POREWATER SOLUTIONS
Expertise • Experience • Innovation

Grant R. Carey, Ph.D., P.Eng.

Profile Of Professional Activities

Dr. Carey has worked on projects across North America and in Europe and Australia with a focus on:

- PFAS site characterization, transport, and remediation modeling
- Environmental forensics and data visualization
- Groundwater and soil vapor flow and transport modeling
- NAPL delineation and remediation
- Regulatory negotiations
- Expert witness and litigation support services

Dr. Carey has more than 30 years of experience, and is recognized as an industry leader in PFAS in-situ remediation. Dr. Carey also specializes in environmental forensics, NAPL delineation, contaminated site and sediment remediation, mining water management, and groundwater flow and transport modeling. Dr. Carey provides regulatory and litigation support to various client sectors including law firms, the U.S. Department of Defense, chemical manufacturing, aerospace, and mining. Dr. Carey has also developed proprietary computer codes for PFAS modeling and visualization. Dr. Carey is currently involved with seven SERDP and ESTCP projects related to PFAS remediation. Dr. Carey is an Adjunct Research Professor at Carleton University and is an Adjunct Professor at the University of Toronto. Dr. Carey has also overseen PFAS and other research grants provided by Porewater Solutions to Carleton University, the University of Waterloo, and the University of Toronto. Dr. Carey has published more than 100 short courses, seminars, and papers, and he has developed and delivered PFAS courses based on interactive classroom, e-learning, and web seminars. Dr. Carey was involved with the development of the ITRC PFAS Guidance manual and is currently participating in the development of the National Ground Water Association White Paper on PFAS Forensics. Dr. Carey also has experience and training as both a mediator and meeting facilitator.

PFAS Qualifications

- Recognized industry leader in predicting the performance and longevity of in-situ sorbent technologies for PFAS remediation
- Widely published proprietary reactive transport model (In-Situ Remediation Model, or ISR Model) for evaluating the feasibility and design of PFAS remediation alternatives
- Proprietary forensic tools for visualizing PFAS source contributions, precursor transformations, redox geochemistry, and site background concentrations

- Expertise and experience gained through participation on industry-leading research teams studying PFAS adsorption to colloidal activated carbon
- 14 PFAS site characterization and remediation peer-reviewed journal articles since 2019, including twelve published and two to be submitted in 2025
- U.S. Patent Pending for an innovative process to enhance PFAS ex-situ treatment using granular activated carbon (GAC)
- Currently involved with seven SERDP-ESTCP projects related to PFAS remediation for the U.S. Department of Defense

SPECIALIZED PFAS CONSULTING SERVICES

In addition to standard site characterization, remediation, and litigation services, Dr. Carey is uniquely positioned to provide the following specialized PFAS services:

- Visualization of large PFAS datasets to delineate exceedances, evaluate the potential for precursor transformations, assess lines of evidence for PFAS attenuation along flow paths, and differentiate source contributions to a commingled plume
- Recommend site characterization methods that support the feasibility study or remedial design of in-situ sorbent alternatives
- Use proprietary reactive transport model (ISR Model) to:
    - Predict future PFAS plume extents, and the potential for natural attenuation to reduce risk at downgradient receptors
    - Compare the performance and longevity of various in-situ sorbent technologies
    - Assess the effects of competitive adsorption on the long-term performance of in-situ sorbents
    - Conduct feasibility or remedial design studies including evaluation of integrated site-wide alternatives for source treatment and plume management
    - Evaluate the influence of rate-limited desorption or back-diffusion on the timing of the downgradient plume response to site remediation
- Apply commercial models including HYDRUS and PFAS-LEACH to quantify PFAS flux from the vadose zone to an underlying aquifer to support cost-benefit analyses of vadose zone remediation strategies.
- Forensic evaluation of PFAS source contributions in support of litigation

EDUCATION

Ph.D.	University of Guelph, Guelph, Ontario, 2015: Predicting Attainable Goals and Depletion Timeframes for DNAPL Source Zones
M. Eng.	Carleton University, Civil and Environmental Engineering, 2001: Development and Field-Validation of a Three-Dimensional, Redox-Dependent Biodegradation Transport Model
1997	One of two Canadian graduate students invited to a NATO Advanced Study Institute (Bioavailability of Organic Xenobiotics in the Environment) in the Czech Republic.
B.A.Sc.	University of Waterloo, Civil Engineering, 1993: Thesis – Development and Validation of a Two-Dimensional, Density-Dependent Vapor Flow and Transport Model

EMPLOYMENT

2006-Present	President and CEO Porewater Solutions
2005-2006	Associate, and Director of Corporate Training Conestoga-Rovers & Associates
2002-2004	Senior Engineer and Training Developer Conestoga-Rovers & Associates
2000-2002	President and CEO Environmental Institute for Continuing Education (EICE)
1996-2002	President and CEO Environmental Software Solutions Inc. (ENSSI)
1997-1999	Carleton University Mediation Centre – Volunteer Mediator
1992-1996	Engineer, Conestoga-Rovers & Associates

PROFESSIONAL AFFILIATIONS

- California Groundwater Resources Association (GRA)
- Professional Engineers Ontario (PEO)
- National Ground Water Association (NGWA)

Representative PFAS Projects

- U.S. DoD Project ESTCP ER25-8483. “Demonstration of SERDP-ESTCP e-Learning Platform for Enhancing Technology Transition” (PFAS In-Situ Remediation Modules).
- U.S. DoD Project ESTCP ER25-8624. “Colloidal Activated Carbon for In Situ PFAS Remediation at Coastal Sites: Field Assessment and Modeling of Long-Term Efficacy.”
- U.S. DoD Project ESTCP ER25-8875. “Evaluation of an Injected Surface Modified Clay Permeable Adsorptive Barrier for PFAS Sequestration.”

