluate the Energy-Water Nexus.** Conducted a set of studies for the Electric Power Research Institute to evaluate the connections between water availability and electricity production in the United States, under the driving forces of population growth, land-use change, climate change, and potential changes in environmental regulations. The studies estimated future withdrawals between now and 2025 at 3,000+ counties across the US and evaluated stresses on existing aquatic systems as well as the need for new storage requirements to meet future demands. Additional work evaluated the use of degraded water sources as cooling water supplies for electricity generation. This work was also the foundation for technical support provided by Tetra Tech to the DOE in the preparation of special report to Congress on the energy-water nexus.

- **Evaluation of Stormwater quality in the City of San Diego Urban Areas.** The receiving water of San Diego storm drains, San Diego Bay, and sediments in the bay have been identified as being contaminated by anthropogenic chemicals, and are listed on the CWA 303(d) list as being impaired for benthic community effects and sediment toxicity. We implemented an extensive monitoring program to characterize the City's storm drain system discharges during both wet and dry weather, and characterized the contamination due to trace elements and organic chemicals that are associated with the toxicity listing.
- **Artificial Neural Networks for Modeling Water Quality in the California Delta.** There is a need for tools to provide rapid responses for water quality parameters to facilitate planning and operations in the Sacramento-San Joaquin Delta, for meeting multiple drinking water quality and ecological objectives. Existing numerical models are computationally demanding and need significant user expertise. We are developing multiple ANNs for capturing the behavior of the Delta Simulation Model, for constituents such as salinity and turbidity, to apply within larger codes that are used for water supply planning in California.
- **Mercury in Adirondacks Lakes.** This study developed a predictive model of mercury transport from watersheds to lakes in the Adirondacks region, and evaluated of concentrations in biota, specifically fish. The goal of the study was to calibrate and validate model representations from well- studied lakes, and to apply the models more generally for estimating future response to mercury atmospheric mercury emission changes.
- **Evaluation of Mercury Loads in the Watersheds of San Francisco Bay.** Conducted a variety of data collection and modeling studies to estimate mercury loads and potential for biotic uptake in aquatic systems. The areas where these studies were focused include San Francisco Bay and the surrounding tributaries. This region has the largest mercury mine in the US, and contains vast amounts of terrestrial mercury because of its use in gold mining during the California gold rush years of the 19th century. As a result, numerous streams and bay are impaired by mercury to this day. The study was focused on characterizing current conditions, and evaluating potential approaches to reduce contamination and thus reduce impairment.
- **Mercury behavior in wastewater treatment plants.** Developed a plan to monitor and analyze data on the removal processes of mercury in various process stages in an advanced wastewater treatment plant. The data collected was used to represent the detailed behavior of this toxic constituent in wastewater processes.
- **Master Plan for the Mokelumne Watershed.** The Mokelumne watershed is the drinking water supply for the East Bay region of the San Francisco Bay Area. The master plan was focused on management of the lands surrounding the drinking water reservoirs (Pardee and Camanche Reservoirs) for long-term protection of source water supply and water quality. Dr. Roy served as the Project Manager for this project and coordinated the activities of a large team of consultants as well as employees of the East Bay Municipal Utility District. As part of this work, Dr. Roy managed the activities of a wide range of experts on topics as diverse as fire management, water quality modeling, practices for limiting pathogens from grazing animals, management of cultural and historical resources, financial management, public outreach, and environmental regulatory certification.
- **Models of Pollutants of Drinking Water Concern in California's Central Valley and Delta.** This study developed conceptual models for organic carbon, nutrients, and pathogens in the watersheds of the San Joaquin River and the Sacramento River. The San Joaquin and Sacramento Rivers are the largest river systems in California and drain the snow-melt from the Sierra Nevada

mountains. The rivers also receive water from agricultural drainage and municipal wastewater, before they join into the San Francisco Bay Delta. The waters are withdrawn from the Delta for drinking water supply to 22 million Californians. The river-delta system is one of the most complex water management systems in the world, and must meet multiple, conflicting goals. The models developed as part of this work serve to facilitate future management actions for controlling the specific constituents in source waters, and create a policy framework to protect the drinking water resource over the coming decades.

PROFESSIONAL ACTIVITIES

Dr. Roy served on National Academy of Sciences panels on Missouri River Basin restoration and on Clean Water Act Implementation across the Mississippi Basin, and as a member of the EPA Science Advisory Board Environmental Engineering Committee (EEC). Dr. Roy has been a reviewer of papers and proposals for the US EPA, National Science Foundation, National Oceanic and Atmospheric Administration and key journals including *Environmental Science and Technology*, *Water Resources Research*, *Journal of the American Water Resources Association*, *Journal of Colloid and Interface Science*, *Water Environment Research*, *Colloids and Surfaces*, *Journal of Computing in Civil Engineering*, *Environmental Engineering*, *Computers and Geosciences*, and *Groundwater*. Dr. Roy served as a reviewer of the Grimsel long-term radionuclide migration study in Switzerland.

RECENT PUBLICATIONS

Roy, S.B., L. Chen, E. Girvetz, E. P. Maurer, W. B. Mills, and T. M. Grieb (2012) Projecting Water Withdrawal and Supply for Future Decades in the U.S. under Climate Change Scenarios. *Environmental Science and Technology*, DOI: 10.1021/es2030774.

Chen, L., S. B. Roy, and R. A. Goldstein (in press). Projected Freshwater Withdrawals under Efficiency Scenarios for Electricity Generation and Municipal Use in the US for 2030, *Journal of the American Water Resources Association*.

Costa-Cabral, M., S. B. Roy, E. P. Maurer, W. B. Mills, and L. Chen (2012), Snowpack and runoff response to climate change in Owens Valley and Mono Lake watersheds, *Climatic Change*, DOI 10.1007/s10584-012-0529-y.

Chen, L., S. Meseck, S. B. Roy, T.M. Grieb, and B. Baginska (2012) Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay, *Estuaries and Coasts*, DOI: 10.1007/s12237-012-9530-y.

National Research Council (Committee Member) (2011) *Missouri River Planning: Recognizing and Incorporating Sediment Management*, National Academies Press, Washington, DC.

Kadlec, R.H., S. B. Roy, R.K. Munson, S. Charlton, and W.R. Brownlie. 2010. Water Quality Performance of Treatment Wetlands in the Imperial Valley, California, *Ecological Engineering*, Vol. 36, pp. 1093–1107.

Johnson, P.I., R.M. Gersberg, M. Rigby, S. B. Roy (2009) The fate of selenium in the Imperial and Brawley constructed wetlands in the Imperial Valley (California). *Ecological Engineering*, Volume 35, Issue 5, pp. 908-913.

Roy, S.B., and M.N. DiFilippo (2008). *Use of Alternate Water Sources for Power Plant Cooling*, EPRI, Palo Alto, CA: 2008. 1014935, 192 pp.

(Roy, pg. 5)

East Bay Municipal Utility District (2008) Mokelumne Watershed Master Plan, 34 pp. (Available from: http://www.ebmud.com/water_&_environment/environmental_protection/mokelumne_environment/mokelumne_master_plan/default.htm)

Conaway, C. H., Black, F. J. , T.M. Grieb, S. B. Roy, (2008) Mercury in the San Francisco Estuary, *Reviews of Environmental Contamination and Toxicology*, pp. 29-54.

Roy, S.B., M.C. Rigby, S. Liu, R. F. Johns, et al. (2007) *New and Alamo Rivers Wetlands Master Plan*, Technical Report prepared for Salton Sea Authority, May, 354 pp.

EDUCATION

M.S. Ecology (Ecotoxicology emphasis), University of California, Davis, 2000

B.A. Integrative Biology, University of California, Berkeley, 1992

YEARS OF EXPERIENCE

Years of Relevant Experience: 15

Years with Tetra Tech: 15

SPECIALTIES

Ecological risk assessment, ecotoxicology, risk-based cleanup goals, ecology, wildlife surveys, wildlife biology.

