Mutch Associates, LLC
Environmental Engineers and Scientists

Robert D. Mutch, Jr., P.Hg., P.E.

President, Principal Groundwater Hydrologist

EDUCATION:

Graduate courses in Groundwater Hydrology and Environmental Chemodynamics, Stevens Institute of Technology, 1991

M.S. in Civil Engineering, New Jersey Institute of Technology, 1977

B.S. in Civil Engineering, Newark College of Engineering, 1972

PROFESSIONAL AFFILIATIONS:

American Society of Civil Engineers

American Institute of Hydrology

National Ground Water Association

REGISTRATIONS:

Professional Hydrogeologist - National

Professional Engineer:
New Jersey, New York

PROFESSIONAL HISTORY:

Mutch Associates, LLC.: President 2009 to present

Columbia University: Adjunct Professor of Hydrogeology, 2005-Present

HydroQual, Inc.: Principal Groundwater Hydrologist, Executive Vice President, 2003 to 2009

Manhattan College: Adjunct Professor of Hydrogeology, 1991-2011

Brown and Caldwell: Senior Vice President, 1998-2003

Eckenfelder Inc.: President and CEO, 1997-1998; Executive Vice President 1984-1997(Eckenfelder Inc. merged with Brown and Caldwell in 1998)

New Jersey Institute of Technology, Adjunct Instructor, Graduate course in "Seepage and Well Analysis", 1980-1986

EXPERIENCE SUMMARY:

Robert Mutch has more than forty years of experience in hydrogeology, groundwater and contaminant fate and transport modeling, urban hydrogeology, forensic hydrogeology, and remediation engineering. His areas of specialization include numerical modeling of groundwater flow and contaminant transport, fate, and reaction during in situ treatment and monitored natural attenuation; aquifer testing, DNAPL behavior, fractured rock hydrogeology, and stereoscopic interpretation of historical aerial photography. Mr. Mutch has extensive experience in the modeling and design of hazardous waste site remedial measures ranging from groundwater extraction systems and subsurface barrier walls to in situ chemical reduction (ISCR), soil vapor extraction (SVE), and monitored natural attenuation (MNA). His experience also includes radioisotope dating of groundwater and sediments using tritium, Cesium-137, and Lead-210. He has taught more than 100 training courses in hydrogeology and hazardous waste site and landfill remediation throughout the U.S. and in Europe and Australia. He also serves as an Adjunct Professor at Columbia University and previously served for 20 years as an Adjunct Professor at Manhattan College where he taught graduate-level courses in groundwater hydrology, contaminant migration in the subsurface, and groundwater modeling.

Frequently serves as project director for large, multi-PRP Superfund projects Frequent public speaker in training programs, conferences, and public meetings. Often provides expert testimony in hydrogeology, environmental forensics, natural resource damages, and the history of waste disposal practice in the U.S.

HONORS AND AWARDS:

Tau Beta Pi
National Engineering Honor Society

Chi Epsilon
National Civil Engineering Honor Fraternity

Tau Chi Alpha
National Environmental Engineering Honor Society

Awarded Citation for Excellence in Manuscript Review by Soil Science Society of America Journal (2009)

PEER REVIEWER for:

Ground Water Journal

Soil Science Journal

SPECIFIC PROJECT EXPERIENCE:

Numerical Modeling Of Groundwater Flow and Contaminant Fate and Transport

Numerical Model Development and Calibration, Sepulveda Site, CA

Developed and calibrated a regional, three-dimensional groundwater flow and contaminant transport model for a chlorinated ethene, chlorinated ethane and 1,4-dioxane site near LAX airport in Los Angeles. The model encompasses two major faults - the Charnock fault and the Newport-Ingelwood Uplift-- and the intervening Gardena Syncline. The model also includes the northern end of the West Coast Basin Barrier Project (WCBBP) seawater intrusion barrier, many of the Western Basin's major water supply wells, and all four major aquifers of the Western Basin - the Gage, Lynwood, Silverado, and Sunnyside. The model was configured to evaluate the effectiveness of different remedial measures, including MNA, to protect downgradient water supply wells.