- U.S. DoD Project ESTCP ER24-8200. “Two PFAS Remediation Models for Understanding and Managing PFAS in the Saturated Zone.”
- U.S. DoD Project ESTCP ER20-5182. “Validation of Colloidal Activated Carbon for Preventing the Migration of PFAS in Groundwater”.
- U.S. DoD Project SERDP ER21-3959. “An investigation of factors affecting in situ PFAS immobilization by activated carbon”.
- U.S. DoD Project SERDP ER21-1070. “Hydraulic, chemical, and microbiological effects of in situ activated carbon sorptive barrier for PFAS remediation in coastal sites”
- Canadian Department of National Defense Site, Comox, British Columbia – Providing expert support for site characterization and remediation assessments using proprietary visualization and modeling tools.
- Collaborating with the Capital Region of Denmark (Copenhagen) and the Technical University of Denmark in support of a research project evaluating PFAS in-situ remediation strategies using colloidal activated carbon.
- Collaborating with Queens University (Kingston, Ontario) on a research project related to PFAS transport in the vadose zone.
- Several Former Manufacturing Facilities, California – evaluated potential for PFAS impacts based on monitoring well results on site, and/or at upgradient and downgradient facilities.
- Mid-West Military Facility – Collaborating with the U.S. Air Force Civil Engineering Center (AFCEC) to assess novel forensic methods for identifying PFAS source composition and evaluating PFAS precursor biodegradation to PFAAs in groundwater; and providing support and guidance to AFCEC on how to evaluate PFAS vadose zone data for the purpose of remedial decision-making.
- Virginia Military Facility – Collaborating with the U.S. Navy to model the initial two years of performance of a colloidal activated carbon barrier, including estimation of field-scale adsorption isotherms for ten short- and long-chain PFAS.
- California Military Facility – Collaborated with the U.S. Navy to model the influence of tidal fluctuations and coastal site geochemistry on the performance of colloidal activated carbon for PFAS in-situ remediation adjacent to the coast.
- South Dakota Military Facility – Collaborated with the U.S. Air Force to model the viability of colloidal activated carbon for in-situ remediation of PFAS at an AFFF-impacted site with high PFOS, PFHxS, and PFOA concentrations in groundwater.
- NGWA PFAS Forensics White Paper – Participating on a committee to prepare a comprehensive white paper on available PFAS forensic methods.
- Confidential Mine site, Australia – Modeled groundwater flow and PFAS transport to assess the feasibility and remedial design options for a colloidal activated carbon barrier to contain a PFAS plume which was preventing the dewatering of a large mineral resource.
- PFAS Manufacturer, Washington, D.C. – Previously retained by a large PFAS manufacturer in a matter related to the assessment of PFAS liability and various allocation methods.

- NSERC Alliance Research Project – PFAS competitive adsorption to collloidal activated carbon and development and verification of several reactive transport model codes, in collaboration with the University of Waterloo, University of Toronto, and Carleton University.
- Ontario Center of Excellence Research Project – PFAS Adsorption isotherms with colloidal activated carbon and PFAS in-situ remediation model code development, in collaboration with the University of Waterloo and Carleton University.
- Central Canada site - Modeled PFAS transport and in-situ remediation performance based on colloidal activated carbon injections into the source zone.
- Former Solvent Processing Facility - Assessment of PFAS trends and remedy implications at a former waste disposal site in New York.

Representative Site Remediation Projects

- Chemical manufacturing facility, Kentucky – Provided technical support for NAPL delineation, hydrogeology assessment, groundwater modeling, and chemical distribution analysis for a comprehensive remedial investigation, feasibility study, remedial design, and remedial action. Activities also included support for regulatory negotiations for one of the largest NAPL-contaminated sites in North America with a final remedy costing several hundred million dollars.
- Confidential Site, Saudi Arabia – Conducted soil vapor flow and transport modeling to support optimization of a soil vapor extraction system and to predict the timeframe for back-diffusion of methane and VOCs from bedrock.
- Cedar Chemical Site, Phillips County, Arkansas – Supported a PRP De Minimis evaluation for a chlorinated solvents site.
- Confidential Site, Ottawa, Canada – conducted forward and back-diffusion modeling to evaluate the timeframe for in-situ chemical oxidation performance in fractured bedrock.
- Aeronautical Manufacturing Facility, San Diego – Provided expert support for the development of a final remedy involving both enhanced bioremediation and monitored natural attenuation of TCE in groundwater.
- San Fernando Valley Superfund Site (Area 2), Glendale, California – Expert peer review for implementation of a basin-scale investigation for delineation of hexavalent chromium, and groundwater modeling to evaluate capture zones for regional supply wells for VOCs (mainly PCE and TCE), 1,4-dioxane, hexavalent chromium, and other emerging chemicals.
- Cache Creek Landfill, British Columbia - Conducted groundwater flow and transport modeling using an integrated system of one- dimensional stream tube models linked to a two-dimensional aquifer model downgradient of the landfill, to assess past and future chloride impacts to groundwater.
- Former manufacturing facility, Glendale, California – Expert peer review for monitoring and remediation of hexavalent chromium and chlorinated solvents including PCE and TCE.
- Solvent Savers Superfund Site, Lincklaen Township, New York – Provided DNAPL expertise and supported regulatory negotiations for development of a TCE monitored natural attenuation remedy.

