

Benjamin G. Petri, Ph.D.

Consultant



Education and Credentials

Ph.D., Environmental Science and Engineering, Colorado School of Mines, Golden, Colorado, 2015

M.S., Environmental Science and Engineering, Colorado School of Mines, Golden, Colorado, 2006

B.S., Environmental Engineering, Colorado School of Mines, Golden, Colorado, 2003

Engineer-in-Training (2003)

Continuing Education and Training

Hazardous Waste Operations and Emergency Response 40-Hour Certification (2016; refresher 2017; 2018)

PSMJ Resources Project Management Bootcamp training for Architects, Engineers and Consultants (2016)

First Aid and CPR Certified (2016, 2018)

Interstate Technology and Regulatory Council Vapor Intrusion Classroom Training (2011)

Emergency Medical Technician (basic) and Wilderness First Responder (2005)

Professional Affiliations

American Chemical Society

National Groundwater Association

Professional Profile

Dr. Benjamin Petri is an environmental engineer with 14 years of experience in the environmental litigation and remediation fields serving a range of clients. Much of Dr. Petri's career has focused on analyzing the fate and transport of contaminants in complex environmental systems and determining the implications for clients. He has developed conceptual site models, and designed and conducted multiple field, laboratory and modeling investigations. He specializes in the analysis of chlorinated solvents and other volatile organic compounds in groundwater systems, including dense, nonaqueous-phase liquids (DNAPLs), as well as the evaluation of alternatives for their remediation and the assessment of the vapor intrusion pathway. Dr. Petri is particularly experienced in working with *in situ* chemical oxidation (ISCO) technologies.

Dr. Petri is also experienced in environmental litigation, having provided support for cost allocation, environmental forensics, cost estimation, and historical facility review. He has collaborated with a variety of colleagues across disciplines in industry, academia, and consulting. In addition, Dr. Petri has authored numerous articles, book chapters, conferences presentations and short courses, and has served as a peer reviewer for multiple refereed journals.

Environmental Engineering and Site Remediation

Lithium Mine, South America—Supported geological studies and resource assessment at a brine extraction and lithium processing facility. Assisted with preparation of work plans and a sampling and analysis plan to support well installation and brine reservoir characterization. Compiled data to support the development of a model to be used to assess the lithium resource. Provided GIS mapping support.

Industrial Site, Minneapolis, Minnesota—Reviewed the technical feasibility of ISCO as a possible follow-on remedy at a railyard with comingled plumes of petroleum hydrocarbons and chlorinated solvents. Evaluated soil data for remedy effectiveness and designed a confirmation sampling plan in anticipation of site closure.

San Jacinto River Waste Pits, Harris County, Texas—Assisted collection of environmental media to assess dioxin contamination from upland and overwater areas of this former paper mill waste



disposal site. Media collected included soil borings, fish tissue, surface sediment, and high-volume surface water samples. Assisted with preparation of the related field sampling reports.

Lithium Manufacturing Facility, North Carolina—Provided engineering support for a facility experiencing soil heave related to infiltration of caustic materials in a manufacturing area. Tasks included analysis of structural monitoring survey data, review of historical data, and the development of risk management and mitigation strategies. Facilitated preparation of work plans for subsurface site characterization.

Drycleaner Site, New York, New York—Assessed chemical fate and transport of a chlorinated solvent plume undergoing biodegradation. Tasks involved determination of aquifer hydraulic properties from aquifer testing, estimation of biodegradation rates, and estimation of the rate and extent of downgradient transport.

Lower Passaic River Remedial Investigation and Feasibility Study, New Jersey—Provided project support for a CERCLA feasibility study for this multiparty Superfund sediment site. Performed calculations and conducted quality assurance and quality control on dredge volume calculations.

Contaminant Transport Modeling at a Sediment Site, Oregon—Supported development of an updated contaminant transport model to evaluate the potential for natural recovery. Identified data needs within the model for assessment of natural recovery.

Humidity Cell Testing at a Mining Site, Nevada—Assisted with humidity cell testing and conducted research into net acid generation testing methods for a mine undergoing the permitting process. Through a laboratory study, researched the effect of carbonate minerals on chemical oxidation and the efficacy of the net acid generation test.