Model Development and Calibration, Former Simmonds Precision Site, Chester, NJ

Developed and calibrated a three-dimensional numerical groundwater flow model of the Former Simmonds Precision site. The site lies in a complex faulted and fractured rock complex composed of saprolite, weathered gneiss, quartzite, and limestone. The upland, faulted rock adjoins an alluvial valley, composed of peat, fluvial sands, and lacustrine silt and clay deposits. The model is being developed in parallel with an ongoing investigation of a plume of PCE emanating from a complex zone of DNAPL residual saturation within the fractured rock. The model is being used to evaluate remedial options, including MNA.

Development and Calibration of a Groundwater Flow and Contaminant Transport Model, Helen Kramer Landfill Superfund Site, Mantua Twp., NJ

Development and calibration of a groundwater flow and contaminant transport model of the Helen Kramer Landfill Superfund Site in Mantua, New Jersey. The modeling involved the parallel, iterative calibration of two groundwater flow

models - one for pre-remediation conditions and one for post-remediation conditions-- and a contaminant transport model for 1,2-DCA. The simultaneous, iterative calibration of the groundwater flow and transport models greatly reduced the uncertainty and "non-uniqueness issue" of the ultimate calibration. The models will be used to evaluate MNA and possible modifications of the original 1989 remediation to manage migration of 1,2-DCA and other chlorinated and non-chlorinated solvents passing through an aquitard underlying the landfill and into the Englishtown Sand Aquifer.

Reactive Transport Modeling, Industrial Plant Site, North Hollywood, California: *Project Manager* - Reactive transport modeling of a proposed in situ chemical reduction pilot test designed to treat a hexavalent chromium plume in situ using calcium polysulfide (CaSx). Utilizing a GMS modeling platform, incorporating MODFLOW and RT3D, and a proprietary chemical reaction model code, developed by Mutch Associates, that describes the chemical reactions between the CaSx and the Cr(VI) and the Soil Reductant Demand (SRD) of the aquifer solids, the modeling guided the engineering team in optimizing the in situ treatment approach. The model was also used to simulate the performance of a "Push/Pull" in situ treatment scenario where the aquifer's SRD was converted to Soil Oxidant Demand (SOD) by the CaSx and then the Cr(VI) was pulled back through the SOD by pumping of the same injection/extraction well.

Numerical Groundwater Flow Modeling, Pennsauken Landfill, New Jersey *Project Manager* - Flow and mass transport modeling to predict historic and future landfill plume migration under various remediation alternatives. Combined with chemical fingerprinting using minor ions, the modeling helped settle a 19-year old litigation by demonstrating the anticipated effectiveness of an in situ treatment remedy that reduced remediation costs by close to 90% compared to the state-ordered pump and treat remedy.

Numerical Groundwater Flow and Reactive Transport Modeling, Industrial Site, Northeast Illinois: *Project Manager and Expert Witness* - In the context of a class action, toxic tort litigation, development of a three-dimensional, flow and mass transport model of a multi-aquifer (glacial outwash and Silurian dolomite) hydrogeologic system using MODFLOW and MT3D. The model was calibrated to both hydrologic and dissolved-phase contaminant concentrations and was used to predict historic plume growth and migration and to predict the annual emissions of vinyl chloride from a marsh into which the plume discharged.

Numerical Groundwater Flow Modeling, ISP Linden Site, New Jersey: *Project Manager* - Numerical groundwater flow modeling of the ISP Linden Brownfields redevelopment site. The three-dimensional modeling of the complex groundwater-surface water interactions and anisotropic bedrock aquifer was done employing Visual MODFLOW and MT3D. The calibrated model was used to predict contaminant migration and to evaluate the performance of various remedial options including barrier walls, horizontal drains and pumping wells.

Numerical Groundwater Flow Modeling, Hill Air Force Base, Utah: *Project Manager* - Numerical groundwater flow modeling of the Hill Air Force Base OU1 Superfund Site near Salt Lake City, Utah. Employing Visual MODFLOW, a cross- sectional model domain was constructed to help

define design parameters for a trench-based groundwater containment and extraction system for the LNAPL/DNAPL source area of OU1.

