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Issue(s):	Hydrogeology
Witness:	Tyler E. Gass
Sponsoring Party:	Union Electric Company
Type of Exhibit:	Surrebuttal Testimony
Case No.:	EA-2012-0281
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MISSOURI PUBLIC SERVICE COMMISSION

Case No. EA-2012-0281

SURREBUTTAL TESTIMONY

OF

TYLER E. GASS

ON

BEHALF OF

UNION ELECTRIC COMPANY
d/b/a AMEREN MISSOURI

Louisville, Colorado
September, 2013

Surrebuttal Testimony

of

Tyler E. Gass

Case No. EA-2012-0281

Q. Please state your name and business address

A. Tyler E. Gass, Integral Consulting Inc., 285 Century Place, Suite 190, Louisville, CO 80027.

Q. By whom are you employed and in what capacity?

A. I am employed by Integral Consulting Inc. as Principal and Chief Hydrogeologist.

Q. What are the duties of your position?

A. I provide hydrogeologic and environmental consulting on complex issues, primarily at hazardous and solid waste disposal sites. In addition, I have management and mentoring responsibilities within Integral Consulting Inc.

Q. Please describe your education background and employment experience.

A. I have a Bachelor of Arts Degree in Geology from the State University of New York at Buffalo, and a Master of Science Degree in Geosciences from the University of Arizona. I am a licensed geologist in Pennsylvania, Illinois, and

Washington, and a licensed hydrogeologist in Washington. I have more than 40 years of professional experience addressing issues related to groundwater resource evaluation and development, and solving complex groundwater and environmental problems. I started work at H2M Corp. as a hydrogeologist. I then went on to become Director of Research and Technical Services at the National Ground Water Association. Following that, I was President of Bennett, Gass & Williams, a hydrogeologic and geologic consulting firm. I then spent more than 25 years as a Principal at Blasland, Bouck & Lee, Inc. until shortly after the firm was acquired by ARCADIS. In 2009, I went to work as an Executive Vice President at Tetra Tech, and for the past 18 months I have been a Principal and Chief Hydrogeologist at Integral Consulting Inc. A copy of my CV is attached hereto and incorporated herein by this reference as Exhibit A.

Q. Have you previously filed testimony in this proceeding?

A. No.

Q. What is the purpose of your surrebuttal testimony in this proceeding?

A. The purpose of my surrebuttal testimony is to respond to questions raised through testimony given during public hearings related to Ameren Missouri's expansion of its Labadie Energy Center to accommodate a new utility waste landfill (UWL), specifically addressing issues related to groundwater. In particular, I will address certain contentions made or concerns raised through local public hearing

testimony from Ms. Diana Haynes, Ms. Petra Haynes, Ms. Barbara Bollman, Ms. Gerry Friedman, Mr. Richard Haynes, Mr. John George, and Mr. Adrian Hutton

Q. Are you sponsoring any schedules with your written testimony?

A. No.

Q. You mentioned testimony given at the local public hearings. Have you reviewed the transcripts of those hearings in their entirety?

A. Yes.

Q. What other documents have you reviewed to arrive at your conclusions in this case?

A. The following documents were documents primarily used to arrive at my conclusions in this case:

- Ameren. 2011. NPDES Permits and Engineering Section. Updated NPDES Permit MO-0004812 Renewal Application, Ameren Missouri's Labadie Energy Center.
- Duley, J.W. 2009. Personal communication (letter to Mr. Paul Pike, Ameren, One Ameren Plaza 1901 Chouteau Avenue, St. Louis MO 63166, regarding Preliminary investigation of the proposed expansion of the AmerenUE-Labadic Utility Waste Landfill). State of Missouri Department of Natural Resources.

- Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012, from temporary groundwater piezometers installed near Labadie Plant. Golder Associates, April 24, 2012.
- Golder. 2012. Report on Piezometer Installation, Water Level Monitoring, and Groundwater Sampling, Labadie, Missouri. Golder Associates, May 9, 2012.
- Gredell Engineering Resources, Inc. 2011. Detailed site investigation report for: Ameren Missouri Labadie Power Plant Proposed Utility Waste Disposal Area, Franklin County, Missouri. February 4, 2011 (revised March 30, 2011).
- Imes, J.L. and L.F. Emmett. 1994. Geohydrology of the Ozark Plateaus Aquifer System in Parts of Missouri, Arkansas, Oklahoma, and Kansas. U.S. Geological Survey Professional Paper 1414-D.
- Martin, R. and D.G. Hartley. 2013. Personal communication (letter to Mr. Paul Pike, Strategic Analyst, Ameren Missouri, PO Box 66149, 1901 Chouteau Avenue, St. Louis MO 64166-6149, regarding review and comments on construction permit application for a Proposed Utility Waste Landfill, Ameren Missouri Labadie Energy Center, Franklin County, Missouri). State of Missouri Department of Natural Resources.
- Pike, P.R. 2008. Personal communication (letter to Mr. Larry Pierce, Unit Chief – Geological Survey Program, Division of Geology and Land Survey,