QUALIFICATIONS

Mr. Torres has more than 15 years of experience in the fields of ecological risk assessment, ecotoxicology, ecology, and wildlife biology. Mr. Torres has conducted ecological risk assessments in support of site assessments and remedial investigations for numerous wetland, aquatic, and terrestrial sites in California. In support of risk assessments, he has designed sampling investigations for chemical concentrations in plant and animal tissues, water, sediment, and soils. Mr. Torres has conducted uptake and bioaccumulation studies on metals, PCBs, and perchlorate in plants, invertebrates, and small mammals in wetlands, aquatic habitats, and terrestrial habitats in California. Mr. Torres has contributed to all aspects of ecological risk assessments, including site characterizations, chemical data management, exposure and bioaccumulation modeling, toxicity assessment, and risk characterization. He has extensive experience in reviewing toxicity research, analyzing bioassay data, and ecologically relevant toxicity reference values for application in risk assessments. He has developed and applied risk-based cleanup goals in support of remedial decision making. He has also participated in field surveys for vegetation, birds, and small and large mammals in wetland, desert, grassland, and forest habitats.

RELEVANT EXPERIENCE

- **New and Alamo River Pilot Treatment Wetlands.** The New and Alamo Rivers have elevated levels of suspended sediments, bacteria, nitrates, and phosphates. To reduce the concentrations of these constituents in river waters, the Imperial Irrigation District has experimented with treatment wetlands. So far, the treatment wetlands have been shown to reduce concentrations of all of these constituents. However, the pilot treatment wetlands may also function to concentrate pesticides and selenium in aquatic organisms, potentially leading to adverse effects in aquatic invertebrates, fish, and birds. Mr. Torres was a lead ecological risk assessor for the pilot treatment wetlands which examined the bioaccumulation and potential impacts from selenium and pesticides. This investigation was conducted to examine the potential risks from contaminants and help determine whether additional treatment wetlands should be constructed to reduce pollutants in the New and Alamo Rivers and the Salton Sea region.

- **Ecotoxicology Research, Mare Island Naval Shipyard, CA**-- Conducted research for his Master's Thesis on exposure, uptake, and trophic transfer of metals in a seasonal coastal wetland formerly used for waste disposal. Mr. Torres evaluated the abundance and demography of local small mammal populations through live trapping over a six-month period, and sampled sediments, soils, and biological tissues for metals to evaluate the transfer of metals into the food web and to test bioaccumulation modeling of metals in small mammals tissues.
- **Ecological Risk Assessment, Sylmar Converter Station, Los Angeles Department of Water and Power, Sylmar, CA (2009 to present)** — Mr. Torres conducted an ecological risk assessment in support of the remedial investigation for the Sylmar Converter Station. During the 1994 Northridge Earthquake, electrical insulating oil was spilled from two transformers, resulting in the release of PCBs, petroleum hydrocarbons, and metals into the storm drain system. Two off-site basins supporting wetlands and a variety of wildlife were potentially impacted by these releases and were the focus of the ecological risk assessment. Mr. Torres contributed to the sampling design and risk assessment methodology in the work plan for the remedial investigation. A key challenge for the ecological risk assessment was maximizing the use of available data, which was accomplished by evaluating multiple lines of evidence, including contributions to metals in sediments by other ambient sources.
- **Ecological Risk Assessments, Lockheed Martin Corporation, Beaumont, CA (2008 to 2012)** — Mr. Torres conducted scoping and predictive ecological risk assessments for two properties consisting of over 10,000 acres of open space. The sites are divided into multiple operational units that were used in the 1960s and 1970s for rocket motor assembly and testing operations, as well as for explosives-related activities. Environmental investigations have tested soils and groundwater for solvents, metals, perchlorate, 1,4-dioxane, semi-volatile organics, PCBs, and petroleum hydrocarbons. In addition to the ongoing predictive ecological risk assessments, Mr. Torres authored work plans and scoping assessments for both sites. Challenges for the ecological risk assessments include addressing potential effects of contaminants on a variety of aquatic and terrestrial habitats and a wide range of plant and wildlife receptors, including the endangered Stephens' kangaroo rat. Mr. Torres contributed to a site-specific study on the uptake and bioaccumulation of perchlorate in plant tissues to support the ecological risk assessments.
- **Predictive Ecological Risk Assessments, U.S. Air Force, Vandenberg AFB, CA (1995 to 2012)** — Mr. Torres conducted ecological risk assessment for more than 20 sites at Vandenberg Air Force Base, California. He completed site-specific risk assessments for a variety of habitats including wetlands, aquatic ponds, valley foothill riparian, grassland, coastal sage scrub, and chaparral habitats. Chemicals of concern included metals, PCBs, dioxins, and a variety of semivolatile and volatile organic compounds. Mr. Torres defined areas and receptors of concern, developed toxicity reference values, oversaw risk calculations, and was the lead author of ecological risk assessments in the RI/FS reports. He coordinated report preparation with site characterization, fate and transport modeling, and human health risk assessment teams to ensure a coherent product. Mr. Torres was the technical lead for Tetra Tech's role in negotiating with representatives of California state regulatory agencies to reach a consensus on toxicity reference values used in the ERAs at Vandenberg AFB. The risk assessment team has been awarded several additional sites as a

result of meeting the high expectations of the VAFB staff.

- **Basewide Validation Study for Ecological Risk Assessments, U.S. Air Force, Vandenberg AFB, CA (2000 to 2003)** — Mr. Torres conducted a field validation study in support of ecological risk assessments at Vandenberg AFB, California. He helped design field sampling and selected toxicity tests to reduce uncertainties and fill data gaps in the predictive ecological risk assessments. He coordinated laboratory analysis of plant and insect tissues, soil, and water for trace-level polychlorinated biphenyls and metals. Mr. Torres oversaw the field sampling, laboratory contracting, data analysis, and preparation of the report. He coordinated statistical analyses to evaluate plant and amphibian toxicity bioassay results and determine relationships between soil and tissue concentrations of contaminants. Mr. Torres helped incorporate the findings of this basewide validation study into the site-specific ecological risk assessments.
- **Human Health and Aquatic Biota Evaluation, Commodore Schuyler-Heim Bridge Replacement Project, Port of Long Beach, CA (2010 to 2011)** — Mr. Torres conducted an ecological scoping assessment for the Schuyler-Heim Bridge in support of a planned demolition and replacement project. He reviewed background documents and site-specific information to characterize biological resources potentially at risk in harbor channel waters and sediments. An exposure pathway analysis focused the assessment on those groups of species potentially exposed to constituents that may leach from soils adjacent to the project into the harbor channel. This analysis supported a risk screening evaluation for human and ecological receptors that identified specific constituents and soil source areas that may impact water quality.
- **Ecological Risk Assessment, Port of Los Angeles, Berths 70-71, Los Angeles, CA (2008 to 2010)** — Mr. Torres conducted an ecological risk screening evaluation for a tank farm at a pier of the Port of Los Angeles. He reviewed environmental reports for neighboring facilities to identify and describe the biological resources in harbor channel waters and sediments that may be potentially exposed to site-related releases. Mr. Torres conducted a risk evaluation for marine organisms for chemicals of potential concern including chlorinated solvents, other volatile organic compounds, and semivolatile organic compounds. A key challenge for the risk assessment was to distinguish constituents with site-related sources from those with other likely sources in the port. Mr. Torres used multiple data sources and lines of evidence to identify spatial patterns of sediment contamination and relationships with groundwater plumes and sediment runoff sources, helping to focus the risk assessment conclusions on those issues attributable to the site.
- **Port of Los Angeles, Former Tank Farm, Los Angeles, CA** — Mr. Torres conducted an ecological risk assessment for a former tank farm that received, stored, and transferred petrochemical and organic compounds by tanker ship, barge, rail tanker car, and tanker trucks for over 75 years. Under oversight by the Los Angeles Regional Water Quality Control Board, he evaluated potential ecological risks for marine and sediment-dwelling biota due to potential migration of constituents in groundwater to the immediately adjacent harbor channel. This work required coordination between exposure and toxicity evaluations and fate and transport analyses.