- Aerospace manufacturing facility, Phoenix, Arizona – Expert peer review for treatability pilot test analysis, and preparation of the corrective measures study and implementation plan for a TCE plume in bedrock.
- Former rocket manufacturing facility, Southern California – Conducted a detailed investigation of chemical fate (perchlorate and chlorinated solvents) including validation of a three-dimensional basin-wide groundwater flow model for the San Bernadino Basin.
- Seaspan Site, British Columbia – Calibrated a three-dimensional transient (tidal oscillation) freshwater groundwater flow model for a coastal site and evaluated remedial design alternatives and sediment cap performance based on groundwater flow and chemical transport modeling;
- Union Bay Site, British Columbia – Calibrated a three-dimensional transient (tidal oscillation) groundwater flow model based on seasonal positions of the freshwater-seawater interface, and used a one-dimensional groundwater flow and chemical transport model to compare remedial alternative performance based on mass discharge reductions.
- Sydney Tar Ponds, Nova Scotia – Directed three-dimensional groundwater flow model calibration and application to evaluate the Phase III feasibility of several remedial alternatives at a large former hazardous waste site.
- Savannah River National Laboratory (SRNL) – Conducted a reactive transport modeling study to evaluate the mass balance for a chlorinated solvent plume attenuation at Plattsburgh Air Force Base (New York) on behalf of SRNL's research efforts related to natural and enhanced attenuation
- Vandenberg Air Force Base, California - Modeled tracer tests and bioremediation pilot tests to evaluate remedial performance as part of a Department of Defense (ESTCP) project related to the design of soluble substrate injection systems

Mining and Water Resource Modeling Projects

- Vale Garson Mine, Sudbury, Ontario – Calibrated a large three-dimensional groundwater flow model based on current pumping rates for a 100-year old underground mine, and used the model to assess the potential influence of a future mine expansion on nearby streams and lakes.
- Impala Iron Ore Mine, Thunder Bay, Ontario – Constructed and calibrated a large three-dimensional groundwater flow model based on recent open pit and underground working pumping rates, and predicted life of mine conditions. Also constructed a three-dimensional transport model to assess potential receptors and steady-state attenuation rates for a future tailings management facility.
- Green Technology Metals Mine, Thunder Bay, Ontario – Constructed and calibrated a three-dimensional groundwater flow model to predict future dewatering rates for two large open pit mines, and evaluated the potential influence on dewatering rates for two nearby water storage ponds.
- Clean Air Metals Mine, Thunder Bay, Ontario – Constructed a three-dimensional groundwater flow model to evaluate the influence of an overlying lake on dewatering rates for planned underground workings.

- Sugar Gold Mine, Thunder Bay, Ontario – calibrated a large three-dimensional groundwater flow model to current conditions and simulated dewatering pumping rates for the underground workings in the life of mine scenario.
- Vale Copper Cliff Complex, Sudbury, Ontario – developed and calibrated a three-dimensional groundwater flow model to assist with remedial design for a pump-and-treat system and partial barrier wall.
- Schefferville Area Iron Ore Mine, Western Labrador – developed and calibrated a three-dimensional groundwater flow model, and developed a phased pumping scheme for dewatering during mine operations.
- Joyce Lake Orebody, Western Labrador – development and calibration of a three-dimensional groundwater flow model, and evaluation of dewatering schemes for the open pit mine.
- Former sand and gravel quarry, Maryland - Developed and calibrated a groundwater flow model to evaluate the range in dewatering pumping rates in support of a large excavation and bioremediation program
- Texas Central Gulf Coast Aquifer Groundwater Availability Model – calibrated a regional groundwater flow model that covered an area that represents more than 10% of the drinking water supply for Texas, and used this model to predict water supply resources over a 50-year period in the future.
- Pebble Project, Northern Dynasty Minerals Ltd., Alaska – developed and calibrated a multi-watershed, three-dimensional groundwater flow model for the world's largest undeveloped copper and gold resource, including a sophisticated representation of groundwater-surface water interactions and a transient water balance calibration for 14 sub-watersheds.

Modeling and Visualization Software Development

Dr. Carey has developed a variety of commercial and public domain software tools, including:

Visual PFAS, 2024-2025 – Software for visualizing PFAS trends using radial diagram and stacked bar maps in support of site characterization, remediation, and forensic assessments.

In-Situ Remediation Model (ISR Model), 2015-2025 – three-dimensional reactive transport model based on the MT3DMS framework, for simulating the performance of PFAS, chlorinated solvents, and metals in-situ remediation technologies, including adsorptive permeable reactive barriers, enhanced in-situ bioremediation (EISB) and in-situ chemical oxidation. Model includes an innovative local domain approach for modeling forward and back-diffusion, and also includes the reaction package from BioRedox.

Visual Bio, 2018 – radial diagram visualization tool for delineating biodegradation zones in groundwater and illustrating lines of evidence in support of MNA and EISB remedies.

NAPL Depletion Model, 2015 – semi-analytical screening model for simulating the depletion timeframe for LNAPL or DNAPL source zones.

BioRedox-MT3DMS, 1999 – a three-dimensional finite difference model for simulating multispecies contaminant transport, including advection, dispersion, sorption, and coupled biodegradation-redox reactions between electron donors and electron acceptors. BioRedox-MT3DMS can simulate oxidation, reduction, and co-metabolic reactions, and is capable of modeling sequential transformation pathways for chlorinated solvents and petroleum hydrocarbons. BioRedox-MT3DMS is also capable of simulating equilibrium or rate-limited dissolution of light or dense NAPL sources, and includes a leachate composition model to represent time-varying landfill constituent concentrations leaching to underlying aquifers. BioRedox-MT3DMS was previously available in the public domain.

SEQUENCE, 1999 – a visualization tool that uses a modified radial diagram approach to illustrate the effects of natural attenuation on groundwater redox conditions. SEQUENCE may also be used to evaluate spatial and temporal trends for chlorinated solvent species. The visual aids prepared using SEQUENCE provide convincing evidence for the effectiveness of remediation by natural attenuation. SEQUENCE integrates these radial diagram tools with a comprehensive data management system is available. SEQUENCE was previously sold as a commercial product.

