Walt W. McNab, Jr., Ph.D., P.G.
Senior Scientist

Technical Specialties:

Over 25 years of experience as a project manager, researcher, and consultant. Dr. McNab's interests and experience span a wide range of complex environmental issues in physical and chemical hydrogeology, soil science, and environmental threat assessment, with a particular focus placed on quantitative analysis. He has directed or played leadership roles in projects entailing environmental data analyses and process modeling for a variety of applications including subsurface chemical transport, multiphase flow through porous media, reconstructing historical industrial discharges, contaminant biodegradation, impacts of agricultural practices on groundwater quality, geochemical impacts of artificial recharge, design of novel groundwater treatment technologies, geologic storage of CO_2, vadose zone processes, dynamic mixing processes in lakes, and aerosol transport. He has managed projects with annual budgets over $1M per year involving characterization of radionuclide migration at the Nevada Test Site as well as modeling efforts focused on subsurface injection and migration of supercritical CO_2. He has also served in lead technical roles for a major federal Superfund site in California. Throughout his career, he has engaged a variety of stakeholders across projects, including industrial clients, attorneys, regulatory bodies, and federal government agencies.

Dr. McNab's quantitative analytic skills include experience using industry-standard environmental modeling software (e.g., MODFLOW, MT3D, VS2DT, HYDRUS, SUTRA, PHREEQC, PHAST, and UTCHEM for environmental media), data exploration and visualization, and statistical analyses. He has also written a variety of customized computer codes to address problems in multiphase flow and reactive geochemistry using programming languages such as Python, MATLAB, and C++.

Credentials:

Professional Geologist in California, #7312
B.A., Geology, University of California, Berkeley, 1988
M.S., Mineral Engineering, University of California, Berkeley, 1990
Ph.D., Mineral Engineering, University of California, Berkeley, 1995

Professional Affiliations:

Member, American Geophysical Union
Member, American Society of Ground Water Scientists and Engineers
Member, Geological Society of America

Key Projects:

Multiphase Flow Modeling

- *Fuel Hydrocarbon Fate Analysis in Groundwater, Confidential Transportation Sector Clients*

Responsible for evaluating behavior of fuel hydrocarbons in soil and groundwater at fueling facilities in several states in the western U.S. Tasks include quantifying the mobility of free product as well as assessing natural bioattenuation. Developed quantitative tool sets to facilitate interpreting the mobility of light non-aqueous phase liquids (LNAPL) from field data. Also employed geochemical modeling to assist in interpreting the effects of biodegradation reactions on the mobilization of trace elements in an aquifer.

- *Modeling Enhanced Oil Recovery in Depleted Reservoirs with CO_2, U.S.-China Clean Energy Research Center*

U.S. Department of Energy-funded project; employed multiphase flow modeling approaches to assess the efficacy of CO_2-enhanced oil recovery in depleted petroleum reservoirs characterized by different geometries, initial conditions, and fluid miscibility relationships. Conducted simulations and directed junior staff.

- *Modeling of Oil Field and Natural Gas Field Brine Chemistry in Response to CO_2 Injection, Oil and Gas Industry Clients, Canada and North Africa*

Contributed to modeling studies of industrial-scale CO_2 geological storage pilot demonstration projects. Specific roles included performing transport modeling to support characterizing reservoir and wellbore cement responses to CO_2 injection and dissolution under elevated temperature and pressure conditions, developing inverse geochemical modeling techniques to characterize brine-rock interactions along subsurface flow paths, and modeling the results of associated laboratory experiments under simulated reservoir conditions. Modeling work was summarized at international scientific conferences as well as in several peer-reviewed journal publications. Also served in task manager and project manager roles.

- *Quantifying Dissolution Rates of NAPLs in Porous Media, Lawrence Livermore National Laboratory (LLNL), California*

Principal investigator for a U.S. Department of Energy-funded academic research study on the dissolution of immiscible fluids in porous media across different spatial scales. Directed a combined laboratory- and computer simulation-based study of mass transfer-limited dissolution of small non-aqueous phase fluid droplets within porous media on the micro-scale; investigated approaches for upscaling dissolution to the aquifer scale.