Department of Natural Resources, PO Box 250, Rolla MO 65402-0250, regarding Preliminary Site Investigation request – proposed utility waste landfill AmerenUE Labadie Power Plant, Franklin County, Missouri). Ameren Services, Environmental Services.

- Reitz & Jens, Inc. 2008. Memorandum, Preliminary Site Conditions, AmerenUE Labadie Power Plant, Proposed Utility Waste Landfill Site. November 12, 2008.
- State of Missouri. 2013. Volume III Transcript of Local Public Hearing before Morris L. Woodruff, Presiding Chief Law Judge, and Robert S. Kenney, Chairman. File No. EA-2012-0281. June 25, 2013. Public Service Commission, Union, MO.
- State of Missouri. 2013. Volume IV Transcript of Local Public Hearing before Morris L. Woodruff, Presiding Chief Law Judge, Robert S. Kenney, Chairman, and Stephen M. Stoll, Commissioner. File No. EA-2012-0281. July 10, 2013. Public Service Commission, Washington, MO.

Q. **To the extent that you relied on any documents, including in forming your opinions, are those documents of the type reasonably relied upon by experts in the area of hydrogeology, and do you consider such documents reasonably reliable?**

A. Yes.

Q. Are the opinions expressed in this testimony given within a reasonable degree of hydrogeological certainty?

A. Yes.

Q. Before addressing the specifics of the testimony given at the public hearings, given the issues about groundwater raised by that testimony, do you have an opinion regarding whether Ameren Missouri has proposed an effective groundwater monitoring network, with a sufficient number of upgradient monitoring wells to permit identification of changes in groundwater quality in the vicinity of the UWL to identify any impacts to groundwater quality?

A. Yes, I do. Ameren's Missouri's proposed Detection Groundwater Monitoring Network meets or exceeds all regulatory requirements, and has a sufficient number of monitoring wells upgradient (7) and downgradient (21) to identify whether chemical compounds from the UWL have had an impact on groundwater in the area around the proposed UWL well before any possible impact could occur off-site. A groundwater model has been used to determine the appropriate spacing between wells, taking into account numerous factors, including longitudinal and transverse dispersion, groundwater velocity, and average contaminant concentrations from a hypothetical release point. In addition, the model has used a groundwater flow direction based on a 12-month average of hydraulic gradient. This is conservative since the average value does not completely reflect the variability of groundwater flow, which seasonally can be

as much as 180 degrees. What this means is that if there were a plume, its width is likely to be larger than depicted by the model, which further improves the early detection of any chemicals that could emanate from the UWL if all of the groundwater protection features of the UWL were to fail.

The seven upgradient monitoring wells have a remote chance of being affected by an anomalous reversal of groundwater flow. If this were to occur, the temporal effects would be very limited and it would likely only affect one or two wells. Such an event would not impact the effectiveness of the groundwater monitoring program, or in any way affect its ability to detect an early release of chemicals from the UWL.

Finally, the 24-month pre-operation baseline groundwater quality monitoring program will effectively determine ambient groundwater quality in the vicinity of the UWL. Groundwater monitoring during UWL operations and after operations are completed is sufficiently robust to expeditiously determine if a release of chemical compounds from the UWL has occurred.

Q. One of the concerns expressed at the local public hearings by several of the witnesses you mentioned above related to the potential for contamination of the public water supply wells in the area as a result of releases from the UWL. If a release were to occur from the UWL that impacted groundwater quality, would groundwater water quality of residential drinking and public water supply wells be affected?

