

# Avram Frankel, P.E.

## Principal



### **Education and Credentials**

M.S., Environmental Engineering, Northwestern University, Evanston, Illinois, 1995

B.A., History, with Honors, Johns Hopkins University, Baltimore, Maryland, 1989

Licensed Civil Engineer, California (License No. C59980)

Licensed Civil Engineer, Oregon (License No. 89636PE)

Licensed Civil Engineer, Washington (License No. 54003)

Licensed Professional Engineer, Georgia (License No. PE41986)

Licensed Professional Engineer, Colorado (License No. PE.0057535)

### **Professional Affiliations**

Member of National Ground Water Association

Member of American Water Works Association

Member of Groundwater Resources Association of California

### **Professional Profile**

Mr. Avram Frankel is a professional engineer, technical expert, and program manager with more than 30 years of experience including work on a wide range of commercial/industrial, municipal, state, and federal sites regulated under CERCLA, RCRA, TSCA, and numerous state programs. A civil and environmental engineer licensed in California, Oregon, Washington, Colorado, and Georgia, Mr. Frankel provides his clients with strategic management and technical analysis in support of due diligence, redevelopment, technology evaluation, remediation, and legal/litigation matters. With a focus on enhancing health and safety, restoration of drinking water aquifers, and delivery of potable water, he has overseen the design, costing, installation, and optimization of groundwater remediation and water treatment systems across the U.S. over a wide range of site scales, geologies, and technical complexities. As a program manager and technical strategist, Mr. Frankel's experience on large, complex, and performance-based projects is extensive, including the successful application of combined remedies and remediation of plumes measured in miles. These projects often included the holistic management and ultimate remediation of large commingled and multi-contaminant groundwater plumes in challenging stakeholder environments and under litigation or settlement conditions.

Mr. Frankel has also spent a large portion of his career addressing emerging contaminants of the past and present including hexavalent chromium, perchlorate, 1,4-dioxane, per- and polyfluoroalkyl substances (PFAS), and 1,2,3-trichloropropane (1,2,3-TCP). Both a practitioner and testifying expert, he currently serves as a technical expert in many groundwater contamination and water treatment matters focused on the mitigation of regulated chemicals in drinking water. He has considerable expertise in the preparation of complex deliverables, incentive-based construction contracts, expert technical reports, cost estimates, and risk-reducing strategic plans and contracting strategies to achieve remediation and treatment goals for the appropriate lifecycle cost.



## Relevant Experience

### Remediation, Aquifer Restoration, and Water Treatment (Selected Projects)

***Chlorinated Solvent Remediation, Multiple Sites, Northern California***—Directing the evaluation and remediation of multiple chlorinated solvent sites in Northern California under Regional Board oversight. Sites involve implementation of a variety of *ex situ* and *in situ* groundwater treatment technologies in drinking water aquifers.

***Paulsboro Well #7 Potable Water Treatment, Paulsboro, New Jersey***—Senior technical advisor for the design, construction, and commissioning of a 1,000-gallon per minute (gpm) PFAS potable water granular activated carbon (GAC) wellhead treatment system to deliver potable water meeting stakeholder requirements to a small rural community. Involved the rapid completion of pre-design studies, including bench-scale testing, to support settlement and lay the groundwork for a successful design—the first of its kind for perfluorononanoic acid removal. Oversaw contractor procurement and supported stakeholder coordination during design. The project is operational and meeting all regulatory, owner, and client requirements.

***Potable Water Treatment System Design, Fresno County, California***—Oversaw evaluation of 1,2,3-TCP treatment requirements for a two-well private water supply system. Oversaw design of a GAC wellhead treatment system to remove 1,2,3-TCP including construction cost estimate.

***PFAS Sorptive Media Treatment Technology Evaluations, New Jersey***—After completion of an initial technology screening that selected GAC and ion exchange resin for additional evaluation, oversaw bench testing of both technologies to treat PFAS in groundwater extracted from beneath an active chemical production facility. Led engineering study comparing bench-scale GAC results to full-scale performance. Evaluated ion exchange field pilot testing program in support of full-scale operation.