Numerical Groundwater Flow Modeling, Dico Company, Iowa: *Project Manager* - Development of a two-dimensional groundwater flow model of the glacial outwash aquifer at the Des Moines TCE Superfund site. The model, which was developed for the DICO Company, was reviewed and approved by USEPA for their use in selecting groundwater control remedies as part of the USEPA-conducted feasibility study. The USEPA-selected 2,000-gallon per minute groundwater extraction remedy was subsequently reduced to 1,300 gallons per minute through more detailed modeling during the design process.

Numerical Groundwater and Contaminant Transport Modeling, Rowe Manufacturing Site, New Jersey: *Project Manager*- Numerical groundwater flow and transport modeling of the Rowe Manufacturing site, a residential Brownfields redevelopment. Visual MODFLOW and MT3D were employed to evaluate contaminant transport parameters by matching the observed plume to a model predicted plume. Various remedial alternatives were evaluated with respect to their ability to contain and restore aquifer water quality and the time necessary to achieve remedial goals.

Contaminated Sediment Characterization and Remediation

Research Project, Active Capping Demonstration Project, Anacostia River, Washington, D.C.: *Task Manager-AquaBlok Cap Uplift Investigation* Researched the potential for uplift of the low permeability AquaBlok cap using a string of ten, highly sensitive inclinometers constructed within the AquaBlok cap. The inclinometers were designed to record even minute fluctuations in the cap potentially caused by transient tidal fluctuations, sediment consolidation, or gas accumulation beneath the cap. The sensors detected slight cyclical vertical oscillations in the cap due to transient tidal pressures. A steady vertical uplift followed by a sudden major uplift in one portion of the cap was observed and attributed to gas buildup beneath the cap.

Sediment Investigation, Forensics, and Allocation Assistance, Sonoco US Mills, Fox River Superfund Site, DePere, WI,: *Project Director* Provided technical assistance to Sonoco US Mills in connection with the Lower Fox River Superfund site. The work included an environmental forensics investigation relative to their potential contributions of PCBs to the Lower Fox River. Forensic techniques included sediment coring and analysis, radioisotope data of the cores using Cs-137 and Pb-210, drilling into a closed and backfilled wastewater settling basin, and stereographic interpretation of historical aerial photography. Assistance was also provided in connection with allocation estimates.

Assessment and Allocation of Sediment Contamination from a PRP located on Berry's Creek (NJ) Superfund Site: *Project Director* An assessment of metals and VOC contamination was performed for a PRP involved in the Berry's Creek Superfund site. Historical loadings of metals from the PRP discharge were compared to total metals present in surficial sediments at Berry's Creek. This information was used to assess the appropriateness of the PRP's cost allocation for the remedial investigation of the site.

Investigation of Sediment Contamination from a Site located on Kill Van Kull (NJ): *Project Director* An investigation of sediment contamination in the highly industrialized Kill Van Kull was undertaken to assess impacts from the upland site and past wastewater discharges. The study involved sectioned vibracore sampling throughout the sediment bed, radioisotope dating, chemical fingerprinting, and quantitative analysis for *dehalococcoides* to assess biodegradation. Potential heavy metals toxicity was evaluated through SEM/AVS analyses.

Groundwater Modeling of Groundwater/Sediment Interactions at the Gowanus Canal (NY) Superfund Site: *Technical Lead for Groundwater Modeling* A three-dimensional groundwater flow model was developed for the Gowanus Canal and the surrounding area to aid in evaluating groundwater-borne fluxes of contamination to the canal and to evaluate the performance of candidate sediment remedial measures, including impermeable capping, reactive caps, and subsurface barrier walls.

RCRA Facility Investigation, Corrective Measures Study, Design and Construction Oversight, Hercules, Glens Falls, NY**:** *Project Director* Provided overall technical direction to a multi-disciplinary team of engineers, hydrogeologists, and scientists in connection with remediation of the Hercules, Glens Falls site, which included upland remediation and dredging of contaminated sediments in the adjacent Hudson River. The COCs at the site were principally heavy metals. After careful studies of the limited toxicity of heavy metal-contaminated sediments in the Hudson River, a modest dredging remedy was negotiated with the NYSDEC involving near-shore dredging of only visibly-contaminated sediments. The sediments were interred beneath the upland site RCRA cap.

