

ERROL P. LAWRENCE, P.G.; SENIOR HYDROLOGIST

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EDUCATION

- M.S., Engineering Geology, Colorado School of Mines
- B.S., Geology, Northern Arizona University

PROFESSIONAL REGISTRATION AND MEMBERSHIPS

- Registered Professional Geologist, Wyoming and Texas
- National Ground Water Association
- American Institute of Professional Geologists
- National Water Well Association


AREAS OF EXPERTISE

- Groundwater Flow and Contaminant Transport Modeling
- Injection Well Transport Modeling and Permitting
- Groundwater Contamination Investigation and Analysis
- Nuclear Regulatory Commission and State Permits for Insitu Recovery (ISR) Uranium Operations
- Environmental Litigation Support
- Groundwater Remediation System Design & Evaluation
- Aquifer Monitoring System Design
- RCRA, including: RCRA Facility Investigation (RFI), Interim Corrective Measures (ICM); Corrective Measures Study (CMS)

PROFESSIONAL EXPERIENCE

(2004 - Present) Petrotek Engineering Corporation, *Senior Hydrogeologist/Permitting Specialist*
 (1997 - 2005) HydroSolutions, Lakewood, CO, *Hydrogeologic Consultant*
 (1990 - 1996) Geraghty & Miller, Inc., Denver, CO, *Project Scientist*
 (1988 - 1990) U.S. Geologic Survey, Lakewood, CO, *Geologist*
 (1980 - 1987) Pogo Producing Company, Houston, TX, *Exploration Geologist*
 (1979-1980) Dresser Atlas, Houston TX, *Wireline Engineer*

- Senior Hydrogeologist for existing and developing uranium ISR projects in Nebraska, Texas, Wyoming and South Dakota, US and Kazakhstan, Paraguay and Turkey. Design and perform pump tests to assess site hydrogeology. Perform numerical modeling for wellfield layout, pattern optimization and water balance. Prepare geologic and hydrologic sections for NRC (Technical and Environmental Reports) and State Permits. Support permits/renewals for current ISR operators and junior development projects. Perform numerical modeling to assess and optimize groundwater restoration operations in Texas and Wyoming.

	
In the Matter of: (Dewey-Burdock In Situ Uranium Recovery Facility)	POWERTECH USA, INC. ASLBP #: 10-898-02-MLA-BD01 Docket #: 04009075 Exhibit #: APP-038-00-BD01 Admitted: 8/19/2014 Rejected: Other:
Identified: 8/19/2014 Withdrawn: Stricken:	

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- Provided expert testimony for State and NRC permit applications related to multiple ISR operations in the US.
- Perform investigations of flow and contaminant transport at injection well facilities. Perform numerical modeling in support of no-migration petitions for deep injection.
- Provided consulting services for hydrologic investigations and groundwater flow and contaminant transport modeling including the development of groundwater compliance programs for several mining/milling facilities, development of numerical models in support of Alternate Concentration Limit applications, review and assessment of groundwater remediation programs, development of soil screening guidelines for the state of New Mexico, and third party review of groundwater flow models.
- Principal groundwater modeler for groundwater characterization at rare earth element mine in Wyoming. Developed conceptual model of the site; performed and analyzed pumping tests; performed groundwater modeling to assess project impacts, and prepared groundwater modeling sections of the Permit to Mine application.
- Management, design and implementation of site investigations, groundwater monitoring programs, and remedial actions for numerous projects. Developed analytical and numerical groundwater flow and contaminant transport models for evaluating remedial alternatives, risk assessments and litigation support. Primary author on numerous site characterization and assessment reports and workplans. Routinely involved in negotiations with state and federal regulatory agencies and presentations to the public regarding groundwater investigation, assessment and remediation.
- Conducted research to evaluate hydrologic, geologic and geochemical controls of the occurrence of radon and its parent radionuclides in fractured groundwater systems. Key components included conductance and analysis of pumping tests, modeling of geochemical reactions along groundwater flow paths and development of a model for estimating radon contribution to indoor air from domestic water supplies
- Identified and delineated oil and gas prospects using well logs, seismic data and reservoir engineering techniques and presented prospects to management, partners and potential investors for approval of lease acquisitions. Served as an expert witness in unitization proceedings involving oil and gas properties.

PUBLICATIONS/PRESENTATIONS

- Lawrence, E.P., Payne, A. "Groundwater Characterization Lodge Rare Earth Element Project Wyoming" presentation at the *Western South Dakota Hydrology Conference*, April 2014, Rapid City, South Dakota.
- Lawrence, E.P., Demuth, H.P., Mays, John. "Groundwater Modeling of the Hydraulic Effects of the Proposed Dewey Burdock Uranium In-situ Recovery Project, Fall River and Custer County, South Dakota" presentation at the *Western South Dakota Hydrology Conference*, April 2014, Rapid City, South Dakota.

