

# Thomas E. McHugh, Ph.D., D.A.B.T.

## Education

---

Ph.D., Toxicology, University of Washington, 1997.

M.S., Environmental Engineering, Stanford University, 1993.

B.A., Biochemistry and Environmental Science, Rice University, 1990.

## Professional Background

---

*Vice President*, Groundwater Services, Inc., Houston, Texas. 2003 to present

*Toxicologist and Environmental Scientist*, Groundwater Services, Inc., Houston, Texas. 1997 to present

*Research Assistant*, University of Washington, Seattle, Washington. 1993 to 1997

*Environmental Scientist*, Groundwater Services, Inc., Houston, Texas. 1990 to 1992

## Professional Affiliations

---

Diplomate, American Board of Toxicology (2002 to present)

Society of Toxicology

Society of Environmental Toxicology and Chemistry

## Project Experience: Toxicology and Risk Assessment

---

*Protocol for Tier 2 Evaluation of Vapor Intrusion at Corrective Action Sites, Various Locations.* Principal Investigator for three-year DoD funded research project to develop and validate Tier 2 and Tier 3 investigation protocols for the evaluation of vapor intrusion.

*Petroleum Vapor Intrusion Database, American Petroleum Institute.* Compiled and analyzed database of petroleum hydrocarbon measurements in groundwater, soil, soil gas, indoor air, and ambient air to obtain a better understanding of site-specific factors contributing to the presence or absence of vapor intrusion impacts at petroleum hydrocarbon corrective action sites.

*Detailed Field Investigation of Vapor Intrusion Processes, Various Locations.* Conducted three-year DoD funded research project on vapor intrusion processes at three DoD facilities. Identified site characteristics contributing to the occurrence of vapor intrusion impacts. Validated cost-effective vapor intrusion investigation methods.

*Barite Risk Assessment, Energy Services Company, Houston, Texas.* Conducted risk assessment comparing toxicity of barite (used in drilling mud) to soluble barium compounds. Based on this analysis, the TCEQ agreed to classify barite a chemical that it not a human health concern. Developed and validated a procedure to distinguish between soluble barium and barite in environmental soil samples.

*Ecological Risk Assessment, Former Pesticide Plant, Houston, Texas.* Completed a Tier 2 ecological risk assessment for soils impacted by chlorinated pesticides. The study included food-chain analyses for estimation of exposures to higher-level receptors. Risk assessment resulted in the development of clean-up standards for the protection of ecological receptors utilizing the uplands habitat adjacent to the facility.

## **Project Experience: Toxicology and Risk Assessment (Continued)**

---

*Vapor Intrusion Exposure Pathway*, American Petroleum Institute, Washington, D.C. Developed new model for evaluation and screening of the groundwater-to-indoor air exposure pathway. Model provides a significant advance over the commonly used evaluation model (i.e., the Johnson Ettinger Model) by providing a mass balance in groundwater rather than considering groundwater to be an infinite source of volatile chemicals. In addition, provided technical evaluation of the 2001 Draft U.S. EPA Vapor Intrusion Guidance.

*Baseline Risk Assessment for RFI Units*, Chemical Manufacturing Facility, Gulf Coast, Texas. Completed baseline risk assessment for former waste management units at a chemical manufacturing facility as part of the RCRA Facilities Investigation (RFI) process for the facility. Evaluation was completed to determine if corrective action measures were needed at the former waste management units to protect human health and the environment. The evaluation included an ecological risk assessment.

*Ecological Risk Assessment*, Pipeline Company, Greenville, Texas. Completed a Tier 2 ecological risk assessment on a creek impacted by 500,000 gallons of oxygenated gasoline released from a pipeline break. The study included food-chain analyses for estimation of exposures to higher-level receptors. Risk assessment found no remediation required in creek due to the natural rapid decrease in gasoline constituent concentrations in creek sediments over time. *TNRCC Ecological Risk Assessment Workgroup*, Austin, Texas. Member of a government and industry workgroup which has developed interim guidance for conducting ecological risk assessments for remediation sites in Texas. Workgroup is currently developing final guidance.

*Risk Management for Remediation Sites*, Major Oil Company, Fairfax, Virginia. Developed risk management guide and prioritization software to facilitate management of risks at remediation sites nation-wide. System allows the client to prioritize risks for resource allocation and to track risk reduction over time in the population of remediation sites.