- **Retention Basin Closure Demonstration, Southern California Edison, Long Beach, CA** — Mr. Torres conducted an ecological risk assessment that was key to demonstrating clean closure of lined retention basins at six generating stations. Closure demonstration is being used to limit or terminate environmental liability from previous releases of boiler cleaning solutions at the retention basins. In addition to evaluating all organic constituents detected in soil, soil gas, and groundwater, risks were evaluated for metals in soil and groundwater that are demonstrated to have concentrations elevated above background, naturally occurring concentrations. Clean closure was successfully demonstrated at the generating station.
- **U.S. EPA Surface Impoundment Study**—Helped design a comprehensive analytical tool to screen, summarize, and evaluate ecological risks in U.S. EPA’s 5-Year Surface Impoundment Study. Impacts were evaluated from industrial wastewaters in surface impoundments due to leaks, sludges, air emissions, and releases to water that could occur during management of these wastes. The exposure and risk model has been used at six pilot facilities and is being applied currently in the national assessment phase to evaluate the risks from industrial wastewaters in surface impoundments at 200 sites.
- **Predictive Ecological Risk Assessment, Mountain Pass Mine, CA (1998 to 2006)** — Mr. Torres contributed to an ecological risk assessment for the only rare earth (lanthanides) mine in the U.S. He helped develop conceptual models, exposure parameters, and toxicity data for a variety of desert organisms. An extensive data review was conducted for the toxicity of lanthanide metals to develop ecologically relevant toxicity reference values. The risk assessment reports were also examined by an oversight committee consisting of the Department of Toxic Substances Control, Department of Health Services Radiological Health Branch, Department of Health Services Environmental Impact Branch, Lahonton Regional Water Quality Control Board, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, and the National Park Service.
- **Ecological Risk Assessments, U.S. Air Force, March AFB, CA (1993 to 1995)** — Mr. Torres contributed to ecological and human health risk assessments for March Air Force Base in Riverside County, California. The 20 sites represented a wide variety of potential waste releases, including: 8 solvent/fuel spill sites, 5 landfills, 2 PCB spill sites, 1 munitions burial site, 2 sewage/water treatment disposal sites, and 2 sites with miscellaneous emissions. He characterized biological resources potentially at risk, developed exposure information for receptors of concern, compiled ecological and human health toxicity data, calculated risk indices, and assisted with interpretation of risks. A key challenge was to address emerging emphasis of the U.S.EPA and State of California regulators on detailed, complex ecological risk assessments. This challenge was met by conferring with regulators and providing detailed rationales for the risk analyses conducted for the threatened kangaroo rat and other ecologically important species.
- **Ecological Risk Assessments, U.S. Air Force, March AFB, CA (1993 to 1995)** — Mr. Torres contributed to ecological and human health risk assessments for March Air Force Base in Riverside County, California. The 20 sites represented a wide variety of potential waste releases, including: 8 solvent/fuel spill sites, 5 landfills, 2 PCB spill sites, 1 munitions burial site, 2 sewage/water treatment disposal sites, and 2 sites with miscellaneous emissions. He characterized biological resources potentially at risk, developed exposure information for receptors of concern, compiled ecological and human health toxicity data, calculated risk

indices, and assisted with interpretation of risks. A key challenge was to address emerging emphasis of the U.S.EPA and State of California regulators on detailed, complex ecological risk assessments. This challenge was met by conferring with regulators and providing detailed rationales for the risk analyses conducted for the threatened kangaroo rat and other ecologically important species.

- **Mohave Ground Squirrel Survey, Edwards Air Force Base, CA (2009)** — Mr. Torres participated in testing survey protocols for Mohave ground squirrels. The study employed footprint measurements at track stations to compile a database for distinguishing the co-occurring Mohave and antelope ground squirrels.
- **Large Mammal Survey, Edwards Air Force Base, CA (2007)** — Mr. Torres was the field crew leader and co-author of a large mammal survey for Edwards AFB. The study investigated the relative abundance and seasonal movements of carnivorous mammals. Methods employed were transects, track stations, motion cameras, and spotlight surveys. Four quarterly surveys were designed to identify seasonal patterns.
- **Small Mammal Demography Study (1998)** — Mr. Torres studied the demography of a small mammal community in tidal and seasonal wetlands along San Pablo Bay, California, as part of his graduate research program. He live-trapped salt marsh harvest mice, western harvest mice, California voles, and shrews over an 18-month to record population trends at Mare Island. In support of this study, Mr. Torres has held a scientific collecting permit issued by the California Department of Fish and Game that authorized live trapping of the endangered salt marsh harvest mouse.

PROFESSIONAL ORGANIZATIONS/ASSOCIATIONS

Society of Environmental Toxicology and Chemistry (SETAC)

The Wildlife Society

PUBLICATIONS

Clark, D.F., Kephart, B.L., Torres, K.C., Shibata, M.F., Rigby, M.C., McElligott, M., and Waitman, K.L. 2002. *Bioaccumulation of PCBs in Terrestrial Plants and Invertebrates at Vandenberg AFB, California*. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, November 16-20, 2002, Salt Lake City, UT.

Shibata, M.F., Torres, K.C., Clark, D.F., Rigby, M.C., Kephart, B.L., and McElligott, M. 2002. *Bioaccumulation of Metals and PCBs in Plants and Soil Invertebrates at Vandenberg AFB: Case Study*. Oral Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, November 16-20, 2002, Salt Lake City, UT.

Torres, K. C. and M. L. Johnson. 2001. Bioaccumulation of metals in plants, arthropods, and mice at a seasonal wetland. *Environ Toxicol Chem.* 20(11): 2617-2626.

Torres, K. C. and M. L. Johnson. 2001. Testing of metal bioaccumulation models with measured body burdens in mice. *Environ Toxicol Chem.* 20(11): 2627-2638.

Torres, K.C., Kephart, B.L., Clark, D.F., Shibata, M.F., Rigby, M.C., Donn, T.E., and Waitman, K.L. 2002. *Bioaccumulation of Metals in Terrestrial Plants and Invertebrates at Vandenberg AFB, California*. Poster Presentation at the 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry, November 16-20, 2002, Salt Lake City, UT.

EDUCATION

Ph.D., Civil and Environmental Engineering, University of California, Berkeley, 1996

M.S., Civil Engineering, University of California, Davis, 1992

B.S., Mechanical Engineering, 1984

RELEVANT EXPERIENCE

- **Project Manager / Lead Principal Investigator** – Water quality, surface hydrology, management strategies; Rice culture in the Sacramento - San Joaquin Delta (Delta) to mitigate past agricultural impacts, improve water quality and sequester carbon. In collaboration with UC Davis (UCD), UC Berkeley (UCB), UC Cooperative Extension (UCCE), United States Geological Society (USGS), Hydrofocus Inc, WWR, SWS, Delta Science Center, 2011- present. Project focuses on identifying local, regional and state scale impacts of growing rice in the highly subsidized Delta as they relate to protecting California's water supply and water quality; mitigating subsidence, affecting greenhouse gas (GHG) emissions, sequestering carbon, and creating a more sustainable agricultural environment. Impacts of different strategies to implement rice in the Delta are being quantified economically in relation to current agricultural management strategies.
- **Lead Principal Investigator – Surface and subsurface hydrology, water quality, statistics, management practices; Focusing on demonstrating cost effective agricultural BMPs to retain and infiltrate storm waters, Kings Basin, CA.** In collaboration with UCD, Sustainable Conservation and Terranova Farms. 2010 – 2012. Project focuses on developing strategies and practices to capture Kings River flood flows and integrating those practices into current farming operations. Goals are to reduce downstream flood risks and to recharge severely overdrafted Kings Basin groundwater using a flexible, rapidly mobilized and cost effective approach.
- **Co-Principal Investigator / Environmental Engineer, Methylmercury cycling and export from agricultural and natural wetlands in the Yolo Bypass, California.** In collaboration with USGS, CDFA, Yolo Basin Foundation, San Jose State. 2007 – present. Understanding hydrologic issues driving seasonal Hg transport and export from shallow flooded agricultural environments and recommending hydrologic and cultural practices to reduce and manage water quality impacts.
- **Principal Investigator – Hydrology, water quality, statistics, management practices; Strategy for Resolving MeHg and Low DO Events in Northern Suisun Marsh, California.** In collaboration with WWR, USGS, UCD, SJ State, Suisun RCD, DWR. 2007 – 2011. Assessed impacts of current wetland management practices on Suisun Marsh mercury and dissolved oxygen levels and recommending more environmentally sustainable practices.
- **Project Manager and Principal Investigator, Quantifying loads and assessing management strategies for reducing drinking water constituents of concern in watersheds, Yolo County, California.** In collaboration with USGS, UCD, Yolo County RCD, and Hydrofocus. 2005 – 2010.
- **Environmental Engineering Consultant various ecosystem and wetland restoration projects in the Delta vicinity:** Ecosystem Restoration services for the Delta for DWR Delta Fish Restoration Program Office in collaboration with WWR, SWS and others; Lower Yolo Wetland Restoration project for State and Federal Water Contractors as subcontractor to WWR; North Parcel Wetland Restoration, Northern San Francisco Bay, California as subcontractor to WWR; Olive and Atherton Wetland Restorations, Northern San Francisco Bay, California as subcontractor to WWR.
- **Principal Environmental Engineer.** South Bay Salt Pond Feasibility Study. 2001. Worked in collaboration with WWR to identify hydrologic, water quality, sediment deficit, logistical and economic factors to restoring salt production ponds in the Bay Area back to tidal wetlands, and to recommend strategies to restoration and their associated costs.