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- Lawrence E.P. "Groundwater Restoration Issues for the Uranium Industry", presentation at the *National Mining Association Uranium Recovery Workshop*, May, 2013.
- Lawrence E.P., Cooper, K.J., and Demuth, H.P. "A Method for Calculating an Aquifer Exemption Boundary for Uranium Insitu Recovery Projects" presented at the *U2011 Uranium Symposium and Trade Show*, Casper, Wyoming, September 21, 2011.
- Lawrence E.P., Demuth, H.P., and Cooper, K.J., "Application of Numerical Groundwater Flow Models to Uranium ISR Projects...What Can We Learn From Them?" presentation at the *National Mining Association/Nuclear Regulatory Commission Uranium Recovery Workshop*, May 25, 2011.
- Lawrence E.P., Demuth, H.P., Cooper, K.J., and Wichers, D. "Use of Hydrologic Tests and Numeric Models to Predict Hydraulic Behavior of an Unconfined Aquifer During Insitu Recovery of Uranium" presentation at the *National Groundwater Association 2010 Groundwater Summit*, Denver, Colorado. April 2010.
- Lawrence E.P., Cooper, K.J., and Demuth, H.P. "Groundwater Modeling Application to Uranium Insitu Recovery Projects: Relationship of Sweep Efficiency to Pore Volume Removal" presentation at the *Global Uranium Symposium 2009*, Keystone, Colorado, USA. May 2009.
- Heili, W. and Lawrence E.P. "Groundwater Restoration Results and Long Term Protection of USDW's: A Case Study of the Irigaray Uranium Project" presentation at the *Colorado State University Health Physics Uranium Symposium*, Ft. Collins, Colorado. February 2, 2008.
- Cooper, K.J., Demuth, H.P., and Lawrence, E.P. "Overview of Operational Issues Associated with Groundwater, Restoration, and Wastewater Management at ISR/ISL Facilities" presentation at the *2008 Ground Water Protection Council Winter Underground Injection Control Meeting*, January 15, 2008; New Orleans, Louisiana.
- Lawrence, E. P., and Wichers, D. "Groundwater Modeling Supporting Aquifer Restoration at a Uranium ISR Facility, Wyoming." In Proceedings of the *Global Uranium Symposium 2007*, Corpus Christi, Colorado, USA. May 2007
- Lawrence, E. P., Erskine, D.W., Yancey, C.L. and Sealy, C.O.. "Evaluation of Groundwater Conditions at a Vanadium Mine Site near Hot Springs, Arkansas." in *Proceedings of the Fifth International Conference on Tailings and Mine Waste '98*, Ft Collins, Colorado. January 26-28, 1998.
- Erskine, D.W., Yancey, C.L., Lawrence, E. P., and Sealy, C.O. "Naturally Occurring Acidity in the vicinity of a Sulfide Ore Deposit: Wilson Springs Mine, Hot Springs, Arkansas." in Proceedings of the Fifth International Conference on Tailings and Mine Waste '98, Ft Collins, Colorado. January 26-28, 1998.
- Erskine, D.W., Lawrence, E. P., and Yancey, C.L. "Natural Attenuation of Hazardous

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Constituents in Groundwater at Uranium Mill Tailing Sites." in Proceedings of the Fourth International Conference on Tailings and Mine Waste '97, Ft Collins, Colorado. January 13-17, 1997.

- Lawrence, E. P., Erskine, D.W. and Sealy, C. "Evaluation of Groundwater Remediation at a Colorado Uranium Mill Site." in *Proceedings of the Fourth International Conference on Tailings and Mine Waste '97*, Ft Collins, Colorado. January 13-17, 1997.
- Lawrence, E. P., Wanty, R. B., and Nyberg, P. "Contribution of Radon-222 in Domestic Water Supplies to Radon-222 in Indoor Air in Homes in Conifer, Colorado." *Health Physics*, Vol. 62, No. 2, 1992. This paper received first place in the Geraghty & Miller Technical Paper Award Program, 1992.
- Lawrence, E. P., and Wanty, R. B. "Hydrogeology and Aqueous Geochemistry, Conifer, Colorado", U.S.G.S. Miscellaneous Field Studies Map, MF 2165, 1991.
- Lawrence, E. P., Poeter, E., and Wanty, R. B. "Geohydrologic, Geochemical and Geologic Controls on the Occurrence of Radon in Ground Water near Conifer, Colorado, USA." *Journal of Hydrology*, Vol. 127, 1991, pp. 367-386. This paper received third place in the Geraghty & Miller Technical Paper Award Program, 1991.
- Lawrence, E. P., Wanty, R. B., and Briggs, P. H. "Hydrologic and Geochemical Processes Governing the Distribution of U-238 Series Radionuclides in Ground Water near Conifer, Colorado." Presented at the Geological Society of America annual meeting in St. Louis, Missouri, 1989. Abstracts with Programs 21(6), a144.
- Wanty, R. B., Lawrence, E. P., and Gunderson, C. S. "A Theoretical Model for the Flux of Radon-222 from Rock to Ground Water", Geological Society of America, Special Papers Series, 1990.
- Lawrence, E. P. "Hydrogeologic and Geochemical Processes Affecting the Distribution of Radon-222 and its Parent Radionuclides in Ground Water, Conifer, Colorado". Colorado School of Mines Master's Thesis T-3923.