

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:

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.

Salton Sea Restoration Program: Development of a Preferred Project, Salton Sea Authority. 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.

Engineering Support Services for the Salton Sea Restoration Project, Salton Sea Authority and US Bureau of Reclamation. Project Manager for a program to restore California's largest lake, a 370square 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

Education:

Ph.D., Civil Engineering, River Mechanics, 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

Continuing Education (90+ PDHs) in Sedimentation, Hydraulics and Hydrology, Treatment Wetlands, Culvert Design, Shore Protection, Program Management, and Ethics

Registrations:

Registered Civil Engineer, California #36192 (1983)

Registered Civil Engineer, Alaska, Delaware, Florida, Illinois, Kansas, Louisiana, New Mexico, Tennessee, Virginia

Professional Affiliations:

American Society of Civil Engineers

Years of Experience:

Since 1981

Years with Tetra Tech:

Since 1981

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, 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 200km 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 I Survey that included compilation of a site database of 1,250 archaeological sites.

Salton Sea Restoration Project EIS/EIR, CA Salton Sea Authority and US Bureau of Reclamation. 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 saltwater 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 100220 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. Serves as 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.

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 15mile 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.

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.

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, US 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, TVA, 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 BayDelta Programmatic Environmental Impact Statement/Report (EIS/EIR), CA, CALFED. Principal-In-Charge for technical and production support for a programmatic EIS/EIR addressing the effects of a 30year 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 50miles to the pumping plants in the south of the Delta.

CALFED BayDelta Program Riverine Hydraulics and Delta Hydrodynamics, CA, CALFED. 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 BayDelta.

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

CALFED BayDelta Water Storage Program Assessment, CA, CALFED. 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.

NEPA Documentation for Air Force BRAC II, US Air Force. Program Manager for \$3.5 million fasttracked 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.

Programmatic Environmental Impact Statement and Other Environmental Support Services for Nuclear Weapons Complex DOE, US Department of Energy. Program Manager for one of the largest environmental programs ever undertaken by the DOE. This 6year, \$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.

Programmatic Environmental Impact Statement and Siting Support, 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, 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, Metropolitan Water District. Quality Assurance Manager for an EIR that 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, Southern California Edison. Performed an engineering analysis of erosion at transmission tower footings along the San Gorgonio and Whitewater Rivers in California. Provided specifications for footing designs.

Design of Pumping Stations for Contaminated Runoff from Mission Bay, CA, City of San Diego. 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 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, City of San Diego. 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, Pacific Gas and Electric. 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, City of San Diego. Principal Investigator for shoreline erosion studies in Mission Bay, San Diego. Prepared conceptual designs for shoreline improvement alternatives.

North Carolina Flood Hazard Studies, 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, 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, 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 in Calcasieu Parish, LA, FEMA. 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, FEMA. Presented the results of flood hazard studies at more than 50 public meetings in four states.

Analysis of Rock Trap and Drain System, 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.

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.

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

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

Drinking water quality

Years of Experience:

Since 1992

Years with Tetra Tech:

Since 1996

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 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.

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.

Mr. Moore has 14 years of civil engineering experience. He has conducted hydraulic studies and supervised the design of storm drain features including natural and concrete channels, pipes, and basins. He has specialized experience in the evaluation and design of embankment protection measures and desilting basins and evaporation ponds. Mr. Moore has also managed the design of liner systems, leachate collection systems, final cover systems, and design of grading, and earthwork improvements. He has overseen the preparation of construction plans and specifications and provided engineering support during the construction phase of numerous projects. Throughout his career, Mr. Moore has managed multi-disciplined design teams, negotiated and interfaced with local regulatory agencies, and coordinated with project stakeholders.

STORMWATER MANAGEMENT:

Multi-stage Stormwater Basin Design, Keller Canyon Landfill, Pittsburg, California. Project Manager for preparation of construction level design documents for a new storm water conveyance system. Work includes creation of a two-stage desilting basin by modifying an existing basin and the addition of a new basin. The design will maximize retention and de-siltation of stormwater in the upper basin. Responsibilities include hydraulic / hydrology studies, basin grading and layout design, design of main inflow and outflow culvert and channels, and design of the barrier system and structural improvements. The proposed improvements will help protect the landfill and ancillary features from a 1,000-year, 24-hour storm event.