RELEVANT PUBLICATIONS

- Bachand, P.A.M., S. Bachand, J.A. Fleck. (submission in progress) Identifying Cultural Practices Affecting Seasonal and Episodic Methyl Mercury Production and Export in Shallow Water Vegetated Agronomic Systems in the Yolo Bypass, California: Rice, Wild Rice and Fallowed Fields. *Science of the Total Environment*
- Bachand, P.A.M., S. Bachand, F. Anderson, J. Fleck (submission in progress). Transpiration Driving Diel and Seasonal Advective Transport Processes in Flooded Soils: A Hydrologic Analysis of Shallow Water Vegetated Systems in the Yolo Bypass, CA. *Science of the Total Environment*
- Florsheim J.L., B.A. Pellerin, N.H. Oh, N. Ohara, P.A.M. Bachand, S.M. Bachand, B.A. Bergamaschi, P.J. Hernes and M.L. Kavvas. 2011. From deposition to erosion: Spatial and temporal variability of sediment sources, storage, and transport in a small agricultural watershed. *Geomorphology* 132(3-4): 272-286.
- Siegel, S., P. Bachand, D. Gillenwater, S. Chappell, B. Wickland, O. Rocha, M. Stephenson, W. Heim, C. Enright, P. Moyle, P. Crain, B. Downing. B. Bergamaschi. 2011. Best Management Practices Report , Strategies for Resolving Low Dissolved Oxygen and Methylmercury Events in Northern Suisun Marsh. Prepared for the State Water Resources Control Board, Sacramento, California. SWRCB Project Number 06 283552 0. July. http://www.swampthing.org/wwr_projects_highlight.html
- Merrill, A, S. Siegel, B. Morris, A. Ferguson, G. Young, C. Ingram, P. Bachand, H. Shepley, M. Singer, N. Hume. 2010. Greenhouse Gas Reduction and Environmental Benefits in the Sacramento-San Joaquin Delta: Advancing Carbon Capture Wetland Farms and Exploring Potential for Low Carbon Agriculture. Prepared for The Nature Conservancy, Sacramento, California. <http://www.stillwatersci.com/>
- Windham-Myers, L., M. Marvin-DiPasquale, J. Fleck, C.N. Alpers, J. Ackerman, C. Eagles-Smith, C. Stricker, M. Stephenson, D. Feliz, G. Gill, P. Bachand, A. Brice, and R. Kulakow. 2010. Methylmercury cycling, bioaccumulation, and export from agricultural and non-agricultural wetlands in the Yolo Bypass. Final Report to the Central Valley Regional Water Quality Control Board. September 2010. 266 p. http://swrcb2.swrcb.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/delta_hg/other_technical_reports/ybwa_hg_final_rpt.pdf
- Saraceno, JF , B.A. Pellerin, B.D. Downing, E. Boss, P.A.M. Bachand and B.A. Bergamaschi. 2009. High-frequency in situ optical measurements during a storm event: Assessing relationships between dissolved organic matter, sediment concentrations, and hydrologic processes, *J. Geophys. Res.*, 114, G00F09, doi:10.1029/2009JG000989. (Available from USGS).
- Hernes, P.J., R.G.M. Spencer, R.Y. Dyda, B.A. Pellerin, P.A.M. Bachand, and B.A. Bergamaschi. 2008. The role of hydrologic regimes on dissolved organic carbon composition in an agricultural watershed. *Geochimica et Cosmochimica Acta* 72 (2008) 5266–5277. <http://www.sciencedirect.com/science/article/B6V66-4T9CCY1-3/2/6871c4c1cf2e52694189e7478590ab54>

EDUCATION

Ph.D., Geography, University of California at Berkeley, 2002

M.A., Geography, University of California at Berkeley, 1993

B.A., Environmental Science, University of California at Berkeley, 1986

B.S., Chemistry, University of California at Berkeley, 1986

QUALIFICATIONS

Dr. Stuart Siegel has been at the forefront of the ecosystem restoration field before it gained its modern name. He began studying tidal marsh restoration science in the mid-1980s as an undergraduate, carried forward his applied research through his graduate work and all the while continued working as a restoration practitioner. He received his Professional Wetland Scientist certification in 1994, his Ph.D. in tidal wetland geomorphic processes in 2002, and founded Wetlands and Water Resources in 1996. Most of his work has been in the San Francisco Estuary Bay-Delta, with additional work in tropical wetlands and mangroves, coastal lagoons, and in stream systems in California, French Polynesia, and Micronesia. Through all of these efforts, Dr. Siegel has developed a unique expertise set that covers technical, policy, planning, regulatory, outreach, management, business, and leadership. Dr. Siegel applies his expertise in three arenas: restoration projects, regional ecosystem planning, and applied restoration scientific research.

Dr. Siegel's project experience covers a broad variety of projects large and small. He has planned, designed, permitted, constructed, and monitored dozens of wetland restoration projects from less than 1 acre to the 3,500-acre Yolo Ranch Restoration Project. He has been Lead Principal Investigator for two large, multi-collaborator research efforts, one on wetland ecosystem functions and one on wetlands water quality. He has served on a number of scientific advisory panels for restoration projects as well as regional science efforts including serving as the Suisun Marsh Science Advisor. He has participated in several regional natural resource planning efforts for the San Francisco Estuary and Delta, contributing scientific expertise, planning, and pragmatic hands-on restoration knowledge. As a result, Dr. Siegel possesses a tremendous breadth and depth of knowledge about the San Francisco Estuary and Delta.

Dr. Siegel currently has a major focus on Suisun Marsh and the Delta. In addition to his role as the Suisun Marsh Science Advisor, DRERIP science co-lead, and lead PI of IRWM, he also supported the Governor's Delta Vision Blue Ribbon Task Force as the Ecosystem Work Group Technical Lead from 2007 to 2008 and participated in development of the Delta Stewardship Council's Delta Plan. He participated in the Bay-Delta Conservation Plan's habitat restoration planning efforts. He served on the Ecological Resources Committee for the Delta Risk Management Strategy in 2007. He is working with the U.S. Geological Survey and Department of Water Resources to initiate the demonstration-scale wetland carbon sequestration project Twitchell Island. He is currently developing a Conservation Assessment for Suisun Marsh, leading design of the 3,500-acre Yolo Ranch tidal marsh restoration project, and working closely with DWR on its planning of tidal restoration at Prospect Island. He is beginning work to support the Delta Stewardship Council's Delta Plan.

RELEVANT EXPERIENCE

- **DELTA PLAN:** Dr. Siegel supported the newly formed Delta Stewardship Council with its early efforts to develop ecosystem restoration strategies and associated governmental infrastructure for their implementation and scientific investigations. 2011. Dr. Siegel also lead preparation of the Ecosystem

White Paper, laying the broad foundation for issues to address in advancing ecosystem recovery in the Delta. See www.deltacouncil.ca.gov.

