

CHARLES R. FITTS

Fitts Geosolutions
79 Winnocks Neck Road
Scarborough, Maine 04074
fittsgeo@gmail.com
(207) 510-7650 (phone)
(815) 642-9273 (fax)

EDUCATION

Ph.D. Civil Engineering, University of Minnesota, Minneapolis, MN, 1990

M.S. Civil Engineering, University of Minnesota, Minneapolis, MN, 1985

M.S. Geological Sciences, Cornell University, Ithaca, NY, 1979

B.A. Geology/Biology, Colby College, Waterville, ME, 1976

EMPLOYMENT AND EXPERIENCE

1991-present: Geosciences Dept. Univ. of Southern Maine, Gorham, ME, Professor

Acting Director of Environmental Science and Policy Program 2001-2003, Chair of Geosciences Department, 2007-2011.

Courses taught at USM: *Physical Geology, Oceanography, Floods Glaciers and Changing Climate, Atmospheric Science, Water Resources, Groundwater Flow and Quality, Groundwater Modeling, and Topics in Groundwater Contamination*. Positive student evaluations of teaching: typically 1 to 1.5 on a scale of 1 to 5, 1 being best.

Principal Investigator or Co-PI on research grants: a) develop environmental geophysics capability at USM, b) evaluate groundwater flow in a sand and gravel aquifer near a local water supply well field, c) evaluate the same aquifer geometry with seismic refraction surveys, d) mapping and modeling a glaciofluvial aquifer in Wells, ME. Advised and mentored students on these grants.

Reviewed 2-6 journal articles per year for the top-flight journals *Water Resources Research, Ground Water, Advances in Water Resources, and Journal of Hydrology*

Guest lectured on various groundwater topics at University of Maine, University of New Hampshire, Colby College, Tufts University, and a National Ground Water Association short-course.

1991-present: Independent Consulting, Fitts Geosolutions (selected examples)

Advised a consulting company about modeling dissolved salt solute transport from a collapsed salt mine into an overlying aquifer in western New York State.

Performed a forensic analysis of pumping tests with a new well in a municipal well field in central Maine, to learn why the new well sand filter failed.

Analyzed aquifer properties and estimated the potential yield of wells near springs in central Maine using 3-D MODFLOW simulations.

Analyzed pumping tests and capture zones for seven different remediation projects for an Indiana environmental consulting firm.

Analyzed two 48-hour pumping tests and created a 3D MODFLOW model to simulate the impacts of proposed groundwater pumping on the sustainability of surface water flows in a sand and gravel aquifer in Fryeburg, ME.

Analyzed the rate of diffusion of radioactivity out of the concrete containment structure at the decommissioned Maine Yankee nuclear power plant in Wiscasset, Maine, to help with decision about whether to remove the structure. Developed both analytic and finite-difference mathematical models of the diffusion.

Helped design educational displays about groundwater for Poland Spring Bottling Co.

Analyzed construction dewatering at a site with a braced excavation and sheet-pile cutoff wall. Used MODFLOW to model 3-D transient flow to sumps inside the cutoff wall. Estimated pump discharges and times to achieve drawdown in stages.

Gave a two-hour short course on non-equilibrium solute transport processes and modeling to geologists and engineers at a Massachusetts groundwater consulting company.

Analyzed the patterns of drawdown near a well field in an anisotropic aquifer, for a consultant in Maryland.

Retained as an expert on groundwater contamination in a class-action law suit regarding MTBE contamination in Maine. Researched the transport and toxicity properties of MTBE relative to other compounds in gasoline and other common organic chemicals.

One of a panel of experts hired by the city of Indianapolis to review mathematical modeling of groundwater flow in the vicinity of three municipal well fields.

Developed mathematical models of seepage beneath a proposed dam in Switzerland for an electric utility.

Provided technical counsel related to a lawsuit involving the timing of gasoline releases and contaminant migration in Waterboro, ME.

Performed review of geotechnical and geohydrological aspects of a proposed special waste landfill expansion in Norridgewock, Maine.

Analyzed construction dewatering at a site with a braced excavation and sheet-pile cutoff wall. Used MODFLOW to model 3-D transient flow to sumps inside the cutoff wall. Estimated pump discharges and times to achieve drawdown in stages.

Testified as an expert witness in New York DEC hearings regarding a proposed large gravel mining operation in western New York. Testimony was about groundwater flow modeling of potential impacts.

1987-1991: GeoTrans, Inc., Harvard, MA. Principal Engineer , groundwater consulting (selected examples)

Responsible for computer operations in the Massachusetts regional office. Responsible for computer hardware and software used for groundwater modeling. Trained others in the use of computers, software, and models.

