

F. BRYAN GRIGSBY

Hydrogeologist

AREAS OF EXPERTISE

- Soil and Groundwater Contamination Investigation and Remediation
- Water Resource Evaluation
- Aquifer Test Design, Implementation and Evaluation
- Field Investigation Design and Management
- Flow and Transport Simulation
- Aqueous Geochemistry Evaluation

SUMMARY OF QUALIFICATIONS

Mr. Grigsby has designed, conducted, and evaluated large-scale subsurface drilling projects, soil- and groundwater-sampling programs, aquifer tests, and soil-gas sampling programs in support of environmental investigations, remediation projects, and water resources evaluations. He has conducted geologic, hydrogeologic, and geochemical evaluations at sites located throughout the United States and over a broad range of environments — from relatively simple alluvial settings to complex fractured bedrock regimes. He has been involved in projects addressing chlorinated compounds, petroleum hydrocarbons, and metals. Over the past several years, his work has also involved the assessment of hydrologic and geochemical impacts of oil and natural gas development and of hydraulic fracturing on groundwater resources in the eastern and western U.S. He has presented findings for several of these projects at public meetings and regulatory hearings.

Mr. Grigsby's background is in sedimentary and structural geology, and he previously worked in the uranium mining and oil and gas industries.

YEARS OF EXPERIENCE: 25+

EDUCATION

MS — Geology, Oregon State University, 1986

BS — Geology, Texas Christian University, 1979

REGISTRATIONS

Professional Geologist:

California No. 5968

Wisconsin No. 993

Wyoming No. 3759

PROFESSIONAL HISTORY

S.S. Papadopoulos & Associates, Inc., 1995 to present

GeoTrans, Inc., 1994–1995

RMT, Inc., 1988–1994

Wisconsin Department of Natural Resources, 1985–1988

Oregon State University, Research Assistant, 1981–1984

REPRESENTATIVE EXPERIENCE

S.S. Papadopoulos & Associates, Inc., Boulder, CO

ENVIRONMENTAL INVESTIGATION AND REMEDIATION

- **Response to Hydrocarbon Release Incident**, West Virginia — Coordinated environmental response efforts for SSP&A, local consultants, and client personnel following a high-pressure release of natural gas, condensate, and produced water at depth into a bedrock water-supply aquifer. Provided overall management for rapid response and long-term surface-water and groundwater sampling, including monitoring of 16 domestic water-supply wells. Designed and directed a field investigation involving the installation and sampling of soil-vapor monitoring probes and shallow monitoring wells and a directed hydrocarbon fingerprint and isotope sampling program that included nearby oil and gas wells of various ages and depths. Coordinated between client and Office of Oil & Gas (OOG), prepared OOG-approved Monitoring and Remediation Plan, and currently negotiating closure monitoring plan with OOG.
- **Contamination Investigation and Remediation, Denver Federal Center**, Lakewood, Colorado — For the General Services Administration (GSA), has served as Principal-in-Charge since 2013 for several phases of Work Plan preparation, contamination investigation, remediation, closure activities, and reporting for two investigation areas at the Denver Federal Center. Work has involved sump, pit, and underground tanks abandonment; asbestos, PAH, and metals soil sampling; asbestos, metals, and PAH soil excavation and confirmation sampling; and preparation

F. BRYAN GRIGSBY

Hydrogeologist

Page 2

of a risk assessment for arsenic in soils. Work has been expanded to include providing site-wide GIS assistance; development of a site-wide waste-handling guidance document that includes the design of an inspection program for areas having environmental use restrictions; and an investigation of site-wide patterns of PAH groundwater occurrences. Work has been conducted in close coordination with GSA and the Colorado Department of Public Health and Environment.