Fate and Transport Studies

- *Water Quality Assessment for Program Environmental Impact Report (EIR), Western States Petroleum Association (WSPA), Kern County, California*

Assessed shallow groundwater and oil field brine water quality data sets to support a comprehensive technical report by the industry to the Kern County Planning Dept. for the Program EIR on future oil and gas permitting in Kern County. Developed statistical summaries of water quality data, identified trends, and computed salt balances.

- *Groundwater Contaminant Plume Analysis, Confidential Attorney Client*

Developed models for quantifying groundwater solvent plume source attribution via computational history matching (for supporting cost allocation calculations). Modeling was used to estimate the proportion of a downgradient co-mingled plume attributable to a specific source area, ultimately to assist in informing remediation cost allocation.

- *Vadose Zone Modeling, Confidential Food and Beverage Industry Client, Central Valley, California*

Developed a coupled vadose zone model and groundwater flow and transport model to calculate the impact of land disposal of process wastewater on underlying shallow groundwater. Models utilized over a decade of operational records and climate data, combined with soil characteristics, to explain observed changes in selected water quality constituents (e.g., sodium, chloride, and total dissolved solids) on underlying groundwater. The successfully calibrated model was then used as a planning tool to assist the client in developing a new process wastewater land application strategy which addressed expanded operations. Modeling results were also presented to the Regional Water Quality Control Board to support permitting.

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- *Modeling of Radionuclide Migration in the Unsaturated Zone, Underground Test Area, Nevada Test Site*

Managed budget and scope and participated in task planning and coordination with the U.S. Department of Energy and other contractors for the Nevada Test Site environmental characterization program. Technical roles entailed conducting unsaturated zone modeling studies to assess radionuclide mobility through the unsaturated zone and in test tunnels. Modeling tools included the U.S. Geological Survey's VS2DT vadose zone simulator, Lawrence Livermore National Laboratory's PARFLOW model, and custom-designed software.

- *Inverse Geochemical Modeling of Shallow Groundwater near a Hydrofracturing Operation, Confidential Client, Pennsylvania*

Used both forward and inverse geochemical modeling approaches to help understand possible impacts of well drilling on the water quality associated with nearby domestic water supply wells. The effort involved the identification and analysis of both regional-scale and local-scale groundwater quality data sets. The project was conducted in a litigation support context.

- *Geochemical Modeling of Soil and Groundwater Contamination, Confidential Client, South Carolina*

Responsible for geochemical modeling in a litigation context for a site in South Carolina. Technical issues included the timing and extent of the evolution of pH and trace metal concentrations in soil and groundwater associated with past industrial activities.

- *Groundwater Contamination Characterization, Confidential Client, Italy*

Applied a geochemical modeling approach, utilizing multiple sources of thermodynamic data, to provide insights into a mercury speciation problem involving both surface water and groundwater samples.

- *In Situ Remediation Modeling, Confidential Client, Midwestern U.S*

Evaluated the potential for in situ immobilization of dissolved metals in groundwater at a site in the Midwestern U.S. Employed a reactive transport geochemical modeling approach to help design and interpret the results of a pilot test involving aquifer via redox manipulation. Modeling results were also used to brief client and regulatory agencies.

- *Reservoir Environmental Impact Study, Bolivia*

Modeled the evolution of water quality in a planned reservoir using the DYRESM-CAEDYM lake modeling codes. Simulations were performed to address potential environmental concerns in the context of due diligence requirements for the client, the Inter-American Development Bank.

- *Source Area Remediation Technology Assessment, Lawrence Livermore National Laboratory (LLNL), California*

Conducted a comparative analysis of the suitability for alternative remediation strategies for chlorinated hydrocarbon plume source areas at the LLNL Livermore Site, a CERCLA site in Northern California. Designed a compartmentalized model of plume source areas which was used to analyze multiple source area data sets. Presented the source area remediation evaluation approach to U.S. Department of Energy management, regulatory agency representatives, a community work group, and subject matter experts from the U.S. EPA's Office of Research & Development.

