<table>
<thead>
<tr>
<th>TABLE OF CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION ......................................................................... 1</td>
</tr>
<tr>
<td>2. BACKGROUND ........................................................................... 2</td>
</tr>
<tr>
<td>3. OBJECTIVE AND SCOPE OF WORK ........................................ 3</td>
</tr>
<tr>
<td>Objective ...................................................................................... 3</td>
</tr>
<tr>
<td>Scope of Work ............................................................................. 3</td>
</tr>
<tr>
<td>4. COMPANY PROFILE .................................................................. 5</td>
</tr>
<tr>
<td>Safety Program ............................................................................ 6</td>
</tr>
<tr>
<td>5. TECHNICAL QUALIFICATIONS ................................................ 7</td>
</tr>
<tr>
<td>Hydrogeology ............................................................................... 7</td>
</tr>
<tr>
<td>Geochemistry ............................................................................... 8</td>
</tr>
<tr>
<td>Toxicology .................................................................................... 8</td>
</tr>
<tr>
<td>Industry, Academic, and Government ......................................... 9</td>
</tr>
<tr>
<td>Regional Expertise ....................................................................... 9</td>
</tr>
<tr>
<td>No Conflicts .................................................................................. 9</td>
</tr>
<tr>
<td>6. PERSONNEL ............................................................................. 10</td>
</tr>
<tr>
<td>Barbara Mickelson, P.E., President and Principal ..................... 10</td>
</tr>
<tr>
<td>Michael Acton, Vice-President and Principal ............................. 10</td>
</tr>
<tr>
<td>Jeffrey Heglie, P.G., C.E.G., R.P.G., Senior Engineering Hydrogeologist ................................................................. 10</td>
</tr>
<tr>
<td>Meng Ling, P.E., Ph.D., Senior Technical Consultant ............... 11</td>
</tr>
<tr>
<td>7. REPRESENTATIVE EXPERIENCE .......................................... 12</td>
</tr>
<tr>
<td>Drinking Water ........................................................................... 12</td>
</tr>
<tr>
<td>Use of Downhole Video Cameras to Evaluate Domestic Water Wells ................................................................. 16</td>
</tr>
<tr>
<td>Evaluation of Domestic Water Well Construction ..................... 16</td>
</tr>
<tr>
<td>Oil and Gas Production .............................................................. 18</td>
</tr>
<tr>
<td>Evaluation of the Integrity of Oil and Gas Wells ...................... 19</td>
</tr>
<tr>
<td>Manufactured Gas Plants .......................................................... 20</td>
</tr>
<tr>
<td>NAPL Modeling .......................................................................... 20</td>
</tr>
<tr>
<td>Bulk Fuel Terminals ................................................................... 21</td>
</tr>
<tr>
<td>Municipal and State Contracts ................................................... 22</td>
</tr>
<tr>
<td>Statistical Evaluation of Environmental Monitoring Data ........... 22</td>
</tr>
<tr>
<td>8. REFERENCES .......................................................................... 24</td>
</tr>
</tbody>
</table>

APPENDIX A ................................................................................. RESUMES
1. INTRODUCTION

Acton ● Mickelson ● Environmental, Inc. (AME) is pleased to present this Statement of Qualifications to provide expert consulting services to the Wyoming Department of Environmental Quality (WDEQ) in its review of the current body of information available for domestic wells in the Pavillion Field. AME has extensive experience in high-profile sites where municipal, residential, and environmental resources have been impacted by petroleum hydrocarbons and other chemical constituents. The following sections describe our understanding of the current status of the Pavillion Field investigations and the Scope of Work required to assist the WDEQ. We look forward to the opportunity to meet with WDEQ representatives to further discuss how we can assist WDEQ in accomplishing their objectives.
2. BACKGROUND

Pavillion is a town of 231 residents in west-central Wyoming, which became the subject of a United States Environmental Protection Agency (EPA) groundwater investigation in 2008 when residents contacted the EPA about smells, tastes, and adverse changes in the water quality of their domestic wells.

The EPA conducted sampling from March 2009 to April 2011, including:

- March 2009: Aqueous samples from 35 domestic and 2 municipal wells
- January 2010: Groundwater samples from 17 domestic, 4 stock, and 2 municipal wells
  - A filter sample from a reverse osmosis system
  - Surface-water and sediment samples from 5 locations along Five-Mile Creek
  - Gas and produced water/condensate samples from 5 production wells
  - Groundwater samples from 3 shallow monitoring wells
  - Soil samples near the perimeter of three known pit locations
- June 2010: Installation of 2 deep monitoring wells to differentiate potential deep versus shallow sources of groundwater contamination
  - September 2010: Gas samples from the well casings of MW01 and MW02
  - October 2010: Groundwater samples from MW01 and MW02 and 3 domestic wells
- April 2011: Resampling of MW01, MW02, and 8 domestic and 3 stock/irrigation wells

The EPA released the results of their sampling at a public meeting in November 2011, followed by a draft investigation report in December 2011. The draft report integrated multiple lines of reasoning to formulate the explanation that constituents associated with hydraulic fracturing were at least partially to blame for resident complaints about drinking-water quality.

Questions were subsequently raised about the methodology and interpretation of data in the draft report, leading to additional sampling by the EPA in the first half of 2012, a United States Geological Survey (USGS) investigation of the EPA investigation, multiple extensions of the public comment period on the draft report, and agreement by the EPA in June 2013 to forego finalization of their draft report in favor of further investigation by the State of Wyoming.
3. OBJECTIVE AND SCOPE OF WORK

OBJECTIVE

The objective is to assist the WDEQ in its review of the current body of information available for the domestic water wells in the Pavillion Field as outlined in the June 20, 2013 Scoping Document and associated Investigation Document.

SCOPE OF WORK

The scope of work includes the following:

- Evaluate the data, conclusions, and recommendations developed from the well bore integrity and pits final reports.

- Compare currently available analytical results for each domestic water well in the Pavillion Field to U.S. Environmental Protection Agency (EPA) primary maximum contaminant levels (MCLs) and secondary maximum contaminant levels (SMCLs), and WDEQ Water Quality Rules and Regulations, Chapter 8, Quality Standards for Wyoming Groundwaters.

- Solicit additional, relevant data from the SEO, WOGCC, EPA, USGS, BLM, Tribes, and the operator, in order to complete the evaluation.

- Identify domestic water wells where additional testing and analysis is necessary. For these wells, undertake two (2) additional rounds of water quality sampling (pre- and post- irrigation season within a twelve (12) month period) to determine domestic well water quality and identify other parameters that might cause palatability or toxicity issues.

- Evaluate each domestic well for well construction and integrity issues (including downhole video), maintenance history and other proximate and pertinent features (e.g., septic systems).

- Prepare a final report that:
  - Summarizes the analytical results relative to standards and, specifically, include a discussion of impacts on palatability associated with constituents and sources identified and appropriate responses.
  - Identifies data gaps, if present, including the need for additional testing and analysis and/or investigation.
  - Determines which wells may benefit from further evaluation using exceedances of the standards listed above as a trigger for evaluation and testing.
  - Recommends, as appropriate, further work that may or may not include additional sampling of domestic wells and/or construction of groundwater monitoring wells.
  - Summarizes the additional work, if any, recommended above.
– Identifies any recommended work which cannot be completed in a reasonable timeframe, including a scope of work.
– Summarizes rationale and criteria used in the selection of domestic water wells for further testing and analysis and also includes rationale and criteria for any determinations made regarding additional testing and analysis and/or investigation.
4. COMPANY PROFILE

AME provides scientific and engineering excellence to public and private industrial, commercial, and financial concerns among America’s finest agencies, institutions, and companies. We assess, define, and remediate environmental risks and impacts for our clients, using decades of industry experience, technical superiority, and financial efficiency.

Founded in 1991, our abilities and experience cover the entire spectrum of site investigation, assessment, remediation, maintenance, and closure. Our company President Barbara Mickelson, P.E. has over 30 years of experience in assessing contaminant impacts to soil and groundwater and planning for appropriate remediation and mitigation, including managing a portfolio of over 300 sites. Our company Vice-President Michael Acton has more than 30 years of experience in the environmental field, specializing in Environmental Assessments and investigation and remediation of soil and groundwater degraded with organic and inorganic constituents.

We make it our business to stay abreast of the latest technologies in assessment, monitoring, and remediation. Solutions to environmental problems involve coordination and interaction with experienced and knowledgeable multi-disciplinary parties working toward cost-effective objectives. Although commonly viewed through a simplistic lens, most sites are complex interactions of physical, chemical, and biologic conditions. Recognition of these technical complexities is critical to project success. We maintain an experienced and diverse staff capable of addressing technical complexities in furtherance of effective project management, including multi-disciplined registered professional soil scientists, geologists, and engineers, and project-management staff with greater than 15 years of average professional experience.

Our experience allows us to discern the technical understanding required to meet project needs. We consistently work to the level of the project, as opposed to addressing project sites as academic problems, which results in excessive characterization and monitoring costs, or conversely addressing project sites as a homogeneous lot, which results in technical omission and errors that may produce significant political and legal problems as well as unnecessary remedial costs.

Our staff are widely sought, having worked with regulatory agencies nationwide including the U.S. EPA, Geological Survey, and Coast Guard; California State Water Resources Control Board, EPA, Department of Toxic Substances Control, and Department of Water Resources; and the environmental regulatory agencies of Texas, New Jersey, New York, Massachusetts, South Carolina, Virginia, West Virginia, Maryland, Montana, Pennsylvania, Washington, Oregon, and Wyoming. Our principal and senior project managers have
combined engineering and geological experience exceeding 150 years in environmental consulting.

SAFETY PROGRAM

Safety is our first priority, and our policy is to strictly enforce all health and safety requirements to protect worker and public health and safety at project sites, each of which has a specific health and safety plan prepared and implemented. All professional and technical personnel have completed cardio-pulmonary resuscitation (CPR), first-aid training, a minimum of 40 hours of Occupational-Safety-and-Health-Administration-mandated health and safety training for work on hazardous waste sites, and annual refresher training. All AME personnel are trained to assess for hazardous site conditions, implement appropriate protection levels, and comply with regulations for safe handling and disposal of hazardous materials.

AME is a licensee of the Loss Prevention System (LPS) behavior-based safety system and utilizes LPS across all clients and projects. All AME personnel are LPS trained and undergo annual LPS update training. Select AME personnel have completed the 32-hour LPS “Train-the-Trainer” course and are qualified to train project personnel, including supervisors and managers.
5. TECHNICAL QUALIFICATIONS

HYDROGEOLOGY

We identify and assess the extent and impact of the migration of chemicals of potential concern, including the use of geophysical technologies to minimize and focus sampling activities. We are fully equipped to create technical illustrations using AutoCad, Geographic Information Systems (GIS) software, and other graphic design tools. We integrate two- and three-dimensional soil and groundwater analytical data, soil characterization, and site features to produce spatially and temporally accurate maps and figures to more effectively plan, conduct, and evaluate site investigations and remedial actions.

We have staff that specializes in groundwater flow and transport modeling using MODFLOW, MT3D, RT3D, BIOCHLOR, BIOSCREEN, and BIOPLUME. Highly experienced in applying 3-D visual imagery techniques to environmental field data, our staff is experienced in multiphase flow and transport modeling using MODFLOW-SURFACT and BIOSLURP, and are also proficient in Groundwater Vistas, Groundwater Modeling System (GMS), and Environmental Visualization System (EVS).

We use Microsoft Access and gINT databases, CTECH Environmental Visualization Software, and Global Positioning System data to create ArcView GIS projects. GIS projects integrate both two- and three-dimensional soil and groundwater analytical data, soils characterization, and site features to produce spatially and temporally accurate maps and figures. These maps and figures were used to more effectively plan, conduct, and evaluate site investigations and remedial actions.

Our personnel produced three-dimensional models of geostatically kriged soil and groundwater data using CTECH Environmental Visualization Software. The models integrated analytical and site spatial data for sites spanning several acres, illustrating the extent of soil impacts and contaminant plumes. Additionally, the models constrained multiple point sources, which limited client liability and aided remedial activity planning. Sample documents and illustrations are available upon request.
GEOCHEMISTRY

AME staff has decades of petroleum and coal industry experience. We have extensive knowledge of the chemical compositions of crude oil-, coal-, gasoline-, diesel- and other fuel-derived sources of contamination in terrestrial and aquatic environments. We also have detailed knowledge of the potential for these chemicals to be found as non-specific source concentrations in urban environments, coal combustion processes, oil and gas exploration, production, and refining, fuel handling and storage operations. We have in-depth knowledge of the regulatory history of refined products, and the influences of environmental weathering on the chemical composition of contaminants.