Biomitigation Channel and Wetlands Design, Prima Deshecha Landfill, Orange County, California. Performed engineering design and support services for drainage features to offset biologic impacts caused by a large landslide remediation program. Work included design of gabion drop structures, gabion channel stabilizers, gabion-reno mattress energy dissipaters, and a modular concrete retaining wall system. In addition, provided engineering support during design of adjacent wetlands area. This included development of plans supporting salvaging various existing plant species, top soil and duff material salvaging and relocation, grading to establish mitigation areas, and irrigation improvements.

Design of Embankment Protection Measures, Brawley Landfill, Imperial County, California. Project Manager for design of embankment protection measures at a landfill located adjacent to the New River. Prepared plans for installation of geotextile backed rip-rap armoring; geotextile backed gabion/reno mattress structures; and concrete revetment. The proposed improvements were designed to protect the landfill final cover from a 100-year flood event.

Education:

M.S., Civil Engineering,
University of Southern California
(2007)

B.S., Civil Engineering;
California State Polytechnic
University, Pomona (2001)

Registrations:

Registered Civil Engineer,
California #66580 (2004)

Registered Civil Engineer,
Illinois (2010)

Registered Civil Engineer,
Guam #1609 (2011)

Professional Affiliations:

Solid Waste Association of
North America

American Society of Civil
Engineers

Years of Experience:

Since 1998

Years with Tetra Tech:

Since 2002

Arroyo Trabuco Mitigation Project, Orange County, California. Project Engineer on a task order to assess the potential for a riparian mitigation project to offset impacts of earthwork construction at OC Waste & Recycling's Prima Deshecha Landfill. Provided permit level design of a diversion structure proposed to divert low-flows from Trabuco Creek into a mitigation area that is to be planted with riparian vegetation. Work included review of hydrologic information for the Arroyo Trabuco Creek, as well as utility data from the Santa Margarita Water district to determine compatibility of proposed riparian mitigation area with nearby water, sewer, and reclaimed water lines.

LANDFILL CLOSURE DESIGN:

Final Closure Design, Palo Verde Landfill, Imperial County, California. Project Manager for preparation of the final closure construction drawings and specifications for installation of final cover system on 9.4-acres refuse footprint, and construction of onsite surface water control features.

Final Closure Design, Ocotillo Landfill, Imperial County, California. Project Manager for development of plans and specifications for final closure of 5.3-acre refuse footprint. A key project issue included use of onsite soils for alternative final cover system. Also performed construction management during final cover construction.

Final Closure Design, Installation Restoration (IR) Program Site 2, Naval Air Station Alameda, California. Project Manager for the design of final cover system for a former disposal site for wastes generated at the former NAS Alameda. The facility received general base waste as well as a number of specific and potentially hazardous industrial or process waste streams. Responsible for updating the existing preliminary designs for site closure. This includes preparation of 60 percent and 90 percent and final design plans, geotechnical design, preparation of technical specifications and a Construction Quality Assurance (CQA) Plan. The final cover system incorporates a unique biotic layer to prevent burrowing animals from penetrating the waste prism.

Final Closure Design, Base Landfill LF-01, Scott Air Force Base, St. Clair County, Illinois. Project Manager for development of final closure construction documents for a 35-acre landfill that was operated from 1940 to the late 1970s. The site is situated between three running creeks, in a wetland and in the floodplain of Silver Creek. Oversaw Development of a final cover and landfill gas collection system that will minimize impacts on the adjacent creeks and wetlands and that will withstand a 100-year flood event from the nearby creek. Permanent erosion control features on the side slopes will minimize impacts on the wetlands during construction. These measures, will support vegetative growth after construction is complete and will reinforce the slopes and allow them to blend with the natural surroundings. Final cover on the side slopes incorporate a geosynthetic turf reinforcement mat (TRM) for erosion control above the vegetative/protective layer.

Final Closure Design, Lockheed West End Landfill, Goldendale, Washington. Project Manager for design of the final closure of an inactive construction debris and industrial landfill. The selected cleanup action alternative called for a low permeability cap with associated institutional controls, long-term maintenance, and monitoring. The cover system was designed to meet the applicable requirements of WAC 173-304, Minimum Functional Standards for Solid Waste Handling. The closure cap consisted of a subgrade layer, a 50 mil linear low-density polyethylene (LLDPE) membrane, a subsurface drainage layer consisting of geocomposite strips and drainage headers, a vegetation support soil layer, vegetative cover, and a stormwater control system to protect the capping system from and 24-hour, 25-year storm and erosion.