A. Such a scenario is extremely unlikely for several reasons. First, it is my understanding that there are several redundant protection systems contained in the UWL's design. Other witnesses address those systems, and they are discussed in Ameren Missouri's Construction Permit Application filed with the Missouri Department of Natural Resources. Second, all drinking wells within the area around the UWL are situated on the bedrock bluffs to the south and east of the UWL. Nearly all drinking water wells in the area are completed in bedrock consisting of several geologic formations cumulatively referred to as the "Ozark Aquifer." Regional groundwater flow in the Ozark Aquifer is toward the Missouri River (and away from the bluffs), and groundwater elevations in the Ozark Aquifer are primarily above the groundwater elevations observed in the alluvial (river deposited sand and gravel) aquifer of the Labadie Bottoms. This means that groundwater from the Ozark Aquifer is generally flowing towards and contributing to groundwater within the alluvial aquifer beneath the Labadie Bottoms, where the UWL will be located. The possibility for normal hydraulic gradients to be reversed between the alluvial groundwater system and parts the Ozark Aquifer during periods of high river stage (flooding) and therefore impact these drinking water wells is quite unlikely. High water levels in the alluvial aquifer generally occur when groundwater elevations in the Ozark Aquifer are higher than normal as well, mitigating the effects of a reversal of flow into the Ozark Aquifer. Moreover, groundwater flow is generally very slow (a few inches to a few feet per day),

and flood events and high water levels, when they do occur in the alluvial aquifer, are on the order of 10 to 100 days. This means that even if a scenario were to occur where there was an extended high water/flood event, it is extremely improbable that the bedrock Ozark Aquifer would be affected by the UWL. In addition, I have not seen site-specific data to support that this scenario has ever occurred or even that a release has occurred from the existing ash ponds, and the proposed UWL is designed to be even more resistant to the effects of flooding and high groundwater levels. Even in the unlikely event of a release from the proposed UWL, there would be remedial response action in the event that chemicals from the UWL were identified in the alluvial aquifers, including the fact that the robust groundwater monitoring network would identify alluvial aquifer impacts early well before impacts to drinking water wells in the area could occur.

Q. How does the alleged risk of drinking water well contamination from the proposed UWL compare to other potential threats to drinking water supplies?

A. The risk of contamination from the proposed UWL is virtually non-existent as compared to other, more likely risks. For example, no witnesses raised the issue of impairment of surface water quality during severe flood events caused by agricultural runoff, discharge of sewers, and overflow of septic systems, etc. The deleterious impact of contaminated flood waters (unrelated to Ameren Missouri's operations) on the alluvial aquifer and/or the Ozark Aquifer is something the witnesses

have not addressed. In my opinion, the possibility that these aquifers may be impacted by contamination unrelated to Ameren Missouri operations during severe flood events is far more likely than that posed by the UWL.

Q. Are you aware of any information that indicates that there has been contamination of drinking water supplies of those living in the area even though ash has been stored in ash ponds at the Labadie Plant for the past 43 years?

A. No. I have reviewed data from groundwater sampling conducted by Golder Associates in the Spring of 2012. Golder drilled three wells along the border of Ameren Missouri's property into the Ozark Aquifer (south and east of the proposed UWL site toward the residents living on the bluffs) at depths that would be typical of the depths of drinking water wells in the area. If the stored coal ash in the existing wet ash ponds was impacting groundwater toward these residences, one would expect for the samples from these wells to reflect that impact. The results of those tests indicated no impact from coal ash in the area between the ash ponds and the drinking water wells. I would also note that while anecdotal, Mr. George testified that he had tested his private drinking water well just a few years ago, and that there was no contamination found. While I have no information to suggest that the existing wet ash impoundments have contaminated groundwater at all, whether in the immediate vicinity of the ponds or otherwise, certainly if there have not been impacts in these three test wells or in wells like Mr. George's well over the past 40 years it is unreasonable to

think that ash stored dry in a solid state in the proposed landfill would lead to contamination. And as I mentioned, the landfill's design, including the liner system, leachate collection system, and groundwater monitoring network, provides a high degree of protection against any such contamination.

Q. Another concern raised at the public hearings related to the potential interaction between groundwater and the coal ash in the proposed UWL. Will high groundwater levels result in groundwater coming in direct contact with UWL waste materials resulting in groundwater contamination?