TOXICOLOGY

AME professionals routinely use toxicological data and concepts related to constituent toxicity, including carcinogenicity (slope factor) and Hazard Quotient to complete human health risk assessments. Our scientists have completed risk assessments related to construction-worker exposures to impacted soil, groundwater, surface water, and soil vapor. For example, we conducted an evaluation of potential exposure by dermal contact to impacted groundwater during construction and trench work by comparing conservative statistics of the most recent groundwater COPC concentrations against “critical” exposure concentrations. Critical concentrations were back-calculated from a cancer risk of 1.0E-6 and a non-cancer risk of 1.0 in terms of hazard quotient, which were the risk thresholds adopted for the site. If the maximum concentration for a COPC is less than its critical concentration, the risk of exposure to this COPC is insignificant; if the maximum concentrations of the COPCs are significantly less than their respective critical concentrations, the cumulative risk of exposure to all COPCs is insignificant.

We completed an ecological risk assessment, including collection of constituent data during both wet and dry seasons, to characterize the risk of impacted groundwater to marine organisms in the Oakland Outer Harbor. We also completed a risk assessment to characterize the human health risk to swimmers in the San Francisco Bay exposed to petroleum hydrocarbon seeps and sheen. We completed a risk assessment of the risk to residents in homes overlying a chloroform groundwater plume from vapors migrating through the formation and building slabs. The results of the risk assessment were a critical decision factor utilized by the responsible regulatory agency to close the environmental case at the site.
INDUSTRY, ACADEMIC, AND GOVERNMENT

Our professionals have extensive experience working with industry. Our professionals also provide training to both private sector and government clients through workshop presentations at numerous professional organization and government sponsored conferences.

REGIONAL EXPERTISE

Professionals on our proposed project team have experience in performing evaluations of surface water and groundwater data from mining properties in the Powder River Basin of Wyoming. They supervised mine-site hydrologic and geomorphic data collection and evaluation for compliance with WDEQ permits, designed and secured permits for sedimentation ponds, diversion ditches, and alternate sediment-control structures in Wyoming, and developed pre-mining geomorphic baseline data for three Wyoming mining properties for use in development of predicted geomorphically stable post-mining topographies. Our staff also prepared a right-of-way study and spill contingency plan for a coal slurry pipeline in the Powder River Basin and has experience collecting geophysical and hydrologic data in the state.

NO CONFLICTS

AME has no conflicts with regard to the WDEQ, US EPA, Encana or any stakeholder related to the Pavillion Field.
6. PERSONNEL

Following are brief biographies for key AME senior technical staff who will be responsible for execution of the work required by the WDEQ:

BARBARA MICKELSON, P.E., PRESIDENT AND PRINCIPAL

Barbara Mickelson will be the executive-in-charge and is a Registered Professional Engineer in Wyoming, Texas and California, with greater than 30 years of experience specializing in assessment of petroleum hydrocarbon impacts to soil and groundwater; analysis of environmental risks associated with organic and inorganic substances and planning for appropriate remediation and mitigation; mining project permitting with respect to water quality and quantity, geomorphology, dam and embankment design and engineering, and design of alternate sediment and runoff control facilities; water and wastewater treatment systems for municipal, industrial, and chemical manufacture, and petroleum refining processes; and expert witness testimony.

MICHAEL ACTON, VICE-PRESIDENT AND PRINCIPAL

Mr. Acton will serve as project manager and has greater than 30 years of experience in the environmental field. He specializes in the assessment of organic (including petroleum hydrocarbon) and inorganic impacts to soil, sediment, groundwater, and fresh and saline surface waters. He is experienced in the analysis of risks to human health and the environment associated with organic and inorganic compounds, and recommendations for risk mitigation. He has extensive experience in surface water oil-spill assessment and shoreline impact analysis.

JEFFREY HEGLIE, P.G., C.E.G., R.P.G., SENIOR ENGINEERING HYDROGEOLOGIST

Mr. Heglie will provide technical assessment of hydrogeologic conditions and well integrity and is a Registered Geologist in California, Oregon, and Washington with greater than 20 years of experience in environmental consulting including industrial site investigation and remediation project management and hydrogeologic investigations. Mr. Heglie served as a Hydrologic Aid for the U.S. Geological Survey, Water Resources Division in Cheyenne, Wyoming, where he compiled and interpreted hydrologic and geophysical data and assisted in groundwater field investigations. His areas of expertise include groundwater flow and chemical transport modeling for remedial system design and risk characterization; litigation support for industrial clients, including groundwater and vadose zone transport modeling; surface and borehole geophysical applications for remedial investigations; groundwater monitoring and environmental data management; and landfill investigation and remediation.
MENG LING, P.E., PH.D., SENIOR TECHNICAL CONSULTANT

Dr. Ling will provide technical review of data and evaluate data integrity and is a Registered Professional Engineer in Texas and Maryland with 16 years experience in environmental and municipal engineering. His professional expertise includes site characterization and remediation, groundwater and contaminant modeling, visualization, statistical and geostatistical analysis, monitoring optimization, water and wastewater engineering, and environmental software development. Dr. Ling has authored a variety of publications regarding groundwater modeling and monitoring, contaminant characterization and assessment, and other technical issues. He is co-author of the Monitoring and Remediation Optimization System (MAROS) decision-support software developed by the Air Force Center for Environmental Excellence (AFCEE) and is a frequent presenter at environmental conferences and workshops.
7. REPRESENTATIVE EXPERIENCE

Following are summaries of representative projects we have advanced:

DRINKING WATER

City of Santa Monica Charnock Wellfield

MTBE was discovered in wells supplying drinking water to the City of Santa Monica (the Charnock Wellfield), and the U.S. EPA Region IX and California Regional Water Control Board (RWQCB) mandated investigation of multiple sites in response to the well impacts. In support of settlement negotiations prepared process flow diagrams, equipment layout drawings, and capital and operational cost estimates for a proposed MTBE/TBA treatment train, utilizing GAC and advanced oxidation processes, to be incorporated into a 7,000 gallon per minute municipal drinking water facility. As a result of settlement negotiations between the city and multiple potentially responsible parties a framework was created to evaluate the impact of the contaminants to the aquifer and the timeframe of impacts by constituent and concentration level to appear at the well field. The information was used to further the design and operation of a state-of the art treatment system. Ms. Mickelson served on the Charnock Technical Advisory Committee, which evaluated drinking water treatment alternatives for the removal of MTBE and tert-butyl alcohol (TBA). Additionally, Ms. Mickelson was retained by the City of Santa Monica to present modeling results at an arbitration hearing regarding legal representation issues raised by the city.

South Tahoe Public Utility District vs. Atlantic Richfield Co., et. al.

The project involved the evaluation of multiple source locations and water supply well locations operated by STUPD. The STUPD wells were claimed to be impacted or pending impact by MTBE. The well network is adjacent to Lake Tahoe, California. Complex hydrogeologic conditions limited the placement and production of groundwater wells for municipal supply. Naturally occurring contaminants, including arsenic and radon, are associated with wells constructed in the nearby Sierra Nevada mountains. We provided deposition testimony and technical support during settlement negotiations.

Petroleum Distribution Facility, Corning, California

This project was a hydrogeologic investigation of the effects of petroleum hydrocarbons (including methyl tertiary butyl ether) resulting from a petroleum distribution facility on two municipal water supply wells servicing a rural agricultural community and greater than 40 private water supply wells servicing individual farm and ranch properties. It included assessment of construction details of existing water supply and monitoring wells, installation of additional monitoring wells, water sampling, evaluation of analytical results,
coordination with public agency and private stakeholders, and aquifer testing. Data evaluation was used for optimization of the monitoring program using Maros software, identification of potential transport pathways, temporal and spatial trend analyses to document contaminant concentration changes, a quantitative estimate of biodegradation capacity, and a biodegradation assessment. The investigation resulted in a recommendation for no further action related to the distribution operation.

**Oil Field, Kern County, California**

This project was a hydrogeologic/geochemical investigation at a Kern County oil field to assess the migration and impacts of saline water containing petroleum hydrocarbons resulting from oil field production operations, including surface evaporation ponds. We installed 18 monitoring wells up to 1,000 feet deep and used downhole geophysical tools and soil and groundwater sampling and analysis to investigate three distinct water-bearing units (confined and unconfined) underlying the site for organic, inorganic, and isotopic constituents to evaluate impacts to private water supply wells servicing agricultural operations in the vicinity of the oil field. A report of findings with recommendations was submitted to the regulatory oversight agencies and other stakeholders on behalf of the client.

**Kentucky (Methane in Residential Water Well)**

Investigation of methane impact at a residential water well near a gas/oil well in Kentucky. Methane gas was found emitting from a residential water well close to a gas/oil well, posing a potential explosion hazard. Investigation was conducted by first reviewing regional geology, construction of the gas/oil well, casing integrity, and the potential geologic connections. The investigation revealed the presence of coal seams beneath the site, which could emit gases known as coal-bed methane. Further investigation was conducted by collecting and analyzing gas samples from the gas/oil well, the residential well, and the coal seams. Results of the analysis indicated that gas emitting from the residential well had similar composition to that from the coal seams, different from the sample from the gas/oil well, and thus excluded the gas/oil well as the potential source. In the meantime, mitigation strategy for the residential well methane issue was proposed and implemented.

**Former Truck Maintenance Facility, Sutter Creek, California**

A mineshaft located at this former truck maintenance facility was historically used by occupants for disposal of hazardous waste, resulting in contaminant introduction at depth. Responding to impacts from these contaminants, we conducted investigation, tank demolition, and recovery of non-aqueous phase liquid (NAPL). Additionally, we have coordinated with area residents to keep them informed of potential impacts to their drinking water. Sampling of potentially impacted private resident drinking water wells and springs was conducted at select locations for up to 13 quarters. Investigation has included well installation using hollow stem, sonic, and mud rotary drilling techniques, ground penetrating radar, and passive soil vapor surveys. Recovery of NAPL is accomplished by
solar-powered electric pumps. We are currently implementing soil vapor extraction to remediate the site.

**Hearne, Texas**

Monitoring and treatment for impacted residential wells downgradient of a fuel terminal in Texas. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were identified in several residential wells several hundred feet downgradient of the active fuel terminal. A thick sandy formation underlying the area connected the petroleum hydrocarbons plume to the residential wells. A groundwater monitoring network consisting of dozens of on-site wells and the residential wells was monitored on a quarterly basis while the source was being remediated. Well head treatment using granular activated carbon (GAC) was designed based on the range of BTEX concentrations and water usage for each of the residential wells. The treatment systems including parallel and/or serial carbon vessels successfully removed BTEX and other organic contaminants from the groundwater, making well water safe to use again.

**City of Dinuba, California**

Municipal wells were impacted by an MTBE-containing gasoline spill, which resulted in unpalatable supply (taste and odor). Hydrogeologic conditions and well construction details were evaluated. A system for treating the municipal supply wells was proposed and implemented.

**Sacramento County, California**

Municipal wells operated by the Fruitridge Vista Water Company serving residential areas near Sacramento, California were impacted by an MTBE-containing gasoline spill, which resulted in unpalatable supply (taste and odor). Hydrogeologic conditions and well construction details were evaluated. Replacement supply wells were drilled and tied into the distribution system to provide the service area with palatable water.

**Los Angeles County, California**

Releases of chlorinated compounds and solid rocket propellant constituents from a former ordnance manufacturing facility impacted palatability (taste and odor) of water from municipal water supply wells. Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of municipal, private, and monitoring wells. Remediation included installation and operation of thermal and catalytic oxidation systems.

**San Benito County, California**

Releases of chlorinated compounds and solid rocket propellant constituents from a former ordnance manufacturing facility impacted palatability (taste and odor) of water from private water supply wells. Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of
municipal, private, and monitoring wells. Designed, constructed, and operated air stripping and carbon treatment systems on various private water supply wells.

Los Angeles County, California

The Bartolo well field is located near the Whittier Narrows Los Angeles County, California. Three wells completed to depths exceeding 600-feet were investigated as a result of organic impacts rendering the drinking water unpalatable and potentially unsafe. The investigation required the use of multiple physical, geophysical logging techniques. The work required that the well pumps be removed, stored, disinfected and replaced. The objective of the work was to evaluate remedial alternatives including sealing select, screened intervals or treatment of the produced groundwater prior to delivery for consumption.

Thurmont, Maryland

Several municipal production wells were impacted by an isopropyl-ether-containing gasoline spill resulting in unpalatable groundwater entering the municipal supply resulting in numerous residential user palatability complaints and the eventual shutdown of the wells. Investigation conducted to find alternate groundwater supply wells was complicated by the complex fractured geology resulting in drilling numerous test wells before a well was completed with sufficient production capacity to replace the compromised, unpalatable water.

Harris County Texas

Harris County Municipal Utility District (MUD) 368, originally known as Three Lakes MUD No. 1. Provided technical evaluation and expert testimony related to claims that a 1940-era blowout of a crude production well had impacted the district's Well No. 1, rendering the water it produced unfit to drink due to palatability issues and health concerns. Well No. 1 was completed in the Evangeline Aquifer. It was ultimately plugged and replaced with Well No.2 located in the deeper Chico Aquifer, which is separated from the contamination in the Evangeline aquifer.