Final Closure Plans, Preparation of Permit-Level Design Drawings, Vandenberg Landfill, Vandenberg Air Force Base, California. Project Engineer responsible for preparing permit level designs in support of the development of the Final Closure / Post Closure Maintenance Plans, and Joint Technical Document for an active solid waste disposal facility.

Final Closure Design, San Bernardino International Airport Waste Disposal Unit, San Bernardino County, California. Project Manager for final grading and drainage design and construction support for the development of a 20-acre parking lot above a closed non-hazardous waste disposal unit. Developed construction plans and specifications for the removal the existing vegetation, and reworking and recompaction of upper soil layer to meet parking area standards. Approximately four inches of asphaltic concrete was placed over six inches compacted base subgrade in accordance with industry and California Department of Transportation standards.

Design of Final Cover and Drainage Improvements, South Coast and Laytonville Landfills, Mendocino County, California. Provided engineering support for drainage improvements in support of final closure design.

Final Closure Planning, Coastal Landfill, Ventura County, California. Provided hydrology and design of drainage improvements in support of project to develop a golf course on portions of a closed 83-acre municipal solid waste landfill.

Final Closure Design Support, Palos Verdes Landfill, Los Angeles County, California. Provided drainage system design in support of the development of a golf course at a former municipal landfill.

LANDFILL LINER SYSTEM DESIGN:

Phase II Liner System Design, Las Pulgas Landfill, Camp Pendleton Marine Corps Air Base. Project Manager for the design of a 19.5-acre lined cell which included preparation of conceptual designs, and development of construction plans and specifications for cell development. A significant technical issue involves connecting the Phase II liner system with the existing Phase I liner, so that the Phase II leachate collection system will operate independently of Phase I. Low levels of tritium have been identified in Phase I leachate. Phase II will be constructed so that the liner and leachate collection system function independently to isolate all waste, runoff, and leachate from the Phase I and unlined landfill areas.

Phase IB Stage 2 Liner System Design, Victorville Sanitary Landfill, Victorville, California. Project Manager for design of 4.3-acre lined refuse disposal cell at a high desert municipal solid waste landfill. Developed design concepts, oversaw preparation of design plans, design calculations, construction cost estimates, construction specifications and bid documents.

Cell 5 Liner System Design, Chiquita Canyon Landfill, Santa Clarita, California. Project Manager for design of liner system consisting of subgrade, geosynthetic clay liner (GCL), 60-mil double textured HDPE geomembrane, a geocomposite drainage layer; and protective cover soil (PCS). Project included design of excavation and fill for subgrade preparation, fill and alluvium excavation and re-compaction, stockpiling of excess material, relocation and construction of new leachate collection removal system and tank facilities, construction of perimeter drainage facilities, and paving of access roads.

Phase CC-I, Sunshine Canyon Landfill, Sylmar, California. Project Manager for design of a 14-acre lined refuse disposal cell. Included preparation of conceptual designs, development of construction plans and specifications for cell development and permitting. The site is unique in that it features fill areas in both the City of Los Angeles and unincorporated areas of Los Angeles County. Phase CC-I was the first cell joining the City and County landfills and was a high-profile project performed under a new permit. Phase CC-I has significant geotechnical issues associated with existing facilities and future development of the master plan.

Phase IB Liner System Design, Tajiguas Landfill, Santa Barbara County, California. Project Engineer for design of Phase IB liner system. Project included excavation of approximately 650,000 cubic yards of soil material from the eastern slope adjacent to the existing Phase IA refuse placement area. Assisted in the preparation of composite liner designs (slope and floor areas), LCRS plans and details, erosion control plans, site access plans, and other related details.

ADDITIONAL EXPERIENCE:

Design of New Landfill, Tinian, Commonwealth of the Marianas Islands. Project Manager for design of a new USEPA RCRA-compliant sanitary landfill on property owned by the U.S. Department of Defense. Responsible for preparation of hydrology study / surface water management plans, grading plans, liner phasing plans, and leachate and landfill gas management systems. Landfill features include lined refuse disposal cells, site access road, scale house and administration building, power distribution and lighting system, and visual screening features. The site receives approximately 81 inches of rainfall per year, so leachate and surface water management are key design considerations. Work is being funded by the U.S. Department of Interior, Department of Insular Affairs, and U.S. Department of Defense.