A. This is extremely unlikely. Let me explain why. One of the concerns raised at the local public hearing was the direct contact between groundwater at or on the surface of the site and the coal ash because of defects in the landfill liner. This hypothetical scenario is a very remote possibility. The Coal Combustion Products (CCP) in the UWL is essentially isolated from the underlying groundwater, regardless of whether groundwater is beneath the surface or at the surface. Although there were general criticisms directed at the UWL liner, no witness ever explained what particular defects could occur in the proposed engineered composite liner system (which exceeds regulatory requirements and represents "best available technology" for waste isolation). If I may present an analogy to clarify my opinion that the UWL is effectively isolated from groundwater, consider a plastic pail filled with concrete (concrete being analogous to the CCP once it has hardened) sitting on a beach right by the water's edge. When the

water rises so that the pail is now standing in the water, the concrete within the pail keeps it from floating. The concrete within the pail remains entirely isolated from the water around it. The liner system isolates the CCP in the UWL in the same fashion. Neither groundwater nor flood water comes in contact with the materials within the liner.

Q. You mentioned a pre-operation baseline monitoring program. Have you seen any results from that program?

A. Yes, I have. I have reviewed a groundwater monitoring report prepared by AECOM that discusses the results of two different sampling events occurring over the past several months.

Q. Do those results support your conclusion that it is highly unlikely that there would be any contamination to drinking water supplies related to the proposed UWL?

A. Yes, they do. As addressed in the testimony of Lisa J.N. Bradley, Ph.D, her firm, AECOM, analyzed results from two separate rounds of sampling from the 28 monitoring wells installed by Ameren Missouri that ring the proposed UWL site. The results indicate that there has been no impact to the UWL area from the operation of the existing coal ash impoundments over the past approximately 40 years. This is consistent with the other evidence I noted above and with my expectations given the hydrogeology in the area, which I explained earlier.

Q. Will reversals in hydraulic gradient in the alluvial system result in groundwater contamination of the Ozark Aquifer system?

A. The regional groundwater flow is generally from the Ozark Aquifer to the alluvial aquifer beneath the Labadie Bottoms. Because of the slow, muted nature of the groundwater-surface water interaction, a brief flood event of the Labadie Bottom does not represent the surface of the water table. For flood events of the duration of weeks or months, groundwater and flood waters will eventually come into a hydrostatic equilibrium in which the water at the surface becomes representative of groundwater elevation. Again, because of the time lag associated with the groundwater-surface water interaction, even after flood waters recede, groundwater may still be at the surface for days or weeks as it slowly drains back to the Missouri River. Also, because groundwater moves only on the order of a few inches to a few feet per day, a short term reversal of gradient in the alluvial aquifer is not going to have an impact on groundwater quality within the Ozark Aquifer, even taking into consideration wells being pumped from the Ozark Aquifer.

Q. Please summarize your opinion regarding the potential for drinking water contamination from the proposed site.

A. There is no material risk of contamination of drinking water supplies. This is due to the hydrogeology in the area and the robust groundwater quality monitoring well system that is in place, as well as the redundant protections included in

the design of the proposed UWL, which are discussed by others. Other risks to drinking water supplies, having nothing to do with the proposed UWL, are likely greater than any minimal risk posed by the UWL.

Q. Are there studies that support your opinion?

A. Yes, there are. As part of the Missouri Department of Natural Resources' ("MDNR") permitting process, Ameren Missouri was required to submit a Preliminary Site Investigation and, if approved, a Detailed Site Investigation. The entire purpose of these investigations is to allow MDNR, prior to the applicant proceeding with actual design of a facility, to determine if the site for the proposed facility is appropriate, meaning would a properly designed and constructed facility be protective of human health and the environment. By letter dated February 2, 2009, MDNR approved the Preliminary Site Investigation. By letter dated April 8, 2011, MDNR approved the Detailed Site Investigation. The Detailed Site Investigation in particular contained a detailed hydrogeological evaluation for the proposed site, and its conclusion, which I share, is that the site is appropriate for the proposed facility. The hydrogeological evaluation was thorough, well-done, and its conclusions are reasonable and supported by the extensive data underlying it.

Q. Would you summarize the opinions you have stated in this testimony?

A. Yes. They are:

- Ameren Missouri has installed a robust and highly effective groundwater quality monitoring network to provide early detection of any chemical coumponds that could potentially migrate in groundwater from the UWL.
- Given the use of Best Available Technologies built into the design of the UWL and the hydrogeology of the area, it is extremely unlikely that it would result in contamination of private or public drinking water wells.
- The design of the UWL essentially isolates the CCP from the effects of high groundwater levels or flood waters.
- The UWL represents a much safer alternative to the disposal of CCP than the existing impoundments which have never been found to have caused any groundwater contamination during the past 40 years of operation.