Madison, Virginia

A small community water system near Madison was rendered unpalatable as a result of a gasoline spill. An alternate water supply was required and following investigation and economic evaluation the residents and businesses were provided water from the nearby municipal system through a pipeline system constructed was run from the municipal water system to replace the community supply.
USE OF DOWNHOLE VIDEO CAMERAS TO EVALUATE DOMESTIC WATER WELLS

City of Santa Monica, California

MTBE impacted the palatability (taste and odor) of drinking water in municipal wells supplying the City of Santa Monica (the Charnock Wellfield). Conducted evaluation of construction of the five wells comprising the wellfield using downhole video camera. Evaluated the impact of MTBE/TBA to the aquifer and the timeframe and concentration levels of constituent impacts appearing at the wellfield. Evaluated drinking water treatment alternatives for the removal of MTBE and TBA and designed and operated a state-of-the-art treatment system.

Los Angeles County, California

The Bartolo well field is located near the Whittier Narrows Los Angeles County, California. Three supply wells completed to depths exceeding 600-feet were investigated as a result of organic impacts rendering the drinking water unpalatable and potentially unsafe. The investigation required the use of multiple physical, geophysical logging techniques. Downhole video cameras were used to document well construction and to guide depth specific sampling locations. The work required that the well pumps be removed, stored, disinfected, and replaced. The objective of the work was to evaluate remedial alternatives including sealing select, screened intervals or treatment of the produced groundwater prior to delivery for consumption.

Kentucky

Methane was reported in water from a private supply well located close to an oil/gas well, posing a potential explosion hazard and palatability issues. Sampling of supply well, oil/gas well, and underlying coal seam was conducted and indicated a similarity between methane from the coal seam and supply well. Downhole video camera was used to identify the gas entry point. A nearby oil well was suspected as the source and the subsurface is a fracture-dominated system, as bubbles will indicate location of coal bed methane entry. Mitigation was implemented for the supply well.

EVALUATION OF DOMESTIC WATER WELL CONSTRUCTION

City of South Lake Tahoe, California

Investigation was required for multiple spills from multiple fuel distribution facilities of MTBE-containing gasoline potentially resulting in unpalatable (taste and odor) water in multiple South Tahoe Public Utility District municipal water supply wells. Evaluated hydrogeologic conditions and supply well construction details using boring logs and aquifer testing data.
City of Corning, California

Two municipal and in excess of 40 private water supply wells were potentially impacted by an MTBE-containing gasoline spill, which resulted in unpalatable supply (taste and odor). Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of municipal, private, and monitoring wells, remediation, trend analyses, and biodegradation analysis resulting in no further action recommendation.

City of Dinuba, California

Municipal wells were impacted by an MTBE-containing gasoline spill, which resulted in unpalatable supply (taste and odor). Hydrogeologic conditions and well construction details were evaluated. A system for treating the municipal supply wells was proposed and implemented.

Sacramento County, California

Municipal wells operated by the Fruitridge Vista Water Company serving residential areas near Sacramento, California were impacted by an MTBE-containing gasoline spill, which resulted in unpalatable supply (taste and odor). Hydrogeologic conditions and well construction details were evaluated. Replacement supply wells were drilled and tied into the distribution system to provide the service area with palatable water.

Los Angeles County, California

Releases of chlorinated compounds and solid rocket propellant constituents from a former ordnance manufacturing facility impacted palatability (taste and odor) of water from municipal water supply wells. Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of municipal, private, and monitoring wells. Remediation included installation and operation of thermal and catalytic oxidation systems.

San Benito County, California

Releases of chlorinated compounds and solid rocket propellant constituents from a former ordnance manufacturing facility impacted palatability (taste and odor) of water from private water supply wells. Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of municipal, private, and monitoring wells. Designed, constructed, and operated air stripping and carbon treatment systems on various private water supply wells.

Amador County, California

Hazardous waste from a truck maintenance facility was disposed in a mine shaft facilitating migration of contaminants to the groundwater source of water supply wells on adjacent properties. Coordination with supply well owners/users and multi-year
sampling of these supply wells was required due to palatability issues and health concerns. Construction details of private supply wells were evaluated to verify inlet depth, screen, and seal intervals.

**Thurmont, Maryland**

Several municipal production wells were impacted by an isopropyl-ether-containing gasoline spill resulting in unpalatable groundwater entering the municipal supply resulting in numerous residential user palatability complaints and the eventual shutdown of the wells. Investigation included evaluation of supply well construction details. Conducted investigation to find alternate groundwater supply wells was complicated by the complex fractured geology resulting in drilling numerous test wells before a well was completed with sufficient production capacity to replace the compromised, unpalatable water.

**Hearne, Texas**

Spills from a fuel terminal impacted private water supply wells several hundred feet away with aromatic hydrocarbons and affected palatability (taste and odor). Coordination with well owners and well sampling were conducted and wellhead treatment systems were installed and operated. Supply well construction details were evaluated. Source remediation was completed.

**Madison, Virginia**

A small community water system near Madison was rendered unpalatable as a result of a gasoline spill. An alternate water supply was required and following hydrogeologic investigation, evaluation of supply well construction details, and economic evaluation the residents and businesses were provided water from the nearby municipal system through a pipeline system constructed was run from the municipal water system to replace the community supply.

**OIL AND GAS PRODUCTION**

**Seeligson, Texas**

Assessment, characterization, and remediation for a former gas plant site in Texas. The site covers over 40 acres of farm land with more than 1,600 monitoring and remediation wells. A large free product plume and the resulting dissolved plume beneath the site potentially threatening water wells were the focus of the investigation and remediation. A thorough evaluation of the site hydrogeologic and contamination conditions was conducted, and site data were incorporated into a 3-D visualization model for more accurate analysis and better understanding. Prior remedial actions including air sparging, vapor extraction, and automatic product recovery were evaluated and found to be of low effectiveness, limited by site soil and free product properties and low mobility of the free product. Further characterization activities were then conducted including LIF-ROST investigation, slug tests, aquifer yield tests, LNAPL baildown tests, LNAPL recovery
assessment, and tracer dye testing. Based on improved site characterization data, the site conceptual model was revised and more cost-effective remedial actions including periodic manual bailing and monitored natural attenuation were implemented, putting the site on track towards a faster closure.

Monte Christo, Texas

This project consisted of characterization and remediation pilot test at a natural gas compressor station in Texas. Groundwater beneath the site was found to contain petroleum hydrocarbons but the occurrence and migration of the plume were little understood. Additional soil borings were drilled to obtain a better understanding of the site lithology and groundwater conditions. A tracer dye testing was conducted at new borings and existing monitoring wells to understand field transport conditions. It was found that a permeable unit between clays and silts constituted the transport pathway. An in-situ chemical oxidation (ISCO) pilot test using calcium peroxide was conducted to evaluate the feasibility of ISCO to treat the impacted groundwater. Optimal injection rate and pressure were obtained and the effectiveness of treatment was evaluated, in order to design a full-scale ISCO treatment.

La Gloria, Texas

This project consisted of free product remedial strategy at a gas plant site in Texas. Slug test were conducted at site wells not impacted by free product to estimate aquifer hydraulic conductivity. LNAPL baildown tests for free product-containing wells were conducted to evaluate the mobility and recoverability of the free product, so that a flexible remedial strategy for different portions of the site could be developed.

West Palm Beach, FL (MGP site)

Design of an interception/treatment system for groundwater remediation at a former manufactured gas plant (MGP) site in Florida. Groundwater impacted with dissolved constituents from the residual Dense Non-Aqueous Phase Liquids (DNAPL) originating from the former MGP needed to be treated before migrating further downgradient. Groundwater flow modeling using MODFLOW was conducted to determine the horizontal layout and vertical configuration of the interceptor wall and a treatment trench. Various scenarios were simulated from which a best design was selected.

EVALUATION OF THE INTEGRITY OF OIL AND GAS WELLS

Kern County, California

Hydrogeologic/geochemical investigation at a Kern County oil field to assess the migration of saline water containing petroleum hydrocarbons resulting from oil field production operations, including surface evaporation ponds and potential impacts to private agricultural and domestic water supply palatability (taste and odor). Hydrogeologic conditions and well construction details were evaluated. Installed groundwater monitoring wells and conducted sampling of municipal, private, and
monitoring wells. A report of findings with recommendations was submitted to the regulatory oversight agencies and other stakeholders on behalf of the client.

Harris County, Texas

Harris County Municipal Utility District (MUD) 368, originally known as Three Lakes MUD No. 1. Provided technical evaluation and expert testimony related to claims that a 1940-era blowout of a crude production well had impacted the districts Well No. 1, rendering the water it produced unfit to drink due to palatability issues and health concerns. Construction details of crude production well were evaluated. Well No. 1 was completed in the Evangeline Aquifer. It was ultimately plugged and replaced with Well No.2 located in the deeper Chico Aquifer, which is separated from the contamination in the Evangeline aquifer. Look at well seal conditions, entry of contaminants through improper seals v well blowout.

MANUFACTURED GAS PLANTS

St. Augustine, Florida

This project consisted of assessment of polycyclic aromatic hydrocarbons (PAHs) impact at a harbor site in Florida. Sediment at the harbor site was impacted with PAHs derived from historical operations of a former MGP site. Lithologic data from numerous borings were compiled to build a 3-D visualization model of the site geology. Sediment concentrations of PAHs were then analyzed using the visualization model to delineate and calculate the impact volume and mass for each of the stratigraphic units. Results of the assessment were the basis for subsequent remediation design.

Jacksonville, Florida

This project consisted of assessment of DNAPL, soil, and dissolved impact at a former MGP site in Florida. A 3-D visualization model was developed for the site to document site lithology and stratigraphic units, and to estimate the distribution and mass of a DNAPL plume, residual soil impact, and a dissolved plume. The assessment greatly facilitated site remedial design.

NAPL MODELING

Mandan, North Dakota

AME Developed a numerical NAPL model to simulate fuel hydrocarbons release and the subsurface migration at a railroad site in North Dakota. Data from hundreds of soil borings were compiled to develop a site geologic model to identify the potential pathways through which the fuel LNAPL migrated. Using the finite-element code BIOSLURP, a numerical NAPL model was developed for the site to simulate the migration and extent of the NAPL plume under historical site conditions. Various scenarios were simulated considering the likely ranges of release volume, hydraulic and NAPL gradient, and soil permeability.
Results of the modeling were compared to actual NAPL impact beneath the site, and helped identify other sources of the NAPL impact.

BULK FUEL TERMINALS

Port of Oakland Berths 23 and 24, Oakland, California

Contaminant plumes were detected underlying these former petroleum bulk terminals, which were redeveloped as intermodal cargo container shipping terminals. We performed pilot testing, prepared a RAP, and designed and installed soil vapor and groundwater remediation systems including 101 vapor extraction and 279 air sparging wells and 39,000 feet of underground piping within 18,000 feet of trenching to connect the wells to aboveground equipment. The aboveground equipment, installed in two enclosures at different locations, includes three 500-scfm thermal/catalytic oxidizers and 17 air sparging blowers. This remedial construction was performed in approximate 4- to 7-acre phases within the operating shipping terminals.

To date, over 500,000 pounds of combined methane and gasoline, diesel, and motor oil hydrocarbons have been removed. Groundwater concentrations of total petroleum hydrocarbons as gasoline and benzene have been reduced four orders of magnitude since full operation of the system was initiated in late 2004. We have conducted semi-annual groundwater monitoring on 53 monitoring wells at the site since 2003, in accordance with a monitoring plan approved by the California RWQCB, as well as additional investigations and remediation including high-intensity targeted product extraction and in-situ chemical oxidation.

Former Bulk Fuel Terminal on Willamette River, Portland, Oregon

Petroleum constituents and metals were migrating in groundwater toward the Willamette River at this active petroleum terminal occupying 29 acres on the river’s western bank. An additional feasibility analysis and Supplemental RAP called for the expansion of the existing site remediation system. We designed and constructed the remedial system, including installation of 13 air sparging (AS) wells, 3 vapor extraction (VE) wells, 3 vapor monitoring wells, and approximately 400 feet of underground and 400 feet of aboveground piping to connect the new AS and VE wells to the existing remediation system. To assess remedial effectiveness, we installed nine groundwater monitoring wells. Additionally, we installed a dual phase extraction system to maintain an inward gradient from the Willamette River. We continued to perform operation
and maintenance of the expanded system along with detailed quarterly monitoring and analysis of a large network of monitoring wells and the remediation system, and have conducted additional investigations in response to new releases by other parties.

*Former Bulk Fuel Terminal, Fisherman’s Wharf, San Francisco, California*

We were retained to remediate this waterfront site on the San Francisco Bay, which was impacted by petroleum hydrocarbons, with the periodic appearance of a sheen-like substance upon adjacent Bay surface water. We developed and implemented a Corrective Action Plan to remediate the sheen, which included construction of a sheet pile enclosure to quarantine the impacted area, excavation of impacted soil, and placement of a permeable reactive barrier covered by fresh fill and riprap. We have also conducted groundwater monitoring and high-intensity targeted hydrocarbon extraction at the site, which is pending closure by the California RWQCB.