- **Oversight Consulting for Contaminated Manufacturing Facility**, Boulder, Colorado — At this site where the previous owner has responsibility for remediating a chlorinated solvent source and groundwater plume in fractured bedrock, provided technical review and comment to the Colorado Department of Public Health and Environment (CDPHE) for reports and work plans submitted by the Responsible Party (RP). Analyzed aquifer-test data generated by the RP, and constructed a groundwater flow model using MODFLOW to evaluate the RP's interim groundwater remediation system. Evaluated results from the source area DNAPL investigation, and provided independent Corrective Measures Study to the CDPHE. Provided oversight for source area excavation and subsequent *in situ* remediation efforts. Conducted ongoing evaluations of groundwater chemistry results to assess progress towards project closure.
- **Development of Water Sampling Certification Program**, Western U.S. — For a confidential client, served as primary author for a cooperative effort to develop a Certification Standard for baseline and post-drilling groundwater and surface-water chemistry sampling to be implemented by Rocky Mountain-region producers who provide natural gas to a western U.S. electrical utility and distributor.
- **Multiple Projects for Marcellus and Utica Shale Plays Natural Gas Producer**, West Virginia and Ohio — Served as Project Manager for preparation of a groundwater-quality evaluation overview report of a four-county region in West Virginia where methane, arsenic, and barium and deep-sourced brines had been investigated for their effects on local and regional water-supply aquifers. Reviewed the company's West Virginia baseline and post-drilling water-quality results, and provided results and explanatory letters to property owners. Provided detailed technical support for complaint investigations. Designed, constructed, and maintained the company's environmental database that included all water-quality and other environmental- sampling results for the Marcellus and Utica operations.
- **Risk-Based Classification of Oil- and Gas-Related Spills**, Colorado — For the Colorado Oil and Gas Conservation Commission (COGCC), evaluated data from oil- and gas-related spills in Colorado to support the COGCC's efforts to streamline and improve the State's oil and gas inspection program. Collected, organized, and categorized spill reports according to operational phase, cause, equipment, location, and size/material. Provided descriptive statistics, and evaluated relationships among categories for COGCC's use in reports and presentations during development of the State's new spills regulations and inspection requirements.
- **Oversight Consulting for the U.S. Environmental Protection Agency (Region V) Superfund Five-Year Review and Investigation**, Elkhart, Indiana — Served as oversight hydrogeologist for this Superfund investigation and cleanup that included:
 - Evaluation of the nature and extent of subsurface contaminants at the site.
 - Review of the Responsible Party's subsurface investigation and aquifer-testing work plans.
 - Participation in negotiating final scope for RP group work plans.
 - Oversight of three phases of drilling that involved cone-penetrometer testing and direct-push and rotary sonic drilling, in-field soil- and groundwater-sampling, and monitoring-well construction.
 - Oversight of two phases of aquifer testing and participation in real-time evaluation of data collected during testing.