***Emerging Contaminant Remediation Technology Evaluations, Multiple Locations and Clients***—For multiple clients, continually evaluating PFAS soil, groundwater, and potable water treatment technologies against prospective and promulgated regulatory standards with focus on cutting through vendor and consultant claims to get to what actually works at full scale. Work includes consideration of combined remedies, alternative mitigation options (e.g., replacement wells, well modifications, blending, alternate water sources), and evaluation of emerging 1,2,3-TCP alternative site remediation and potable water treatment technologies.

***Reese Center, Reese Air Force Base, Lubbock, Texas***—Served as program director for implementation of \$43.5 million drinking aquifer restoration project that achieved regulatory closure. Remediation included 200-gpm directed groundwater recirculation system with GAC treatment and *in situ* enhanced reductive dechlorination (ERD) to treat a 3-mile-long trichloroethylene (TCE) plume in the Ogallala aquifer resulting from industrial sewer releases. Within 6 years, the plume footprint was reduced by 90 percent. All compliance wells achieved maximum contaminant levels 8 years from installation of systems. Oversaw soil remediation activities. Negotiated multiple RCRA permit modifications. Robust groundwater fate and



transport modeling supported all groundwater remediation and guided adaptive design and remedy optimization. This is one of the largest cleanups and closure of a TCE plume of this magnitude to date in the U.S.

***RCRA Corrective Action, Brunswick, Georgia***—Serving as principal-in-charge for the remediation of volatile organic compounds (VOCs) at an active industrial site. Developed alternate integrated remedial approach to address offsite plume migration and meet RCRA 2020 regulatory goals while addressing third-party litigation. Leading team that reinterpreted conceptual site model to support revised interim corrective action approach. Currently overseeing pre-design studies.

***Former Cooling Tower Manufacturing Site, Merced, California***—Developed remedial approach and fixed price costing for the \$15 million guaranteed remediation of a large hexavalent chromium and arsenic groundwater plume in a drinking water aquifer. Served as program director. Performed optimization of existing 500-gpm groundwater extraction and treatment system to meet compliance goals. Within 3 years, shallow soil remediation was completed and the costly aboveground groundwater treatment system was decommissioned. Within 5 years, the shallow zone plume was remediated to state goals using *in situ* biological reduction technologies.

***Soil and Groundwater Remediation at Former Pesticide Plant, Lathrop, California***—Served as senior advisor for development of an alternative aquifer restoration strategy to significantly enhance mass removal and close a longstanding liability. Alternative included aggressive excavation of source soil fumigant and sulfolane mass in soil and *in situ* delivery of oxygen to address shallow groundwater source zones. In addition, the program included a 300-gpm revised groundwater extraction, GAC/bioreactor treatment, and reinjection system that dramatically increased mass removal to reduce lifecycle costs. Negotiated complex waste discharge requirements permit revision to support system modifications, including innovative groundwater containment and background monitoring program for both the shallow and regional aquifers.

***Soil and Groundwater Remediation at Former Ordnance Facility, Hollister, California***—Served as project manager and lead engineer for a site impacted with hexavalent chromium, chlorinated solvents, and perchlorate. Implemented *in situ* anaerobic bioremediation in source areas, resulting in significant decreases in groundwater chemical concentrations, including achievement of perchlorate and hexavalent chromium soil and shallow groundwater cleanup goals. Achieved first perchlorate cleanup in vadose soil using *in situ* biological reduction methods. Was lead engineer for 250-gpm groundwater containment system, including bioreactor and GAC to treat anions and chlorinated volatile organic compounds (CVOCs).

***Downey Landing, Downey, California***—Served as the program director for a \$16 million Phoenix award-winning aquifer restoration project in a drinking water aquifer that achieved regulatory closure. This guaranteed remediation of CVOCs in a drinking water aquifer was implemented on behalf of a multiple stakeholder group and facilitated a massive site redevelopment including retail center, movie studio, and new hospital. Oversaw ERD remediation of a 1.5-mile-long plume before, during, and after redevelopment under a voluntary remediation program. Project included soil closure after soil vapor extraction and in-site chemical oxidation



remediation. Negotiated groundwater closure framework with the state based on site-specific, attenuation-based cleanup goals. Creative approach addressed commingled plume issues discovered after contract execution.