BioTrends, 1999 – a suite of tools for evaluating spatial and temporal trends using x-y charts with unique features that were specifically designed for evaluating chemical analytical data. Additional tools are provided for calculating first-order degradation rates between well pairs, or the average degradation rates along a flowpath based on a log-linear regression analysis, using the methods presented in the USEPA and AFCEE natural attenuation protocols. Another tool is provided to calculate the natural attenuation "score" for a site based on criteria presented in the USEPA protocol. BioTrends is integrated with a chemical properties database (CHEMbase), and the same project data management system used for the SEQUENCE visualization tool. BioTrends was previously sold as a commercial product.

BioTracker, 1999 – a one-dimensional screening model that is integrated with visualization tools for transport model calibration and documentation. BioTracker utilizes a one-dimensional version of the BioRedox finite difference model to simulate multispecies transport processes including advection, dispersion, sorption, and single or sequential transformation reactions with optional halogen accumulation. BioTracker incorporates a particle tracking tool that delineates flowpaths downgradient from one or more point source locations. The customized particle tracking routine utilizes Surfer contour maps of observed or simulated groundwater elevations as input. BioTracker is also integrated directly to the same project data management system used with BioTrends and SEQUENCE, and it is integrated with a chemical properties database (CHEMbase). BioTracker was previously sold as a commercial product.

Vapor-2D, 1992 – a two-dimensional finite element model that simulates multispecies, density-dependent vapor flow and transport. Vapor-2D was modified to predict the migration of gasoline vapors from a subsurface spill area, and includes a multicomponent NAPL source model. Vapor-2D was successfully validated by simulating laboratory experiments of vapor flow and transport of heptane in the vadose zone, and Vapor-2D has been used to assess density-dependent vapor migration at field sites. Vapor-2D is currently a proprietary model.

REPRESENTATIVE SHORT COURSES, WORKSHOPS, AND TRAINING SEMINARS

- Lead instructor for the three-hour in-person short course entitled “PFAS Visualization and Modeling Workshop: Site Characterization, Remediation, and Forensics”, pre-conference workshop to be presented at the 2025 RemTEC Summit in Denver, Colorado on October 13, 2025.
- Instructor for the three-hour in-person short course entitled “PFAS Visualization and Remediation Case Studies”, pre-conference workshop to be presented at the 2025 GRA Western Groundwater Congress in San Diego, California on October 6, 2025.
- Invited instructor for a half-day short course for the Canadian Federal PFAS Working Group: PFAS In-Situ Remediation Using Colloidal Activated Carbon, May 2025.
- Invited instructor for an internet seminar related to PFAS visualization for site characterization, remediation, and forensics, organized by Regenesis with more than 1500 registrations, February 20, 2025
- Invited instructor for an internet seminar entitled: PFAS In-Situ Remediation Case Studies and Long-term Strategies, organized by Regenesis with over 1200 registrations, May 2024
- Invited instructor for the 8-hour short course entitled “In Situ Management of PFAS in Groundwater”, including recent SERDP-ESTCP research advancements, presented at the Battelle 2024 Chlorinated Conference in Denver on June 2, 2024
- Invited instructor for an internet seminar with 1,500 registrations entitled “Longevity of PFAS Remediation Using Colloidal Activated Carbon at AFFF-Impacted Sites”, organized by Regenesis, January 26, 2023.
- Invited instructor for an internet seminar with 1,200 registrations entitled “Longevity of PFAS Remediation Using Colloidal Activated Carbon”, organized by Regenesis, November 19, 2020.
- Invited instructor for a PFAS short course entitled “Managing PFAS at Your Site: Key Technical and Regulatory Issues Associated with PFAS”, International Cleanup Conference, Adelaide, Australia, September 12, 2019.
- Invited instructor for a workshop entitled: “PFAS Remedial Strategies”, at the RPIC 2018 Federal Contaminated Sites Workshop, Toronto, Ontario, June 13, 2018.
- Invited instructor for a workshop entitled: “Innovative Methods for Optimizing Remediation Efficiency”, at the 2018 Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, April 10, 2018.
- Instructor for a Learning Lab presentation entitled: “Visualizing Biodegradation Zones in Groundwater”, to be presented at the 2018 Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, April 10, 2018.
- Invited instructor for an internet seminar with between 500 and 1,000 participants entitled: “In-Situ Remediation Modeling and Visualization Tools”, organized by Regenesis on October 26, 2017.

- Invited instructor for a workshop entitled “Innovative Visualization, Modeling, and Optimization Tools for Improving Remediation Efficiency”, presented at the 2017 Cleanup Conference, Melbourne, Australia, September 10, 2017.
- Invited Instructor for the ITRC webinar entitled "Remediation of Contaminated Sediments" offered from 2014 through 2016.
- Invited Instructor for the ITRC webinar entitled "Use and Measurement of Mass Flux and Mass Discharge" offered from 2010 through 2016.
- Invited Instructor for a 1.5-hour short course entitled “Mass Flux/Discharge: DNAPL and Back-Diffusion” at the 24th Annual NAPRM Training Program, United States Environmental Protection Agency, Pittsburgh, Pennsylvania.
- Instructor for a 4-hour short course entitled “Using the NAPL Depletion Model for Estimating Timeframes for Natural and Enhanced Attenuation”, presented at the Third International Symposium on Bioremediation and Sustainable Environmental Technologies, Miami, Florida, May 18, 2015.

PUBLICATIONS

Refereed Journal Papers

Carey, G.R., P. Hatzinger, A. Danko, B. Sleep, D. Lippincott, G. Lavorgna, 2025, Modeling the Performance of a Field-Scale PFAS In-Situ Adsorption Barrier, in preparation.

Carey, G.R., M. Rebeiro-Tunstall, R. Krebs, K. Mumford, S. Brown, 2025, Visualization and Validation of PFAS Mass Discharge in the Vadose Zone Based On Typical Field Methods, in preparation.