**MUNICIPAL AND STATE CONTRACTS**

*California Department of Corrections*

We were awarded a multi-year fixed-price contract to conduct quarterly, semi-annual, and annual monitoring, sampling, compliance evaluation, and reporting on the landfill at the California Sierra Conservation Center in Jamestown, California. The Class III landfill was terminated in 1987 after 25 years of use, at which time an estimated 11,000 cubic yards of waste had been disposed there. Final closure of the landfill was completed in 1995 with the placement of a landfill cap consisting of four layers including a Geosynthetic Clay Liner. The former landfill is regulated through Waste Discharge Requirements (WDRs) by the California Regional Water Quality Control Board, Central Valley Region. We conducted monitoring and sampling of groundwater, surface water, soil moisture, rainfall, and landfill gas at the site, as well as compliance evaluation under the WDRs and an evaluation of the effectiveness of the Corrective Action Plan implemented at the site. Semi-annual and annual reports were submitted. All environmental monitoring tasks were conducted under the site specific restrictions for working at California Sierra Conservation Center.

*City of Galt Wastewater Treatment Plant*

We conducted monthly depth to groundwater measurements and quarterly groundwater monitoring events for monitoring wells in the vicinity of the Wastewater treatment plane under a fixed fee contract for the city. The monitoring work included the collection of samples for Coliform analysis, which required special techniques and equipment to reduce the risk of external contamination and associated false detections.

**STATISTICAL EVALUATION OF ENVIRONMENTAL MONITORING DATA**

We develop and use new and existing spatial/temporal statistical methods for evaluating environmental monitoring data and have conducted numerous statistical evaluations of environmental data from different media and situations using robust and effective methods. Sporadic constituent concentrations in drinking water wells can occur purely by
chance from a statistical standpoint, and thus the appropriate selection and use of suitable statistical methods are crucial to the detection of true contamination. We have developed a set of new analyses to evaluate and improve groundwater monitoring programs, including spatial redundancy reduction, network augmentation, frequency optimization, and sufficiency analysis, which allows the dynamic optimization of monitoring programs as site and contaminant conditions change over time. These methods were incorporated into the Monitoring and Remediation Optimization Systems (MAROS) developed for the Air Force Center for Environmental Excellence (AFCEE).
8. REFERENCES

Available upon request.
APPENDIX A

Resumes
MICHAEL ACTON

Education and Professional Development

- M.S., Environmental Management, University of San Francisco, 1984
- B.S., Conservation of Natural Resources (Soil Resource Management emphasis), University of California, Berkeley, 1977
- OSHA Hazardous Waste Operations and Emergency Response Training 40-Hour Course
- Loss Prevention System Train the Trainer 32-Hour Course
- Water Pollution Control for Construction Sites 24-Hour Course
- Conferences and Seminars on Remedial Technologies, Site Characterization Techniques, and Regulatory Compliance

Professional Affiliations

- Association of Groundwater Scientists and Engineers
- National Water Well Association
- Groundwater Resource Association

Summary of Professional Experience

Mr. Acton has more than 30 years of experience specializing in:

- Assessment of organic (including petroleum hydrocarbon) and inorganic impacts to soil, sediment, groundwater, and fresh and saline surface waters
- Analysis of risks to human health and the environment associated with organic and inorganic compounds, and recommendations for risk mitigation
- Surface water oil-spill assessment and shoreline impact analysis

Representative Experience

- Project Manager of a hydrogeologic/geochemical investigation for a major oil company to assess the migration and impacts of saline water containing petroleum hydrocarbons from oil field production operations, including surface evaporation ponds. Installed monitoring wells up to 1,000 feet deep and used downhole geophysical tools and soil and groundwater sampling and analysis to investigate three distinct water-bearing units (confined and unconfined) underlying the site for organic, inorganic, and isotopic constituents to evaluate impacts to private water supply wells servicing agricultural operations.
• Project Manager of an evaluation for an oil products distributor of the effects of petroleum hydrocarbons (including methyl tertiary butyl ether) on two municipal water supply wells servicing a rural agricultural community and in excess of 40 private water supply wells servicing individual farm and ranch properties. Included assessment of well construction details, water sampling, evaluation of analytical results, coordination with public agency and private stakeholders, aquifer testing, identification of potential transport pathways, temporal and spatial trend analyses to document contaminant concentration changes, a quantitative estimate of the biodegradation capacity, and assessment on the occurrence of biodegradation.

• Project team member for preparing a right-of-way study and an oil spill contingency plan for a coal slurry pipeline in the Powder River Basin, Wyoming.

• Project Director for assessment and corrective action for a major oil company of petroleum hydrocarbon impacted soil/sediment and groundwater and resulting non aqueous phase liquid on groundwater and bay surface water sheen at an operating bulk fuel marine terminal. Involved permitting with the U.S. Army Corps of Engineers and various state and local resource agencies, tidal studies, public meetings with stakeholders and resource agencies, sheen observations, and corrective action including installation of a sheet pile coffer dam, dredging/excavation of petroleum hydrocarbon impacted soil/sediment, placement of a permeable reactive barrier, restoration of the shoreline site to grade, risk assessment, and risk management plan.

• Project Director for a remedial investigation for a major timber products company at a former timber products mill facility located on the Pacific Ocean coast. Aerial photography, geophysical survey, and direct push sampling were utilized to assess the impacts of petroleum hydrocarbons, chlorinated solvents, metals, dioxins and dibenzofurans, and other constituents to soil, freshwater pond and ocean shoreline sediments, groundwater, freshwater ponds and springs, and ocean water. Coordinated archeological and botanical studies/surveys and a public participation/information program.

• Project Director for an investigation and remediation for an ordnance manufacturer of an operating ordnance facility with perchlorate, trichloroethene (TCE), and hexavalent chromium impacts to soil and groundwater. Coordinated the installation of air-stripping systems on 500 to 750-gallon per minute agricultural production wells and carbon filtration systems on low-yield domestic wells to treat TCE-impacted groundwater. Coordinated the installation of an ion exchange system for the treatment of perchlorate-impacted groundwater from low-yield recovery wells. Provided oversight of closure activities for areas with cyclotetramethylene tetranitramine and heavy metals-impacted soil. Supervised biotreatability studies on perchlorate-impacted soil that identified treatment alternatives for use as interim and long-term remedial measures. Coordinated the establishment of risk-based cleanup criteria for the constituents of concern referenced above.

• Project Manager of Resource Conservation and Recovery Act clean closure certification activities for an ordnance manufacturer for hazardous waste management units at a former ordnance facility. Included hydrogeologic assessment involving monitoring well
installation, aquifer testing, and sampling for organic, inorganic, and isotopic constituents of a confined water-bearing unit at a depth of approximately 500 feet below ground surface underlying a phosphorus-stabilization pond; extraction and treatment using catalytic oxidation of TCE vapors from soil underlying a former surface impoundment; and remediation of soil with heavy metal components and regulatory compliance using statistical analysis of former propellant burning areas and ordnance detonation areas.

- Project Manager of two multi-year research studies conducted for a major oil company to assess the effectiveness of soil vapor extraction in removing volatile petroleum hydrocarbons from the subsurface. Studies included detailed subsurface investigations including design and implementation of groundwater monitoring wells, vadose zone instrumentation wells for measuring pressure distribution, temperature, oxygen, carbon dioxide, and acquiring soil vapor samples; and remediation using soil vapor extraction with thermal destruction and catalytic oxidation and groundwater pump and treat. Studies evaluated vapor extraction efficiencies related to physical soil properties, treatment method, vapor flow, vacuum, and groundwater.

- Project Director for the assessment and remediation of over 30 service station sites with leaking underground storage tanks for a major oil company.

- Project Manager of numerous subsurface investigations and remediations involving petroleum hydrocarbons, organic solvents, pesticides, and heavy metals at industrial and commercial facilities, and environmental assessments for commercial real estate transactions.

- Field team leader in the shoreline cleanup and assessment program for the Valdez oil spill in southern Alaska. Responsible for the team submittal of Shoreline Oiling Summary reports documenting oil spill effects and recommending appropriate treatment alternatives.

- Involved in the emergency response and assessment of various surface water oil spills, as well as in the preparation of numerous oil spill contingency plans for pipelines, refineries, marine terminals, oil field production areas, and offshore platforms.

- Participated in the preparation of environmental impact reports, range management and erosion control studies, and soil surveys.

Publications and Presentations


Co-author of several publications regarding surface water oil spill assessment and disturbed site restoration which are available upon request.
Summary of Professional Experience

Barbara Mickelson is a Registered Professional Engineer in California, Texas, and Wyoming, and has over 30 years of experience specializing in the following:

- Assessment of petroleum hydrocarbon impacts to soil and groundwater
- Analysis of environmental risks associated with organic and inorganic substances and planning for appropriate remediation and mitigation
- Mining project permitting with respect to water quality and quantity, geomorphology, dam and embankment design and engineering, and design of alternate sediment and runoff control facilities
- Water and wastewater treatment systems for municipal, industrial, and chemical manufacture, and petroleum refining processes
- Expert witness testimony

Education and Professional Development

- B.S., Civil Engineering - South Dakota School of Mines and Technology
- Short Courses at University of Texas, Oklahoma State University, University of Tennessee and Colorado School of Mines
- OSHA 40-Hour Training for Hazardous Waste Operations
- OSHA Health and Safety Training for Supervisors of Hazardous Waste Workers
- Numerous Conferences and Seminars on Remedial Technologies, Site Characterization Techniques and Regulatory Compliance

Registrations and Professional Affiliations

- Professional Engineer - California, Texas, and Wyoming
- American Society of Civil Engineers
- National Water Well Association
- Association of Groundwater Scientists and Engineers
- American Water Works Association
Representative Experience

Evaluation and Remediation of Petroleum Hydrocarbons

- Executive-in-charge of external technical assessment activities at a major southern California refinery including analyses of NAPL physical properties and mobility as well as assessment of recovery techniques and mechanisms for enhancements. AME performed visualization of soil vapor, soil, groundwater, and NAPL data to assist development of a refined site conceptual model. AME modeled dissolved phase contaminant transport trends through time including rates of mass transfer. AME utilized these data to assess the transport pathways and impacts of both on and off-site well pumping on dissolved contaminant flow and NAPL recovery.

- Participated in arbitration between Arco and ConocoPhillips as an independent third party. Determinations regarding cost allocation, release timing and remediation liability were made by a three party panel including representatives of each oil company and the independent third party. Decisions of the panel were binding on the parties. Participated in two arbitration sessions evaluating costs and responsibilities for cleanup at 12 retail sites in California.

- Project coordinator for investigation of MTBE contamination at a retail gasoline service station as part of a regional assessment of impacts to a major southern California well field. Ms. Mickelson provided oversight of regional assessment activities, which included a basin-wide groundwater flow model.

- Coordinated under ground storage tank program including tank upgrade, testing and regulatory compliance for over 4,000 service station sites, administered retail store capital projects, and retail site divestment activities while employed by a major oil company.

- Coordinated investigation and mitigation of environmental incidents related to underground gasoline storage system operation at over 300 sites in the Eastern United States and California while employed by a major oil company.

- Served on U.S. Air Force technical panel on bioremediation of hydrocarbon contaminated sites to evaluate emerging technologies and research needs for effective remediation.

- Managed and permitted the installation and operation of remedial systems for groundwater and soil contamination. Supervised installation of remediation systems, including groundwater recovery and treatment and soil vapor extraction and treatment.

- Investigations completed included product source identification, groundwater quality characterization and assessment, groundwater modeling (vadose zone and saturated zone), modeling and evaluation of differential transport of contaminants, and risk assessments.

- Prepared final environmental impact assessment in satisfaction of RCRA 7003 Consent Order issued by EPA Region I. Coordinated a cooperative oil company (Exxon, Gulf/Chevron, Amoco) aquifer evaluation and monitoring program required by EPA.
Region III, in Jacksonville, Maryland. RCRA 3013 cooperative monitoring program included monitoring well construction, aquifer pump testing, and soil and groundwater sampling and analyses.

- Provided expert witness testimony in support of underground storage tank related environmental litigation in Maryland, Delaware, California, Colorado, Texas, Arizona, and the U.S. Virgin Islands. Provided environmental testimony at numerous hearings and negotiations with environmental compliance agencies in Delaware, Maryland, Pennsylvania, Virginia, West Virginia, California, and Nevada.

- Coordinated precision testing program of underground product storage systems at over 15 retail sites in Guam, under contract to ESSO Eastern and the government of Guam, in satisfaction of Guam EPA requirements.

**Remedial Investigation/Feasibility Studies**

- Project Coordinator for investigation and remediation of a former truck maintenance facility in Sutter Creek, California. AME conducted investigation, AST demolition and NAPL recovery at the site. The site is located on Tertiary Mehrten Formation, which overlies Tertiary gold-bearing gravel, which in turn overlies highly sheared and recrystallized volcanic bedrock. Investigation at the site has included well installation using hollow stem, sonic and mud rotary drilling techniques, ground penetrating radar and passive soil vapor surveys. Recovery of NAPL is accomplished by solar powered electric pumps. A mineshaft located at the site was historically used for waste disposal resulting in contaminant introduction at depth.