*Risk-based Decision Making Performance Study*, Five States. Conducted an evaluation of the impact of Risk-Based Decision Making (RBDM) on the performance of corrective action program in five pilot states. The study, funded by the EPA through ASTM, involved development of program performance measures and analysis of state program databases to determine the impact of RBDM on risk reduction, program efficiency, and cost control.

*Baseline Risk Assessment*, Major Oil Company, Louisiana. Completed baseline risk assessment for a bayou and associated wetlands which have previously received discharges from an adjacent chemical manufacturing facility. Report summarized potential risk associated with occasional recreational use of the bayou and consumption of resident biota. Adult and child lead models developed by the EPA were utilized to assess potential risks from lead exposure.

## **Project Experience: Short Course Development and Teaching**

---

*Texas Risk Reduction Program (TRRP) Guidance and Policy*: Developed and taught one-day training course on TRRP guidance and policy. Key topics include: land use classification, groundwater classification, laboratory data validation, ecological risk assessment, total petroleum hydrocarbons, monitored natural attenuation, and non-aqueous phase liquids, and use of state mandated report forms.

*Texas Risk Reduction Program*, Developed and taught two-day training course on the Texas Risk Reduction Program regulations. Key topics include: overview of rule, applicable program areas, comparison to former Risk Reduction Program rules, affected property assessment, development of PCLs, remedy standards, and response actions.

*Texas Risk Reduction Program Software*, Developed and taught one-day training course on use of TRRP software package for calculation of PCLs under TRRP. Key topics include calculation of PCLs and understanding of how land use, application of institutional controls, and other site-specific factors impact PCL values.

## **Project Experience: Short Course Development and Teaching (Continued)**

---

*Risk-Based Corrective Action Training*, Developed and taught two-day training course on Risk-Based Corrective Action (RBCA). Key topics include: overview of corrective action, environmental fate and transport, development of site-specific clean-up standards, remedy selection, monitored natural attenuation, and use of RBCA software.

*Natural Attenuation*, Developed and taught one-day training course on application of natural attenuation to corrective action sites. Key topics include: overview of natural attenuation, primary, secondary, and option lines of evidence for evaluation of natural attenuation, and use of software for evaluation of natural attenuation.

*ASTM Course on Remediation by Natural Attenuation*, Taught two-day ASTM training course on remediation by natural attenuation.

*ASTM Tier 2 RBCA Toolkit Training*, Taught one-day training course on use of the RBCA Toolkit software for development of site-specific clean-up standards for corrective action sites.

*ASTM Course on Risk-Based Corrective Action*, Taught two-day training course on Risk-Based Corrective Action.

## **Project Experience: Litigation Support**

---

*Leaking Underground Storage Tank Site, Texas*. Testified concerning timing of gasoline release from former underground storage tanks and likelihood of achieving state remediation requirements.

*Contaminated Property, Texas*. Testified concerning potential toxicity of and exposure mechanisms for chlorinated solvents present at a contaminated site in north Texas. Also testified concerning the obligations to investigate and remediate contaminated properties in Texas.

*Diesel Plume, North Dakota*. Testified concerning human health impacts an LNAPL diesel plume underlying a small town in North Dakota. Vapor intrusion was identified as the key potential exposure concern. Used multiple lines of evidence to distinguish between background indoor air impacts and diesel vapor intrusion. Determined that no vapor intrusion impact occurred.

*Pipeline Break, Texas*. Testified concerning human health and ecological impacts associated with a release for oxygenated gasoline from a pipeline into an adjacent creek and drinking water reservoir. Evaluation included gasoline fate and transport, exposure potential, health impact, and remedy selection.

*Pesticide Plant, Texas*. Testified concerning human health and ecological risks associated with chlorinated pesticides present in soils adjacent to a former pesticide manufacturing facility. Evaluation included the development of clean-up standards for the protection of human health and ecological receptors.

*Landfill Permit Hearing, Texas*. Testified regarding the potential health risks associated with a Type IV (Construction and Inert Material) Landfill. Furthermore, testified on the topic of the toxicity of waste material accepted by the landfill and the adequacy of site operating procedures to prevent unacceptable exposure to the materials.

*Chlorinated Solvent Plume, Illinois*. Provided litigation support of potential sources, fate, and transport of chlorinated solvent plume under residential neighborhood. Key issues included relative contribution from potential sources and potential for dissolved plume to cause indoor air impacts in residential neighborhoods.