Litigation Support

Industrial Site on the Lower Duwamish Waterway, Washington, Confidential Client—Provided technical support for an industrial client in a cost allocation process. Conducted historical operations research, environmental data analysis, GIS mapping support, remedy cost review, chemical fate and transport evaluations, report preparation, and expert witness support at the request of the client. Ongoing matter.

Industrial Site, Missouri, Confidential Client—Provided technical support to an expert witness for an industrial client in an allocation process. The work involved conducting a forensic analysis of a solvent release by estimating the age of a source zone through data analysis and modeling. Managed a field data collection effort that gathered soil and aquifer test data to support the modeling analysis. Reviewed and critiqued opposing expert opinions in preparation for trial. Ongoing matter.

Confidential Gas Station Site, New York—Conducted forensic transport calculations and data analysis to determine the date of a methyl *tert*-butyl ether release. The work was performed in



support of an expert witness for an insurance cost recovery case. The case went to trial and the verdict was found in favor of the client.

Perfluoroalkyl Site, Confidential Location—As part of a natural resource damage lawsuit, investigated sources and assessed impacts to groundwater by a number of perfluoroalkyl substances including PFOS and PFOA.

Confidential Client involved in Litigation at Multiple Locations, United States—Provided data loading support for the development of a database supporting litigation in multiple geographic locations. Tasks included data review and research to ensure quality upload of environmental data.

Active and Former Rocket Launch Facilities, California and Florida, Confidential Client—Researched the administrative record for multiple defense sites and assisted an expert witness in preparing expert reports and a counter-allocation in support of a cost recovery action. Researched historical military and industrial operations, analyzed environmental data, critiqued the cost allocation model, presented findings to the client, and contributed to report writing. Ongoing matter.

Confidential Gas Station Site, New Jersey, Confidential Client—Provided technical support to an expert witness for an insurance cost recovery case. Reviewed historical site operations, records, and environmental data. Case resolved in a settlement.

CERCLA PCB Site, Michigan—Provided investigative and analytical support for an expert witness as part of a cost contribution litigation process for a river system with multiple sources of PCBs from multiple paper mills. Researched historical industrial operations, analyzed environmental data, modeled important environmental processes, critiqued opposing expert reports, prepared trial exhibits, and supported deposition and trial activities. Ongoing matter.

Litigation Support for an Industrial Site, Rhode Island—Supported trial preparation by drafting figures based on site data, for use in courtroom exhibits.

Research and Development

Laboratory Research and Modeling Evaluation of Vapor Intrusion from NAPL Sources and Groundwater Plumes, Colorado School of Mines, Golden, Colorado—Conducted laboratory experiments for a project that focused on developing a more complete understanding of the vapor intrusion pathway, with particular emphasis on spatial and temporal dynamics. Developed numerical models to evaluate temporal vapor dynamics in response to rain and water table fluctuation events. Contributed extensively to project reporting and final debriefing. Strategic Environmental Research and Development Program (SERDP) Grant ER-1687.

In Situ Chemical Oxidation for Groundwater Remediation, Colorado School of Mines, Golden, Colorado—Reviewed state-of-the-science and best practices for the development of new tools, protocols, and guidance to support implementation of ISCO for groundwater remediation. Assisted with the development of a protocol and tools to support ISCO technology selection and



implementation, and with publication of a book documenting the findings from this project. Environmental Security Technology Certification Program (ESTCP) Grant ER-0623.

Reaction and Transport Processes Controlling In Situ Chemical Oxidation of DNAPLs, Colorado School of Mines, Golden, Colorado—Conducted laboratory research for master’s thesis project. The objective of the project was to evaluate the efficacy of treating DNAPL sources with ISCO technologies. The research focused on mass transfer from DNAPL source zones undergoing oxidation using permanganate. Assisted with preparing the final report and project debriefing. The project team won the SERDP Project of the Year Award in 2005. SERDP Grant ER-1290.

Publications

Petri, B., R. Fučík, T. Illangasekare, K. Smits, J. Christ, T. Sakaki, and C. Sauck. 2015. Effect of NAPL source morphology on mass transfer in the vadose zone. *Groundwater* 53(5):685–698.