Carey, G.R., R. Krebs, G.T. Carey, M. Rebeiro-Tunstall, J. Duncan, G.N. Carey, and K. Rooney, 2025, Visualizing PFAS Trends at a South Dakota AFFF-Impacted Site, *Remediation Journal*, 35(3): E70023.

Newell, C.J., W.B. Smith, K. Kearney, S. Clay, H. Javed, G.R. Carey, S. Richardson, C. Werth, 2025, Tool and Database for Estimating Potential Longevity of Colloidal Activated Carbon Barriers for PFAS in Groundwater, *Remediation Journal*, 35(3): e70017.

Jiang, L., X. Chen, G. Carey, X. Liu, G. Lowry, D. Fan, A. Danko, and G. Li, 2025, Effects of Physical and Chemical Aging of Colloidal Activated Carbon on the Adsorption of Per- and Poly-fluoroalkyl Substances, *Environmental Science & Technology*., 59(7): 3691-3702.

Carey, G.R., Danko, A., Pham, A.L-T., Soderberg, K., Hoagland, B., 2025, Modeling the influence of coastal site characteristics on PFAS In Situ Remediation, *Ground Water*, 63(2): 175-191.

Singh, M., S.G. Hakimabadi, P.J. Van Geel, G.R. Carey, A.L. Pham, 2024, Modified Competitive Langmuir Model for Prediction of Multispecies PFAS Competitive Adsorption Equilibria

on Colloidal Activated Carbon, Separation and Purification Technology, 345, 127368: 1-12.

Mole, R., C. de Velosa, G. Carey, X. Liu, G. Li, D. Fan, A. Danko, G. Lowry, 2024, Groundwater Solutes Influence the Adsorption of Short-Chain Perfluoroalkyl Acids (PFAA) to Colloidal Activated Carbon and Impact Performance for In Situ Groundwater Remediation, Journal of Hazardous Materials, 474, 134746, 1-10.

DiGuiseppi, W.H., C.J. Newell, G.R. Carey, P.R. Kulkarni, Z. Xia, J. Stults, T.L. Maher, E.F. Houtz, R. Mora, R. Wice, P.W. Tomiczek, S.D. Richardson, J. Xiong, J. Hale, J.P. Hnatko, R. McGregor, J.T. McDonough, A. Oka, R. Thomas, J. Fenstermacher, J. Hatton, 2024, Available and emerging liquid treatment technologies for PFASs, Remediation Journal, 34:e21782.

Carey, G.R., R.H. Anderson, P. Van Geel, R. McGregor, K. Soderberg, A. Danko, S.G. Hakimabadi, A.L.T. Pham, M. Rebeiro-Tunstall, 2023, Analysis of colloidal activated carbon alternatives for in situ remediation of a large PFAS plume and source area. *Remediation Journal*, 34(1): e21772.

Carey, G.R., S.K. Hakimabadi, M. Singh, R. McGregor, C. Woodfield, P. Van Geel, A.L. Pham, 2022, Longevity of Colloidal Activated Carbon for In-Situ PFAS Remediation at AFFF-Contaminated Airport Sites, *Remediation Journal*, 33(1): 1-21.

Bryant, J.D., R. Anderson, S.C. Bolyard, J.T. Bradburne, M.L. Brusseau, G. Carey, D. Chiang, R. Gwinn, B.R. Hoye, T.L. Maher, A.E. McGrath, M. Schroeder, B.R. .Thompson, D. Woodward, 2022, PFAS Experts Symposium 2: Key Advances in PFAS Characterization, Fate and Transport, *Remediation Journal*, 32(1-2): 19-28.

Carey, G.R., R. McGregor, A. Pham, and B. Sleep, and S. Hakimabadi, 2019, Evaluating the Longevity of a PFAS In-Situ Colloidal Activated Carbon Remedy, *Remediation Journal,* Winter 2019.

McGregor, R. and G.R. Carey, 2019, The In-Situ Treatment of Synthetic Musk Fragrances in Groundwater, Remediation Journal, Spring 2019.

Carey, G.R., E.A. McBean, and S. Feenstra, 2018, Estimating Transverse Dispersivity Based on Hydraulic Conductivity, *Environmental Technology & Innovation*, 10(5): 36-45.

Carey, G.R., E.A. McBean, and S. Feenstra, 2016, Estimating Tortuosity Coefficient based on Hydraulic Conductivity, *Ground Water*, 54(4): 476-487.

Carey, G.R., S.W. Chapman, B.L. Parker, and R. McGregor, 2015, Application of an Adapted Version of MT3DMS for Modeling Back-Diffusion Remediation Timeframes, *Remediation Journal*, Autumn 2015, p. 55-79.

Carey, G.R., E.A. McBean, and S. Feenstra, 2014, DNAPL Source Depletion: 1. Predicting Rates and Timeframes, *Remediation Journal*, Summer 2014, p. *21-47*.

Carey, G.R., E.A. McBean, and S. Feenstra, 2014, DNAPL Source Depletion: 2. Attainable Goals and Cost-Benefit Analyses, *Remediation Journal*, Autumn 2014, p. 79-106.

Schreiber, M., G.R., D. Feinstein, G.R. Carey, and J. Bahr, 2004, Mechanisms of Electron Acceptor Utilization, *Journal of Contaminant Hydrology*, 73(1-4), p. 99-127.

Carey, G.R., P.J. Van Geel, T.H. Wiedemeier, and E.A. McBean, 2003, A Modified Radial Diagram Approach for Evaluating Natural Attenuation Trends for Chlorinated Solvents and Inorganic Redox Indicators, *Ground Water Monitoring and Remediation*, 23(4): 75-81.