Q. Does this conclude your surrebuttal testimony?

A. Yes, it does.

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Tyler E. Gass, P.G., P.Hg.

Principal and Chief Hydrogeologist

PROFESSIONAL PROFILE

Mr. Tyler Gass is a licensed professional geologist and hydrogeologist with more than 30 years of experience broadly ranging from the evaluation and design of village water supply in developing countries to major municipal groundwater supply systems in the United States, and including the investigation and remediation of some of the most chemically hazardous sites in the United States. Mr. Gass has worked at numerous hazardous waste sites across the United States, where he has performed subsurface site characterization and contaminant assessments and designed and implemented groundwater and soil remediation programs. As a former Director of Research for the National Ground Water Association, Mr. Gass testified before several congressional committees and made presentations to a variety of state legislative bodies encouraging the development of rational regulations to protect groundwater quality from solid and hazardous waste disposal. Mr. Gass was appointed to the Army Science Advisory Board in 1994 and served three terms on the Board until 2000. During that time, Mr. Gass was the primary author of a white paper addressing the performance of groundwater remediation systems at Army installations throughout the United States, and he was the Chairman of the Infrastructure and Environment Committee from 1998 to 2000.

CREDENTIALS AND PROFESSIONAL HONORS

M.S., Geosciences, University of Arizona, Tucson, Arizona, 1977
B.A., Geology, University of New York, Buffalo, New York, 1970

Licensed Professional Geologist: Illinois #196-000104; Pennsylvania #PG002906G; Washington #1906
Licensed Hydrogeologist: Washington #1906
Certified UST Subsurface Evaluator: New Jersey #0010881

PROFESSIONAL AFFILIATIONS

Past Chairman of the Association of Ground Water Scientists and Engineers
Past Member of the U.S. Army Science Board
Former Director and Life Member of the National Ground Water Association
Life Member of the American Water Works Association

American Institute of Professional Geologists
American Institute of Hydrology

RELEVANT EXPERIENCE

Representative Superfund/CERCLA Projects

Hydrogeologic Investigation and RI/FS for Chemical Waste Beds, Solvay, New York—Project manager for an investigation focusing on shallow and deep groundwater flow patterns and groundwater/surface-water interactions. Of primary concern were inorganic leachate in groundwater and chemical loading to adjacent streams and surface-water bodies.

Middleground Landfill Site, Bay City, Michigan—As project officer for the Middleground Landfill site RI/FS, was responsible for developing the RI/FS work plan and negotiating with the Michigan Department of Natural Resources (MDNR) to obtain acceptance of the work plan. The Middleground Landfill was constructed on an island in the Saginaw River. The site received several municipal and industrial wastes including PCB-containing liquids, solvents, pesticides, and waste oils. Sampling of soil, sediment, groundwater, and surface water indicated multimedia contamination by PCBs; chlorinated solvents; pesticides including endosulfans, endrin, dieldrin, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT; and metals including arsenic, cyanide, and mercury. Of concern to MDNR were issues related to groundwater discharge to the Saginaw River and the nature and extent of the impact of surface water and sediment. The work plan was approved and fieldwork was initiated in spring 1997. The scope of work included evaluating groundwater/surface-water interactions; delineating the extent of PCBs, pesticides, and metals contamination of sediment; the extent of groundwater and surface-water quality impacts; and the ecological risk associated with PCBs, pesticides, and metals such as arsenic.

Coke Plant, Ironton, Ohio—Principal investigator for a remedial investigation addressing the impact of operations of coke plant on subsurface media and surrounding surface-water bodies. Potential receptors included several tributaries of the Ohio River. Chemicals of concern at the site include PAHs, phenols, arsenic, and other trace metals. Discharge from coke quenching operations was dispersed to a series of unlined impoundments that recharged the groundwater system. Then, groundwater discharged to streams, both north and south of the plant, and directly to the Ohio River. The remedial investigation identified significant groundwater contamination, as well as surface-water and sediment contamination. The facility filed Chapter 11 bankruptcy before a more extensive investigation to define the extent of contamination was performed.