Illangasekare, T., B. Petri, R. Fučík, C. Sauck, L. Shannon, T. Sakaki, K. Smits, A. Cihan, J. Christ, P. Schulte, B. Putman, and Y. Li. 2014. Final report. Vapor intrusion from entrapped NAPL sources and groundwater plumes: Process understanding and improved modeling tools for pathway assessment. SERDP Project ER-1687. Strategic Environmental Research and Development Program, Washington, DC. 206 pp.

Clayton, W.C., B.G. Petri, and S.G. Huling. 2011. Chapter 5: Fundamentals of ISCO using ozone. pp. 193–232. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Crimi, M.L., T.J. Simpkin, T.A. Palaia, B.G. Petri, and R.L. Siegrist. 2011. Chapter 9: Systematic approach for site-specific engineering of ISCO. pp. 355–412. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Munakata-Marr, J., K.S. Sorenson, B.G. Petri, and J. Cummings. 2011. Chapter 7: Principles of combining ISCO with other *in situ* remedial approaches. pp. 285–317. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Petri, B.G., N.R. Thomson, and M.A. Uranowicz. 2011. Chapter 3: Fundamentals of ISCO using permanganate. pp. 89–146. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.



Petri, B.G., R.J. Watts, A.L. Teel, S.G. Huling, and S.A. Brown. 2011. Chapter 2: Fundamentals of ISCO using hydrogen peroxide. pp. 33–88. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Petri, B.G., R.J. Watts, A.L. Tsitonaki, M.L. Crimi, N.R. Thomson, and A.L. Teel. 2011. Chapter 4: Fundamentals of ISCO using persulfate. pp. 147–191. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Simpkin, T.J., T.A. Palaia, B.G. Petri, and B.A. Smith. 2011. Chapter 11: Oxidant delivery approaches and contingency planning. pp. 449–480. In: *In Situ Chemical Oxidation for Remediation of Contaminated Groundwater*. R.L. Siegrist, M.L. Crimi, and T.J. Simpkin (eds). SERDP and ESTCP Remediation Technology Monograph Series. C.H. Ward (series ed). Springer Science and Business Media, LLC, New York, NY.

Krembs, F.J., R.L. Siegrist, M.L. Crimi, R. Furrer, and B.G. Petri. 2010. ISCO for groundwater remediation: Analysis of field applications and performance. *Ground Water Monit. Remediation* 30:42–53.

Tsitonaki, A., B. Petri, M. Crimi, H. Mosbæk, R.L. Siegrist, and P.L. Bjerg. 2010. *In situ* chemical oxidation of contaminated soil and groundwater using persulfate: A review. *Crit. Rev. Environ. Sci. Technol.* 40:55–91.

Petri, B.G., R.L. Siegrist, and M.L. Crimi. 2008. Effects of groundwater velocity and permanganate concentration on DNAPL mass depletion rates during *in situ* oxidation. *J. Environ. Eng.* 134:1–13.

Siegrist, R.L., M. Crimi, J. Munakata-Marr, T. Illangasekare, P. Dugan, J. Heiderscheidt, B. Petri, and J. Sahl. 2008. Chemical oxidation for clean up of contaminated groundwater. pp. 45–58. In: *Methods and Techniques for Cleaning-up Contaminated Sites*. M.D. Annable, M. Teodorescu, P. Hlavinec, and L. Diels (eds). Springer Netherlands.

Siegrist, R., M. Crimi, J. Munakata-Marr, T. Illangasekare, K. Lowe, S. Van-Cuyk, P. Dugan, J. Heiderscheidt, S. Jackson, B. Petri, J. Sahl, and S. Seitz. 2006. Reaction and transport processes controlling *in situ* chemical oxidation of DNAPLs: Final report to SERDP for project CU-1290. Strategic Environmental Research and Development Program, Washington, DC. 235 pp.

Lectures and Short Courses

Petri, B. 2014. Lecture: Vapor Transport 1 and 2. CEEN584 Subsurface Contaminant Transport, Colorado School of Mines, Golden, CO.



Petri, B. 2013, 2014, 2015. Lectures: Introduction to *In Situ* Chemical Oxidation. CEEN575 Hazardous Waste Site Remediation, Colorado School of Mines, Golden, CO.