Engineering Analysis, Tonopah Airfield Auxiliary Annex (TAAA), Nellis Air Force Base, Nevada. Prepared diminishing capacity calculations for waste disposal site.

Santa Maria Landfill, Santa Barbara County, California. Provided engineering support during development of preliminary, permit-level designs for a new landfill being developed by the City of Santa Maria.

Mid Valley Sanitary Landfill Environmental Protection Program, San Bernardino County, California: Providing engineering support for a program to relocate waste from unlined refuse disposal units 1 and 2 of the Mid-Valley Sanitary Landfill into lined areas of the site. Sand and gravel materials under Units 1 and 2 will then be excavated and sold, generating additional disposal capacity which can be lined for future use.

Barstow Sanitary Landfill Expansion, San Bernardino County, California. Provided engineering support during development of preliminary, permit-level engineering designs for lateral and vertical expansion of landfill.

Mr. Huffmire is an experienced construction superintendent who oversees construction activities on Tetra Tech projects throughout California. He has been Construction Manager on large excavation projects, lined cell development projects, and landfill closure projects. In addition, Mr. Huffmire has provided oversight during construction of access roadways, drainage improvements, scale houses, administrative buildings, and landfill civil infrastructure. He has demonstrated experience in planning, organizing, and monitoring construction projects, and in project schedule and cost control. He is a licensed general contractor and has had special training in stormwater management, and geosynthetic liner and compacted clay liner installation. He has also provided constructability review of engineering drawings, evaluated construction specifications, and provided technical assistance to field personnel during construction operations. Throughout his career, Mr. Huffmire has coordinated construction management staff, geotechnical and geosynthetic CQA staff, and coordinated on-site project review of construction issues during large landfill development and closure projects.

SELECTED PROJECT EXPERIENCE:

All the following projects have included comprehensive documentation, including meeting minutes, daily reports, schedules, payment applications, preparation and tracking of change-orders and submittals, photo logs, and contract time accounting. Mr. Huffmire is also experienced in the use of computer programs such as Expedition (contract control software), Excel, and Microsoft Word for Windows.

Biomitigation Channel Construction, Prima Deshecha Landfill, Orange County, California. Construction Manager during construction of biomitigation channel to offset impacts caused by a large landslide remediation program. Work included installation of gabion drop structures, gabion channel stabilizers, gabion-reno mattress energy dissipaters, and a modular concrete retaining wall system. Worked with client and contractor during construction of channel to substitute channel liner materials which resulted in an estimated savings of approximately \$200,000 for the client.

Santa Ana River Embankment Construction, Colton, California. Provided construction management during installation of embankment protection measures at a municipal solid waste landfill located adjacent to the Santa Ana River. Major elements of the project included construction of riprap/gabions embankment protection and wetlands mitigation along the border of the site. Also provided construction management services and bidding assistance during installation of bentonite cement slurry trench wall at the site.

Drainage System, Access Road Construction, Mesquite Regional Landfill, Imperial County, California. Senior Construction Manager on a five-year contract with the Los Angeles County Sanitation Districts in

Education:

Long Beach City College
Long Beach, California

Registrations:

Qualified SWPPP Developer
and Practitioner (#00193)

Los Angeles County Engineer
Reinforced Concrete Inspector
(#0259)

California State Contractors
License (#456135)

Years of Experience:

Since 1968

Years with Tetra Tech:

Since 1990

support of initial construction projects for a new waste-by-rail landfill being developed by the Los Angeles County Sanitation Districts. Projects involved construction of 10 miles of drainage channels and levees, the site access road, and site administrative facilities.

East Channel and Access Road Construction, Olinda Alpha Landfill, Brea, California. Provided construction management/engineering support during construction of Armorflex® channel. Construction included clearing and grubbing; alluvial material removal; placement and compaction of fill material; installation of trapezoidal channel sub drain; installation of geomembrane liner beneath proposed channel sections; construction of cellular concrete block channel, PCC trapezoidal channel, transition structures, masonry splash walls, and a trapezoidal channel bridge crossing; and construction of AC pavement access road and AC berms.

Construction Supervisor of Crossroads Business Park, a 100-acre site with over 2 million cubic yards of import. The project also included: construction of a 12 ft. by 12 ft. reinforced concrete storm drain box with lateral connections ranging from 72 in. RCP to 18 in. RCP; a VCP main line sewer, curb, gutter, and roadway construction; and coordination of all utility installations for the site. Also coordinated construction schedules. Maintained all documentation related to the projects, such as daily progress reports, change-orders and pay applications. Ensured compliance with contract documents and coordinated with various agencies and utility companies to expedite the completion of projects.