Environmental Forensic Analyses

Chemical Fingerprinting and Reactive Transport Modeling, Industrial Plant, Illinois: *Project Manager and Expert Witness,* Conducted a forensics analysis of a plume containing vinyl chloride, 1,1-DCE, and other constituents using stable isotopes of H, O, and N; and major and minor ions to demonstrate that the plume could not have impacted residential wells in a nearby village. Developed a calibrated groundwater flow and reactive chemical transport model to calculate historic volatilization of vinyl chloride from a marsh into which the plume discharged. These values were then used by an air modeling expert to estimate historic exposures of nearby receptors from the vinyl chloride volatilized from the marsh.

Chemical Fingerprinting and Chemical Transport Modeling of a Co-Disposal Landfill Plume, Pennsauken, New Jersey: *Project Manager and Expert Witness,* Conducted a forensics analysis of a complex landfill-derived plume in a major water supply aquifer with multiple sources of similar groundwater contaminants, namely TCE, PCE, benzene, chlorobenzene, arsenic, and ammonia. The minor ions, bromide and iodide, were found to be diagnostic of the landfill-derived plume allowing for differentiation of the landfill's impact from the myriad other sources of contamination to the aquifer. This fingerprinting, together with stereographic interpretation of historical aerial photographs and a calibrated groundwater flow and contaminant transport model, permitted redesign of the NJDEP ordered remedy, approval of the new design by NJDEP, settlement of a 19-year long litigation, and reduction in the costs from $120 million to $12 million.

Environmental Forensics Analysis of a Comingled Plume at an Major Electronics Manufacturing Site, Owego, New York: *Project Director,* Conducted a forensics study of a comingled plume at a major electronics manufacturing facility as part of an allocation effort. The work included application of Logarithmic Correlation Analysis of the reductive dechlorination of TCE and TCA, minor ion analyses, and analysis of septic system diagnostic constituents, such as boron and ammonia.

Environmental Forensic Analysis of PCB-Contaminated Sediments, Fox River Superfund Site, Wisconsin: *Project Manager,* Conducted a multifaceted environmental forensics analysis of PCB-contaminated sediments in the OU4 section of the Fox River Superfund Site offshore of a major paper company as part of an allocation litigation. The investigation involved sediment core profiling of PCBs, radioisotope dating of the sediment cores using Cesium 137 and Lead 210, stereographic analysis of historic aerial photography, and drilling and analysis of residual wastewater treatment sludges from a historic, wastewater treatment lagoon now buried beneath the expanded "footprint" of the plant.

Aquifer Testing and Hydrogeologic Systems Analysis

Aquifer and Tracer Test, Seneca Meadows, Inc. Sanitary Landfill, Seneca Falls, New York: *Project Manager* Conducting a comprehensive aquifer test and tracer test of a fractured limestone aquifer at the Seneca Meadows, Inc. Sanitary Landfill in Seneca Falls, New York. The aquifer test involved manual and automatic data logging in more than 50 monitoring wells at radial distances of up to 4,000 feet. After corrections were made for fluctuations in barometric pressure based upon measured barometric efficiencies, data were analyzed using Hseih and Neuman's "cross-hole" technique to determine directional hydraulic diffusivities and directional hydraulic conductivities; Hantush's "r/B" technique and DeGlee's distance-drawdown methodology to determine aquifer transmissivity and storativity; Neuman and Witherspoon's "ratio method" to determine an overlying aquitard's vertical hydraulic conductivity; and Hantush and Thomas' technique for determination of areal anisotropy. Simultaneously with the aquifer test, a radially-convergent tracer test was conducted using Bromide and Rhodamine WT to determine the aquifer's fracture porosity.

Aquifer/Aquitard Testing, CIBA-GEIGY Toms River Superfund Site, New Jersey: *Project Manager* As part of the design of a 2.5 mgd groundwater extraction system at the Ciba-Geigy Superfund site in Toms River, New Jersey, analysis of data from seven aquifer tests in both the Upper and Lower Cohansey sand aquifers were analyzed by time-drawdown and distance-drawdown techniques. In addition, a highly instrumented aquitard test was conducted and analyzed by Neuman and Witherspoon's "ratio method" to determine vertical hydraulic conductivity. Results of this analysis were corroborated by determining the profile of naturally occurring tritium within the aquitard.