F. BRYAN GRIGSBY

Hydrogeologist

Page 3

- **Review of the U.S. Environmental Protection Agency Draft Report**, Pavillion, Wyoming — For the Independent Petroleum Association of America, provided comprehensive review of the USEPA's December 2011 draft report on groundwater contamination in Pavillion. Evaluated the geologic and geochemical evidence for links between hydraulic fracturing and groundwater contamination. Conducted a detailed review of previous contamination investigations in the area, and evaluated USEPA's drilling and well-completion activities and sampling protocols. Reviewed inorganic water-quality parameters, total petroleum hydrocarbon characteristics, and stable isotope results to evaluate water and contaminant sources. Served as co-author and signing Professional Geologist for report submitted to USEPA for project peer review.
- **Evaluation of Water-Supply Aquifer Impacts due to Natural Gas Development**, Piceance Basin, Colorado — For Antero Resources, served as Project Manager for a groundwater quality evaluation that involved comparing baseline water chemistry with water chemistry following natural gas drilling and hydraulic fracturing. Used results from inorganic water-quality parameters, VOCs, dissolved gases, and isotopes of methane and carbon dioxide to demonstrate the improbability that water quality had been impacted by gas drilling and hydraulic fracturing.
- **Evaluation of Water Quality in Mamm Creek Natural Gas Field Area (*Mamm Creek Phase II Hydrogeologic Investigation Report*)**, Piceance Basin, Colorado — For the Colorado Oil and Gas Conservation Commission (COGCC) and the Garfield County Board of Commissioners, served as Project Manager for a groundwater chemistry study in an area having numerous water-supply wells and active natural-gas production. Managed a field program involving sampling of domestic wells and produced water from gas wells. Evaluated an extensive set of water-quality, gas-composition, and gas-isotope data to identify possible impacts to water-supply aquifers from natural gas development activities. At the request of the COGCC, reviewed a report prepared by a third party that attributed area hydrochemical characteristics to effects from natural-gas drilling, hydraulic fracturing, and production. Used statistical analysis to demonstrate that drilling and gas production activities likely had not affected the water supply aquifer except in the area of a known gas release.
- **Voluntary Cleanup Plan at Diesel Engine Maintenance Facility**, Liberal, Kansas — Managed the preparation of a Voluntary Cleanup Plan for a site impacted by chlorinated VOCs. Conducted additional subsurface site characterization of a newly discovered source area and of the deep water-supply aquifer beneath the site. Performed SVE pilot-scale testing, and rehabilitated and optimized the existing groundwater extraction system. Developed a work plan and cost estimate to cover full cleanup of the contaminated soil and groundwater at this site.
- **Investigation and Remediation of Eight Natural Gas Compression Stations**, Colorado — For Panhandle Eastern Pipeline Company, served as Project Manager for investigation and remediation activities at eight sites. Designed and conducted groundwater characterizations, directed soil-gas surveys, installed and sampled groundwater wells, and evaluated geochemical data to assess potential for biodegradation of hydrocarbon contamination. Directed soil-vapor extraction (SVE) pilot-scale tests at four of the sites, and analyzed test data to evaluate feasibility of SVE as a remedial technology. Managed the design and construction of SVE and/or air-sparging remediation systems using both vertical and horizontal wells.
- **Review of Sampling Work Plan for the Rulison Nuclear Test Site**, Piceance Basin, Colorado — For the Colorado Oil and Gas Conservation Commission, provided technical review of an industry-prepared environmental sampling work plan to be implemented for natural-gas drilling in the vicinity of this former nuclear test site. Employed the services of a Certified Health Physicist to assist in the evaluation of potential exposure to radionuclides that theoretically could be released during drilling, well-completion, and/or gas-production activities. Participated in a public hearing where the sufficiency of the work plan was debated.

F. BRYAN GRIGSBY

Hydrogeologist

Page 4

- **Investigation and Remediation of Manufacturing Facility Solvent Contamination, Colorado Springs, Colorado** — For Schlage Lock, designed the groundwater investigation and aquifer-testing programs to evaluate extent of a chlorinated VOC plume. Directed the installation, sampling, and aquifer-testing of groundwater monitoring wells, recovery wells, and injection wells. Analyzed aquifer-test data and reinterpreted site geology based on new data. Constructed geologic maps and cross-sections, potentiometric maps, and isoconcentration contour maps. Constructed site conceptual hydrogeologic model and assisted in construction of MODFLOW model used to design groundwater remediation system. Designed groundwater injection wells and operations plan for a 300–400 gpm groundwater recovery and injection remediation system.