Crimi, M., F. Krembs, B. Petri, R. Siegrist, T. Simpkin, and M. Unger. 2009. Short course: Principles and practices of *in situ* chemical oxidation. Partners in Environmental Technology: Technical Symposium and Workshop, Washington, DC.

Siegrist, R., M. Crimi, T. Simpkin, B. Petri, and F. Krembs. 2008. Workshop: Technical practices to enable successful application of *in situ* chemical oxidation (ISCO) for site remediation. March 25–28. Air Force Center for Engineering and the Environment Technology Transfer Workshop, San Antonio, TX.

Presentations/Posters

Guyer, E., B. Petri, A. King, S. Gheen, and K. Peterson. 2019. How can the cost allocation process adapt to an adaptive remedy? Platform presentation at Tenth International Conference on the Remediation and Management of Contaminated Sediments, New Orleans, LA. February 11–14.

Greer, B., B. Petri, A. Nicholson, and S. Helgen. 2016. Net acid generation test pH, alkalinity, and sulfate, experimental and modeled results in a well constrained system. February 21–24. Society of Mining Engineers Annual Conference and Expo, Phoenix, AZ.

Petri, B., R. Fučík, T. Illangasekare, T. Sakaki, and C. Sauck. 2014. The influence of transient hydrologic factors on dynamic vapor plume behavior in the vadose zone: Experimental and modeling study with practical implications for vapor intrusion. July 6–11. Flow and Transport in Permeable Media, Gordon Research Conferences, Bates College, Lewiston, ME.

Illangasekare, T., and B. Petri. 2013. Vapor intrusion from entrapped NAPL sources and groundwater plumes—factors contributing to uncertainty. April 21–26. Groundwater Quality Conference GQ13, Gainesville, FL.

Petri, B., T. Illangasekare, C. Sauck, and T. Sakaki. 2013. Effects of water table fluctuation and rain infiltration on soil vapor concentrations for the vapor intrusion exposure pathway. March 4–6. Remediation Technologies Symposium (RemTEC), Westminster, CO.

Petri, B., C. Sauck, T. Illangasekare, T. Sakaki, and J. Christ. 2012. The effect of vadose zone dynamics on the vapor intrusion exposure pathway: Development of new conceptual models and implications for sustainability. January 31–February 2. Sustainable Remediation Forum Meeting, SURF19, University of California San Diego, CA.

Illangasekare, T., T. Sakaki, J. Christ, B. Petri, C. Sauck, P. Schulte, A. Cihan, K. Smits, Y. Lee, L. Shannon, and B. Putman. 2011. Vapor intrusion into subsurface structures—an improved understanding for guideline development through physical and numerical modeling. November



29–December 1. Partners in Environmental Technology: Technical Symposium and Workshop, SERDP-ESTCP, Washington, DC.

Petri, B., T. Illangasekare, T. Sakaki, J. Christ, and C. Sauck. 2011. Effect of source conditions on mass-transfer from nonaqueous phase liquids to soil gas in the vadose zone. August 28–September 1. American Chemical Society National Meeting and Expo, Denver, CO.

Petri, B., T. Illangasekare, T. Sakaki, J. Christ, and C. Sauck. 2011. Experimental and numerical investigation of mass-transfer rate for prediction of vapor generation from NAPLs for the evaluation of the vapor-to-indoor air exposure pathway. June 5–8. MODFLOW and More 2011, Colorado School of Mines, Golden, CO.

Petri, B., C. Sauck, T. Illangasekare, T. Sakaki, and J. Christ. 2011. Effects of vadose zone soil moisture dynamics on the mass-transfer and transport of volatile compounds: Investigations using physical models at multiple scales. December 5–9. American Geophysical Union Fall Meeting, San Francisco, CA.

Illangasekare, T., T. Sakaki, J. Christ, B. Petri, C. Sauck, A. Cihan, and P. Schulte. 2010. Vapor intrusion from entrapped NAPL sources and groundwater plumes: Process understanding and improved modeling tools for pathway assessment. November 30–December 2. Partners in Environmental Technology: Technical Symposium and Workshop, SERDP-ESTCP, Washington, DC.