Aquifer Testing, Elf Atochem Myers Farm Superfund Site, Pittstown, New Jersey: *Project Manager* Conducting a comprehensive aquifer test of the Myers Farm Superfund Site. The aquifer test was designed to define key hydrogeologic parameters of the Lockatong formation fractured rock aquifer as part of design of a groundwater extraction system. Data collected by both automatic data

logging and manually were analyzed by Hseih and Neuman's "cross-hole" technique to define directional hydraulic diffusivities and conductivities; Theis' time-drawdown method and Cooper and Jacob's "straight-line" distance drawdown technique to define aquifer transmissivity and storativity; and Hantush and Thomas's technique to calculate areal anisotropy.

Aquifer Testing, Kodak, Rochester, New York: *Project Manager* - Conduct and analysis of low-flow aquifer test of the Grimsby sandstone beneath the KPW Distilling Area of Kodak's Rochester, NY plant. The data, after correction for barometric pressure fluctuations, were analyzed by Papadopoulos' modification of the Theis method designed to account for well bore storage in the relatively large diameter pumping well.

Hydrogeologic Characterization, Chemsol Superfund Site, Piscataway, New Jersey: *Project Director* for the hydrogeologic characterization of the Chemsol Superfund Site which sits atop a complex fractured rock hydrogeologic system within the Passaic Formation of New Jersey. The analysis included evaluation of prior aquifer tests, packer tests, and slug testing, evaluation of effectiveness of an interim groundwater pumping system to contain a plume of groundwater contamination on-site, and groundwater modeling to evaluate modifications to that system to extend the zone of capture beyond its current limits.

Natural Resource Damage Experience

Major Electronics Manufacturing Site, Dayton, New Jersey: *Project Manager* – Conduct of a hydrogeologic and natural resource damage assessment relating to groundwater. Developed technical arguments countering NRD claim for in excess of $2.5 million. Contributed to successful settlement of claim for less than $100,000.

ISP, Linden, New Jersey Site: *Project Director* – Developed an assessment of NRD for site. Conducted extensive groundwater modeling of site to understand plume migration and potential extent of NRD claim. Assisted in development of alternative beneficial projects. Settlement discussions are continuing.

Hoffman LaRoche, Nutley, New Jersey: *Project Manager* – Developed technical basis for off-setting NRD at the Nutley site based upon donation of property of a former Hoffman LaRoche plant in Sterling Forest, New York. The Sterling Forest plant, while outside of New Jersey, lies within the critical Wanaque Reservoir watershed that serves numerous municipalities in NJ, including Nutley, NJ—the site of the NRD claim. The project resulted in an unprecedented partial settlement of a NJ NRD claim based upon donation of land in another state.

Sharkey Farm Landfill Superfund Site, Parsippany, New Jersey: *Project Manager* – Retained as an expert witness by the Sharkey Farm Landfill PRP group in connection with NJ’s NRD claim for replacement of 188 acres, which in Morris County NJ could translate to costs of in excess of $5 million. Developed an NRD valuation demonstrating that lost groundwater services were negligible. A substantially less costly alternative NRD valuation was developed for settlement purposes based upon the minor reductions in the quantity of base flow in the Rockaway and upper Passaic Rivers attributable to the landfill cap.

Waste Site Remediation Projects

Peer Review of Remediation Sites for Fortune 100 Company in USA, Europe, South America, and Australia Peer reviews of more than 45 remediation sites throughout the US, Europe, South America, and Australia. This work involved projects in all stages of investigation, pilot-testing, remedial design, and remediation system implementation. Frequent web meetings and communication with other consultants were a mainstay of the projects. Reviews often involved in-depth evaluations of the feasibility and cost-effectiveness of virtually all forms of in-situ treatment technologies, often in complex hydrogeologic settings.

SPAQUE, Mellory Hazardous Waste Site, Belgium: *Project Manager* retained by SPAQUE to provide assistance to the agency with the investigation and remediation of this industrial waste landfill. The landfill was, in effect, Belgium's highest priority Superfund-type site. Migration of contaminated groundwater and landfill gases from the unlined, sandpit-based landfill had led to evacuation of a number of local residences. A focused feasibility study was performed, evaluating a number of remedial alternatives, including circumferential subsurface barrier walls, capping, and retrofitted leachate collection systems.