***Former Pharmaceuticals Plant, Flint River, Albany, Georgia***—Served as program director for \$13 million guaranteed remediation of multiple groundwater plumes in a drinking water aquifer and more than 50 RCRA units to facilitate site demolition and redevelopment. Oversaw costing, design, and implementation of all soil and groundwater remedial systems and negotiation of RCRA permit modifications. Systems included air sparging, soil vapor extraction, and *in situ* anaerobic oxidation to address multiple toluene and methylene chloride plumes.

***Guaranteed Remediation Program, Del Monte Center, Monterey, California***—Served as program director for performance-based remediation of CVOCs in fractured bedrock at a former dry cleaners site at an active downtown outdoor mall. Implemented soil excavation, soil vapor extraction for soils, and *in situ* ERD systems for soil and groundwater in a drinking water aquifer.

***Guaranteed Remediation Program, Fig Garden Village, Clovis, California***—Served as program director for performance-based remediation of VOCs in deep groundwater in a drinking water aquifer at a former dry cleaners site at an active outdoor mall. Completed all remediation in 10 years and protected multiple nearby city water supply wells from adverse impacts.

***Guaranteed Remediation Program for Seven Power Plants, Various Sites, Texas***—Served as program director for the \$26 million guaranteed closure of 36 areas of concern at 7 power plant sites in south Texas. Liability transfer facilitated repowering/redevelopment of critical energy resources. Implemented a variety of soil and groundwater remediation programs to complement risk-based closer approaches. Within 7 years, all sites were closed via multiple innovative regulatory and technical strategies under the Texas Risk Reduction Program.

***Baylands Recovery Project, Menlo Park, California***—Served as project manager and lead engineer for the completion of a remedial action plan and remedial design for a lead-impacted salt pond and upland area. Despite difficult regulatory, environmental, and technical implementability concerns given the soft site sediments, the remedial action plan and remedial design were accepted by all stakeholders within the required project timeframe and resulted in a completed site remediation and regulatory closure.

***Product Recovery and Groundwater Treatment, Port of Oakland, Oakland, California***—Served as project manager and lead engineer for a diesel product recovery and groundwater treatment system associated with Vision 2000 port redevelopment. System design was completed quickly to meet the port's compliance, financial, and engineering requirements. Oversaw system construction, startup, and operation and maintenance. Efforts resulted in rapid completion of construction in midst of port terminal expansion and achievement of associated regulatory compliance. Achieved regulatory closure.



***Singer-Friden State Superfund Site, San Leandro, California***—Project manager and design engineer for a 200-gpm GAC groundwater remediation system to treat CVOCs to drinking water cleanup goals. Completed the design package for the system and oversaw bid and construction. Efforts resulted in completion of key client milestone on time and on budget.

***Lorentz Barrel and Drum Superfund Site, San Jose, California***—Designed large dual-phase extraction system at this Superfund site to treat soil and groundwater including GAC treatment for CVOCs and benzene, toluene, ethylbenzene, and xylenes in soil vapor and groundwater. Oversaw bid and construction of a remediation system and asphaltic concrete cap. Completed significant field engineering changes to ensure construction was completed on time, despite difficult site conditions. Earned a commendation from EPA for completing the remedial action on time and on budget.

### **Legal/Litigation Support**

***Litigation Support and Expert Witness Testimony, Various Claims, Nationwide***—Retention as testifying expert for the evaluation of claims regarding the occurrence and mitigation of PFAS in soil and groundwater including potable groundwater supplies (*In re: Aqueous Film-Forming Foams Products Liability Litigation, Case No. MDL 2:18-mn-2873-RMG, U.S. District Court, District of South Carolina, Charleston Division*). Support includes technical and regulatory evaluations. Testimony as part of Science Day proceedings.

***Litigation Support, Various Claims, Morgan and Limestone Counties, Alabama***—Retention as testifying expert for the evaluation of claims regarding the occurrence and mitigation of PFAS in potable water supplies (*Tommy Lindsey, Lanette Lindsey, and Larry Watkins, Individually, and on Behalf of a Class of Persons Similarly Situated, vs. 3M Company, et al., Case No. 5:15-cv-01750-MHH, U.S. District Court, Northern District of Alabama, Northeastern Division*).