Provided technical consultation regarding the characterization and remediation of a contaminated industrial site in Massachusetts. Recommended and helped design deep bedrock monitoring wells, a ten-day pilot test of the groundwater extraction/treatment system, and laboratory experiments to assess the sorption of chlorinated organic contaminants. Mediated discussions between the present and former landowners regarding the remedy, which included groundwater extraction and treatment, soil excavation, and ex-situ soil venting.

Investigated dissolved TCE and PCE contamination in the vicinity of water supply wells in Natick, MA. Used soil gas surveys and micro-well installations in the sand and gravel aquifer to map the distribution of contaminated groundwater and help define the source of contamination.

Helped design and oversee the construction of a passive trench to skim petroleum LNAPL off the water table in an unconfined aquifer in Everett, MA.

Evaluated solvent contamination problems and potential remedies at two industrial sites in New Jersey. One was a soap manufacturing facility bordering the Passaic river, and the other was an airport with engine repair shops. Defined, as well as possible, the probable sources and timing of contaminant releases to help settle a litigated dispute between the owner and its insurance companies.

Evaluated hydrogeologic conditions at proposed landfill sites for private clients in Maine, Minnesota, and New Jersey. Using analytic and numerical models, analyzed the three-

dimensional groundwater flow patterns for pre- and post-construction conditions. Estimated drawdowns and discharges associated with proposed underdrain systems, assessed the contaminant migration patterns for hypothetical failures. Recommended monitoring systems and contingency plans to minimize the potential adverse impacts on groundwater.

Estimated off-site contaminant discharges via groundwater at seven hazardous waste sites in Niagara Falls, for a study of contaminant discharges to the Niagara River.

Set up and monitored a 48 hour pumping test at a landfill site in Minnesota. Used pressure transducers and data loggers to collect data at eight wells. Estimated formation hydraulic conductivity and storativity from the test.

Taught a workshop on the use of the USGS modular three-dimensional groundwater flow model (MODFLOW) to engineers and geologists at a large consulting firm.

Provided technical counsel and expert testimony regarding contaminant migration via groundwater to the Delaware River. Gave testimony in a deposition and in the trial.

1986-1987: CDM, Boston, MA. Water Resources Engineer , groundwater consulting (selected examples)

Evaluated groundwater flow and contaminant transport patterns for the US EPA at two Superfund hazardous waste sites in New Jersey. Used a three-dimensional finite element program for flow simulation and a random-walk particle tracking program for simulation of contaminant transport. Evaluated alternatives for site cleanup, and the effectiveness of an existing slurry-wall barrier.

1979-1983, 1985-1986: GEI, Winchester, MA., Geologist/Engineer , geotechnical consulting (selected examples)

Investigated groundwater contamination in the vicinity of paper mill waste dewatering lagoons. Field program consisted of borings, well installations, hydraulic testing, surface and groundwater sampling. Did 2-D modeling of groundwater flow and contaminant transport patterns.

Design of a 1500 foot embankment dam in Maine. Soil and rock conditions were mapped in the foundation and borrow areas. Strength and permeability tests were performed on borrow materials. Seepage and stability analyzes were performed, a design was recommended, and the dam was constructed.

Evaluated the liquefaction potential of a sand being considered for construction of large offshore oil drilling caissons in the Arctic Ocean. Performed dynamic triaxial strength tests to determine the liquefaction behavior as a function of density.

Simulated groundwater flow beneath a dam in Colorado. The simulated heads were used in stability analyses of the dam.

Field experience includes installation and monitoring of: soil borings, groundwater monitoring wells, dedicated groundwater sampling systems, borehole permeability tests, large-scale pumping tests, gas monitoring wells, pneumatic and electronic piezometers, borehole inclinometers, settlement plates and tiltmeters.

Performed geotechnical lab tests including permeability tests in triaxial cells, triaxial compression tests, cyclic triaxial compression tests, resonant column dynamic triaxial torsion tests, consolidation tests, direct shear tests, compaction tests, and index tests.

COMMERCIAL SOFTWARE

Fitts, C.R., *AnAqSim (Analytic Aquifer Simulator)*. This software is based on the techniques outlined in the 2010 *Water Resources Research* journal article. It simulates groundwater flow analytically and allows multiple layers, anisotropy, heterogeneity, and transient flow. 105 page User Guide. Released in 2011.