WATER RESOURCES EVALUATION

- **Hydrologic Monitoring Program Management, Arkansas River Valley, Colorado** — Assisted in management of ongoing hydrologic monitoring and reporting for a spring-water producer in compliance with county permitting requirements. Assessed irrigation flows, river hydrographs, groundwater levels, and spring flows to determine if pumping of water that is tributary to the Arkansas River is affecting conditions at the site of the springs. Conducted a study to refine calculations of spring flows based on water levels from nearby groundwater monitoring wells. Prepared a Sustainability Report for the spring-water production at the site, including using the MODFLOW groundwater model previously constructed by SSP&A for other purposes to determine a water budget for the watershed where the spring site is located.
- **Stream Depletion Analysis, Piceance Basin, Colorado** — For Delta Petroleum, evaluated whether produced water from an active gas field would be tributary under Colorado statutes. Constructed a conceptual site model that considered the geology in the gas-producing horizons as well as the non-productive overlying units. Developed a database of water production data, and collected information on the permeability, porosity, and physical characteristics from rock samples and field tests from natural gas wells. Based on analysis of these data, determined that produced water was not tributary.
- **Basin-wide Groundwater Assessments for Tribal Water Rights Adjudication, Montana** — Used an extensive water well geologic log dataset and local geologic maps to prepare a bedrock surface map for use in three basin-scale groundwater models prepared by SSP&A for the Confederated Salish and Kootenai Tribes to evaluate alternate water use scenarios and impacts of land and water use on groundwater storage and instream flows. For map preparation, designed a search algorithm and assisted in writing code to identify key geologic terms to help assign elevations to first bedrock occurrence at well locations.
- **Stream Depletion Assessments, San Juan, Raton, and Piceance Basins, Colorado** — For the Colorado Division of Water Resources, the Colorado Oil and Gas Conservation Commission, and the Colorado Geologic Survey, served as Project Manager and Hydrogeologist for studies evaluating surface-water depletions due to production of water from coalbed methane (CBM) wells. Evaluated geologic conditions in the basins and prepared hydrogeologic conceptual models for CBM-producing intervals in each basin. Provided technical oversight and assistance in compiling production- and aquifer-characteristics data for the application of Theis and Glover-Balmer analytical tools to estimate depletions due to CBM water production in the basins. Used PEST to assist in identifying appropriate coalbed hydraulic parameters where formation pressure data were available for numerical calibration. Participated in public presentations explaining goals and results of the studies.
- **Middle Rio Grande Hydrogeologic Investigation, New Mexico** — For the State of New Mexico and the U.S. Army Corps of Engineers, served as Project Manager for a large-scale drilling project and hydrogeologic investigation of a 50+-mile reach of the Rio Grande. Determined drilling locations, well depths, and construction details for more than 100 monitoring wells and 5 test

F. BRYAN GRIGSBY

Hydrogeologist

Page 5

extraction wells. Provided assistance in obtaining landowner right-of-entry agreements. Assisted in preparing Biological and Cultural Resources Assessments, and installed network of staff-gages instrumented with dataloggers. Provided management and field support for the drilling phase of the project and subsequent aquifer-pump testing. Designed a long-term water-level and water-chemistry monitoring program to provide data for use in subsequent MODFLOW simulations within the Rio Grande valley.

- **Salt Playa Groundwater vs. Surface-water Investigation, Utah** — For the U.S. Department of Justice, designed and implemented a hydrogeologic study in a playa environment covering more than 50 square miles in the Utah desert. Supervised field activities that included drilling and core sampling, well construction, hydrogeologic testing, and surface-water and groundwater sampling for assessment of water quality parameters and tritium and noble gases. Presented results in a public forum with several leading geologists, hydrogeologists, and geochemists in the fields of playa hydrology and geochemistry.

RMT, Inc., Madison, WI

As Hydrogeologist, Project Manager, and Program Manager, worked on a variety of environmental contamination projects including underground storage tank (UST) abandonment, investigation, and remediation for petroleum hydrocarbon and chlorinated VOCs projects; RCRA facility investigations and consent decree negotiations; and closed/abandoned landfills investigations. Served as Program Manager for Aratex/Aramark, one of RMT's top five national clients, on projects throughout the U.S. that involved UST abandonment, soil and groundwater investigation, and remediation design and construction involving contamination caused by spills of gasoline, diesel fuel, fuel oil, Stoddard Solvent/mineral spirits, and tetrachloroethene. Also directed and conducted projects that involved wastewater and air emissions permitting and asbestos sampling. Responsible for client relations, program and project budgets, and overall project activities.

PROFESSIONAL SOCIETIES

American Geophysical Union
American Water Resources Association, Colorado Section
Geological Society of America
Geothermal Resources Council
Rocky Mountain Association of Geologists