- *Radiological Materials Threat Assessment*

Developed threat assessments for radiological exposure scenarios for the U.S. Department of Health and Human Services and U.S. Department of Homeland Security BioShield program. Assembled and directed a team of experts to identify and simulate threats, conducted a stakeholder workshop, and prepared a final report and briefing package.

- *Groundwater Contaminant Plume Analysis*

Conducted statistical study of chlorinated hydrocarbon groundwater plume behavior for the U.S. Department of Energy. Responsibilities included statistical interpretation and modeling of contaminant and hydrologic data from approximately 100 groundwater contamination sites across the U.S. (DOD, DOE, and commercial/industrial facilities) impacted by chlorinated hydrocarbon plumes. Initial study results led to follow-on funding and three peer-reviewed journal publications.

Miscellaneous Environmental Studies

- *Groundwater Banking and Blending Study, Antelope Valley, California*

Supported evaluation of planned recharge/extraction operations on water quality to support design of banking and blending alternatives of the large banking project. Effort entailed evaluation of the distribution of key water quality parameters to identify preferential zones of recharge and flow in the underlying aquifer as well as geochemical modeling, coupled with solute transport modeling, to predict water quality impacts associated with artificial groundwater recharge. Also developed and applied analytical and semi-analytical screening-level flow models to provide rapid assessments of various proposed recharge and extraction scenarios.

- *Remediation Technology Research and Development, Lawrence Livermore National Laboratory (LLNL), California*

Investigated the in situ catalytic destruction of dissolved chlorinated hydrocarbons in groundwater, in collaboration with scientists from Stanford University. Project was supported in part by a competitive three-year research grant through LLNL. Results of project research yielded two peer-reviewed journal publications, two functioning groundwater treatment systems, a U.S. patent, and follow-on funding.

- *Expert Committee Member for a U.S. Department of Defense-funded Fuel Hydrocarbon Natural Attenuation Assessment Project*

Reviewed and analyzed soil and groundwater data from nine military bases across the state of California and participated in site visits and briefings. The study yielded three peer-reviewed journal publications.

- *Fuel Hydrocarbon Biodegradation, Lawrence Livermore National Laboratory (LLNL), California*

Analyzed groundwater quality data pertaining to biodegradation of fuel hydrocarbons under the elevated temperatures of a post-thermal remediation subsurface environment. Responsibilities included data interpretation, geochemical modeling, and interacting with project collaborators at Stanford University. Project results led to regulatory closure of the site from further remediation requirements for fuel hydrocarbons.

Journal Publications and Conference Proceedings:

McNab, WW, A Monte Carlo-based approach for groundwater chemistry inverse modeling. Open Journal of Modern Hydrology 2014;(4): 112-120; http://dx.doi.org/10.4236/ojmh.2014.44011.

Carroll SA, McNab WW, Dai Z, Torres SC. Reactivity of Mount Simon Sandstone and the Eau Claire Shale under CO_2 storage conditions. Environ Sci Technol 2013; (47): 252-61.

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McNab W, Rupp J, Ellett K, Wagoner J. Simulating CO_2 injection and storage with limited site data: the utility of a variably complex modeling approach. Energy Procedia 2013; 3842–3849.

McNab WW, Ramirez AL, Johnson JW. Quantifying reactive chemistry along an injected CO_2 flow path at the field scale using a Monte Carlo simulation approach. International Journal of Greenhouse Gas Control 2013, (16): S194-S202.

Carroll SA, McNab WW, Torres SC. Experimental study of cement – sandstone/shale – brine – CO_2 interactions. Geochemical Transactions 2011; 12:9 doi:10.1186/1467-4866-12-9.

McNab W, Carroll S. Geochemical indicators of migrating brine impacted by CO_2 identified through laboratory experiments and reactive transport modeling. Proceedings of the Tenth Annual Conference on Carbon Capture and Sequestration, Pittsburgh, Pennsylvania, May 2-5, 2011.