Petri, B., M. Crimi, J. Munakata-Marr, R. Siegrist, F. Krembs, K. Lowe, T. Palaia, and T. Simpkin. 2010. A protocol for site-specific screening of *in situ* chemical oxidation for groundwater remediation. May 24–27. Seventh International Conference on the Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA.

Petri, B., T. Illangasekare, J. Christ, T. Sakaki, and C. Sauck. 2010. Vapor generation from entrapped sources of nonaqueous phase liquids (NAPL) in the unsaturated zone. July 10–16. Flow and Transport in Permeable Media, Gordon Research Conferences, Bates College, Lewiston, ME.

Petri, B., T. Illangasekare, T. Sakaki, C. Sauck, and J. Christ. 2010. Evaluation of volatilization from NAPL sources under low velocities with implications for the vapor intrusion pathway. March 22–24. AGU Hydrology Days 2010, Colorado State University, Fort Collins, CO.

Illangasekare, T.H., T. Sakaki, J. Christ, B. Petri, and A. Cihan. 2009. Vapor intrusion from entrapped NAPL sources and groundwater plumes: Process understanding and improved modeling tools for pathway assessment. Partners in Environmental Technology: Technical Symposium and Workshop, SERDP-ESTCP, Washington, DC.

Petri, B., M. Crimi, R. Siegrist, F. Krembs, T. Illangasekare, J. Munakata-Marr, K. Lowe, T. Simpkin, T. Palaia, G. Ng, N. Ruiz, and M. Singletary. 2008. Development of a protocol and decision support tools for screening ISCO technologies for groundwater remediation. Sixth International Conference on the Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA.



Petri, B.G., R.L. Siegrist, and M.L. Crimi. 2008. Implications of the scientific literature for field applications of ISCO. May 18-21. Sixth International Conference on the Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA.

Siegrist, R., M. Crimi, J. Munakata-Marr, T. Illangasekare, T. Palaia, T. Simpkin, B. Petri, F. Krembs, K. Lowe, G. Ng, and M. Singletary. 2008. *In situ* chemical oxidation for ground water remediation: responses to project managers' frequently asked questions. Partners in Environmental Technology: Technical Symposium and Workshop, SERDP-ESTCP, Washington, DC.

Petri, B., R. Siegrist, and M. Crimi. 2007. The state of the science: A cumulative review of ISCO related literature. Fifth International Conference on Oxidation and Reduction Technologies for *In Situ* Treatment of Soil and Groundwater, Niagara Falls, NY.

Petri, B., R. Siegrist, M. Crimi, and F. Krembs. 2007. A survey of remediation professional views on the ability of ISCO to meet remediation goals within typical project constraints. Fifth International Conference on Oxidation and Reduction Technologies for *In Situ* Treatment of Soil and Groundwater, Niagara Falls, NY.

Siegrist, R., M. Crimi, J. Munakata-Marr, T. Illangasekare, T. Palaia, T. Simpkin, B. Petri, F. Krembs, K. Lowe, G. Ng, and M. Singletary. 2007. *In situ* chemical oxidation for groundwater remediation: technology practices manual. Partners in Environmental Technology: Technical Symposium and Workshop, SERDP-ESTCP, Washington, DC.

Petri, B.G., R.L. Siegrist, and M.L. Crimi. 2005. Impacts of permanganate flushing parameters on mass transfer from dense, nonaqueous phase liquid residuals. Fourth International Conference on Oxidation and Reduction Technologies for *In Situ* Treatment of Soil and Groundwater, Chicago, IL.

Petri, B.G., R.L. Siegrist, and M.L. Crimi. 2004. Mass transfer impacts of oxidant flushing parameters during *in situ* chemical oxidation of DNAPLs. Third International Conference on Oxidation and Reduction Technologies for *In Situ* Treatment of Soil and Groundwater, San Diego, CA.

Petri, B.G., R.L. Siegrist, and M.L. Crimi. 2004. Mass transfer impacts of oxidant flushing velocity during *in situ* chemical oxidation of DNAPLs. American Water Works Association Water Environment Federation Student Chapter Conference, Golden, CO.