*Impacted Drinking Water Well, Texas*. Provided litigation support on methods for evaluation of toxicological impacts associated with petroleum hydrocarbon and lead contamination of an on-site water well used to provide drinking water.

## **Project Experience: Environmental Engineering**

---

*Corrective Measures Study*, Chemical Manufacturing Facility, Gulf Coast, Texas. Completed Corrective Measures Study (CMS) in accordance with Texas Risk Reduction Rules, Standard 3. CMS identified stabilization and containment for historic waste management units and associated affected soils and natural attenuation for affected groundwater as the preferred remedies.

*Radioactive Material License Renewal Application*, Chemical Manufacturing Facility, Gulf Coast, Texas. Completed application for renewal of a Radioactive Materials License (RML) subject to state and federal regulations for on-site disposal of low-level radioactive waste associated with chemical manufacturing. The application included a modeling evaluation of potential radiological impacts associated with the disposal units in accordance with state and federal regulations.

*Risk Prioritization Study of Petroleum Hydrocarbon Sites*, Major Oil Company, Torrance, California. Compiled data-base of 300 petroleum hydrocarbon sites based on questionnaires completed by site contractors. Incorporated the ASTM Risk-Based Corrective Action (RBCA) framework to rank sites based on relative risk to human health. Identified site where natural attenuation was the preferred remedy.

*Full Scale In-Situ Biotreatment System, Gas Processing Plant*, Wexford, Michigan. Analyzed design basis information and utilized the OASIS/BIOPLUME modeling system to design a full scale in-situ bioremediation system for remediation of dissolved BTEX plume. Coordinated system construction and installation. Provided analysis of performance and operation data.

*Dense Non-Aqueous Phase Liquid (DNAPL) Dissolution Study*, MOTCO Superfund Site, La Marque, Texas. Contributed to the development of a conceptual design for management of DNAPL contaminated portions of site. Project included design and evaluation of field scale study of the dissolution of soluble components of DNAPL. Compared field results to computer model predictions and used results to refine computer model. Developed cost effective long-term containment strategy.

## **Project Experience: Biochemistry and Microbiology**

---

*Dissertation Project*, Metabolism of Aflatoxin Epoxide by Glutathione Transferase Enzymes. University of Washington, Seattle, Washington. Aflatoxin is a known human carcinogen which is produced by fungal molds growing on grains and nuts stored under warm humid conditions. Understanding the biochemical mechanism by which the mouse Glutathione Transferase enzyme provides protection against aflatoxin toxicity, increases our understanding of how human detoxification enzymes protect us against environmental toxins.

*Resistance of Pseudomonas Bacteria to Hydrogen Peroxide*, Undergraduate Research, Rice University. Studied the ability of low hydrogen peroxide concentrations to induce the detoxification enzyme catalase in *Pseudomonas* bacteria isolated from a petroleum hydrocarbon affected aquifer. Hydrogen peroxide is a potential oxygen source for the bioremediation of petroleum hydrocarbon sites. Induction of the catalase enzyme increases resistance of the bacteria to higher concentrations of hydrogen peroxide.

*Forced Evolution of Detoxification Enzymes in E. coli*, Ph.D. Rotation Project, University of Washington. Used the natural processes of evolution in a laboratory environment to create modified versions of detoxification enzymes which provided increased resistance to *Escherichia coli* against specific toxic chemical. These modified enzymes and bacteria can be used in industrial applications or for bioremediation.