New Lyme Landfill Superfund Site, Ohio: *Project Director* retained by the New Lyme Landfill PRP Group to review the performance of a USEPA and Ohio EPA-led remedy at the site. The review resulted in discovery of significant mis-characterizations of the hydrogeologic system, which ultimately led to abandonment of a major bedrock groundwater extraction system, mothballing of a multi-million-dollar groundwater treatment plant, and implementation of a monitored natural attenuation remedy. The remedy modifications resulted in reductions of approximately $500,000 per year in O&M costs to the PRP Group.

Remedial Investigation and Feasibility Study, General Electric's Aircraft Plant, Massachusetts: *Project Director* responsible for the design and construction oversight of the cleanup of PCBs from the floors of the manufacturing buildings.

***Hydrogeologic Investigation, Design and Construction of Environmental Controls, Monroe Township Landfill Superfund Site, New Jersey*:** *Project Manager* that supervised the hydrogeologic investigation, design, and construction of the environmental controls for the 83-acre Monroe Township Landfill. The remedial effort included 6,500 linear feet of subsurface cut-off wall, a retrofitted leachate collection system, capping of the site, and provision for discharge of collected leachate. Emergency measures were undertaken at the outset to mitigate existing public health impacts.

Hydrogeologic Investigation, Design, and Construction, Shope's Landfill Superfund Site, Pennsylvania: *Project Manager* for hydrogeologic investigation and design of remediation system, which included removal of drums, capping of the five-acre landfill with a composite compacted clay/PVC cap, and construction of an upgradient slurry trench cut-off wall.

***Hydrogeologic Investigation, Design of the Landfill Expansion, and Upgrading Plan for the Edgeboro Disposal, Inc. Sanitary Landfill, New Jersey*:** *Project Manager* - Design landfill

expansion with a capacity of 25,000,000 truck yards, which brought the landfill into compliance with current, more stringent regulations. The plans centered upon a 15,000 foot long slurry trench cutoff wall which effectively isolated the landfill from an underlying and adjacent water supply aquifer, the Farrington Sand.

Hydrogeologic Investigation, Remediation Design, Eastman Kodak's KPW Distilling Area, New York: *Project Manager* responsible for supervision of the hydrogeologic and DNAPL investigation and the design of a migration control system for Eastman Kodak's KPW Distilling Area in Rochester, NY. The KPW Distilling Area contains over 150 underground storage tanks containing chlorinated organics.

COURSES AND TRAINING PROGRAMS

Co-Director "Groundwater Contamination and Remediation: Principles and Practices", Northwest Environmental training Center and NJ LSRP Association, New Windsor, NJ (2014)

Presenter "Aquifer Behavior and Testing," Licensed Environmental Professional Association (LEPA), Training Course, Hartford, CT (2003).

Presenter "Quantitative Hydrogeology; Design of Groundwater Extraction Systems" LEPA and LSPA Associations, Hartford, CT and Marlboro, MA (2002-2003).

Director, Center for Professional Advancement's "Remediation of Hazardous Waste Sites" course offered regularly in the United States and Europe (1982 – 1990s).

Director, Center for Professional Advancement's "Management of Contaminated Groundwater and Aquifer Restoration" course (1989 - 1993).

Director, Center for Professional Advancement's "Applied Hydrogeology in Environmental Management" course (1993).

Director, Environmental Education Enterprises' (E3) "Landfill Remediation" course offered throughout the United States (1993).

Director, Center for Professional Advancement's "Treatment of Contaminated Soil and Rock" course (1989).

Director, Center for Professional Advancement's "Management of Underground Storage Tanks" course (1987 - 1993).

Co-director, Center for Professional Advancement's "Groundwater Monitoring" course offered regularly in the United States and Europe (1983 - 1988).

Lecturer, Vanderbilt University's regularly offered short course entitled "Management of Leachate and Contaminated Groundwater" (1983).

Lecturer, University of Arkansas, National Hazardous Materials Training Course (1979-1980).

Lecturer, University of Florida, TREEO Center courses in "Assessment of Groundwater Contamination" and "Aquifer Renovation: Hydrogeologic and Chemical Fundamentals".

Lecturer, University of Queensland (Australia), International Winter Environmental School, courses in Landfill Remediation and Remediation of Contaminated Land, (1994).