Automotive Manufacturing Facility RI/FS, Saginaw, Michigan—Negotiated an RI/FS work plan with the state regulatory agency for a site where PCB-contaminated waste oil had impacted the aquifer underlying a large automotive manufacturing facility with an onsite landfill. The underlying geology was complex due to its glacial-fluvial origins. The state was concerned with discrete pathways that would permit PCBs to migrate into the Saginaw River. Supervised the RI/FS, designed and implemented interim remedial activities at the

site, and evaluated the potential for flow of PCBs dissolved in groundwater to the Saginaw River.

Landfill Site RI/FS, Elyria, Ohio—Retained by a PRP group to negotiate and develop a work plan for an RI/FS at a former municipal landfill site that had taken industrial waste for 50 years. Served as principal-in-charge of a multidisciplinary team that negotiated a statement of work for inclusion in an administrative order of consent and the subsequent RI/FS work plan on behalf of the PRP group for a landfill located along the Black River in Elyria, Ohio. Through the presentation of a detailed analysis of available site-specific information, EPA accepted a limited scope of work for the RI/FS, which excluded the initial demands for characterization of landfill wastes, collection and analysis of river system biota for comparison to biocriteria, and integrated NRD evaluations.

Fultz Landfill RI/FS, Byesville, Ohio—Negotiated an RI/FS work plan and implemented the remedial investigation program for the Fultz Landfill located in east-central Ohio, which had operated as a municipal solid waste disposal facility for approximately 20 years. The landfill was developed in a former surface mine above an abandoned room and pillar coal mine. In 1983, the facility was placed on the National Priorities List (Superfund) because of the known burial of hazardous constituents that were accepted at the landfill. Although most, if not all, of the drums of hazardous constituents were reported to have been removed, EPA was concerned that geologic and hydrologic conditions of the site created a situation where there was a high potential for groundwater impact. As a result, the owner/operator of the facility voluntarily initiated a hydrogeologic investigation to characterize subsurface conditions and monitor for leachate and any hazardous wastes that may have migrated from the facility confines. Subsequent work included design and construction of a surface-water diversion system, design of a partial closure of the facility, and recommendations for changes in the facility's operating procedures.

Groundwater Plume Investigation, Southwest Florida—Senior officer directing a project to delineate the extent of a contaminant plume consisting of TCE, PCE, and TCA. Flow from the site was radial from the source area. In addition, a downward hydraulic gradient caused significant vertical migration into bedrock units below the overburden. Following delineation, evaluated various remedial activities to hydraulically contain the extent of contaminated groundwater and aggressively remove contaminant mass.

Representative RCRA Projects

Manufactured Gas Plant Investigations, Hudson Valley, New York—Project manager for site characterizations and groundwater quality assessments at eight former manufactured gas plants in the Hudson Valley Region of New York State. Served as expert witness for a regional utility company in a case in which offsite migration of PAHs and dense nonaqueous-phase liquids was alleged.

Assessment of Solvent Recycling Facility, Akron, Ohio—Project manager and principal investigator for a RCRA facility assessment (RFA) of a solvent recycling facility constructed above limestone bedrock. The RFA included defining groundwater flow patterns,

groundwater discharge points, and impacts to groundwater quality. The site was located in EPA Region 3.

RCRA Groundwater Quality Assessment Monitoring Program, Toledo, Ohio—Responsible for coordinating the activities of several consulting firms performing investigations at a hazardous waste facility located in Northwest Ohio, and for preparing the facility's RCRA Groundwater Quality Assessment Monitoring Program. Also served as the company's consultant of record for all meetings with state and federal regulatory agencies.

Refinery Investigation, Cheyenne, Wyoming—Supervised a comprehensive environmental program at a 30,000 bbl/day refinery in Wyoming. Following the assessment of hydrocarbon migration, designed a product recovery system and coordinated all hydrogeologic and engineering activities.

Confirmation of Groundwater Contamination Delineation, Midland, Michigan—Principal investigator for the evaluation of previous hydrogeologic work performed to define the vertical and horizontal extent of 2,3,7,8-TCDD (dioxin) migration in the groundwater and vadose zone beneath a manufacturing facility.

Groundwater Investigation at an Aluminum Manufacturing Facility, Lancaster, Pennsylvania—Directed a program to delineate other local potential sources of TCE contamination causing groundwater degradation at an aluminum manufacturing facility. Initiated this project on the belief that existing data were inconclusive and that additional work was necessary to determine other possible sources before the client committed to a costly remediation program. Efforts resulted in definitively identifying the previously unknown source of contamination.