- **DELTA VISION:** Dr. Siegel served as the Ecosystem Workgroup Technical Lead. Delta Vision was created in 2006 by Executive Order of California Governor Schwarzenegger to develop a Vision and Strategy for addressing the decades of conflict in the Sacramento-San Joaquin River Delta between water exports to 3 million acres (1.2 million hectares) of irrigated agriculture and 25 million Californians, ecosystem decline, and in-Delta water uses for 0.75 million ac (0.3 million ha) of agriculture and extensive recreational use. Delta Vision utilized four workgroups (ecosystem, water, governance, and land use) and extensive public involvement to achieve its recommendations. In his capacity as Ecosystem Workgroup Technical Lead, Dr. Siegel lead this large group through development of integrated technical understandings of key issues affecting ecosystem recovery and development of integrated recommendations and strategies for ecosystem restoration. Dr. Siegel also provided technical review for the overall Delta Vision Strategy Report. See www.deltavision.ca.gov.
- **SUISUN MARSH CONSERVATION STRATEGY:** Dr. Siegel and his staff at WWR prepared a comprehensive Conservation Strategy for the 100,000-acre Suisun Marsh in the upper San Francisco Estuary. This strategy examined existing conditions and natural processes controlling those conditions and their restoration including climate change and other future factors. The strategy developed an integrated landscape-scale conceptual model for tidal restoration of Suisun Marsh from which the Strategy put forward recommendations for where to locate tidal restoration efforts and how to approach restoration. It concluded with detailed GIS-based analysis of each of the more than 180 diked managed wetlands in terms of restoration feasibility. Prepared in 2011 for The Nature Conservancy in collaboration with the Delta Stewardship Council.
- **CACHE SLOUGH CONSERVATION STRATEGY:** Dr. Siegel and his staff at WWR will be preparing in 2012 a Conservation Strategy for the Cache Slough Complex in the northwest Delta, a companion effort to that prepared for Suisun Marsh. The effort will be developed for the California Department of Water Resources in close collaboration with the Department of Fish and Game, Delta Stewardship Council, and the Delta Conservancy• Cache Slough Conservation Strategy: Dr. Siegel and his staff at WWR will be preparing in 2012 a Conservation Strategy for the Cache Slough Complex in the northwest Delta, a companion effort to that prepared for Suisun Marsh. The effort will be developed for the California Department of Water Resources in close collaboration with the Department of Fish and Game, Delta Stewardship Council, and the Delta Conservancy.
- **SUISUN MARSH SCIENCE ADVISOR:** Dr. Siegel served from 2006-2010 as the Science Advisor for development of the Suisun Marsh Habitat Management, Enhancement and Restoration Plan. This Plan, developed by six local, state, and federal agencies, will provide a 30-year framework for Suisun Marsh, addressing decades of conflict between endangered species, management of diked wetlands for duck hunting, and the effects of upstream withdrawals of freshwater by the State Water Project and federal Central Valley Project. As the Science Advisor, Dr. Siegel guided preparation of several conceptual models examining natural habitats, processes, and stressors in Suisun Marsh. He lead preparation of the Tidal Marsh and Aquatic Habitats conceptual model. Dr. Siegel formed and guided the work of a six-member Advisory Panel of academic and research scientists to provide expertise in Plan development
- **DELTA REGIONAL ECOSYSTEM RESTORATION IMPLEMENTATION PLAN:** Dr. Siegel was one of three co-lead scientists for DRERIP, a state and federal effort to develop the first regional strategy for ecosystem restoration under the CALFED Bay-Delta program. Dr. Siegel was a member of the agency Adaptive Management Planning Team that formulated the approaches and oversaw DRERIP development. DRERIP first established an evaluation methodology for assessing the efficacy of ecosystem restoration actions, in which Dr. Siegel played a major role. DRERIP organized the development of

several conceptual models to integrate existing science on natural habitats, ecosystem processes, species, and stressors; Dr. Siegel guided development of many of these models by regional experts

- **SUISUN MARSH LOW DISSOLVED OXYGEN/METHYLMERCURY WETLANDS MANAGEMENT STUDY:** Dr. Siegel served as Lead Principal Investigator for this two year, \$900,000 field study of environmental biogeochemical processes and wetland management activities affecting the generation of low dissolved oxygen and high methylmercury waters in the diked managed wetlands of Suisun Marsh, for the purpose of developing Best Management Practices aimed at reducing these water quality problems. Project participants included the local resource conservation district, UC Davis, Department of Water Resources, Department of Fish and Game, U.S. Geological Survey, and Bachand and Associates. Dr. Siegel lead science integration and development and assessment of BMPs.
- **INTEGRATED REGIONAL WETLANDS MONITORING PILOT PROJECT:** Dr. Siegel served as Lead Principal Investigator for the two-year, \$3.7 million field study of the effects of tidal marsh restoration on recovering ecosystem functions necessary to support fish, wildlife and plant species of the San Francisco Estuary. Project participants included researchers from four California universities, one non-profit research group, and two private consulting firms. Dr. Siegel also lead the Physical Processes team and co-lead the Landscape Ecology team

RELEVANT PUBLICATIONS

Tuxen, K., N.M. Kelly, L. Schile, and S.W. Siegel. 2008. Vegetation colonization in a restoring tidal marsh: A remote sensing approach. *Restoration Ecology* 16(2): 313-323

Siegel, S.W. 2004. Tidal marsh restoration in Suisun Marsh. Pp. 91-94 in: R.L. Brown, ed., *Summary of 2004 Workshop Making Science Work for Suisun Marsh*. Bay-Delta Science Consortium, Sacramento, CA.

Siegel, S.W. 2002. *Slough Channel Network and Marsh Plain Morphodynamics in a Rapidly Accreting Tidal Marsh Restoration on Diked, Subsided Baylands, San Francisco Estuary, California, USA*. Ph.D. Dissertation, University of California at Berkeley. 360 pp.

Malamud-Roam, K., S. Siegel, M. Goman, and L. Wells. 1995. Tidal Marshes: the Marginal Landscapes of San Francisco Bay. Pp. 251-269 in: Sangines, E.M. and D.W. Anderson, eds., *Recent Geologic Studies in the San Francisco Bay Area*. Pacific Section SEPM, Oakland, CA.

Siegel, S.W. and L.E. Wells. 1995. The Limited Applicability of Hydraulic Geometry Principles to Tidal Marsh Channel Design. *Eos* 75(44) Supplement: 266.

Years with Tetra Tech - 18

Years with other Firms - 10

EDUCATION:

University of New Hampshire: Ph.D., Zoology, 1983

Clark University: B.A., Biology (High Departmental Honors), 1977

CERTIFICATIONS/TRAINING:

Certified Senior Ecologist, Ecological Society of America (1994 - present)

Tropical – Basic Offshore Safety Induction and Emergency Training (OPITO) (2009-2012)

Further Offshore Emergency Training (OPITO) (2011-2015)

DISTANCE Sampling

SPECIALTIES:

Population and Community Ecology, Ecological Risk Assessment, Water Quality, Sediment Quality

QUALIFICATIONS:

Dr. Donn is a quantitative population/community ecologist and ecological risk assessor with over 28 years of post-doctoral experience. Dr. Donn has prepared over 50 ecological risk assessments for sites associated with terrestrial, marine, and freshwater systems. Key projects included the evaluation of potential effects on marine resources due to historical disposal of nuclear and hazardous wastes in the Gulf of the Farallones National Marine Sanctuary, and the development of work and field sampling plans for ecological assessments at NAWS Point Mugu and Vandenberg AFB. Dr. Donn provided support to the East Bay Regional Parks District by assessing bayside properties for ecological and human health risks prior to their purchase. Dr. Donn has conducted evaluation of the effects of mercury and other contaminants on benthic organisms and fish in the Gulf of Thailand. He has conducted ecological risk assessments for over 33 sites on two U.S. Air Force Bases in southern California. Dr. Donn was responsible for the development and analysis of a comprehensive ecotoxicological database for terrestrial organisms. He was a contributing author to an issue paper on ecological risk assessment for the Oceans and Coastal Protection Division of EPA's Office of Wetlands, Oceans and Watersheds.

Beaumont Ecological Risk Assessments, Beaumont CA (2009-2011)

Dr. Donn has provided senior oversight for the ecological risk assessments at Beaumont Sites 1 and 2 located in arid non-native grassland and riparian habitat. In addition, Dr. Donn designed and directed implementation of soil-to-plant and groundwater-to-plant uptake studies that examined the uptake of the emerging chemicals 1,4-dioxane and perchlorate. This study was conducted to address data gaps in the ecological risk assessment stemming from the lack of applicable studies describing uptake patterns. Dr. Donn conducted multivariate analyses to describe the patterns of uptake.