PATENT

Hydraulic Barrier Secure Landfill (Patent No. 4,335,978)

BOOKS

Hazardous Waste Site Soil Remediation: Theory and Application of Innovative Technologies, Wilson, David J. and Ann N. Clarke, (R Mutch-contributing author), Marcel Dekker, Inc., New York, 1993.

PUBLICATIONS AND PRESENTATIONS

Sharpe, C.W., R. Hinchee, T.L. Conklin, R.D. Mutch, C.B. Andrews, and P. Hare. 2019. Low-Rate Biodegradation Demonstration of Benzene in Cold Saline Groundwater. *Proceedings of the Fifth International Symposium on Bioremediation and Sustainable Environmental Technologies.* Baltimore, MD, Battelle. April 15-18, 2019

Mutch, R.D., R.F. Carbonaro, D.C. Changa-Moon, P.K. Gupta, J.J. Morris, A. Nambiar, L. Cordone, J.M. O'Loughlin. 2015. In Situ CO2 Sparging. II: Groundwater Mounding and Impacts on Aquifer Properties. *Journal of Hazardous, Toxic, and Radioactive Waste* 19:C4014006-4014001 - C4014006-4014009.

Carbonaro, R.F., R.D. Mutch, D.C. Changa-Moon, P.K. Gupta, J.J. Morris, A. Nambiar, L. Cordone, J.M. O'Loughlin. 2014. In Situ CO2 Sparging. I: Neutralization of a Caustic Brine Plume and Reduction of Mercury Levels. *Journal of Hazardous, Toxic, and Radioactive Waste* 19:C4014005-4014001 - C4014005-4014015.

Mutch, R.D., and J.D. Mahony. 2008. A Study of Tritium in Municipal Solid Waste Leachate and Gas, *Fusion Science and Technology*, Vol. 54, No. 1, *FUSTE8 (1)*, pp.305-310, July 2008.

Mutch, R.D., J.D. Mahony, P.R. Paquin, and J.C. Cleary. 2007. A Study of Tritium in Municipal Solid Waste Leachate and Gas, *Proceedings of the WEF Compounds of Emerging Concern Conference, Providence, RI*, July 29-30, 2007

Reible, D., D. Lampert, D. Constant, R. D. Mutch, and Y. Zhu, 2006. Active Capping Demonstration in the Anacostia River, Washington, DC, *Remediation*, 17(1): 39-53, Winter 2006.

Mutch, R. D. 2005. A Distance-Drawdown Aquifer Test Method for Aquifers with Areal Anisotropy. *Ground Water*, Vol. 23, No. 6, pp.935-938; November-December 2005

Mutch, R. D., and D. K. Kearney. 2003. Geotechnical/Hydrogeologic Factors in In Situ Contaminated Sediment Capping, *Proceedings of the EPRI/USEPA/USACE/NOAA In Situ Contaminated Sediment Capping Workshop*, Cincinnati, Ohio, May 12-14, 2003 (PowerPoint presentation)

Mutch, R. D., and R. D. Norris. 2001.The Fate of Drummed Organic Solvents in a Landfill Environment: Implications to Remedial Action, *Proceedings of Waste Tech 2001*, San Diego, California, February 11-14, 2001.

Mutch, R. D., R.E. Ash, IV, and J.R. Caputi, 1997.Contain Contaminated Groundwater. *Chemical Engineering*, Volume 104, No. 5, pp. 114-119, May 1997.

Mutch, R. D., R.E. Ash, IV, and Jeffrey R. Caputi. New Technologies for Subsurface Barrier Wall Construction. *Proceedings of the Fourteenth Annual Environmental Management and Technology Conference International,* Atlantic City, New Jersey, pp. 503- 519, June 18-20, 1996.

Mutch, R. D., R.E. Ash, IV, and N. P. Cavalli. 1994. Advancements in Subsurface Barrier Wall Technology. *Proceedings of Superfund XV*, Washington, DC, November 29-December 1, 1994.

Mutch, R. D. 1994. Collective Ignorance and Escalating Expectations. *Environmental Progress*, Vol. 13, No. 3, August 1994.