- Project Coordinator for investigation, remediation and closure of a chloroform plume in groundwater at a former packaging facility in Tracy, California. The site features a stormwater percolation basin used for disposal of waste cooling water and stormwater runoff from the plant. Chloroform was formed in the basin when sodium hypochlorite bleach was added to the ponded water to mitigate complaints of sulfite-type. AME conducted investigation, groundwater monitoring, system demolition, soil vapor surveys and in-situ air ozone sparging to mitigate residual chloroform.

- Project coordinator for the investigation of areas of concern identified to be impacted by contaminants associated with former ordnance manufacturing operations. Contaminants of concern included volatile and semivolatile organics, metals and explosives. Perchlorate was detected in groundwater and surface water at the site. Nitrosodimethylamine (NDMA) a potential breakdown product of the explosives HMX and RDX was also detected in groundwater at the site. The investigation of the occurrence and extent of the perchlorate and NDMA in groundwater included depth specific sampling using innovative sampling equipment and traditional multi-depth monitoring well clusters. Coordinated a testing program of both onsite and offsite monitoring and production wells to identify wells impacted by perchlorate following the California Department of Health Services development of testing methods for low level perchlorate analyses in water samples.
• Project Coordinator for preparation of a remedial investigation/feasibility study (RI/FS) work plan for a 1,000-acre former ordnance facility in Santa Clarita. The RI/FS work plan includes a prior Site Investigation Report, a Remedial Investigation Work Plan, a Project Management Plan, a Communication and Coordination Plan, and a Public Participation Plan. Field activities to assess/remediate the site include geophysical surveys, soil gas surveys, soil borings, exploratory trenches, and shallow soil sampling.

• Project Manager for design of a water treatment system for the San Gabriel Valley Areas 1, 2, and 4 Superfund sites (Bartolo Wellfield) in Los Angeles County, California, under contract to the U.S. Army Corps of Engineers. The treatment plant design incorporated treatment of water containing VOCs by packed column air stripping and off-gas treatment with activated carbon to remove airborne VOCs.

• Project Manager responsible for remedial investigation and feasibility study of six sites at Air Force Plant 42, Palmdale, California, as part of the Air Force Installation Restoration Program (IRP) to define the magnitude, extent, direction, and rate of migration of identified constituents of concern within the soil column as well as to evaluate the magnitude of any volatile emissions from the impacted areas. Remedial investigation data were evaluated to identify and screen potential technologies and to assemble alternatives for remediation of impacted areas. Each of the alternatives was evaluated against identified ARARs and TBCs and criteria of (1) effectiveness, (2) implementability, and (3) cost.

• Managed soil vapor assessments performed in support of IRP Phase I Remedial Investigations at Edwards Air Force Base, Lancaster, California, and Plant 42, Palmdale, California. Over 300 vapor points were installed and evaluated for petroleum (jet fuel) related hydrocarbons and chlorinated organic compounds.

• Project Engineer responsible for closure of an explosive burn area. The former explosive waste burn area was excavated and residual soil metals concentrations statistically compared to background for three different soil types. The area received acknowledgment of clean closure from the California Environmental Protection Agency.

• Engineer responsible for oversight of design, installation, and operation of 500 and 600 gallon per minute air strippers and residential carbon activated carbon systems for treatment of TCE impacted groundwater used for irrigation and drinking water. Responsible engineer for design and oversight of installation of activated carbon treatment systems at an active ordnance manufacturing facility.

• Project Director responsible for over 35 tasks associated with obtaining closure of five former RCRA units at a 1,000-acre former ordnance facility in Santa Clarita, California, including routine NPDES permitting, quarterly groundwater monitoring, and vacuum extraction system monitoring. Activities in support of closure include excavation and statistical evaluation of metals contaminated propellant burn areas, hydrogeologic assessment of a phosphorus-stabilizing lagoon, and ongoing remediation system operations support. One of the remediation technologies being utilized at this site is a state-of-the-art TCE dual-stage, fixed-bed catalytic oxidizer, with batch scrubbing.
Wastewater Treatment

- Environmental engineer responsible for technical support and operating supervision of 13 million gallon per day (mgd) chemical plant waste treatment facility and bio-solids incinerator. Selected and designed treatment schemes for final clarification, sludge thickening, and belt filtration dewatering. Designed and implemented upgraded polymer blending facility.

- Responsible for preparation of selected unit operations manuals, operator training, and on-shift supervision during start-up of a 7 mgd refinery waste treatment plant. Designed and implemented operability modifications and enhancements to the effluent treatment system. Following successful start-up of the effluent treatment system, monitored kinetics of the biological system, set clarifier recycle, and waste rates and nutrient and polymer feed rates to optimize treater performance.

Mining Water Quality Management

- Responsible for evaluation of surface water and groundwater data from mining properties in Wyoming, Arkansas, and Texas. Supervised mine-site hydrologic and geomorphic data collection and evaluation for compliance with state and federal permits. Designed and secured permits for sedimentation ponds, diversion ditches, and alternate sediment control structures in Wyoming and Arkansas. Developed pre-mining geomorphic baseline data for three Wyoming mining properties for use in development of predicted geomorphically stable post mining topographies.

Litigation Support

Ms. Mickelson provides technical support to litigation including participation in mediation and expert testimony. Examples of her recent litigation experience include the following:

City of Santa Monica vs. Shell Oil Company, et. al.
Case No. 01CC04331
Superior Court of the State of California, County of Orange

- Provided technical support to and participated in mediation between the city and major oil company client. Evaluated drinking water treatment alternatives for the removal of MTBE and tert-butyl alcohol (TBA). Prepared process flow diagrams, equipment layout drawings, and capital and operational cost estimates for a proposed MTBE/TBA treatment train, utilizing GAC and advanced oxidation processes, to be incorporated into a 7,000 gallon per minute municipal drinking water facility. Participated in settlement related technical committee and participated in issue specific arbitration.
City of Oakland/Port of Oakland vs. ExxonMobil Oil Corporation  
Case No. C022968 JSW  
United States District Court for the Northern District of California

- Provided technical support to mediation to resolve environmental issues related to prior operation of a bulk fuel terminal at a site redeveloped into an intermodal cargo facility. Provided preliminary design and cost estimates for remedial options including soil vapor extraction and air sparging to mitigate acute risk posed by methane vapors and chronic risks to human health and the environment posed by the presence of petroleum hydrocarbons in soil and groundwater. Implemented the selected remedy as required by the settlement agreement resulting from the mediation. Participate on technical committee established by settlement agreement to evaluate remediation progress and other environmental, human health and ecological risks associated with the site.

South Tahoe Public Utility District vs. Atlantic Richfield Co., et. al.  
Case No. 999128  
Superior Court of California, County of San Francisco

- Evaluated the hydrogeology of the drinking water wells utilized by the utility district and the history of releases and constituent transport associated with numerous underground storage tank sites within the areas of influence of the operating drinking water wells. Provided deposition and trial testimony.

Communities for a Better Environment vs. Unocal Corporation, et. al.  
Case No. 99128  
Superior Court of California, County of San Francisco

- Evaluated the environmental conditions at over 80 underground storage tank sites throughout California. Evaluated constituent concentration trends and groundwater transport rates at each location. Provided affidavit describing plume migration and composition as well as affidavit related to chemical analytical procedures resulting in false positive identification of gasoline oxygenates.

Communities for a Better Environment vs. Tosco Corporation, et. al.  
Case No. 300595  
Superior Court of California, County of San Francisco

- Provided technical support to mediation regarding remediation progress and future needs for a major oil company refinery. Participated in mediation and presented data and remediation needs and plans for mitigation of impacts resulting from hydrocarbon releases.
Carlton A. Sullins, Rita Sullins, and Don-Sul, Inc., a California Corporation vs. Exxon Mobil Corporation, a New Jersey corporation, Case No. RG08411579; in the Superior Court of California, county of Alameda

- Provided technical allocation hydrocarbon impacts based on source and extent and fingerprinting of petroleum hydrocarbons. Provided Deposition and Trial Testimony. Following a six-day trial the jury found in favor of Exxon Mobil.

AR Automotive, LLC; Bald Eagle Ventures I, LLC vs. Henry Khachaturian, et al., and related cross-claims Case No. RG09450197; in the Superior court of California, county of Alameda

- Provided technical support in action related to remediation requirements and professional conduct associated with investigation and remediation of in-ground hoists and associated hydraulic fluid. Participated in mediation and provided Deposition testimony.

Publications


JACOB CLARK

Education and Professional Development

- B.S., Materials Engineering, California Polytechnic State University, San Luis Obispo
- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and Emergency Response Training
- CPR, AED, and First Aid Certification
- Loss Prevention System (LPS) Certification
- LPS Trainer Certification
- Possesses a Transportation Worker Identification Credential (TWIC) Card

Registrations and Professional Affiliations

- California Engineer In Training

Summary of Professional Experience

Mr. Clark is a project engineer with approximately 5 years of environmental consulting experience. His experience includes:

- Design, operations, maintenance, and repair of soil and groundwater remediation systems
- In-situ chemical oxidation (ISCO), aquifer testing, soil excavation, and construction oversight
- Project budgeting, permitting with regulatory agencies, and reporting for investigations and regulatory compliance
- Soil investigation and well installation using direct push and hollow-stem auger drilling techniques
- Groundwater monitoring and sampling, preferential pathways and tidal studies, and waste management
- Knowledgeable of the LPS safety program, LPS tools, stewardship of the safety program, and experience as site safety officer.
Representative Experience

- Mr. Clark engaged in operations, maintenance, and repair of air sparging / vapor extraction (AS/VE) systems. Work included soil vapor monitoring and sampling, rebound testing, and system optimization.

- Mr. Clark engaged in the design and implementation of a focused interim remedial measure of VE and the design of the expansion to existing AS/VE systems.

- Mr. Clark engaged in a preferential pathways and tidal study to assess groundwater flow and tidal influence. Work included use of automatic sampling equipment, pressure transducers, and water quality logging devices.

- Mr. Clark engaged in coordination and implementation of bioremediation using ISCO utilizing temporary borings and dedicated injection wells. Work included project planning and developing procedures, material storage and transportation, handling and mixing materials onsite, using direct-push and gravity feeding injection equipment, monitoring subsurface conditions, regulatory permitting and reporting.

- Mr. Clark served as site-safety officer and staff engineer during soil excavation and construction along a riprap embankment in San Francisco. Work included marine construction oversight which involved pile driving to construct a cofferdam and excavation of impacted materials using barge-based equipment. Site safety and security was maintained with implementation and stewardship of the LPS safety program.

- Mr. Clark engaged in aquifer testing in Portland, Oregon. Work involved conducting pump and slug tests that included use of pressure transducers and groundwater monitoring at the target and surrounding groundwater monitoring wells.

- For a corporation that manufactures and delivers proprietary coatings for catalytic converters, Mr. Clark modified a 3-point bend test mechanism to perform repeatable 4-point bend tests, developed a testing procedure for qualifying raw, coated, and finished substrates, redesigned Excel worksheets for the NOx emission of each coating process, and wrote Standard Operating Procedures and reports for internal publication.

- On a senior project involving friction stir welding AZ31 magnesium alloy, Mr. Clark determined the rotation speed and weld speed for a defect-free weld with 85 percent base-metal properties, researched friction stir weld and magnesium alloys, mounted and polished specimens for optical microscopy and analysis of weld nugget, conducted micro hardness traverse and tension test for mechanical analysis, gave an oral presentation, and published a paper.
Education and Professional Development

- B.A., Environmental Studies, California State University, Sacramento

Summary of Professional Experience

Mr. Emery is an Environmental Scientist with extensive experience implementing sediment and erosion control for land development, sensitive habitats, construction, and surface waters. He has prepared and designed site-specific Stormwater Pollution Prevention Plans with effective best management practices to reduce point source and non point source impacts to groundwater quality, and has prepared and submitted regulatory permits in compliance with the State Water Resources Control Board's General Construction Permit and Clean Water Act.

Representative Experience

- Technical writing for reports, work plans, and site health and safety plans

- Acted as the primary water treatment designer and trainer at large environmental firm.

- Designed, implemented, installed, and managed water treatment systems with flow rates up to 2,000 gallons per minute.

- Project management responsibilities included providing guidance and technical assistance, training, job tracking, job cost and forecasting, job estimates, retention basin design, hydrology calculations, and client consultation.

- Acted as contact point between large environmental firm and regulatory agencies/customers on environmental matters with regards to training, water treatment, treatment data, environmental reports, and jobsite inspections and evaluations.

- Prepared documentation and amendments for WDID discharges into State waterways.

- Prepared and submitted Notice of Intent (NOI) and Notice of Termination (NOT) forms to comply with the State Water Resources Control Board's General Construction Permit.

- Prepared site-specific SWPPP maps, detailing Erosion and Sediment Control.

- Designed cost effective best management practices estimates for stormwater management plans.

- Conducted onsite project evaluations and inspections while working in various weather conditions.

- Collected and analyzed soil and water samples for treatability using sand filtration systems.
• Researched manufacturers, new technologies, and processes that would enhance water filtration.

• Acted as an environmental associate drafting various CEQA/NEPA studies, conducting archival research, conducting field inspections, analyzing data, reviewing and writing technical reports, contributing to environmental compliance documents, and providing environmental technical support in water quality and water resources to various projects.