Fitts, C.R., *TWODAN*, Two-dimensional analytic groundwater flow model, Windows program and 41 page manual. Over 500 licenses have been distributed to a wide range of domestic and foreign universities, consulting firms, and public agencies. Released in 1993.

Fitts, C. R., *SOLUTRANS*, a computer program for modeling groundwater contaminant transport using analytic solutions. About 50 licenses have been distributed to universities, consulting firms, and public agencies. Released in 1999.

BOOKS

Fitts, C.R., 2012, *Groundwater Science 2nd Ed.*, Elsevier.

Under contract for a second edition with work to begin in 2011.

Fitts, C.R., 2002, *Groundwater Science*, 450 p., Academic Press (Elsevier), San Diego.

Over 2800 copies sold, adopted by geology and civil engineering departments at 50+ universities including U. Colorado, U. New Mexico, U. Wisconsin, U. Massachusetts, U. Maine, Rutgers U., Delft U. (Netherlands), Copenhagen U. (Denmark). Under contract for a second edition – work to begin in 2011.

Fitts, C.R., 2002, *Groundwater Science Solutions Manual*, 68 p., Academic Press (Elsevier Science), San Diego.

JOURNAL ARTICLES

Fitts, C.R., 2010, Modeling Aquifer Systems with Analytic Elements and Subdomains, *Water Resources Research*, 46, W07521, doi:10.1029/2009WR008331.

Fitts, C.R., 2006, Exact Solution for Two-Dimensional Flow to a Well in an Anisotropic Domain, *Ground Water*, 44(1), 99-101.

Fitts, C.R., Analytic Modeling of Impermeable and Resistant Barriers, *Ground Water*, 35(2), 312-317, 1997.

Fitts, C.R., Uncertainty in Deterministic Groundwater Transport Models due to the Assumption of Macrodispersive Mixing: Evidence from the Cape Cod and Borden Tracer Tests, *Journal of Contaminant Hydrology*, 23, 69-84, 1996.

Fitts, C.R. and Strack, O.D.L., Analytic Solutions for Unconfined Groundwater Flow Over a Stepped Base, *Journal of Hydrology*, 177, 65-76, 1996.

Fitts, C.R., Well Discharge Optimization Using Analytic Elements, *Ground Water*, 32(4), 547-550, 1994.

Fitts, C.R., Modeling Three-Dimensional Flow about Ellipsoidal Inhomogeneities, with Application to Flow to a Gravel-Packed Well and Flow Through Lens-Shaped Inhomogeneities, *Water Resources Research*, 27(5), 815-824, 1991.

Fitts, C.R., Simple Analytic Functions for Modeling Three-Dimensional Flow in Layered Aquifers, *Water Resources Research*, 25(5), 943-948, 1989.

CONFERENCE PRESENTATIONS (since 2004)

Fitts, C. R., 2011, Analytic Element Modeling with Subdomains and Finite-Difference Time Steps, International Ground Water Modeling Center MODFLOW and More, Golden, CO.

Fitts, C. R., 2010, Engineered Perched Aquifers for Low-Cost Small Water Supplies, National Ground Water Association Ground Water Summit, Denver, CO.

Fitts, C.R., 2007, Analyzing the Sustainability of Groundwater Pumping in the Fryeburg Sand and Gravel Aquifer, Maine Water Conference, Augusta, ME.

Fitts, C.R., 2006, Modeling Groundwater Flow in Layered, Anisotropic, and Heterogeneous Aquifer Systems using Discrete Analytic Domains, Geological Society of America Annual Meeting, Philadelphia, PA.

Fitts, C.R., 2006, Discrete Analytic Domains: A New Technique for Groundwater Flow Modeling in Layered, Anisotropic, and Heterogeneous Aquifer Systems, MODFLOW and More 2006, International Ground Water Modeling Center, Golden, CO.

Fitts, C.R., 2006, Discrete Analytic Domains: A New Method to Model Complex Aquifer Systems with Layers, Anisotropy, and Heterogeneity, 5th International Conference on the Analytic Element Method, Kansas State University, Manhattan, KS.

Fitts, C.R., 2004, Discrete Analytic Domains: A New Technique for Groundwater Flow Modeling in Layered, Anisotropic, and Heterogeneous Aquifer Systems, American Geophysical Union Fall Meeting, San Francisco, CA.

Fitts, C.R., 2004, Discrete Analytic Domains: a New AEM Formulation for Modeling Anisotropy and Heterogeneity, USEPA/NGWA Fractured Rock Conference, Portland, ME.

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer, Maine #5513

Member, American Geophysical Union

Member, National Ground Water Association

Member, Geological Society of Maine