Mutch, R. D., and W. W. Eckenfelder. 1994. The 'Dusty Archives'-A Final Word, *Environmental Solutions*, Advanstar-Tower Publishing, Glen Ellyn, Illinois, June 1994.

Mutch, R. D., and R. E. Ash, IV. 1994. Cutoff Walls in Landfill Remediation: Successes, Recent Advancements, and Research Needs. *Proceedings of WasteTech '94 Conference*, NSWMA, Charleston, South Carolina, January 1994.

Mutch, R. D., and W. W. Eckenfelder. 1993. Out of the Dusty Archives: The History of Waste Management Becomes a Critical Issue in Insurance Litigation. *Hazmat World*, Advanstar-Tower Publishing, Glen Ellyn, Illinois, October 1993.

Mutch, R. D., J. I. Scott, and D. J. Wilson. 1993. The Impact of Matrix Diffusion on the Cleanup of Fractured Igneous, Metamorphic, and Sedimentary Rock Aquifers. *Proceedings of the Focus Conference on Eastern Regional Groundwater Issues*, National Ground Water Association, Burlington, Vermont, September 1993.

Mutch, R. D., D. J. Wilson and J. I. Scott. 1993. Estimating the Vertical Hydraulic Conductivity of Aquitards Using Naturally Occurring Tritium. *Proceedings of the Hazardous Materials and Environmental Management Conference/ Central*, Chicago, Illinois, pp. 375-396, March 1993.

Mutch, R. D., and R. E. Ash, IV. 1993. Subsurface Cutoff Walls Still Valuable in Site Remediation Role. *Hazmat World*, Advanstar-Tower Publishing, Glen Ellyn, Illinois, February 1993.

Mutch, R. D., D. J. Wilson and J. I. Scott, 1993. Cleanup of Fractured Rock Aquifers: Implications of Matrix Diffusion. *Environmental Monitoring and Assessment*, Kluwer Academic Publishers, The Netherlands, 24: 45-70, 1993.

Mutch, R. D., A.N. Clarke, D.J. Wilson, and K.H. Oma. 1992. Design and Implementation of Pilot Scale Surfactant Washing/Flushing Technologies Including Surfactant Reuse. *Water Science Technology.* Vol. 26, No. 1-2, 1992.

Mutch, R. D., A. N. Clarke, D. J. Wilson, and S. Kayana. 1992. Groundwater Cleanup by In Situ Sparging I. Mathematical Modeling. *Separation Science and Technology* 27(8 and 9), pp. 1023-1041, 1992.

Mutch, R. D. I. Scott, and D. J. Wilson. 1992. Control and Cleanup of Contaminated Fractured Rock Aquifers., *Proceedings of the Tenth Annual Hazardous Materials and Environmental Management Conference/ International,* Atlantic City, New Jersey, June 10-12, 1992.

Clarke, A.N., K. H. Oma, R. D. Mutch, and D. J. Wilson. 1991. Surfactant Washing/Flushing Approaches to the Remediation of Contaminated Soil, *Proceedings of the Ninth Annual Hazardous Materials Management Conference/International*, Atlantic City, NJ, June 1991.

Mutch, R. D., A. N. Clarke, et al., 1991. Results of a Year-Long Field Study of In Situ Vapor Stripping Simulating the End of Remediation. *Proceedings of the Fourth Annual Hazardous Materials Conference/Central*, Chicago, Illinois, pp. 45-68, April 1991.

Clarke, A. N., Mutch R. D., et al., 1990. In Situ Vapor Stripping: Results of a Year-Long Pilot Study. *Hazardous Materials Control*, Vol. 3(6), pp. 25-39, November-December 1990.

Oma, K. H., D. J. Wilson, and Mutch R. D. 1990. In Situ Vapor Stripping: The Importance of Non-Equilibrium Effects in Predicting Cleanup Time and Cost. *Proceedings of the Eighth Annual Hazardous Materials Management Conference/International*, Tower Conference Management Company, Glen Ellyn, Illinois, June 1990.

Mutch, R. D. and G. DiPippo. 1990. Intragradient Cutoff Walls in Waste Disposal Site Remediation. *Proceedings of the Third Annual Hazardous Materials Management Conference/Central*, Tower Conference Management Company, Glen Ellyn, Illinois, March 1990.

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