Ecological Assessment of Gas and Oil Production Activities in the Central Gulf of Thailand, Chevron Thailand Exploration and Production, Bangkok (1996 to present)

Dr. Donn has been a project manager and chief scientist since its inception in 1996 and was responsible for the preparation of over 40 reports and technical memoranda over the period of this project. Dr. Donn's responsibilities have included development and implementation of survey program designs, interpretation of benthic community data, evaluation of bioaccumulation of mercury and arsenic in benthic invertebrates and fishes, evaluation of risks to marine environment, and preparation of annual monitoring and special studies reports. This ongoing project addresses concerns for potential environmental and human health risks due to levels of mercury and arsenic in sediments and fish around offshore processing platforms due to release of mercury in produced waters. Dr. Donn has prepared several documents on the effects of drill cuttings discharges and recovery of benthic communities from the deposition of petroleum. The sampling program includes sampling of sediments, surface water, benthic invertebrates, plankton, and fishes to evaluate a mercury cycling and to estimate human health risks due to consumption of fish caught from the platforms. Other studies addressed spatial and temporal community-level effects of petroleum hydrocarbons on benthic infaunal communities at wellhead platforms. In addition, Dr. Donn has prepared two major synthesis documents (1997 and 2006) on the effects of mercury in the Gulf of Thailand.

Effects of Subsea Processing on Deepwater Environments of the Gulf of Mexico (2006-2008)

Oil and gas exploration is continuing to expand into deeper waters in the Gulf of Mexico and throughout the world. New technologies are being developed to address problems associated with deep sea production and to improve yield and commercial viability of these operations. Dr. Donn prepared a review of the available subsea pressure boosting and processing technologies and the potential environmental impacts resulting from their implementation for the U.S. Minerals Management Service. The report provides a detailed discussion of the technologies and their environmental effects, and provides MMS with information necessary to effectively develop regulations for implementation.

Characterization of Tar and Sand Balls Deposited on Gulf of Thailand Beaches (2010)

Tar balls and sand balls were discovered on beaches along the western shore of the Gulf of Thailand in January 2010. Tetra Tech performed a rapid turnaround assessment of the sand and tar balls to determine their composition and possible source. Sand balls were determined to be derived from processed palm oil, whereas the tar balls were shown to be crude oil. Comparison of the tar ball extracts with exemplars of locally produced crude oil and drill cuttings indicated substantial differences between the locally produced crude and the tar balls.

Ecological Risk Assessment for Alaskan Oil Production Facility

Tetra Tech conducted supplementary sampling and prepared a human health and ecological risk assessment of past releases at the Trading Bay oil production facility

located on Cook Inlet. Dr. Donn was responsible for preparing the ecological risk assessment. The primary ecological issue addressed was groundwater transport of petroleum-derived compounds, primarily BTEX, PAHs, and other semi-volatile components, towards Cook Inlet and their potential ecological effects on the intertidal community and nearshore subsistence fisheries.

Review of KFM Joint venture Clean-up Activities, Cosco Busan Spill, San Francisco Bay.

Dr. Donn performed an expert review of secondary clean-up efforts of barges and in-water construction equipment oiled as a result of the Cosco Busan oil spill. Described physical and chemical characteristics of spilled oil. Reviewed and compared clean-up technologies. Using photographs, written notes, and interviews, estimated quantities of oil adhering to barges and in-water structures. Assessed and compared potential effects of alternative clean-up technologies on marine environment. Prepared recommendations for improved response to environmental emergencies.

Baseline Surveys of Marine Environment at Ban Bang San, Gulf of Thailand. (2006)

Dr. Donn managed the design, collection and reporting of sampling data from the nearshore environment at Ban Bang San, Thailand. These data will be used to define baseline conditions in an EIA report to Thai regulatory agencies to obtain permits for construction of a harbor facility. Eighteen stations were occupied between the 0m and 12m depth contours. Samples were collected for determination of sediment quality, benthic infaunal community structure, and water quality.

Ecological Risk Assessment Design, Naval Air Warfare Center - Point Mugu, CA

Dr. Donn coordinated the preparation of an ecological risk assessment study design for the RI/FS conducted at NAWS Point Mugu for the U.S. Navy. The primary focus of the project was to evaluate the potential impacts of past disposal activities at eight sites on the base to the biota of Mugu Lagoon and associated wetlands.

Ecological Risk Assessments, Vandenberg Air Force Base, CA (1995-2007)

Dr. Donn prepared screening level ecological risk assessments using Phase 1 data for 23 sites located primarily in stabilized dune/coastal sage scrub habitat, as well as grassland and chaparral habitats. These assessments identified contaminants of ecological concern, potential contaminant migration pathways and exposure routes, assessment endpoints data gaps, and information needs for subsequent sampling. The ecological risk assessment assessed impacts both at the site of contaminant deposition, and impacts to offsite receptors due to contaminant migration.

Ecological Risk Assessments, March Air Force Base, CA

Dr. Donn conducted ecological risk assessments as part of a remedial investigation for Operable Unit 2 at March AFB. Work involved extensive discussions with regulatory agencies to design a mutually agreed upon approach to completing the risk assessment. Dr. Donn was responsible for evaluation of ecological exposure pathways, development of ecological toxicity data, and selection of reference toxicity values. Risk assessments were prepared for 10 IRP sites.

Noyo River Bridge Ecological Risk Assessment, Fort Bragg, CA

Dr. Donn prepared an ecological risk assessment of potential effects of lead paint-contaminated sandblast waste on biota inhabiting the shores of a coastal river. Developed a sampling plan to determine the extent of metal contamination along the banks of the river. Sampling included a botanical survey and collection and chemical analysis plants from impacted and presumably unimpacted areas. A simplified food web model was used to evaluate risks to terrestrial receptors. Risks to aquatic receptors were considered to be negligible due to the periodic maintenance dredging of the harbor.

Burns Creek Bridge Ecological Risk Assessment, Big Sur, CA

Dr. Donn conducted an ecological risk evaluation of potential effects of lead paint-contaminated sandblast waste on biota inhabiting a coastal canyon. Issues addressed included potential toxic effects to an endangered butterfly species and impacts of remediation on the butterfly's host plant and the biological community in the canyon and adjacent shoreline. The study concluded that the ecological effects of full scale remediation (habitat destruction) were likely more severe than localized removal of contaminated hot spots.

Mendota Pool Environmental Assessments (2000 – 2004)

Dr. Donn prepared Environmental Assessments (EA) for 2001 and 2002 and an Environmental Impact Statement (EIS) for a subsequent 10-year project. These documents addressed the effects of a groundwater pumping and exchange program between the U.S. Bureau of Reclamation and the farmers of the Mendota Pool Group. Issues addressed in these environmental documents included groundwater level and quality, land subsidence, surface water quality, and impacts to biological resources including special status species. The primary environmental impacts addressed were salt and selenium loading to the Mendota Pool, and the effects of groundwater drawdowns on nearby communities.

GARY G. WORTHAM

**Senior Environmental Scientist/Aquatic Toxicologist
Office Health & Safety Representative**

Tetra Tech, Inc.

EDUCATION/SPECIAL TRAINING

B.S., Oceanography, California State University Humboldt, 1987
40 Hour HAZWOPER [29 CFR 1910.1209(e)]. Certificate Number 36132

QUALIFICATIONS

Mr. Wortham has over 22 years of field monitoring; marine and freshwater systems aquatic toxicity methods development, implementation and data interpretation; federal and state water quality regulations, including NPDES permit writing; analytical chemical laboratory management experience; project design; aquatic system data analyses; QA/QC oversight and Health & Safety policy implementation. Mr. Wortham has lead the field sampling component of several projects including the San Francisco Bay Selenium Study, Torres-Martinez Cahuilla Desert Indians CWA106 Water Quality Plan implementation, Guadalupe River Mercury TMDL, the City of San Jose Streamflow Augmentation, the Calaveras River Watershed Baseline study, the Monterey Harbor Sediment Lead study, the Eureka Waterfront ERA, the New and Alamo River Wetlands selenium assessment projects, and has provided QA/QC review and developed project-specific Health and Safety Plans (HASPs) for Stringfellow and various other internal and external projects.

His current projects include providing water quality expertise to the San Francisco Bay Selenium Project (WSPA) and the Torres-Martinez Desert Cahuilla Indian Tribe. Additionally, Mr. Wortham is providing technical expertise and support for several other aquatic and watershed-based projects.