• Contributed to Initial Studies, Mitigated Negative Declarations, Environmental Impact Reports, Mitigation Monitoring Plans, Notice of Preparations, and Findings of Fact.

• Organized archival research, maintained CEQA case law archives, and maintained open lines of communication with internal staff, multi-task with multiple projects and organize time accordingly.
Education and Professional Development

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and Emergency Response Training
- Bay Area Training Corporation Safety Program for Refineries
- Cardiopulmonary Resuscitation and First Aid Certification
- Loss Prevention System Trained
- TWIC Carded and Approved TWIC Escort Trained

Summary of Professional Experience

Mr. Guthmiller is an environmental technician with 12 years experience in environmental site investigation and operation. His expertise includes:

- Soil and groundwater sample collection
- Operation of vacuum excavation equipment
- Operation and maintenance of remedial equipment
- Soil vapor sampling
- Project oversight

Representative Experience

- Mr. Guthmiller has been responsible for installation of over 90 vapor extraction wells using a vacuum excavator.

- Mr. Guthmiller provided groundwater monitoring including sample collection and field analysis of bioremediation parameters (including dissolved oxygen and ferrous iron) to document oxygen release compound-enhanced biodegradation at an operating timber products distribution facility.

- Mr. Guthmiller provided operation and maintenance of an air/ozone sparge remediation system including monthly and quarterly groundwater sampling for analysis of chlorinated volatile organic compounds.

- Mr. Guthmiller was responsible for construction of a groundwater remediation system incorporating in-well submersible pumps and aboveground eductor pumps at an operating marketing terminal.

- Mr. Guthmiller was responsible for collection of soil samples using hand auger techniques at numerous locations including a former ordinance facility bulk terminal and a levee.
• Mr. Guthmiller has provided routine groundwater sampling using low-flow purge techniques at numerous locations in northern California.

• Mr. Guthmiller has provided groundwater sampling using BARCAD nitrogen purge techniques at operating fueling terminals.

• Mr. Guthmiller provided operations and maintenance of numerous types of LPH recovery systems in deep well applications.

• Mr. Guthmiller provided operations and maintenance of a 97 well vapor extraction system, utilizing multiple thermal and catalytic oxidizers, and over 150 air sparge wells.
Education and Professional Development

- Graduate Studies, Hydrogeology, University of California Berkeley
- Graduate Studies, Hydrogeology, University of Nevada, Reno
- B.S., Geophysics, Massachusetts Institute of Technology
- OSHA 40-Hour Hazardous Waste Operations and Emergency Response Training
- OSHA Health and Safety Training for Supervisors of Hazardous Waste Workers
- Loss Prevention System Training
- Conferences and seminars on environmental geophysics, environmental laboratory analysis, landfill remediation, and project management

Registrations and Professional Affiliations

- California Certified Engineering Geologist #1882
- California Professional Geologist #5601
- Oregon Registered Professional Geologist #G1913
- Washington Licensed Geologist #2525
- Association of Groundwater Scientists and Engineers
- American Geophysical Union

Summary of Professional Experience

Mr. Heglie is a registered geologist in California, Oregon, and Washington and Certified Engineering Geologist in California with more than 20 years of experience in environmental consulting including industrial site investigation and remediation, project management, and hydrogeologic investigations. His areas of expertise include:

- Groundwater flow and chemical transport modeling for remedial system design and risk characterization
- Litigation support for industrial clients, including groundwater and vadose zone transport modeling
- Surface and borehole geophysical applications for remedial investigations
- Groundwater monitoring and environmental data management
- Landfill investigation and remediation
Representative Experience

Industrial Site Investigation and Remediation Project Management

- Mr. Heglie served as Project Manager for investigation and remediation of methyl tertiary butyl ether and tertiary butyl alcohol contamination at retail gasoline service stations as part of a regional assessment of impacts to a major southern California well field. He directed remediation of a perched groundwater zone at an operating service station using high-intensity targeted dual-phase extraction events and in-situ chemical oxidation. He provided oversight for the client of regional assessment activities, which included a detailed basin-wide transient-state groundwater flow model, aquifer characterization, and permitting for drinking water treatment.

- Mr. Heglie served as Project Manager/Technical Lead for a fast-track remedial investigation for a 1,000-acre former ordnance facility slated for redevelopment. The remedial investigation addressed over 70 potential areas of concern across the facility and evaluated the potential presence of a variety of organic and inorganic compounds related to the manufacture of ordnance components. He directed the preparation of the work plan, supervised the initial phase of field investigation, negotiated with regulatory agencies, managed data reduction and validation, coordinated preparation of a baseline Human Health Risk Assessment and Ecological Risk Assessment, and performed senior review of final reports. The risk assessment work plan incorporated future commercial and residential land use.

- Mr. Heglie served as Project Manager for a pilot test of innovative steam injection/vapor extraction technology at McClellan Air Force Base. He completed initial treatability studies and field investigation for site characterization and coordinated efforts of the technology developer, United States Air Force, Environmental Protection Agency site program, and various regulatory agencies.

- Mr. Heglie has varied management and project experience in solid waste, underground fuel and solvent tanks, property assessments, environmental impact reports, and project oversight.

Site Assessment and Remedial Action

- Mr. Heglie served as Project Hydrogeologist for the investigation and remediation at a former petroleum distribution terminal in northern California. Investigation work has characterized the presence of petroleum constituents in soil, soil vapor, groundwater, and surface water; it has included extensive monitoring and sampling of the storm drain system which is subject to tidal flow. Mr. Heglie also performed characterization of human health and ecological risks, and developed site-specific cleanup goals.
Mr. Heglie served at Project Hydrogeologist for the remedial investigation at a large former lumber mill site on the northern California coast. To expedite site characterization work, he employed surface geophysical surveys and direct push sampling of soil and groundwater. The investigation addressed the presence of petroleum constituents, solvents, metals, and other organic constituents in fill material, soil, groundwater, pond sediments, and springs.

Mr. Heglie served as Technical Lead for investigation of perchlorate and nitrosodimethylamine in groundwater at a former ordnance facility in southern California. He completed initial modeling of fate and transport of perchlorate in the vadose zone and groundwater to assist in planning remedial investigations and providing initial estimates of soil cleanup goals. He negotiated work plans with regulatory agencies, supervised monitoring well installation, and prepared reports on investigation results.

Groundwater Flow and Chemical Transport Modeling

As Project Hydrogeologist for remediation at an active petroleum distribution terminal in Oregon, Mr. Heglie developed a three-dimensional transient-state groundwater flow model for the evaluation of remedial alternatives. The MODFLOW model addressed interaction between groundwater and an adjacent river, and incorporated site features such as a slurry wall and a concrete revetment. The model was calibrated against transient monitoring data, historical river levels, and multiple aquifer tests.

Mr. Heglie served as Project Hydrogeologist for litigation support involving impacts to a high-rise building dewatering system from groundwater contaminated with petroleum constituents and chlorinated solvents. He completed groundwater flow modeling to evaluate the effectiveness of alternative dewatering systems for a multi-level parking garage beneath the high-rise office building. The groundwater flow model addressed three-dimensional groundwater flow into alternative dewatering systems, groundwater flow beneath several former retail service stations, and a source of chlorinated solvent contamination.

Mr. Heglie performed two-dimensional analytical element modeling for groundwater extraction system design for petroleum distribution terminals in California and Washington.

Mr. Heglie has experience with groundwater flow modeling and analysis software including MODFLOW/ MODPATH, TWODAN, and AQTESOLV, along with chemical transport analysis software such as BIOSCREEN, SESOIL, versions of the Johnson and Ettinger vapor intrusion model, and other analytical models.

Litigation Support

Mr. Heglie served as Project Hydrogeologist for litigation support involving manufacturing facilities. He completed groundwater and vadose zone modeling studies of fate and transport of chlorinated solvents to explain the source of the chemicals and/or
evaluate potential future impacts and the necessity for remediation. He demonstrated that contaminant sources at several sites did not present a significant risk.

- Mr. Heglie served as Project Hydrogeologist for litigation support involving a retail gasoline service station. He completed groundwater modeling studies of fate and transport of gasoline constituents for estimation of the probable date of release and evaluation of general cleanup scenarios. He was responsible for soil and groundwater sampling, aquifer testing, data analysis, and interpretation of the nature, extent, and potential source(s) of subsurface petroleum contamination.

- Mr. Heglie served as Project Hydrogeologist for litigation support involving petroleum distribution terminals and electronics manufacturing facilities. He characterized the nature, extent, and source of groundwater contamination and used equilibrium partitioning models to explain the observed distribution of contaminants in groundwater, soil, and soil vapor. He reviewed and interpreted results of detailed petroleum fuel fingerprinting analyses, which included identification of the 100 largest components of the fuel mixture by gas chromatography/mass spectrometry.

- Mr. Heglie served as Project Hydrogeologist for litigation support for a major petroleum industry client. He provided recommendations for additional investigation and the most appropriate remedial alternatives for six facilities. He developed cost estimates for site investigation, remediation, monitoring, and site closure for a 6-year period.

**Surface and Borehole Geophysical Applications**

- Mr. Heglie expedited the investigation of numerous large areas of concern at a 1,000-acre former ordnance facility by applying surface geophysical and soil vapor surveys. Surface geophysical techniques included electromagnetic ground conductivity (EM) and magnetometer surveys over landfills and other former disposal sites.

- As Project Hydrogeologist for investigation work at a former petroleum distribution terminal, Mr. Heglie managed a program of ground penetrating radar surveys to characterize the presence of subsurface voids associated with the storm drain system beneath the site.

- Mr. Heglie has conducted EM and magnetometer geophysical surveys at manufacturing and commercial sites, and has applied borehole geophysical methods to numerous site investigations to characterize subsurface stratigraphy.

**Groundwater Monitoring and Environmental Data Management**

- Mr. Heglie implemented low-flow and passive sampling for more efficient and improved water quality characterization at multiple groundwater monitoring sites.

- Mr. Heglie established programs for AME for management of analytical data using databases and electronic data deliverables from laboratories. Mr. Heglie designed relation databases for management, quality assurance, and reporting of analytical and geological
data. He coordinated the implementation of geographical information systems with linked databases in ACCESS and gINT.

- Mr. Heglie instituted data validation programs for projects consistent with EPA guidance for analytical data review.

**Landfill Investigation and Remediation**

- Mr. Heglie served as Project Hydrogeologist for development of Article 5 water quality monitoring and Corrective Action Plans for two solid waste landfills. He evaluated historic data, provided hydrogeologic interpretation, identified constituents of concern, and specified points of compliance and monitoring parameters.

- Mr. Heglie served as Project Hydrogeologist for closure design for a hazardous waste landfill. He was responsible for the numerical modeling of leachate and groundwater flow at the 125-acre landfill for the technical evaluation of leachate extraction alternatives. The numerical model accounted for infiltration, subsurface outflow, surface springs, inflow from consolidation of underlying Bay mud, barrier walls, and effects of leachate collection and extraction alternatives. Mr. Heglie designed subsurface components of a leachate collection and removal system.

- Mr. Heglie served as Project Hydrogeologist for a Solid Waste Assessment Test investigation and leachate management plan development for a large municipal landfill.

**Publications and Presentations**


DENNIS JONES

Education and Professional Development

- B.S., Geology, California State University at Chico
- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and Emergency Response Training
- Occupational Safety and Health Administration 24-Hour Confined Space Training
- U.S. Army Corps of Engineers 40-Hour EM 385-1-1 Safety and Health Training
- U.S. Army Corps of Engineers Construction Quality Management for Contractors 16-Hour Training Course
- California Water Environmental Association 5-Hour Water/Wastewater Sampling Training
- California Water Environmental Association 10-Hour Stormwater Sampling Training

Summary of Professional Experience

Mr. Jones is a geologist with over a decade of experience in environmental geology for the Department of the Navy, Department of the Air Force, U.S. Army Corps of Engineers, Bureau of Reclamation, and public and private-sector clients. His experience includes site safety officer, construction quality control officer, explosive contaminated soil excavation and bioremediation, landfill cap operation and maintenance, wastewater and stormwater sampling, soil vapor and groundwater monitoring and sampling, petroleum hydrocarbon assessment and remediation, and environmental and hydrogeologic studies for a wide range of projects including residential, commercial, industrial, and governmental development and remediation.

Representative Experience

- Mr. Jones performed duties as a site safety/quality control officer at numerous aboveground and underground storage tank investigations and removals for government, public, and private clients throughout northern and central California.

- Mr. Jones performed duties as a site safety/quality control officer for the U.S. Army Corp of Engineers at the former Concord Naval Weapons Station. The project involved excavation, sampling, and removal of potential unexploded ordinance soils impacted with lead from within an environmentally protected salt marsh pond. Aqua barriers were deployed to provide a dam to dewater the proposed excavation zone.

- Mr. Jones performed duties as a site safety/quality control officer for the U.S. Army Corps of Engineers during the excavation of explosive impacted soils and bioremediation treatment of soils at the largest north American munitions depot, located at Hawthorne, Nevada.
• Mr. Jones performed duties as a site safety/quality control officer for the Department of the Navy at Hunters Point, San Francisco, California, which involved the excavation, sampling, and removal of mercury-impacted soils.