Senior Inspector for Davidson City Pump Plant, Effluent Screening Station, and the Secondary Treatment Facility/Biological Reactors, and for Los Angeles County Sanitation District projects ranging from main line installation to treatment plant construction. Typical projects included a variety of grading, reinforced concrete, masonry, mechanical, and electrical installations. Primary responsibilities included verifying conformity with the plans and specifications, documentation of daily progress, coordination between the contractor and engineer, and review of contract change-orders and pay applications.

On-Call Solid Waste Engineering and Construction Management, OC Waste & Recycling North Region Landfills. Project Manager for on-call contract in support of site development projects. This has included task orders for design of improvement of site access road and administrative facilities, scale area, fueling facility and assessment of groundwater remediation system. Projects also included preparation of a no-liner waiver for a future development phase. Construction management services were also provided for installation of four new in-ground scales and complete re-construction of the scale area improvements, and the east perimeter drainage improvements.

Construction Manager for Site Development Projects at Frank R. Bowerman Landfill, Orange County, California. Projects included Phase V-D expansion, expansion of site office facilities, and construction management during remediation of landslide at site. Also provided construction manager during installation of an alternative final cover system demonstration project on the front face of the landfill.

Construction Manager, Prima Deshecha Landfill Household Hazardous Waste Collection Center, San Juan Capistrano, California. Provided field construction management during facility development. Construction included installation of a perimeter geomembrane landfill gas barrier; grading for foundation pads; concrete work for building slabs; construction of a pre-engineered steel building; installation of masonry partition walls in the load check area; installation of fire suppression system and utilities; construction of concrete slab, curbs and gutters in the storage area; and construction of drainage improvements.

On-Call Construction Management Services, County of San Bernardino SWMD On-Call Construction Management Contract. Provided construction management for composite geosynthetic liner expansion projects at Mid Valley and Victorville Landfills, pond liner project at Barstow Landfill, and alternative cover landfill closure construction at Phelan and Twenty-nine Palms Landfills.

Program Manager, Engineering Services Contract, California Integrated Waste Management Board, Solid Waste Disposal and Codisposal Site Cleanup Program. Coordinated engineering and construction management services for closure of more than 30 illegal and abandoned disposal sites throughout California. Provided constructability review of engineering drawings, evaluated Site Investigation Reports and construction specifications, and provided technical assistance to field personnel during construction operations. Project has involved clean closure of illegal disposal sites and burn dumps.

Construction Manager, Royal Boulevard Land Reclamation Site Closure, Torrance, California. This site, surrounded by a residential neighborhood, required recovery of inert foundry waste from adjacent properties and reconsolidation on site, import and placement of low-permeable and vegetative material, construction of A.C. perimeter roadway and 3,400 LF of concrete block wall, reconstruction of miscellaneous structures and garages, placement of geotextile over the entire site, and surface and sub-surface drainage improvements.

Construction Manager, CAP Groundwater Treatment System, Milliken Landfill, San Bernardino County, California. Performed construction management during construction of a water conveyance and treatment system. Major components included installation of HDPE piping, reinforced concrete, electrical and instrumentation, and miscellaneous paving.

Construction Manager during Construction of the Crazy Horse Landfill Phase I Groundwater Protection Project. Major elements of this project included mass excavation and grading; processing, placement, and compaction of Bentonite amended low permeability material; installation of a leachate collection and recovery system placement of 90 mm geomembrane; installation of eight-ounce and sixteen-ounce geotextile; construction of the protective cover layer; and installation of miscellaneous drainage improvements.

Construction Manager for Berry Street Mall Closure Construction, Roseville, California. Closure activities for this 20-acre site included mass grading for subgrade preparation, import and placement of 130,000 cubic yards of random and low permeable material, installation of a leachate and gas collection system, construction of A.C. access roads, miscellaneous surface drainage improvements, and erosion control.

Senior Inspector/Project Manager of Fairway Industrial Park, Fairway Drive improvements and reconstruction, Workman Mill road construction, and numerous public work projects.

As a General Contractor, was involved with the construction of single and multi-family dwellings, with responsibility for all phases of construction.