Projects Related to Karst and Fractured Rock Environments

Process and Chemical Facility, Rochester, New York—As project manager, developed and implemented several groundwater monitoring programs, and designed remedial activities at several process units. The facility overlies limestone bedrock with the potential for discharges to the Genesee River.

Program Management of Retail Service Stations, Nationwide—Served as program manager for many retail service stations and terminals in the United States. Responsible for reviewing all remediation and site assessment programs. The vast majority of the sites are underlain by carbonate aquifer systems.

Review of Work Plans for Groundwater Characterization, Various Locations—Retained by the U.S. Army Environmental Command to review and comment on work plans for investigation and characterization of groundwater flow systems and/or remediation programs at several military installations underlain by karst environments. Sites included Letterkenny Army Depot (Pennsylvania), Milan Army Ammunition Plant (Tennessee), Lexington Bluegrass Army Depot (Kentucky), and Camp Bullis (Texas).

Groundwater Resource Evaluation and Development

Water and Sanitation for Health (WASH) Program Support, Philippines—Assisted the U.S. Agency for International Development (USAID) during the early years of the original WASH Program. Coauthored the Manual of Primitive Well Construction Technologies for USAID and the Barangay Water Manual funded by USAID for the Republic of the Philippines. In conjunction with work on the Barangay Water Manual, spent 6 months in the Philippines supporting village water supply development programs and training engineers to perform water resources evaluations to identify locations for village water supply systems, sanitary well construction practices, and water well maintenance and rehabilitation. Provided similar services funded by the United Nations Development Programme to Liberia immediately after the 1980 coup.

Production Capabilities of Water Supply Wells, Tucson, Arizona—For a city water and sewer department, analyzed well cuttings during the installation of water supply wells and interpreted borehole geophysical logs to determine production capabilities of the wells. Worked in a field laboratory and performed sieve analyses, as well as performed aquifer tests and analyzed aquifer test data.

Comprehensive Groundwater Evaluation for the South Fork of Long Island, New York—Accepted responsibility from the prior lead investigator for this major groundwater resources investigation to evaluate the long-term sustainability of the groundwater resources for a 500 square mile area of the southeastern end of Long Island. Completed the study and made numerous presentations to government and civic groups to explain and sometimes defend the conclusion of the study.

Water District Operations, Long Island, New York—Responsible for selecting locations for five new water supply wells; overseeing the drilling and logging of each well; supervising aquifer tests and analyze aquifer test data; and determining the "safe yield" of the well prior to its connection to the township water distribution system.

Well Field Investigation, Columbus, Ohio—Oversaw testing and analyses of aquifer performance data for several Ranney-type collector wells near the Sciota River. The goal of the project was to add an additional 6 million gallons per day to the city's water supply capacity.

Water Supply Well Investigation at a State University, Ohio—Evaluated the performance of two water supply wells belonging to Central State University. Noticing a significant reduction in yield, designed and provided oversight of a well maintenance and rehabilitation program that resulted in both wells exceeding their capacity at the time they were originally installed.

Representative Litigation Support Activities

RCRA Compliance Program, Marysville, Ohio—Expert witness for a process facilities RCRA compliance program. Client was accused of RCRA violations by EPA Region 5 related to the effectiveness of its groundwater-monitoring program. Prevailed in demonstrating that

the existing groundwater-monitoring program was in compliance, despite the complexity of groundwater flow through the karst limestone underlying the site.

Hillview-Porter State Superfund Site, Palo Alto, California—Retained by Judicial Arbitration and Mediation Services as a technical neutral expert to mediate a $40M remediation cost allocation among the 14 parties contributing chlorinated solvents from Stanford Research Park. Proposed allocation among the parties was quickly accepted and settlement among the parties was therefore expedited.

Corrective Actions for a Water Supply System, Fresno, California—Neutral expert for mediation of corrective action and costs for DBCP contamination of the City's water-supply system. Parties involved were Dow Chemical, Shell Oil Co., and the City of Fresno, California.

Indoor Air Claim, Saluda, North Carolina—Expert witness in litigation pertaining to migration of contaminant fumes into buildings from an abandoned gasoline site in Saluda, North Carolina, resulting in claims being denied to plaintiffs and a minimal remediation program.

Allocation of Liability, Kalamazoo, Michigan—Expert witness in litigation pertaining to responsibility of contamination. Parties involved two major oil companies and a fast food chain. Case was settled to client's satisfaction.