• Mr. Jones performed duties as a site safety/quality control officer for the Bureau of Reclamation during the installation of aqua barriers and dewatering of approximately 1,500,000 gallons from the spillway at Stampede Dam, Truckee, California.

• Mr. Jones conducted environmental exploration and remediation that included the installation of soil borings, soil vapor borings, air sparging, soil vapor extraction, and groundwater monitoring wells.

• Mr. Jones provided operation and maintenance and vapor and groundwater monitoring at several Department of the Navy landfills.

• Mr. Jones performed environmental quarterly groundwater monitoring and wastewater and stormwater sampling at Beale Air Force Base, California.
Education and Professional Development

- Ph.D., Environmental Engineering, University of Houston
- M.S., Municipal Engineering, Beijing Polytechnic University
- B.S., Civil Engineering, Beijing Polytechnic University
- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and
- Emergency Response Training
- Risked Based Corrective Action Training
- Loss Prevention System (LPS) Training and other Health and Safety Trainings

Registrations and Professional Affiliations

- Licensed Professional Engineer, Texas # 98583
- Licensed Professional Engineer, Maryland # 43341
- Association of Ground Water Scientists and Engineers

Summary of Professional Experience

Dr. Ling is a licensed professional engineer with 19 years of experience in environmental and municipal engineering. He holds a M.S. degree in Municipal Engineering and a Ph.D. degree in Environmental Engineering. His professional expertise includes site characterization, remediation, and risk assessment, groundwater and non-aqueous phase liquids (NAPL) modeling, visualization and litigation support, statistical and geostatistical analysis, monitoring optimization, wastewater engineering, and environmental software development. Dr. Ling has authored a variety of publications regarding groundwater modeling and monitoring, NAPL characterization and assessment, litigation support, and other technical issues. He is co-author of the Monitoring and Remediation Optimization System (MAROS) decision-support software developed for the Air Force Center for Engineering and the Environment (AFCEE). Dr. Ling is a frequent presenter at environmental conferences and workshops. He is a key technical resource and his responsibilities include technical consulting, litigation support, project management, and field program oversight.

Representative Experience

Site Characterization, Remediation, and Risk Assessment

- Site conceptualization and remedial design for a former truck maintenance facility in California. Identified the fractured rock/clay nature of the underlying water–bearing units, obtained fracture porosity information through literature review, and provided a
reliable range of LNAPL volume estimates. Evaluated various LNAPL remedial alternatives including hot water flooding and electrical resistance heating, and recommended a less risky yet cost-effective method to achieve LNAPL recovery to the asymptote in a reasonable timeframe. Designed an in-situ chemical oxidation pilot study for treating groundwater at a localized area containing elevated VOC concentrations.

- Assessment, characterization, and remediation for a former gas plant site in Texas. Performed a thorough evaluation of the site hydrogeologic and contamination conditions by incorporating site data into a 3-D visual imagery model. Evaluated existing remedial actions and identified its lack of effectiveness. Conducted further characterization activities including LIF-ROST investigation, slug tests, aquifer yield tests, LNAPL baildown tests, LNAPL recovery assessment, and tracer dye testing. Revised the site conceptual model and implemented more cost-effective remedial actions towards a faster site closure.

- Assessment, characterization, and remedial evaluation for a Texas oil refinery along shoreline. Developed a 3-D visual imagery model integrating the upland area and the offshore area to study the geological, hydrological, and contamination conditions. Estimated the potential seepage risk along the shoreline through the evaluation of lithology, LNAPL thickness, dissolved concentrations, and tidal fluctuations. Identified preferential flow zones and classified the shoreline into different zones of risk. Assessed various remedial strategies and prioritized the remedial actions.

- Assessment, remediation support, and risk assessment for petroleum hydrocarbons contamination at a diesel bulk storage facility in the San Francisco Bay Area. Developed a 3-D visual imagery model for the site and prepared presentations for client and regulatory meetings. Delineated the areal extent and depth of remediation, evaluated remedial strategies, and assisted in remedial design. Conducted risk assessment for the site, identified the significant and complete route of exposure, and proposed site-wide and location-wise cleanup goals taking into account the dilution and attenuation of contaminant concentrations due to tide-induced mixing.

- Characterization and remediation pilot test at a natural gas compressor station in Texas. Conducted additional drilling and obtained a better understanding of the site lithology and groundwater conditions. Conducted in-situ chemical oxidation (ISCO) pilot test using calcium peroxide to evaluate its feasibility. Conducted tracer dye testing at new borings and existing monitoring wells to understand field transport conditions.

- Assessment, characterization, and remediation of chlorinated solvents contamination at an Oklahoma chemical plant. Studied site data, identified data gaps for additional characterization, refined site conceptual model, and evaluated remedial options for the DNAPL source and dissolved plumes. Source excavation for DNAPL removal and natural attenuation for dissolved plumes were finally selected and implemented. Designed and implemented ISCO using RegenOX at one source area where excavation was not possible.
• Remedial planning for dissolved petroleum hydrocarbons contamination at an oil refinery in California. Conducted groundwater modeling to delineate zones of hydraulic influence for the placement of pumping wells and remedial systems.

• Assessment of well network for monitored natural attenuation (MNA) at a California oil refinery. Conducted particle tracking simulations and utilized 3-D visual imagery to evaluate the effectiveness of each monitoring well in tracking the dissolved plume.

• Design of carbon adsorption systems for treating petroleum hydrocarbons contaminated groundwater from residential wells downgradient of a fuel terminal in Texas.

• Assessment of petroleum hydrocarbons and heavy metals contamination at a bulk fuel terminal site along a major river in Oregon. Identified the sources, potential transport pathways, and extent and magnitude of the contamination. Developed a site conceptual model that facilitated the remedial evaluation and planning. Conducted hydrological and hydraulic analyses and provided an evaluation of the potential impact on river sediment.

• Feasibility study and remedial action planning of fuel oxygenates contamination (MTBE and TBA) at a service station site in California. Evaluated multiple remedial options and proposed action plans.

• Analysis, characterization, and risk assessment of petroleum hydrocarbons contamination at an active port facility in California. Investigated preferential pathways, tidal influence, plume stability, and soil vapor issues, and demonstrated the effectiveness of site remediation through visualization and statistical analyses. Designed and implemented a field characterization work to quantify the mixing of groundwater and seawater within aquifers caused by tidal action. Evaluated and improved the long-term monitoring program at the site. Participated in the development of risk-based cleanup goals for human health and ecological receptors at the site, identified the inappropriateness of some of the regulatory criteria, and conducted field and modeling studies to determine the appropriate cleanup goals.

• Development of site conceptual model for LNAPL contamination at an oil refinery in California. Assessed site characterization data, built a 3-D site visual imagery model, delineated LNAPL distribution in the subsurface, and identified preferential pathways.

• Assessment of mineral distribution in coal slurry impoundments for numerous mining sites across the nation. Estimated coal volume, quantity, and recovery progress and superseded traditional 2-D mapping with 3-D interactive imagery in presenting the results.

• Design of an interception/treatment system for groundwater remediation at a former Manufactured Gas Plant (MGP) site in Florida. Used groundwater modeling to determine the configuration and layout of an interceptor wall and a treatment trench.
• Assessment of sediment contamination at a harbor site in Florida and a lake site in Washington. Estimated contaminant distribution in the sediment and provided remedial calculation utilizing 3-D visualization techniques.

• Characterization, assessment, and remedial planning for various projects: LNAPL contamination at three gas plants in Texas and Minnesota, DNAPL contamination at three former MGP sites in Indiana and Florida, oil-water interaction in rock fractures at a Texas oil well field, impact of coal-bed methane at a gas well site in Kentucky, soil vapor contamination at an oil refinery site in California, and chemical contamination at two industry sites in New Jersey.

Groundwater and NAPL Modeling

• Modeling of variable-density flow using SEAWAT at an active port facility in California. Developed a 3-D cross sectional model to estimate the dilution of contaminant concentrations caused by tidal fluctuation within the aquifer near the aquifer-ocean boundary. Two scenarios were simulated: a vertical sheet pile wall boundary and a sloping riprap boundary. The dilution factor was calculated as the ratio of total outflow to the net groundwater outflow. Simulated results of salinity distribution and groundwater fluctuations within the aquifer were used to guide the installation of two lines of monitoring wells that are perpendicular to the shoreline and at different depths. Field data are being collected to refine and calibrate the model to update the dilution factors.

• Development of a groundwater fate and transport model for heavy metals contamination at a former fertilizer manufacturing plant site in North Carolina. The modeling effort was focused on arsenic, the more mobile and prevalent metal at the site, using MODFLOW and MT3D for flow and dual-domain transport simulations. Applied the model to refine characterization of the hydrogeologic and geochemical conditions at the site and assessed the potential for future plume migration.

• Modeling of dissolved PCBs transport resulting from soil contamination at an industrial facility in New Jersey using the AT123D analytical model. Assessed the potential migration and extent of the dissolved PCBs for different combinations of source release, hydraulic, and sorption conditions.

• Development of a groundwater fate and transport model for remedial planning at a fuel terminal site in Virginia. Used MODFLOW-SURFACT to simulate the dissolution of residual LNAPL and subsequent reactive transport in vadose and saturated zones.

• Development of a groundwater flow model for remedial evaluation at a Delaware refinery. Simulated the groundwater system in connection with a river to investigate the potential impact of a proposed 550-foot sheet pile wall along the river shoreline.

• Review of a groundwater fate and transport model for MTBE and TBA contamination at a public well field in California. Performed a thorough check of model assumptions and parameters and estimated a reasonable initial mass for use in transport simulations.
- Development of a groundwater fate and transport model to evaluate natural attenuation with source control at a dry-cleaner site in Texas. Used RT3D to simulate reductive dechlorination and conducted an uncertainty analysis to assess the reliability of model predictions.

- Development of a groundwater fate and transport model to study chlorinated solvents contamination at an industrial site in South Carolina. Conducted various modeling analyses to support site assessment and remedial design.

- Key contributor to the development of a regional groundwater flow model surrounding an oil refinery in California. Developed model boundary conditions, checked calibration targets, evaluated parameter sensitivity, and assisted in model calibration.

- Development of a groundwater flow model for the design of an interception/treatment system at a former MGP site in Florida.

- LNAPL mobility analysis and recovery calculation for a California site using various LNAPL modeling tools developed by the American Petroleum Institute (API).

- Development of a numerical NAPL model to simulate fuel hydrocarbons release and the subsurface migration at a railroad site in North Dakota. Used finite-element code BIOSLURP to simulate the LNAPL migration and extent under historical site conditions.

- Development of a numerical model with BIOSLURP to evaluate the feasibility of LNAPL removal via vacuum enhanced recovery at an Oklahoma gas plant. Evaluated a number of scenarios to find the optimal number and configuration of dual phase recovery wells.

- Development of numerical model with BIOSLURP to evaluate the feasibility of an LNAPL recovery trench design at a Washington site.

- Modeling analysis for a pipeline release in Europe to simulate the fate and transport of LNAPL and dissolved plume using finite-element codes ARMOS and BIOTRANS.

- Modeling evaluation of contaminant transport, tracer test, capture zone, and aquifer characteristics for numerous projects using analytical codes such as BIOSCREEN, BIOCHLOR, SOLUTE, WHPA, TWODAN, AQETSOVL, and HSSM.

**Visualization and Litigation Support**

- Technical analysis and visualization service for a California case involving gasoline and diesel release at a service station. Assessed potential past releases over the operating history and estimated the mass of the contaminants using advanced 3-D interpolation technique. Generated a set of convincing animations to present site hydrogeologic conditions, plume migration through time, and mass allocation results. This work led to a verdict in favor of the client.
• Technical support for a legal dispute over remediation costs for a former petroleum terminal in California. Based on site use, potential receptors, hydrogeologic conditions, and risk screening, the remedial endpoint and methods that would be considered reasonable at the time of property transfer were determined with the related costs quantified. In addition, a presentation package detailing these findings was prepared for the legal team to facilitate negotiation. This work led to a settlement that significantly reduced the client’s payout.

• Technical analysis and visualization service for a California case regarding cost allocation for gasoline and diesel release in an industrial area. Reviewed site ownership and operating history, assessed forensic and hydrogeologic data, evaluated site data with a 3-D visual imagery model, conducted contaminant mass and liability allocations, evaluated remedial system performance, and proposed further remedial strategies. Proved that significant contributions of contaminants from potential offsite sources was impossible by assessing sanitary sewer and storm drain networks and by comparing the spatial distribution and concentration levels of key contaminants in site vicinity. This is an ongoing case pending further actions.

• Technical analysis and state-of-the-art visualization service for a major litigation case in North Dakota involving fuel hydrocarbons release from a railroad site. Assessed site hydrogeology and built a 3-D visual imagery model to visualize the distribution of LNAPL in a complex geologic setting with a fluctuating water table. Conducted numerical modeling to simulate the LNAPL release and migration in the subsurface. Demonstrated that it was impossible for the LNAPL reaching a certain area of concern. The technical analyses and 3-D visualization exhibition significantly strengthened the client’s case, resulting in a verdict that saved the client tens of millions of dollars.