Carroll S, McNab W, Torres S, Singleton M, Zhao P. Wellbore integrity in carbon sequestration environments: 1. Experimental study of cement – sandstone/shale – brine – CO_2. Energy Procedia 2011; 5186-5194.

McNab W, Carroll S. Wellbore integrity at the Krechba carbon storage site, In Salah, Algeria: 2. Reactive transport modeling of geochemical interactions near the cement–formation interface. Energy Procedia 2011; 5195-5202.

McNab WW, Jr, Singleton MJ, Moran JE, Esser BK. Ion exchange and trace element surface complexation reactions associated with applied recharge of low-TDS water in the San Joaquin Valley, California. Appl Geochem 2009; 24(1):129–137.

McNab WW, Jr, Singleton MJ, Moran JE, Esser BK. Assessing the impact of animal waste lagoon seepage on the geochemistry of an underlying shallow aquifer. Environ Sci Technol 2007; 41(3):753– 758.

Singleton MJ, Esser BK, Moran JE, Hudson GB, McNab WW, Harter T. Saturated zone denitrification: potential for natural attenuation of nitrate contamination in shallow groundwater under dairy operations. Environ Sci Technol 2007; 41(3):759–765.

Newell CJ, Cowie I, McGuire TM, McNab W. Multi-year temporal changes in chlorinated solvent concentrations at 23 MNA sites. J Environ Eng 2006; 132(6):653–663.

Beller HR, Madrid V, Hudson GB, McNab WW, Carlsen T. Biogeochemistry and natural attenuation of nitrate in groundwater at an explosives test facility. Appl Geochem 2004; 19(9):1483–1494.

McNab WW, Jr. Forensic analysis of chlorinated hydrocarbon plumes in groundwater: A multi-site perspective. Environ Forensics 2001; 2(4):313–320.

McNab WW, Jr. A Monte Carlo simulation method for assessing biotransformation effects on groundwater fuel hydrocarbon plume lengths. Comput Geosci 2001; 27(1):31–42.

McNab WW, Jr, Rice DW. Ascertaining the effect of reductive dehalogenation on chlorinated hydrocarbon plume lengths in groundwater: analyses of multi-site data. Soil Sediment Contam 2001; 10(1):1–19.

McNab WW, Jr, Ruiz R. In situ measurement of electro-osmotic fluxes and conductivity using single wellbore tracer tests. Ground Water Monit Rem 2001; 21(4):133–139.

McNab WW, Jr, Rice DW, Tuckfield C. Evaluating chlorinated hydrocarbon plume behavior using historical case population analyses. Biorem J 2000; 4(4):311–335.

McNab WW, Jr, Ruiz R, and M. Reinhard, In-situ destruction of chlorinated hydrocarbons in groundwater using catalytic reductive dehalogenation in a reactive well: Testing and operational experiences. Environ Sci Technol 2000; 34(1):149–153.

Cherepy N, McNab W, Wildenschild D, Ruiz R, Elsholz A. Electro-osmotic remediation of fine-grained sediments. Proceedings, Electrochemical Society, Environmental Aspects of Electrochemical Technology, 1999–39, 97–110, 1999.

McNab WW, Jr. Comparisons of geochemical signatures of biotransformation of fuel hydrocarbons in groundwater. Environ Monit Assess 1999; 59(3):257–274.

McNab WW, Jr, Dooher BP. Authors' reply to discussion of "Uncertainty analyses of fuel hydrocarbon biodegradation signatures in ground water by probabilistic modeling." Ground Water 1999; 37(2):167–168.

McNab WW, Jr, Dooher BP. A critique of a steady-state analytical method for estimating contaminant degradation rates. Ground Water 1998; 36(6):983–987.

McNab WW, Jr, Dooher BP. Uncertainty analyses of fuel hydrocarbon biodegradation signatures in ground water by probabilistic modeling. Ground Water 1998; 36(4):691–698.

McNab WW, Jr, Ruiz R. Palladium-catalyzed reductive dehalogenation of dissolved chlorinated aliphatics using electrolytically-generated hydrogen. Chemosphere 1998; 37(5):925–636.