Carey, G.R., T.H. Wiedemeier, P.J. Van Geel, E.A. McBean, J.R. Murphy, and F.A. Rovers, 1999, Visualizing Natural Attenuation Trends: Petroleum Hydrocarbons Attenuation at the Hill Air Force Base, *Bioremediation Journal*, 3(4): 379-393

Book Contributions

Carey, G.R., P.J. Van Geel, E.A. McBean, and F.A. Rovers, 1999, Application of a Biodegradation-Redox Model for Predicting Bioremediation Performance, in P. Baveye, J.C. Block, and V.V. Goncharuk, (Eds.), Bioavailability of Organic Xenobiotics in the Environment: Practical Consequences for the Environment, Kluwer Academic Publishers, pp. 73-77.

Farquhar, G.J. and G.R. Carey, 1991, An Overview of Landfill Practices Now and in the Future, Municipal Solid Waste Management: Making Decisions in the Face of Uncertainty, University of Waterloo Press, Waterloo, Ontario, pp. 77-92.

Software Manuals

Carey, G.R., 2017, Visual Bio: Radial Diagrams for Visualization Natural and Enhanced Chemical Degradation Trends, Porewater Solutions, Ottawa, Ontario, Canada.

Carey, G.R., 2015, NAPL Depletion Model (NDM): User's Guide, Porewater Solutions, Ottawa, Ontario, Canada.

Carey, G.R., P.J. Van Geel, and J.R. Murphy, 1999, BIOREDOX-MT3DMS: A Coupled Biodegradation-Redox Model for Simulating Natural and Enhanced Bioremediation of Organic Pollutants – V2.0 User's Guide, Conestoga-Rovers & Associates, Waterloo, Ontario, Canada

Carey, G.R., P.J. Van Geel, and J.R. Murphy, 1999, BIOREDOX-MT3DMS: A Coupled Biodegradation-Redox Model for Simulating Natural and Enhanced Bioremediation of Organic Pollutants – V2.0 Verification Manual, Conestoga-Rovers & Associates, Waterloo, Ontario, Canada

Carey, G.R., 1999, BIOREDOX-MT3DMS Tutorial Guide: Modeling Natural Attenuation at the Plattsburgh Air Force Base, Conestoga-Rovers & Associates, Waterloo, Ontario, Canada

Carey, G.R., 1999, The Remediation ToolKit (SEQUENCE, BioTrends, BioTracker) – User's Guide, Conestoga-Rovers & Associates, Waterloo, Ontario, Canada

Conference Presentations and Workshops

Carey, G.R., Longevity of Colloidal Activated Carbon for PFAS Plumes, Invited by the Danish Ministry of Defense to present at the Second Baltic PFAS Workshop in Copenhagen, Denmark, June 3-4, 2025.

Carey, G.R., M. Vanderkooy, A. Schneider, P. Erickson, K. Gaskill, B. Sleep, 2024, Lessons Learned for Increasing PFAS Remediation Effectiveness, poster presented at the 2024 SERDP-ESTCP Symposium in Washington, D.C., December 4, 2024.

Carey, G.R., R. Krebs, G.T. Carey, M. Rebeiro-Tunstall, J. Duncan, G.N. Carey, and K. Rooney, 2025, PFAS Visualization for Site Characterization, Remediation, and Forensic Analysis, poster presented at the 2024 SERDP-ESTCP Symposium in Washington, D.C., December 4, 2024.

Carey, G.R., 2024, PFAS In-Situ Remediation Using CAC: Modeled Field Performance and Cost-Benefit Analysis, presented at The REMTEC Summit, Denver, Colorado, October 14, 2024.

Carey, G.R., A. Danko, R. Anderson, P. Hatzinger, and K. Soderberg, 2024, Case Studies and Long-Term Strategies for PFAS In-Situ Remediation Using Colloidal Activated Carbon, Battelle 2024 Chlorinated Conference in Denver on June 4, 2024.

Pennel, K., M. Vanderkooy, A. Pham, N. Thomson, B. Sleep, G. Carey, 2024, Novel Research on PFAS Adsorptive Technologies, 90-minute webinar organized by SERDP-ESTCP, February 22, 2024.

Vanderkooy, M., A. Pham, N. Thomson, B. Sleep, G. Carey, 2023, Opportunities, Issues, and Ideas for Activated Carbon at PFAS Sites, platform presentation at the 2023 SERDP-ESTCP Symposium in Washington, D.C., November 3, 2023.

Carey, G.R., S. Hakimabadi, M. Singh, R. McGregor, C. Woodfield, P. Van Geel, A. Pham, 2022, Longevity of Colloidal Activated Carbon for In-Situ PFAS Remediation at AFFF-Contaminated Airport Sites, poster presentation at the 2022 SERDP-ESTCP Symposium in Washington, D.C., November 30, 2022.

Carey, G.R., P. Van Geel, M. Singh, 2022, New Empirical Model for Predicting PFAS Breakthrough in Granular Activated Carbon, poster presentation at the 2022 SERDP-ESTCP Symposium in Washington, D.C., November 30, 2022.

Carey, G.R., 2022, Radial Diagram Visualization and Semi-Quantitative Forensic Methods for PFAS Site Characterization, poster presentation at the 2022 SERDP-ESTCP Symposium in Washington, D.C., November 30, 2022.

Bryant D. and G.R. Carey, 2022, invited expert participant in the PFAS Experts Webinar entitled USEPA's Health Advisory Levels Explained: What, Why, and When, presentation on Background PFAS Concentrations, organized by the Remediation Journal, July 19, 2022.

Carey, G.R., 2021, Invited expert participant in the PFAS Experts Symposium 2, organized by the Remediation Journal, June 29, 2021.

Carey, G.R., 2019, State of PFAS Remediation, Invited Panelist at the PFAS Research Symposium organized by CRC Care, Adelaide, Australia, September 2019.