SELECTED PUBLICATIONS AND PRESENTATIONS

- Meromy, L., F.B. Grigsby, M. Hansen, and M. Ash, 2015. Minimizing Risk to Groundwater and Environment: Pinpointing Causes of Releases During Oil & Gas Operations. Presentation at the National Groundwater Association Summit, San Antonio, TX, March 2015.
- Barth, G., K. MacClune, D. Hathaway, and F.B. Grigsby, 2007. Making the Most of a Simple Model: Using Extensive Data Sets and Parameter Estimation to Get Basin-Scale Insight on Outcrop Recharge. Presentation at the National Ground Water Association (NGWA) Groundwater Summit, Albuquerque, NM, April 30–May 2, 2007.
- Barth, G., C. Schott, K. MacClune, D. Hathaway, and F. Grigsby, 2007. Assessing Mountain Pine Beetle Infestation: Anticipated Hydrologic Impacts and Suggestions for Minimizing Watershed Impacts, Sustaining Colorado Watersheds. Presentation at *Sustaining Colorado Watersheds*, Breckenridge, CO, October 2–4, 2007.
- Barkmann, P.E. and F.B. Grigsby, 2006. Evidence for a Regional Groundwater Flow System in the Coal-Bearing Fruitland Formation in the Northern San Juan Basin, Colorado—A New Look Using

F. BRYAN GRIGSBY

Hydrogeologist

Page 6

- Geologic and Hydrologic Data. *in Geological Society of America Abstracts with Programs*, v. 38, no.6, p. 10.
- Hathaway, D., G. Barth, F.B. Grigsby, and K.L. MacClune, 2006. MODFLOW . . . NOT: A Simple but Effective Solution to a Regulatory Question. *in Proceedings of MODFLOW and More 2006 Managing Ground-Water Systems*. International Groundwater Modeling Center, Colorado School of Mines Golden, CO, v. 1, pp. 137–141. May 22–24, 2006.
- Grigsby, F.B., S.R. Lindblom, L. Wilcox, R.S. Bowman, and P. Pegram, 2003. Responses of Shallow Groundwater to Changes in River Stage in the Middle Rio Grande Valley, New Mexico. Presentation at the 2003 American Water Resources Association (AWRA) Annual Conference, San Diego, CA, November 3–6, 2003. Oral Presentation Session 52.
- Schmidt-Peterson, R., N. Shafike, P. Pegram, D.L. Hathaway, F.B. Grigsby, R.S. Bowman, L. Wilcox, T. Newton, and K. Schafer, 2003. Groundwater/Surface-Water Monitoring in the Middle Rio Grande Basin. *Southwest Hydrology*, v. 2, no. 1.
- Pegram, P., F.B. Grigsby, R. Schmidt-Peterson, and K.T. Schafer, 2002. Investigation of Surface-Water/Groundwater Interactions in the San Acacia Watershed, New Mexico. *in Proceedings of the American Water Resources Association (AWRA) 2002 Summer Specialty Conference: Ground Water/Surface Water Interactions*, Keystone, CO, July 1–3, 2002, p. 113.
- Grigsby, F.B., 1988. Structural Development of the Ventura Avenue Anticlinal Trend at the San Miguelito and Rincon Oil Fields, Ventura County, California: Santa Barbara and Ventura Basins Tectonics, Structure, Sedimentation—Oilfields Along an East/West Transect. *in Coast Geological Society*, Field Guide No. 64, pp. 111–124.
- Yeats, R.S., G.J. Huftile, and F.B. Grigsby, 1988. Oak Ridge Fault, Ventura Fold Belt, and the Sisar Decollement, Ventura Basin, California: Santa Barbara and Ventura Basins: Tectonics, Structure, Sedimentation—Oilfields Along an East-West Transect. *in Coast Geological Society*, Field Guide No. 64, pp. 133–144.
- Yeats, R.S., and F.B. Grigsby, 1987. Ventura Avenue Anticline — Amphitheater Locality, California. *in Decade of North American Geology Centennial Field Guide*. Geological Society of America, Boulder, CO, v. 1, pp. 219–224.
- Grigsby, F.B., and R.S. Yeats, 1986. Active Fault Propagation Fold in the Western Transverse Ranges, California. Presentation at the American Geophysical Union (AGU) 1986 Fall Meeting and at the ASLO Winter Meeting, San Francisco, CA, December 8–12, 1986. *in Eos*, v. 67, no. 44, p. 1223.
- Grigsby, F.B., 1984. Geology and Associated Hanging Wall Deformation of the Padre Juan Fault, Ventura County, California. *in Geological Society of America, Abstracts with Programs*, v. 16, no. 6, p. 524.