## Publications

---

- McHugh, T.E., and Connor, J.A. "Selection of Effective Technologies for Management of Contaminated Lands," in Simeonov, L. and Chirila, E. (ed.), Chemicals as Intentional and Accidental Global Environmental Threats, Springer Publishers, The Netherlands, 2006.
- McHugh, T.E., and Connor, J.A. "Evaluating Health Risks and Prioritising Response Actions for Contaminated Lands," in Simeonov, L. and Chirila, E. (ed.), Chemicals as Intentional and Accidental Global Environmental Threats, Springer Publishers, The Netherlands, 2006.
- Newell, C.J., and McHugh, T.E. "The Use of Models for the Evaluation of Chemical Attenuation in the Environment," in Simeonov, L. and Chirila, E. (ed.), Chemicals as Intentional and Accidental Global Environmental Threats, Springer Publishers, The Netherlands, 2006.
- McHugh, T.E., de Blanc, P.C., and Pokluda, R.J. "Indoor Air as a Source of VOC Contamination in Shallow Soils Below Buildings" *Soil and Sed. Contam.*, Vol. 15, No. 1, pp. 103-122, January 2006.
- McHugh, T.E. Ahmad, F. Connor, J.A. "Empirical Analysis of Groundwater-to-Indoor-Air Exposure Pathway Based on Measured Concentrations at Multiple Groundwater Impact Sites" *Env. Forensics*. Vol. 5, No. 1, pp. 33-44, March 2004.
- Connor, J.A., and T.E. McHugh, "Impact of Risk-Based Corrective Action (RBCA) on State Corrective Action Programs", Human and Ecological Risk Assessment, CRC Press, Volume 8, Number 2, April 2002.
- Connor, J.A., R.L. Bowers, and T.E. McHugh, "RBCA Toolkit: Comprehensive Risk-Based Modelling System for Soil and Groundwater Cleanup," in Linders, J.B.H.J. (ed.), Modelling of Environmental Chemical Exposure and Risk, Kluwer Academic Publishers, The Netherlands, 2001.
- Connor, J.A., R.L. Bowers, T.E. McHugh, and J. P. Neven, "Software Guidance Manual, RBCA Tool Kit for TRRP", Groundwater Services, Inc., 2001
- York, J. L., L. C. Maddox, P. Zimniak, T. E. McHugh, and D. F. Grant, "Reduction of MTT by Glutathione S-Transferase", *Biotechniques*, Volume 25, pp. 622-8, October, 1998.
- Van Ness, K. P., T. E. McHugh, T. K. Bammler, and D. L. Eaton, "Identification of Amino Acid Residues Essential for High Aflatoxin B1-8,9-Epoxy Conjugation Activity in Alpha Class Glutathione S-Transferase through Site-Directed Mutagenesis", *Toxicology and Applied Pharmacology*, Volume 152, pp. 166-174, September, 1998.
- McHugh, T. E., W. M. Atkins, J. K. Racha, K. L. Kunze, and D. L. Eaton, "Binding of the Aflatoxin-glutathione Conjugate to Mouse Glutathione S-Transferase A3-3 is Saturated at Only One Ligand per Dimer", *The Journal of Biological Chemistry*, Volume 271, pp. 27470-74, November 1, 1996.
- Chiang C., P. Petkovsky, M. Beltz, S Rouse, T. Boyd, C. Newell, T. McHugh, "An Enhanced Aerobic Bioremediation System at a Central Production Facility - System Design and Data Analysis", *Proceedings of the Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water*, National Ground Water Association, Houston, Texas, November, 1993, pp. 661-678.
- Newell, C.J., J.A. Connor, D.K. Wilson, and T. E. McHugh, "Impact of Dissolution of Dense Non-Aqueous Phase Liquids (DNAPLs) on Ground Water Remediation", *Proceedings of the Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground water*, National Water Well Association, Houston, Texas, November, 1991.

## Conference Presentations

---

McHugh, T.E., S. Maberti, et. al, "The Use of Empirical Data to Evaluate the Impact of Biodegradation on Petroleum Hydrocarbon Vapor Intrusion", Vapor Intrusion: The Next Great Environmental Challenge - An Update, Los Angeles, California, September 13-15 2006.

McHugh, T.E., T.N. Nickels, I.O'Brien, "Detailed Field Investigation of Vapor Intrusion Processes", Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2006.

McHugh, T.E., J.A. Connor, "Evaluating Health Risks and Prioritising Response Actions for Contaminated Lands", NATO Advanced Study Institute on Chemicals as Intentional and Accidental Global Environmental Threats, Borovetz, Bulgaria, November 16-27, 2005.

McHugh, T.E., J.A. Connor, "Selection of Effective Technologies for Remediation of Contaminated Lands", NATO Advanced Study Institute on Chemicals as Intentional and Accidental Global Environmental Threats, Borovetz, Bulgaria, November 16-27, 2005.

Newell, C.J., T.E. McHugh, "The Use of Models for the Evaluation of Chemical Attenuation in the Environment", NATO Advanced Study Institute on Chemicals as Intentional and Accidental Global Environmental Threats, Borovetz, Bulgaria, November 16-27, 2005.