Carey, G.R., 2019, In-Situ PFAS Remediation Using Colloidal Activated Carbon, Invited Keynote address at the International CleanUp Conference, Adelaide, Australia, September 9-11, 2019.

Carey, G.R., 2018, Modeling LNAPL Depletion at a Former Xylene Processing Facility (Germany), accepted for platform presentation at the 2018 Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, April 9, 2018.

Carey, G.R., 2018, Innovative Visualization Method for Demonstrating Natural and Enhanced Attenuation, presented at the 2018 SmartRemediation conference in Ottawa, Ontario, February 15, 2018.

Carey, G.R., 2017, Innovative Visualization Method for Delineating Biodegradation Zones in Groundwater, presented at the 2017 Cleanup Conference, Melbourne, Australia, September 12, 2017.

Carey, G.R., R. McGregor, and J. Birnstingl, 2017, In-Situ Remediation of a PFOS/PFOA Plume In Ontario, presented at the 2017 Cleanup Conference, Melbourne, Australia, September 12, 2017.

Carey, G.R., 2016, In-Situ Remediation (ISR-MT3DMS) For Modeling Back-Diffusion Timeframes, platform presentation at the 10th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Palm Springs, California, May 22-26, 2016.

Carey, G.R., 2016, Forensic Analysis of NAPL Architecture at a Field Site using the NAPL Depletion Model (NDM), poster presentation at the 10th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, Palm Springs, California, May 22-26, 2016.

Carey, G.R., 2015, Using the NAPL Depletion Model (NDM) for Forensic Analysis of NAPL Architecture at a Field Site, presented at the 30th Biennial Groundwater Conference, Sacremento, California, October 6-7, 2015.

Carey, G.R., 2015, Using In-Situ Remediation (ISR-MT3DMS) to Model Back-Diffusion Timeframe for Thin Silts and Clays, presented at the 30th Biennial Groundwater Conference, Sacremento, California, October 6-7, 2015.

Carey, G.R., 2015, Invited to Chair the Fractured Rock Session at Cleanup 2015 Conference, organized by CRC Care, Melbourne, Australia, September 13-16, 2015.

Carey, G.R., 2015, Review of Characterization Methods for NAPL Source Zone Delineation and Mass Estimation, Invited Keynote presentation at Cleanup 2015 Conference, organized by CRC Care, Melbourne, Australia, September 13-16, 2015.

Carey, G.R., 2015, ISR-MT3DMS for Modeling Back-Diffusion Timeframe, invited platform presentation at Cleanup 2015 Conference, organized by CRC Care, Melbourne, Australia, September 13-16, 2015.

Carey, G.R., 2015, Modeling LNAPL Depletion at a Former Xylene Processing Facility (Germany), invited platform presentation at Cleanup 2015 Conference, organized by CRC Care, Melbourne, Australia, September 13-16, 2015.

Carey, G.R., 2015, ISR-MT3DMS for Modeling Back-Diffusion Timeframe, presented at REMTEC Summit, Westminster, Colorado, March 3, 2015.

Carey, G.R. and E.A. McBean, 2013, Predicting Achievable Mass Discharge Goals, Timeframes, and Back-Diffusion Contributions, invited platform presentation at REMTEC Summit, Westminster, Colorado, March 4-6, 2013.

Carey, G.R., M. King, J. Christensen, and C. Pattersen, 2013, Modeling the Influence of Tidal Pumping on Naphthalene Transport through an AquaBlok Cap, presented at Battelle's Conference on Remediation of Contaminated Sediments, Dallas, Texas, February 4-7, 2013.

Carey, G.R. and E.A. McBean, 2010, Uses, Benefits, and Limitations of Mass Flux and Mass Discharge: A Case Study Review, presented at Consoil 2010, Salzburg, Austria, September 22-24, 2010.

Carey, G.R. and E.A. McBean, 2010, NAPL Depletion Model (NDM) for Predicting Remediation Timeframe, presented at Consoil 2010, Salzburg, Austria, September 22-24, 2010.

Carey, G.R. and E.A. McBean, 2010, Validation of a Mass Balance Approach for Estimating DNAPL Remediation Timeframe, presented at Battelle 2010 Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 24-27, 2010.

Carey, G.R. and E.A. McBean, 2010, A Mass Balance Approach for Estimating DNAPL Source Remediation Timeframe, presented at the 2010 RPIC Federal Contaminated Sites National Workshop in Montreal, QC May 10-13, 2010.

Carey, G.R. and E.A. McBean, 2010, Back-Diffusion and Discount Rate Implications for DNAPL Remediation Strategies, presented at the 2010 RPIC Federal Contaminated Sites National Workshop in Montreal, QC May 10-13, 2010.

Stroo, H. and G.R. Carey, 2010, Use and Measurement of Mass Flux and Mass Discharge, invited platform presentation at the AFCEE Technology Transfer Workshop in San Antonio, Texas, April 6-9, 2010.

Carey, G.R., 2006 Plattsburgh Mass Balance Modeling Case Study, invited to submit to Savannah River National Laboratory, 2006.

Carey, G.R., J. Vaillancourt, M.G. Mateyk, and J. Maude, 2006, Case Study Feasibility Study for an In Situ Oxygen Curtain, presented at the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 22-25, 2006.

Carey, G.R., 2006, "Overview of Monitored Natural Attenuation", excerpt from the "ITRC MNA and Enhanced Attenuation Resource Guide", available online in 2006.

Kean, J., K. Wilson, J. Doyon, K.M. Vangelas, and G. Carey, 2006, Monitored Natural Attenuation and Enhanced Attenuation – A National Overview: Results of an ITRC Survey, in Proceedings of the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 22-25, 2006.