***Litigation Support, Deposition, and Expert Witness Testimony, Potable Water Treatment Claims, Atwater, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (*City of Atwater v. Shell Oil Company et al., Case No. SCVSS 120627, Superior Court of the State of California for the County of San Bernardino*). Retention included technical support, settlement negotiation assistance, deposition, trial preparation, and trial testimony. Support included technical and regulatory evaluation, design, and cost opinions for installation and operation of long-term potable water wellhead treatment systems and associated infrastructure and claims.

***Multiple Depositions, Pre-filed Direct Testimony and Fact Witness Testimony, U.S. District Court for the Eastern District of California on behalf of Merck and Co., 2012***—As previous project manager and program director, supported client in defense of third-party class action lawsuit claiming local community health impacts from both past wood treatment plant operations and current remedial efforts. Depositions and testimony outlined history and extent of groundwater and soil impacts, as well as scope and results from remedial efforts.



***Deposition, Expert Reports on Remedial Costs and Other Damage Claims, Superior Court of Washington for King County, Confidential Clients***—Technical expert for evaluation of past remedial action effectiveness and defense of claims at a former industrial dry cleaning site undergoing redevelopment (*Washington Builders LLC et al v. 700 Dexter LLC et al.*, Case No. 16-2-30634-9 SEA, Superior Court of Washington for King County). Matter settled.

***Litigation Support, Potable Water Treatment Claims, City of Fresno, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (*City of Fresno v. Shell Oil Company, et al.*, Case No. CGC 107-461557, In the Superior Court of the State of California for the County of San Francisco). Retention scope similar to Atwater case. Ongoing matter.

***Litigation Support, Potable Water Treatment Claims, Hemet, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (*City of Hemet v. The Dow Chemical Company, et al.*, Case No. 18-CV-02022, U.S. District Court, Central District of California). Expert report filed. Retention scope similar to Atwater case. Settled.

***Litigation Support, Potable Water Treatment Claims, Private Wells, Various Counties, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (*Golden State Water Company v. The Dow Chemical Company, et al.*, Case No. 18-CV-08199, U.S. District Court, Central District of California). Retention scope similar to Atwater case. Settled.

***Litigation Support, Potable Water Treatment Claims, Kern County, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (e.g., *Arvin Community Service District v. The Dow Chemical Company, et al.*, Case No. CGC 12-522788, Superior Court of the State of California in and for the County of San Francisco). Retention scope similar to Atwater case. All matters settled.

***Litigation Support, Potable Water Treatment Claims, Tulare County, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (e.g., *London Community Service District v. The Dow Chemical Company, et al.*, Case No. VCU278903, In the Superior Court of the State of California in and for the County of Tulare). Retention scope similar to Atwater case. All matters settled.

***Litigation Support, Potable Water Treatment Claims, Group 3 Cases, Various Counties, California***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells (e.g., *City of Manteca v. The Dow Chemical Company, et al.*, Case No. SCVSS 120627, In the Superior Court of the State of California in and for the County of San Bernardino). Retention scope similar to Atwater case. Ongoing matters.

***Litigation Support, Potable Water Treatment Claims, Group 2A Cases, Various Counties, California***—Joint retention as testifying expert for resolution of claims associated with occurrence



of 1,2,3-TCP in potable groundwater supply wells (e.g., *Monte Verde Water District and City of Chino v. The Dow Chemical Co., et al.*, Case No. CIVDS 1800720, In the Superior Court of the State of California in and for the County of San Bernardino). Retention scope similar to Atwater case. Ongoing matters.

***Litigation Support, Potable Water Treatment Claims, Fresno County, California***—Testifying expert for resolution of claims in five cases involving occurrence of 1,2,3-TCP in potable groundwater supply wells (e.g., *Del Rey Community Services District vs. The Dow Chemical Company, et al.*, Case No. CGC-12-522921, Superior Court of the State of California in and for the County of San Francisco). Retention scope similar to Atwater case. All matters settled.

***Settlement Negotiation Support, Potable Water Treatment Claim, Kern County, California, Confidential Clients***—Joint retention as expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells in a residential community. Performed regulatory and technical evaluations to develop designs and cost opinions. Settled.

***Settlement Negotiation Support, Potable Water Treatment Claim, San Joaquin County, California, Confidential Clients***—Joint retention as expert for resolution of claims associated with occurrence of 1,2,3-TCP in a potable groundwater supply well. Performed regulatory and technical evaluations to develop designs and cost opinions. Settled.