• Technical and visualization analyses for a Missouri case regarding a limestone quarry flooded by nearby river flow. Studied quarry operation history and water breakthrough events and investigated potential causes. Developed a 3-D visual imagery model to help understand the interrelationships between quarry operation, change in hydraulic conditions, nearby sinkhole occurrences, and water breakthrough. Demonstrated that it was the deepening and dewatering of the quarry that caused the subsurface channeling and subsequent flooding. The analysis led to a settlement in favor of the client.

• Technical and visualization support for a litigation case in Colorado where a river was impacted by former MGP derived coal tar DNAPL. Assessed site characterization data and developed a 3-D visual imagery model of the site. Investigated the petroleum hydrocarbons impact from a nearby service station. Evaluated the commingling of the DNAPL and the dissolved petroleum hydrocarbons plume. Conducted transport analysis to illustrate the change in DNAPL migration under the influence of dissolved petroleum hydrocarbons. A settlement was reached in favor of the client.
Technical analysis and visualization service for a number of litigation cases involving methane vapor intrusion, petroleum hydrocarbons contamination, and heavy metals pollution at oil exploration, gas and chemical plants, refinery, bulk fuel terminals, and service station sites.

Statistical and Geostatistical Analysis

- Development of a three-component soil sampling program for an active port facility in California. The sampling program was designed to confirm if cleanup has been achieved in certain treatment areas, demonstrate the progress of remediation, and to identify potential hot spots at some historical source areas. The number of sample size and locations were determined based on the evaluation of historical sampling data, derived population statistics, and historical site information. Statistical software ProUCL was used in the design.

- Development of a statistical evaluation method for determining the frequency of sampling at monitoring locations and a geostatistical method for optimizing a monitoring network. Applied these methods to multiple sites to evaluate their groundwater monitoring programs.

- Application of appropriate statistical analyses to a groundwater monitoring program at an airport site in Washington. Client was concerned with elevated arsenic concentrations and wanted to know if they were true exceedance. Proposed intra-well analysis using combined Shewhart CUSUM Control Chart, seasonality adjustment, and verification re-sampling. Set up the protocol for statistical analysis after the project was awarded.

- Improvement on the statistical evaluation of remedial performance at an active port facility in California. Selected Sign test for site-wide comparison to address the significant percentage of non-detects in the monitoring data and replaced linear trend test with a nonparametric test.

- Statistical analysis for LNAPL investigation at an oil refinery in California. Assessed the changes in LNAPL composition over time using an altered version of Mann-Kendall analysis and revealed the difference between samples from different depths with paired t-test.

- Direction of the sediment mapping of polychlorinated biphenyls in a 6-mile river section in Washington. Problems emerged when two firms presented inconsistent results using different methods (kriging vs. IDW). Identified the cause of such differences, introduced Thiessen Polygon method for additional check, examined the goodness-of-fit by cross-validation, and directed GIS specialists on how to improve the mapping.

- Statistical analysis for compliance evaluation at a number of sites and application of geostatistical uncertainty analysis to soil and groundwater characterization programs for suggesting locations of sampling.
Monitoring Optimization

- Development of a set of spatial and temporal methodologies for evaluating groundwater monitoring plans. The methodologies handle many aspects of monitoring evaluation (spatial redundancy reduction, network augmentation, frequency optimization, and sufficiency analysis) and allow the dynamic optimization of the monitoring program as site and contaminant conditions change over time.

- Key developer of the AFCEE’s decision-support software, Monitoring and Remediation Optimization Systems (MAROS), which is available to the general environmental practitioners for formulating cost-effective and scientifically-based long-term monitoring plans. Constantly provide guidance on how to use or benefit from the software for practitioners and researchers seeking suggestions.

- Evaluation of groundwater monitoring programs six sites across the nation as part of a joint U.S. EPA & AFCEE study for demonstrating innovative long-term monitoring optimization strategies and their applicability.

- Optimization of groundwater monitoring programs at numerous other sites to achieve more effective and/or efficient monitoring on a dynamic basis over the life cycle of the projects.

Wastewater Engineering

- Design of a 100,000 ton/day (26.5 MGD) urban wastewater treatment plant (Urban WTP) in XinJiang Autonomic Region, China. The treatment process consists of bar screening, grit removal, activated sludge treatment by oxidation ditch, sedimentation, disinfection, and sludge digestion and dewatering. Completed hydraulic calculations for the entire process, determined dimensions of major structures, selected relevant equipments, designed plant layout, and conducted hydraulic calculation and layout of major pipelines (wastewater, sludge, recycle sludge, and storm).

- Design of the aeration tank and bar screens for a 50,000 ton/day Urban WTP in northern China. Performed hydraulic calculation, determined dimensions, calculated air volume, and selected blowers and aeration equipments.

- Feasibility study of an Urban WTP for DuYun, GuiZhou Province, China. Performed a water budget calculation, estimated wastewater quantity and contaminant loadings, and considered the city’s population and development blueprint. Proposed a conventional activited sludge process with a treatment capacity of 100,000 ton/day. Calculated process parameters and conducted an engineering economic analysis on the cost-benefits of the proposed project.

- Key developer of the Urban WTP Process Selection Expert System for the Ministry of Construction of China. This decision-support software selects the optimal treatment process by evaluating experts’ opinions regarding capital and operation costs, land use, technical maturity, operation and maintenance difficulty, and discharge quality.
Publications

Book Chapter


Journal Articles


Conference Proceedings


Software


Talks and Workshops


Education and Professional Development

- B.S., Chemical Engineering, University of California, Berkeley
- Professional seminars and company classes, including project cost estimating, hazard communication, process plant safety, wastewater treatment, Proposition 65 compliance, hazop analysis, soil and groundwater remediation, and plant environmental compliance
- Occupational Safety and Health Administration 40-Hour Hazardous Waste Operations and Emergency Response Training
- Grade I Water Treatment Operator’s Certificate
- Bay Area Training Corporation Safety Program for Refineries

Registrations and Professional Affiliations

- California Professional Chemical Engineer #CH5946
- American Institute of Chemical Engineers

Summary of Professional Experience

Mr. Twiford is a California Registered Professional Chemical Engineer with over 19 years of chemical industry and environmental consulting experience including process and project engineering, environmental compliance oversight, and remediation project management. His areas of expertise include:

- Remediation and risk assessment for regulatory closure of petroleum and chemical release sites
- Design, construction, and operation of soil and groundwater remediation systems
- Process improvements and cost control in chemical manufacturing, waste treatment, and environmental compliance operations
- Chemical plant and Resource Conservation and Recovery Act (RCRA) facility environmental compliance, safety audits, and hazard training.
Representative Experience

Remediation and Risk Assessment for Closure of Petroleum and Chemical Release Sites

- Mr. Twiford served as Project Manager for a former petroleum distribution terminal site where risk assessment obtained regulatory closure despite remaining hydrocarbon concentrations in groundwater.

- Mr. Twiford served as Project Manager for a former airport shuttle service site where risk assessment was performed to recommend regulatory closure despite remaining hydrocarbon concentrations in groundwater. The regulatory agency is currently reviewing the closure request.

- Mr. Twiford served as Project Manager for a refinery site where risk assessment was performed to convince the regulatory agency that further remedial action was not required at a specific operating area.

- Mr. Twiford served as Project Manager for a former medical device manufacturing site where regulatory closure was obtained by fate and transport modeling to convince the regulatory agency that perchloroethylene detected in groundwater samples poses limited risk.

- Mr. Twiford served as Project Manager for seven locations of a wood products client where diesel underground storage tanks were removed followed by remedial excavations, onsite soil remediation, and follow-up drilling and sampling as required by regulatory agencies to achieve closure at each site.

Design, Construction, and Operation of Soil and Groundwater Remediation Systems

- Mr. Twiford performed all in-house environmental engineering as Supervisor of Technical Services for a chemical manufacturing company. Projects included groundwater characterization, feasibility studies, a Remedial Action Plan, and the design, construction, and operation of groundwater remediation and process wastewater treatment systems. Chemicals of concern included solvents (dense nonaqueous phase liquid [DNAPL] suspected), wood preservatives, dioxin, metals, and gasoline.

- Mr. Twiford served as Project Manager for design, construction, and operation of one soil and three groundwater remediation systems at a refinery site. Work included pilot testing and development of a Remedial Action Plan.

- Mr. Twiford served as Project Manager for design, construction, and operation of 400 and 600 gallon per minute air strippers for treatment of irrigation water from agricultural wells containing solvents.
Mr. Twiford served as Project Manager for design, construction, and operation of a groundwater remediation system at a trichloroethylene release site with suspected DNAPL. Work included pilot testing.

Mr. Twiford served as Project Manager for design, construction, and operation of a groundwater remediation system at a perchloroethylene release site. Work included pilot testing and development of a Remedial Action Plan.

Mr. Twiford served as Project Manager for design, construction, and operation of a vapor extraction system remediating aviation gasoline releases at an airport site. Work included pilot testing.

Mr. Twiford served as Project Manager for design, construction, and operation of a vapor extraction system remediating gasoline and diesel releases at a fruit cannery site. Work included pilot testing and development of a Remedial Action Plan.

Mr. Twiford served as Project Manager for design, construction, and operation of an air sparging system at an operating petroleum distribution terminal site.

Mr. Twiford served as Project Manager for design, construction, and operation of remediation systems at numerous petroleum retail service station sites, with systems including groundwater extraction, soil vapor extraction, and air sparging. Work included pilot testing and development of Remedial Action Plans.

Process Improvements and Cost Control

As Plant Manager at a continuous operations chemical plant, Mr. Twiford increased production volume by more than 20 percent and decreased unit product cost by more than 15 percent through a series of process improvements and de-bottlenecking projects over a period of three years.

As manager of operations at a newly-constructed RCRA wastewater treatment facility, Mr. Twiford decreased operating costs more than 20 percent in 1 year through process modifications and operating improvements.

Environmental Compliance of Operations

Mr. Twiford served as Manager of Operations for three RCRA wastewater treatment facilities at a major aerospace company with no environmental violations. In addition to RCRA regulation, compliance included discharge permits to air, sanitary sewer, and surface water (National Pollutant Discharge Elimination System [NPDES]). Regulatory oversight included annual audits by the California Environmental Protection Agency.

Mr. Twiford managed environmental compliance at two chemical manufacturing plants in California for different companies. Issues included air discharge permits, NPDES surface water discharges, sanitary sewer discharges, and stormwater management plans. At one of
the companies, Mr. Twiford also updated the stormwater management plan for a plant in Ohio.

- Mr. Twiford served as Project Manager for development of Stormwater Pollution Prevention Plans at an ordnance manufacturing facility and an aircraft controls manufacturing facility.

- Mr. Twiford developed RCRA groundwater monitoring plans for two client-operated RCRA units.

- Mr. Twiford served as Project Manager for implementation of a groundwater Containment Zone Management Plan at a former heavy truck manufacturing facility adjacent to San Francisco Bay.

**Process Safety**

- Mr. Twiford served as Project Manager for installation and maintenance of carbon adsorption treatment units at 12 residential water systems served by domestic wells containing solvents.

- Mr. Twiford served as Project Engineer for a nationwide program of safety improvements for oxygen pipelines at an industrial gasses company.

- Mr. Twiford conducted hazard communication training at chemical plants in Alabama, California, Georgia, and South Carolina, including Proposition 65 training in California.

- Mr. Twiford developed and/or revised Hazardous Materials Management Plans at three California chemical plants for different companies. Also, Mr. Twiford served as Project Manager for development of a Hazardous Materials Management Plan at an aircraft controls manufacturing facility.
JOSEPH WILSON

Education and Professional Development

- B.S., Environmental Science, University of North Carolina at Charlotte
- ESRI ArcGIS Certified Training and GIS System Architecture courses
- Trimble GPS Analyst and Mobile GIS mapping using ArcPad and GPScorrect training courses
- Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations 29 CFR 1910.120

Summary of Professional Experience

Mr. Wilson has over 14 years of professional experience consulting and using Geographic Information Systems (GIS) technology. He has worked on various geospatial projects throughout North America, executing successful implementations of enterprise GIS technology for local, state, and federal government agencies, military bases, public safety and emergency management agencies. Mr. Wilson has extensive technical skills in GIS application development, geodatabase design, mobile GIS, GPS data capture, course development and training.

Representative Experience

- Mr. Wilson has worked with several agencies to launch the use of GIS, and has served as GIS Project Manager for several multi-year GIS implementations.
- Mr. Wilson developed and deployed GIS applications and geodatabase models used for multi-department agencies for data analysis and distribution.
- Mr. Wilson directed GIS sales opportunities for military and public safety agencies.
- Mr. Wilson calculated annual GIS budgets for several State and Local Governments.
- Mr. Wilson wrote and published several GIS industry articles and GPS success stories.
- Mr. Wilson trained and mentored several co-workers and clients on the use of geospatial technology.