RELEVANT EXPERIENCE

- **North San Francisco Bay Selenium TMDL.** *Field and QA/QC Lead.* Selenium has been a concern in the Central Valley and San Francisco Bay for several decades, a region with selenium sources from San Joaquin Valley and various point sources including refineries. A TMDL project is underway to address selenium toxicity in North San Francisco Bay led by the San Francisco Bay Regional Board. With funding provided by WSPA, Tetra Tech is providing technical support to the Regional Board for the development of the TMDL. Mr. Wortham is the field lead and primary QA/QC analyst for this multi-year project which includes sample collection from the Golden Gate Bridge to the Sacramento Valley and from several of the major tributaries to the North San Francisco Bay.
- **Downtown Anchorage and B Street/Broadway Pier Areas Storm Drain System Characterization Study.** *Co-Project Manager.* Mr. Wortham assisted the City of San Diego in implementing the Downtown Anchorage and B Street/Broadway Piers Monitoring Program to further characterize the City's storm drain system discharges during both wet and dry weather. This monitoring program evaluated the potential sources of the pollutants-of-

concern (POCs) throughout the MS4 system and collect data to calibrate and validate wet weather runoff modeling efforts for the San Diego Bay TMDLs. The scope included collecting and interpreting toxicity and chemical data for both aqueous and sediment samples.

- **Chollas Creek Storm Drain System Characterization Study.** *Co-Project Manager.* Mr. Wortham assisted the City of San Diego in implementing the Chollas Creek Monitoring Program to further characterize the City's storm drain system discharges during both wet and dry weather. This monitoring program evaluated the potential sources of the pollutants-of-concern (POCs) throughout the MS4 system and collect data to calibrate and validate wet weather runoff modeling efforts for the San Diego Bay TMDLs. The scope included collecting and interpreting toxicity and chemical data for both aqueous and sediment samples.
- **Technical Support to the Torres-Martinez Desert Cahuilla Indians (TMDCI) Constructed Wetlands.** *Project Manager.* Providing technical support to the TMDCI in implementing their Water Quality Plan for the constructed wetlands on the Reservation. The purpose of the Torres Martinez Constructed Wetlands Project is to study how wetlands can improve the quality of Whitewater River water inflows to the Salton Sea by reducing or removing selenium, nutrient and bacterial loads into the Sea. To achieve this goal, the inflow and outflow of the Torres Martinez wetlands are monitored regularly to determine the effectiveness of the design to improve water quality by removing nutrients, sediment, selenium and other contaminants. An additional component of this project was to develop an EPA approved Quality Assurance Project Plan.
- **Technical Support to the Torres-Martinez Desert Cahuilla Indians (TMDCI) CWA 106 Project.** *Project Manager.* Providing technical support to the TMDCI in implementing their Water Pollution Control Plan for the CWA 106 Grant. The Tribal EPA has developed a Water Pollution Control Program with funding from the EPA Clean Water Act (CWA) Section 106 program. The primary objective for water resources on the Torres-Martinez Reservation is to restore and maintain the quality and quantity of Tribal waters. To achieve this objective, a reservation-wide water quality and quantity monitoring program has been implemented to provide sufficient information to prepare a 305(b) Tribal Water Quality Assessment. An additional component of this project was to develop an EPA approved Quality Assurance Project Plan.
- **Operation and Management of Shallow Habitat near the Salton Sea and Alamo River.** Responsible for operation and management of a 100-acre system of shallow wetlands using water from the Salton Sea and Alamo River. The wetlands contain four cells with increasing salinity and serve as a pilot system for evaluating potential ecological risks for similar habitats. Tetra Tech has operated this pilot shallow habitat since 2006 with the assistance of a subcontractor (Agrarian Research).
- **Upper Mokelumne River Sanitary Survey.** *Project Manager/QAQC Manager.* Performed a sanitary survey of the watersheds that provide source water for Calaveras County Water District (CCWD) and Calaveras Public Utility District (CPUD). This sanitary survey assessed the potential impacts on surface water quality of all existing and future watershed activities as well as the ability of each of the utilities to meet the Impending Enhanced Surface Water Treatment Rule and Stage I Disinfection Byproducts Rule; both of which will

be required to be implemented within the next four years. A major part of this assessment included performing a QA/QC review of all existing water quality data and procedures used by the various water agencies.

- **EPA Region IX Nutrient Criteria.** Water Quality co-Project Leader for EPA Region IX efforts to assess the feasibility of using the newly released National protocols for developing nutrient water quality criteria on an ecoregional basis, suggesting modifications if necessary, and determining regional nutrient criteria. One aspect of this project is to create a database containing water, sediment, and habitat quality data. All data are subjected to an intensive QA/QC review by Mr. Wortham prior to their being entered into the database, which includes an evaluation of methods used to collect the samples and analyze the data as well as an assessment of the laboratory QA/QC procedures. This study is part of the National Nutrient Criteria Project.
- **Toxicity Identification/Reduction Evaluations (TI/REs).** *Project Manager.* Designed and performed effluent toxicity characterization evaluations to determine if effluent limits and water quality objectives were being met and, if not, whether a TI/RE was the next logical step. These evaluations included multi-species bioassay testing and dilution modeling. Performed and successfully completed all three phases of the TI/RE on major industrial and municipal plant discharges, as well as urban stormwater runoff resulting in the identification of the causative toxicants, the location of probable sources, and the evaluation of potential reduction methodologies.
- **Toxicity Identification/Reduction Method Development.** *Project Manager.* Instrumental in developing methodologies required to perform chronic TI/REs prior to the publication of the USEPA's methods manual. Developed, performed, and successfully completed chronic TI/RE methods using *Selenastrum capricornutum*, *Ceriodaphnia dubia*, *Pimephales promelas*, *Oncorhynchus mykiss*, *Strongylocentrotus purpuratus*, *Mytilus edulis*, *Crassostrea gigans*, *Eohaustorius estuarius*, *Dendraster excentricus*, *Mysidopsis bahia*, *Menidia beryllina*, *Atherinops affinis*, *Macrocystis pyrifera*, and *Haliotes rufescens* on several industrial and municipal effluents resulting in the identification of the causative toxicant(s), the location of the probable source(s) and, the evaluation of potential reduction methodologies. In addition, developed the methodologies required to perform chronic TI/REs using estuarine sediment porewater and the "West Coast Species" suite of test organisms.

EDUCATION/SPECIAL TRAINING

M.S., Marine Science, CSU Moss Landing Marine Laboratories, 2005

B.S., Ecology Systematic Biology, California Polytechnic State University, 2000

Basic Wetland Delineation Training, Wetland Training Institute, 2008

QUALIFICATIONS

Ms. Perez is a marine scientist with nine years of marine biological and ecological research experience. She has five years of experience with Tetra Tech, Inc. investigating the effects of mercury, arsenic, other metals, and TPH on sediment, fish, seawater, benthos, and plankton in the vicinity of oil and gas facilities in the Gulf of Thailand. She has worked with Tetra Tech scientists to compile and synthesized data to produce over 80 environmental monitoring and environmental impact assessment reports for oil and gas operations in the Gulf of Thailand. She has NEPA/CEQA experience. Her project management experience includes an ecological study of ephemeral pools and a habitat restoration project at Edwards Air Force Base.

RELEVANT EXPERIENCE**Environmental Monitoring**

- **North San Francisco Bay Selenium Characterization, Western States Petroleum Association (August 2010-Present).** Environmental scientist responsible for dry and wet season sampling of refinery outfalls and transect surveys to determine reference conditions in the San Francisco Bay and in the San Joaquin and Sacramento Rivers. The objective of the receiving-water sampling is to characterize the mixing characteristics of the discharge and the speciation of the selenium upon initial dilution in the receiving water. Additional duties include the collection, filtering, and preservation of refinery effluent samples in order to meet laboratory hold times. Effluent samples are sent the lab to be analyzed for the dissolved and particulate selenium species.
- **Mission Bay Bivalve Survey, Mission Bay Shoreline Protection Project, Port of San Francisco (December 2010).** Environmental scientist responsible for conducting a bivalve survey of hard substratum within the intertidal and shallow subtidal zone along the shoreline of Bayfront Park in Mission Bay. The objective of this study was to determine the presence and relative abundance of native oysters and mussels prior to restoration and repair of the shoreline. Environmental scientist responsible for data analysis, interpretation, and compilation of this report.
- **Pillar Point Air Force Station, Storm water Sampling, Department of the Air Force, Vandenburg Air Force Base, California (May 2007 to present).** California Ocean Plan requires Pillar Pt. Air Force Station (AFS) to monitor discharge into the James Fitzgerald Marine Reserve (Area of Special Biological Significance, California Ocean Plan (COP)). Responsibilities include the collection of storm water runoff from two discharge points into the reserve and one reference location to determine concentrations of metals, bacteria, and other contaminants and their resulting affects to aquatic organisms.