***Settlement Negotiation Support, Private Well Water Treatment Claims, Kern County, California, Confidential Clients***—Joint retention as testifying expert for resolution of claims associated with occurrence of 1,2,3-TCP in potable groundwater supply wells at an agricultural production facility. Performed regulatory and technical evaluations to develop designs and cost opinions. Ongoing matters.

***Settlement Negotiation Support, Private Well Water Treatment Claims, Kern County, California, Confidential Clients***—Joint retention as technical expert for resolution of claims associated with 1,2,3-TCP in groundwater supply wells at two agricultural production facilities. Performed regulatory and technical evaluations to develop designs and cost opinions. Ongoing matters.

***Litigation Support, Industrial Facility, Brunswick, Georgia, Confidential Client***—Technical expert for review of claims and evaluation of interim remedies related to a third-party claim of VOC contamination in groundwater (*Lanier Parkway Associates, LLC et al. v. Hercules Inc. et al.*). Ongoing matter.

***Potential Litigation Matter, Superfund Site, California, Confidential Clients***—Technical expert for review of claims by EPA of historical chlorinated solvent releases to groundwater from sanitary sewers at a Superfund site. Ongoing matter.

***Litigation Support, Former Smelter Site, Selby, California, on behalf of Celanese Corporation***—Review of a former industrial facility to evaluate claims of historical site impacts. The evaluation included extensive historical review of photogrammetry and temporal process engineering to produce a compelling conceptual site model that resulted in plaintiff abandoning claims.



**Settlement Support, Minnesota, Confidential Client**—Supported client team in developing costing of remediation scenarios and risk management options, including insurance, financial, and other potential risk management mechanisms, to facilitate successful settlement negotiations between client and a major utility at a former manufactured gas plant site.

**Settlement Support, Utility Strike Emergency Response, Long Island, New York, Confidential Client**—Evaluated damage claims against client and prepared expert report presenting technical underpinnings of defense strategy. Supported deposition preparations.

**Litigation Support, Cement Plant, Seattle, Washington, Confidential Client**—Technical expert for review of claims and evaluation of sediment remediation cost estimates to support potential settlement under tolling agreement. Oversaw completion of independent cost estimate for use in expert report to compare with plaintiff and insurer estimates. Proposed probabilistic modeling approach to support settlement of contingent liabilities. Case resolved.

**Allocation Support, Former Rocket Launch Facilities, California, Confidential Client**—Technical expert for defense of claims at active U.S. Department of Defense site. Coauthored expert report covering soil and groundwater cost recovery claims at four sites. Performed extensive data review, historical research, financial analysis, and development of alternate allocation model using a number of different technical approaches that significantly reduced projected pre-settlement claims.

## Invited Presentations

Frankel, A. 2019. PFAS Occurrence and Treatment: Key Observations. Oral Presentation. Law Seminars International PFAS Litigation Conference, December 9, San Diego, CA.

Frankel, A. 2019. A Short List of Remediation Game Changers and Key Drivers Past and Present—a 30-year Perspective. Oral Presentation. National Groundwater Association Groundwater Week, December 4, Las Vegas, NV.

Frankel, A., and M. Martin. 2019. PFAS wellhead treatment considerations—Intersection of water supply with plume remediation. Oral Presentation. National Groundwater Association PFAS Management, Mitigation, and Remediation Conference, June 19, Westerville, OH.

Frankel, A., S. Sliver, and D. Henrich. 2018. Plenary Session: PFAS. Oral presentation and panel discussion. 2018 National Groundwater Association Groundwater Week, December 3–6, Las Vegas, NV.

Frankel, A., K. Gettmann, and A. Bass. 2018. PFAS Panel: Oral presentation and panel discussion. 2018 Environmental Law Conference at Yosemite, September 19–21, Fish Camp, CA.

## Presentations

Frankel, A. 2019. PFAS Remedial Strategies. Panel Chair and Presentation. Presentations published in the proceedings of the 35th International Conference on Soils, Sediments, Water, and Energy, Amherst, MA.