McNab WW, Jr. Simulation of reactive geochemical transport in groundwater using a semi-analytical screening model. Comput Geosci 1997; 23(8):869–882.

McNab WW, Jr, Narasimhan TN. Reactive transport of petroleum hydrocarbon constituents in a shallow aquifer: Modeling geochemical interactions between organic and inorganic species. Water Resour Res 1995; 31(8):2027–2033.

McNab WW, Jr, Narasimhan TN. Degradation of chlorinated hydrocarbons and groundwater geochemistry: A field study. Environ Sci Technol 1994; 28(5):769–775.

McNab WW, Jr, Narasimhan TN. Modeling reactive transport of organic compounds in groundwater using a partial redox disequilibrium approach. Water Resour Res 1994; 30(9):2619–2635.

McNab WW, Jr, Narasimhan TN. A multiple species reactive transport model with sequential decay chain interactions in heterogeneous subsurface environments. Water Resour Res 1993; 29(8):2737–2746.

Selected Technical Presentations:

McNab WW. Impact of climate change on soil and groundwater chemistry subject to process waste land application. Poster Presentation, American Geophysical Union, Fall Meeting, San Francisco, CA, December 2013.

McNab W, Rupp J, Ellett K, Wagoner J. Simulating CO_2 injection and storage with limited site data: the utility of a variably complex modeling approach. Poster Presentation, Greenhouse Gas Control Technologies (GHGT11) Conference, Kyoto, Japan, November 2012.

McNab WW, Ramirez A, Johnson J. A Markov chain Monte Carlo inversion approach for assessing reactive chemistry along a flow path with application to subsurface CO_2 injection. Poster Presentation, American Geophysical Union, Fall Meeting, San

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Francisco, CA, December 2011.

McNab WW, Carroll S. Geochemical indicators of migrating brine impacted by CO_2 identified through laboratory experiments and reactive transport modeling. Poster Presentation, Tenth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, May 2011.

McNab WW, Carroll S. Wellbore integrity at the Krechba carbon storage site, In Salah, Algeria: 2. reactive transport modeling of geochemical interactions near the cement–formation interface. Poster Presentation, Greenhouse Gas Control Technologies (GHGT10) Conference, Amsterdam, the Netherlands, September 2010.

McNab WW, Hao Y, Foxall W, Carroll S. Hydromechanical simulations of surface uplift due to CO_2 storage, including reactive transport modeling. Ninth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, May 2010.

McNab WW, Carroll S, Morris J. Core-scale geochemistry: implications for wellbore integrity. In Salah CO_2 Joint Industry Project Technical Review, Cambridge, UK, February 2010.

McNab WW, Carroll S, Morris J. Interaction of CO_2-rich fluid with wellbore cement and adjacent formation mineral assemblages: contrasting potential impacts to porosity. Poster Presentation, American Geophysical Union, Fall Meeting, San Francisco, CA, December 2009.

McNab WW Jr. Constraining denitrification mechanisms in shallow groundwater at an instrumented dairy site using reactive transport modeling. Poster Presentation, Groundwater Resources Association, Nitrate in California's Groundwater: Are We Making Progress?, Modesto, CA, April 2006.

McNab WW Jr, Ezzedine S, Detwiler R. Quantifying an intrinsic mass transfer rate for TCE dissolution via pore-scale experiments and simulations. Groundwater Resources Association, DNAPL Source Zone Characterization and Remediation Symposium, San Francisco, CA, December 2005.

McNab WW Jr, Singleton M, Esser B, Moran J, Beller H, Kane S, Letain T. Nitrate loading and groundwater chemistry at a dairy site in California's Central Valley. SAFEWATER 2005, International Conference on Safe Water, San Diego, CA, October 2005.

McNab WW Jr. Groundwater environmental investigation activities at Lawrence Livermore National Laboratory. Establishing research and development priorities in the environmental sciences within Ukraine, Dnipropetrovsk, Ukraine, September 2005.