McHugh, T.E., "Indoor Air as a Source of VOC Contamination in Shallow Soil Below Buildings", Southeast Asia Environmental Forensics Conference, Taipei, Taiwan, September 19-20, 2005.

McHugh, T.E., "Vapor Intrusion Investigation Methods", API Petroleum Vapor Intrusion Workshop, Costa Mesa, CA, August 17, 2005.

McHugh, T.E., J.A., Connor, "Methods for Characterization of Exposure to Volatile Chemicals Due to Vapor Intrusion:", 2005 NGWA Ground Water and Environmental Law Conference, Baltimore, MD, July 21-22, 2005.

McHugh, T.E., J.A., Connor, "Methods for Characterization of Background Indoor Air and Subsurface Vapor Intrusion", Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2004.

McHugh, T. E., J.A.Connor, "Vapor Intrusion: An Environmental Snipe Hunt?", 19<sup>th</sup> Annual International Conference on Soils, Sediments, and Water, Amherst, MA, October 20-23, 2003.

McHugh, T. E., P. C. DeBlanc, J.A.Connor, "A Mass Flux Model for Screening the Groundwater-to-Indoor-Air Exposure Pathway", CONSOIL 2003, Ghent, Belgium, May 12-16, 2003.

McHugh, T. E., P. C. DeBlanc, J.A.Connor, "A Mass Flux Model for Evaluation of the Groundwater-to-Indoor-Air Exposure Pathway", NGWA Petroleum Hydrocarbons Conference, Atlanta, GA, November 6-8, 2002.

Connor, J.A., F. Ahmad, T. E. McHugh, P. C. DeBlanc, C. J. Newell, R. J. Pokluda, "Development of Simple Screening Criteria for the Indoor Air Exposure Pathway", RCRA National Conference, Washington, DC, January 15-18, 2002.

McHugh, T.E., J.A., Connor, R.S. Lee, "Weight-of-Evidence Screening Criteria for Ecological Risk Assessment of Metals", Society of Environmental Toxicology and Chemistry 22<sup>nd</sup> Annual Meeting, Baltimore, Maryland, November 14-18, 2001.

McHugh, T.E., J.A., Connor, "Impact of Risk-Based Decision Making on LUST Programs in Five States", Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2000.

McHugh, T. E., J. A. Connor, M. W. Malander, "Use of Human Health, Ecological, and Other Risk Drivers to Prioritize Remediation of Contaminated Sites", Society of Environmental Toxicology and Chemistry 20<sup>th</sup> Annual Meeting, Philadelphia, PA, November 11-15, 1999.

## Conference Presentations (Continued)

---

McHugh, T. E., K. P. Van Ness, T. K. Bammler, D. L. Eaton, "Evidence that Mouse Glutathione S-Transferase A3-3 Evolved under a Specific Selective Pressure", 37th Annual Meeting of the Society of Toxicology, Seattle, WA, March 1 - 5, 1998.

McHugh, T. E., T. K. Bammler, W. M. Atkins, and D. L. Eaton, "Effect of Dimerization on the Catalytic Activity of the Heterodimeric Glutathione S-Transferase mGSTA3-rGSTA3". International Workshop on Glutathione Transferases, Rome, Italy, November 7-10, 1997.

McHugh, T. E., and D. L. Eaton, "The Evolution and Function of Drug Metabolizing Enzymes", 25th Anniversary Symposium, Department of Biochemistry & Cell Biology, Rice University, Houston, TX, October 3 - 4, 1997.

McHugh, T. E., W. M. Atkins, J. K. Racha, K. L. Kunze, and D. L. Eaton, "Binding of the Aflatoxin-glutathione Conjugate to Mouse Glutathione S-Transferase A3-3 is Saturated at Only One Ligand per Dimer", International Conference on Glutathione and Glutathione-Linked Enzymes in Human Cancer and Other Diseases, Hilton Head, SC, October 31 - November 3, 1996.

McHugh, T. E., K. P. Van Ness, T. K. Bammler, and D. L. Eaton, "Structure Function Analysis of Aflatoxin B1 - Epoxide Conjugating Activities on Glutathione S-Transferase-Yc Isoenzymes", 35th Annual Meeting of the Society of Toxicology, Anaheim, CA, March 10-14, 1996.

---