Martin, M., A. Frankel, and K. Brodock. 2018. Lessons learned from implementation of a potable water wellhead treatment system for a long chain perfluoroalkyl acid. Poster presented at the First Annual Groundwater Congress, September 25–27, West Sacramento, CA.

Frankel, A. 2018. State of the Practice – Advances in In Situ Remediation. Panel chair and organizer. 27th International Conference on Soil, Water, Energy and Air, March 19–22, San Diego, CA.

Halmstad, A., A. Frankel, D. Moser, T. Wotan, and C. Sandefur. 2018. Lessons learned from ERD implementation at a CVOC contaminated site in Monterey, CA. Oral Presentation. 27th International Conference on Soil, Water, Energy and Air, March 19–22, San Diego, CA.

Martin, M., A. Frankel, and K. Brodock. 2018. Lessons learned from implementation of a potable water wellhead treatment system for a long chain perfluoroalkyl acid. Poster presented at the Emerging Contaminants Summit, March 6–7, Westminster, CO.

Frankel, A., and R. Keenan. 2016. Guiding decisions and managing risk – Environmental applications of decision analysis and probabilistic evaluation current state of practice. Panel Chair. 32nd International Conference on Soils, Sediments, Water, and Energy, Amherst, MA.

Frankel, A., J. Anderson, and P. Goodrum. 2016. Water quality standards for perfluoroalkyl compounds, crossroads between regulatory toxicology and remedy selection. Oral Presentation. 10th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA.

Frankel, A. 2015. Lessons learned from redevelopment and reuse of federal and private sector industrial sites. Oral presentation. 31st International Conference on Soils, Sediments, Water, and Energy, Amherst, MA.

Frankel, A. 2015. California Brownfields reuse and transactions. Panel chair and organizer. 25th International Conference on Soil, Water, Energy and Air, San Diego, CA.

Frankel, A., T. Trent Henderson, E. Putnam, and P. Hall. 2006. Selection of bioreactor and LGAC to treat groundwater with perchlorate, nitrate, and hexavalent chromium. Oral presentation. Groundwater Resources Association of California's Symposium, Perchlorate: Progress Toward Understanding and Cleanup, Santa Clara, CA.

Frankel, A., S. Potter, and L. Cekan. 2006. Fate and transport modeling with dual domain and residual source to guide remedial approach evaluation. Oral presentation. 2006 National Ground Water Association Groundwater Summit, San Antonio, TX.

Frankel, A., S. Potter, and L. Cekan. 2005. Fate and transport modeling with dual domain and residual source. Oral presentation. 2005 National Ground Water Association Remediation Conference: Site Closure and the Total Cost of Clean-up, Houston, TX.



Wuerl, B.J., A. Frankel, N. Morgan-Butcher, and J. Ely. 2005. Enhanced *in situ* co-reduction of perchlorate, hexavalent chromium, and halogenated VOCs in groundwater. Oral presentation. 2005 National Ground Water Association Conference on MTBE and Perchlorate: Assessment, Remediation, and Public Policy, San Francisco, CA.

Frankel, A., and B.J. Wuerl. 2005. *In situ* anaerobic remediation of perchlorate-impacted soils. Oral presentation and paper. 2005 National Ground Water Association Conference on MTBE and Perchlorate: Assessment, Remediation, and Public Policy, San Francisco, CA.

Frankel, A., L.M. Owsianiak, and J. Peters. 2004. Development of an animated site conceptual model to support groundwater remediation data gap identification and resolution. Oral presentation. Groundwater Resources Association of California's 13th Annual Meeting and Conference, Rohnert Park, CA.

Wuerl, B.J., L.M. Owsianiak, A. Frankel, and B. Molnaa. 2004. *In situ* anaerobic bioremediation of perchlorate-impacted vadose zone soil. Oral presentation and paper. The Eleventh Symposium in the Groundwater Resources Association of California's Series on Groundwater Contaminants, ClO<sub>4</sub>- 2004—Perchlorate in California's Groundwater, Glendale, CA.

Frankel, A., L.M. Owsianiak, B.J. Wuerl, and J.F. Horst. 2004. *In situ* anaerobic remediation of perchlorate-impacted soils. Oral presentation and paper. 2004 National Ground Water Association Remediation Conference: Site Closure and the Total Cost of Clean-up, New Orleans, LA.