Personal Injury Claim, Mineola, New York—Expert witness in litigation pertaining to a personal injury claim from gasoline fumes alleged to have migrated into the basement of a building from an adjacent service station. Testimony resulted in dismissal of the case.

Plastics Manufacturing Liability, Akron, Ohio—Litigation support and expert testimony pertaining to the allocation of liabilities associated with contamination at a plastics manufacturing facility resulting in the reduction in allocated claims from $24 million to $4 million.

Oil and Gas Resource Development, Ohio—Litigation support and expert testimony at numerous sites in Ohio pertaining to alleged environmental damages associated with oil and gas resource development.

Alleged Water Supply Contamination, Town of Sardinia, New York—Expert witness for the town pertaining to groundwater quality, groundwater flow, and water-supply contamination.

Environmental Damages Responsibility, U.S. Gulf Coast—Expert witness for a chemical firm for environmental damages associated with prior ownership and operation of chemical plants in four Gulf Coast states.

Selected Cases for Which Testimony Was Provided

United Technologies (Carrier Corp.) v. Home Insurance, et al—Case No.CV-88-3523835 in the Superior Court J/D of Hartford. Subject: Nature of a release of chlorinated solvents from an above ground storage tank. Deposition: 1994–1995.

Integrated Waste Systems v. New York State—Case No. NYSDEC # 9-0438-00004/00003, NYSDEC Adjudicatory Hearings on Landfill Application Permit. Subject: Appropriateness

of the site of a new landfill and the ability of it to be constructed to protect a vital groundwater resource. Expert Testimony: 1994–1996.

Clarkson v. Chevron U.S.A., Inc.—Case No. 94-472881-CZ, County of Oakland, State of Michigan. Subject: Case involved the timing of a release of gasoline into the environment. Deposition: March 23, 1995.

Polish American Club of Coatesville v. Chevron U.S.A., Inc.—Case No. 92-80910 in the Court of Common Pleas, Chester County. Subject: Case involved the source of petroleum hydrocarbons in an area of multiple possible sources. Expert Testimony: 1996.

Newton v. Chevron U.S.A., Inc.—Case No. C-92-0322-L(M) in the U.S. District Court Western District of Kentucky, Louisville Division. Subject: Case involved timing of releases of petroleum hydrocarbons. Deposition: February 13, 1997.

Lincoln Properties v. Dry Cleaners—Case No. CIV-S-91-760 DFL in the U.S. District Court East, District of California. Subject: Served as a technical neutral expert on the appropriateness of remediation and oversight costs. Deposition: September 10, 1997.

Ciba-Geigy Corp v. Liberty Mutual Insurance Co—Case No. UNN_L-8573-89 & L-97515-87 in the Superior Court of New Jersey, Law Division, Union County. Subject: Issues of causation. Deposition and Expert Testimony: July 13 and September 3, 1998.

City of Newburgh v. Central Hudson Gas & Electric Co.—Case No. CEN 95-LV-3863 in the U.S. District Court of New York. Subject: Source of contamination on a property adjacent to a former manufactured gas plant. Deposition and Expert Testimony: September 1, 1998, and December 1998.

BBL v. City of North Miami—Case No. 97-1484-CIIV-HURLEY in the U.S. District Court, Southern District of Miami, Miami Division. Subject: Appropriateness of the costs for site investigation and the recommended remedial alternative. Deposition and Expert Testimony: November 2, 1998, and July 30, 1999.

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Hermiz et al. v. Texaco Inc., et al.—Case in the Circuit Court, County of Wayne, Michigan. Subject: Timing and nature of a petroleum contamination. Deposition: November 6, 2002.

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SELECTED INVITED PRESENTATIONS/PANELS/PEER REVIEWS

02–03/11—Australian National Center for Groundwater Research and Training in Perth and Melbourne: Groundwater Pollution and Remediation Course.

04/11—AIPG Kentucky Section Meeting, Lexington, KY. Presentation titled "Overview of Contaminated Site Investigation and Remediation. "

05/11—NGWA Groundwater Summit, Baltimore, MD. Panel Session Moderator for Emerging Groundwater Issues.

12/09—Chartis, Inc., Global Loss Prevention, Environmental Claims Division. Presentation titled "Groundwater Natural Resource Damages Assessment."

PRESENTATIONS/POSTERS

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