Kean, J., K.M. Vangelas, K. Wilson, G.R. Carey, D. Green, J. Doyon, and P. Harrington, 2005, Monitored Natural Attenuation and Enhanced Attenuation – A National Overview: Results of an ITRC Survey, presented at the SERDP conference, Seattle, Washington, November 2005.

Carey, G.R., “Visualizing the Effectiveness of MNA and Enhanced Attenuation Remedies Using SEQUENCE “, presented at the ITRC EACO team meeting, October 2005.

Carey, G.R., D. Major, D. Verret, and M. Roworth, 2003, Visualization and Modeling of Bioaugmentation at Kelly Air Force Base, presentation at the Seventh International Symposium on In Situ and On-Site Bioremediation, Orlando, Florida, June 2-5, 2003

Carey, G.R and M. Roworth, 2003, Evaluating Remediation Timeframe for Combined Source Containment-MNA Remedies, presentation at the Seventh International Symposium on In Situ and On-Site Bioremediation, Orlando, Florida, June 2-5, 2003.

King, M., G. Carey, D. Abbey and F. Baechler, 2003, Groundwater and Contaminant Transport Modelling at the Sydney Tar Ponds, in Proceedings of the 2003 IAH Conference, Winnipeg, Canada.

Carey, G.R., 2001, Case Study of New Techniques for Calculating Biodegradation Rates, presented at the Sixth International Symposium on In Situ and On-Site Bioremediation, San Diego, California, 2001.

Carey, G.R., Derivation of Multi-Dimensional Inverse Models for Estimating First-Order Biodegradation Rates, Technical Note published online by the Environmental Institute for Continuing Education, July 17, 2001.

Carey, G.R. and P.J. Van Geel, 2000, Calibration of a Leachate Natural Attenuation Model for the Vejen Landfill (Denmark), in Proceedings of the Groundwater 2000 Conference, Copenhagen, Denmark, June 2000.

Van Geel, P.J., K. Britton, and G.R. Carey, 1999, Impact of Biodegradation Rates on the Redox Zones Generated below Landfills, Proceedings of the 52nd Canadian Geotechnical Conference, Regina, Saskatchewan, October 24-27, 1999.

Carey, G.R., P.J. Van Geel, J.R. Murphy, E.A. McBean, and F.A. Rovers, 1999, Modeling Natural Attenuation at Plattsburgh Air Force Base, Presented at the Fifth International Symposium on In Situ and On-Site Bioremediation, San Diego, California, April 19-22, 1999.

Carey, G.R., E.A. McBean, and F.A. Rovers, 1999, Visualizing Natural Attenuation Trends, in Proceedings of the Fifth International Symposium on In Situ and On-Site Bioremediation, San Diego, California, April 19-22, 1999.

Carey, G.R., E.A. McBean, and F.A. Rovers, 1999, Risk Management Using Natural Attenuation Processes, presented at the 1999 Risk Management Symposium, Air Force Space Command, February 1999.

Carey, G.R., P.J. Van Geel, J.R. Murphy, E.A. McBean, and F.A. Rovers, 1998, Full-Scale Field Application of a Coupled Biodegradation-Redox Model (BIOREDOX), in Proceedings of the First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998.

P.J. Van Geel, G.R. Carey, E.A. McBean, and F.A. Rovers, 1998, An Integrated Landfill Modeling System (ILMS) for Evaluating Remediation Alternatives, in Proceedings of the First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998.

Harris, S.M., S. Day, E. Roberts, F.A. Rovers, and G.R. Carey, 1998, Applications of an Innovative Method for Visualizing Natural Attenuation, in Proceedings of the First

International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998.

Carey, G.R., P.J. Van Geel, J.R. Murphy, E.A. McBean, and F.A. Rovers, 1998, Coupled Biodegradation-Redox Modeling to Simulate Natural Attenuation Processes at the Plattsburgh Air Force Base (New York), in Proceedings of MODFLOW'98, Golden, Colorado, October 5-7, 1998.

Carey, G.R., P.J. Van Geel, J.R. Murphy, and E.A. McBean, 1998, An Efficient Screening Approach for Modeling Natural Attenuation, in Proceedings of MODFLOW'98, Golden, Colorado, October 6-8, 1998.

Carey, G.R., P.J. Van Geel, E.A. McBean, and F.A. Rovers, 1997, An Innovative Modeling and Visualization Approach for Demonstrating the Effectiveness of Natural Attenuation, presented at the IBC Natural Attenuation '97 Conference, December 8-10, Scottsdale, Arizona.

Carey, G.R., P.J. Van Geel, E.A. McBean, F.A. Rovers, and G.T. Turchan, 1997, Modeling Landfill Cap Influence on Natural Attenuation, in Sardinia'97, Proceedings of the Sixth International Landfill Symposium, October 13-17, Cagliari, Italy.

Carey, G.R., P.J. Van Geel, E.A. McBean, F.A. Rovers, 1997, Effect of Landfill Cap Permeability on the Natural Attenuation of Chlorinated Solvents Below a Landfill, in 1997 Canadian Geotechnical Conference Proceedings, October 20-22, Ottawa, Ontario.

Carey, G.R., M.G. Mateyk, G.T. Turchan, E.A. McBean, F.A. Rovers, J.R. Murphy, and J.R. Campbell, 1996, Application of an Innovative Visualization Method for Demonstrating Intrinsic Remediation at a Landfill Superfund site, Proceedings of API/NGWA Petroleum Hydrocarbons and Organic Chemicals in Groundwater Conference, Houston, Texas.

Carey, G.R., M.G. Mateyk, E.A. McBean, G.T. Turchan, J.R. Campbell, and F.A. Rovers, 1996, Multiple Lines of Evidence for Evaluating Intrinsic Remediation at a Landfill Site, Proceedings of the Nineteenth International Madison Waste Conference, Madison, Wisconsin.