- **NAVFAC Atlantic Biological Resource Services (March 2010 to January 2011).** Environmental scientist responsible for compiling and updating previous marine resource assessments provided to the Navy on the oceanography of the Atlantic Ocean, adjacent Seas, and the western Indian Ocean. This section, in part, will fulfill the 2010 Marine Resource Assessment of the Atlantic Ocean in an effort to support the Navy's future environmental planning and compliance efforts.

- **Aquatic Invertebrate Survey at Edwards Air Force Base, California, Environmental Conservation Management Program at Edwards Air Force Base (September 2008 to September 2009).** Project manager responsible for surveying ephemeral ponds on Edwards Air Force Base to characterize the occurrence and distribution of branchiopod crustaceans. Responsibilities included project design, leading a team in the field to collect water chemistry and aquatic branchiopods in ephemeral ponds, compiling and synthesizing data to produce a report.

KAREN L. DIKEMAN

Staff Scientist

Tetra Tech, Inc. - Lafayette, CA

Years with Tetra Tech - 10

Years with other Firms - N/A

EDUCATION/SPECIAL TRAINING

M.A., Biostatistics, University of California, Berkeley, 2007

B.S., Ecology, Behavior, and Evolution, University of California, San Diego, 2001

REGISTRATIONS/CERTIFICATES

2005, 40-Hour HAZWOPER [29 CFR 1910.120 (e)]. Certificate Number 70201

YEARS OF EXPERIENCE

Years of Relevant Experience: 10

Years with Tetra Tech: 10

SPECIALTIES

Statistical analysis, R, human health and ecological risk assessment (HHERA), risk calculation, risk modeling, environmental database management, bioaccumulation, ecotoxicology, Air Force.

QUALIFICATIONS

Mrs. Dikeman has 10 years of experience with Tetra Tech's Environmental Assessment and Ecological Risk Assessment team. Her repertoire includes advanced statistical and computational techniques to analyze and interpret categorical data, linear and non-linear models, survival analysis, parametric and non-parametric data and models, and distributions. She has experience using the programs R, Stata, Statistica, and SAS to implement methods and present results. She completed graduate coursework in a variety of theoretical and applied statistical methods, including theory and application of probability, statistics, and statistical models, multivariate statistics, maximum likelihood, bootstrapping and Monte Carlo techniques, and analysis of categorical, censored, non-linear, and non-normally distributed data. Her background also includes experience generating and using models to simulate population responses to environmental stressors.

She also specializes in human health and ecological risk assessments, risk assessment model development, statistics, and database compilation and management. She maintains a database of bioaccumulation models and chemical toxicity as new methods, guidance, and literature emerge. Mrs. Dikeman is also responsible for the organization and management of databases for the majority of the human health and ecological risk assessment projects. She has experience using SAS, Microsoft Excel, and Microsoft Access to organize, combine, clean, and query datasets to obtain and assess the pertinent information.

RELEVANT EXPERINCE

- **New and Alamo Pilot Treatment Wetlands.** Participated in a study of suspended sediments, bacteria, nitrates, phosphates, and accumulation of pesticides and selenium the Imperial and Brawley wetlands in the vicinity of the Alamo River for the Imperial Irrigation District. Conducted fieldwork on the rivers collecting water, sediment, fish, and invertebrate tissues, and used the results to develop bioaccumulation factors and models to estimate potential concentrations of selenium and pesticides in food sources for affected fish and birds. However, the pilot treatment wetlands may also function to concentrate pesticides and selenium in aquatic organisms, potentially leading to adverse effects in aquatic invertebrates, fish, and birds. Mrs. Dikeman also developed a risk assessment exposure model for the ecological receptors, which included the capability of comparing site specific uptake models with those from literature and guidance.
- **Ecological Risk Assessment, Salton Sea, California.** Provided risk assessment and statistical support for an ERA of pilot desalination ponds at the Salton Sea for the Salton Sea Authority. Conducted fieldwork at the Salton Sea and the evaporation pond site, collecting water and invertebrate tissue samples for biouptake analysis and risk assessment. Assisted in development of site-specific bioacummulation parameters. Adapted the ecological risk assessment model, developed site-specific toxicity reference values, species exposure parameters, and biouptake models, organized data, performed risk calculations and analysis, and wrote portions of the report.
- **Statistical Algorithm Review and Support for Online Water Quality and Toxicity Monitoring Research, U.S. EPA.** Performed review of code in R which maintained an ongoing database of frequent monitoring measurements, updated current summary statistics of the data, and computed methods to detect change in the activity of the bivalves in the system. The Online Toxicity Monitoring consisted of clams affixed with electronic sensors to measure the gape of each animal, in addition to water quality parameters.
- **Statistical Evaluation of Water Quality, Vandenberg Air Force Base, California.** Conducted statistical evaluation of water quality parameters collected over time at one lake and four creeks on Vandenberg Air Force Base. Investigated changes in parameters over time, correlations between parameters, compared measurements before and after a fire to identify effects and determine if recovery was occurring, and compared different points along creeks between the points they entered the base and exited at the ocean.
- **Human Health and Ecological Risk Assessment, Lockheed Martin Corporation, Beaumont, California.** Performed detailed statistical comparisons of site and background data to identify potentially elevated metals at two main sites. Along with the HHERA team, she has performed a scoping ecological risk assessment at one site and developed workplans for scoping and predictive ecological risk assessments and human health risk assessments for both Beaumont sites, in accordance with DTSC guidance. Mrs. Dikeman developed spreadsheet tools for both human and ecological risk calculations. The ecological model included options for complex food web modeling scenarios, enabling the user to quickly calculate exposures to receptors (i.e., herbivores) from a selection of food sources, which would contact contaminants in either shallow or deep soils, or groundwater. In support of the

Ecological Risk Assessment, she also worked on the development of plant and mammal uptake models for perchlorate from soil to mammal and plant tissues, and included comparisons of the site specific models with others from literature or guidance.

- **Human Health and Ecological Risk Assessment Model Development.** Developed a Microsoft Excel-based risk model, integrating site chemical concentrations data, exposure parameters, chemical intake calculations, vapor modeling, bioaccumulation modeling, and chemical toxicity data. The model quickly and efficiently computes a quantitative measurement of the risk at a site and presents the resulting information in a report-ready format agreeable to clients and regulators, and has the capability and flexibility to calculate risks simultaneously for a variety of receptors, user-defined exposure scenarios, and conceptual site models. Maintains the models with current data and guidance and adapts them to specific project needs.
- **Mojave Ground Squirrel Sampling Protocol, Edwards Air Force Base, California.** Evaluated methods to adapt existing sampling protocol developed by California Fish and Game to efficiently study the base-wide presence and abundance of this sensitive species. Used linear discriminant analysis in R to differentiate between tracks of coexisting ground squirrel species, investigated association of presence with environmental factors, and calculated density and abundance estimates from mark-recapture sampling results.
- **Ecological Risk Assessments, Edwards Air Force Base, California.** Project manager and primary risk assessor for the completion of 58 predictive ecological risk assessments, 3 scoping risk assessments, and five pre-scoping risk assessments. Developed an ecological risk assessment model in support of large-scale base wide ecological risk assessments, and evaluated background risks at a representative site on the base. Continuously improves risk calculation methodologies and the database of toxicity reference values and biouptake parameters.
- **Population Study on Desert Cymopterus.** Conducted statistical comparisons, and correlation and regression analysis to identify relationships between plant growth, sustainability, and reproductive ability to the desert environment of this California Species of Special Concern.
- **Base wide Validation Study, Vandenberg Air Force Base, California.** Performed statistical analyses on plant growth responses to varying concentrations of constituents in soils. Conducted parametric and non-parametric comparisons, regression analyses, and created graphs illustrating results.
- **Research Assistant, Center for the Reproduction of Endangered Species, San Diego Zoo.** Assisted in field data collection and preliminary data analysis for studies on the Coast Horned Lizard, Desert Rosy Boa, and Red Diamond Rattlesnake. The research involved comparison of animal utilization patterns across seasons to habitat size and quality.
- **Biological Statistics Teaching Assistant, University of California, San Diego.** Prepared and administered lab component of course introducing students to quantitative analysis and understanding of biological data. Guided students through the use of statistical software in lab exercises and reviewed course material.

EMPLOYMENT HISTORY

April 2002 – Present Tetra Tech, Inc.
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PROFESSIONAL REFERENCES

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