

# Brad D. Wolaver

## Professional Summary

October 19, 2019

Business address: The University of Texas at Austin  
Bureau of Economic Geology  
University Station, Box X  
Austin, TX 78713-8924  
Telephone: (512) 471-1368  
E-mail address: brad.wolaver@beg.utexas.edu

## Professional Preparation

### Academic Background

Ph.D. Geology, The University of Texas at Austin, 2008

M.S. Hydrology, The University of Arizona, 1999

Fulbright Scholar in Environmental Sciences, Santiago, Chile, Pontificia Universidad Católica de Chile, June 1997

B.S. with Honors Geology, The University of Texas at Austin, 1995

### Professional Appointments

Present Position: Research Associate, Bureau of Economic Geology, The University of Texas at Austin (August 2011 - Present).

UTemps Consulting Research Hydrogeologist, Bureau of Economic Geology, The University of Texas at Austin (2011 - 2011). Performed original and independent research on: (1) Gulf Coast aquifer groundwater monitoring at carbon dioxide geologic sequestration sites in Brazoria and Jackson Counties, (2) rapidly evolving regulations pertaining to groundwater monitoring issues at carbon dioxide enhanced oil recovery (CO<sub>2</sub> EOR) in Texas, and (3) investigated novel groundwater sources for hydraulic fracturing from previously unstudied Paleozoic aquifers in north central Texas for Barnett Shale Play.

Wrote reconnaissance level hydrogeologic characterization reports for groundwater monitoring at two CO<sub>2</sub> EOR facilities in the Texas Gulf Coast.

Wrote report on groundwater monitoring implications of new Texas CO<sub>2</sub> EOR regulations that will be expanded to a peer-reviewed journal article.

Performed subsurface correlation of thin sand units in the Chicot and Evangeline aquifers of the Texas Gulf Coast using Petra software to optimize groundwater monitoring network design with the goal of demonstrate containment of CO<sub>2</sub> enhanced oil recovery (EOR) projects to meet federal and state regulations.

Used ArcMap GIS software to map North Central Texas Paleozoic aquifer sand bodies for use as a novel Barnett Shale hydraulic fracturing water supply because currently no Groundwater Availability Model (GAM) exists for this part of Texas--a critical State of Texas groundwater management gap this research fills.

Integrated potentiometric, water quality, geologic, stratigraphic and other data into GIS spatial databases top facilitate create of hydrogeologic conceptual models of the Gulf Coast aquifer near CO<sub>2</sub> EOR sites and Paleozoic aquifers for Barnett Shale water supply.

Synthesized historic pumping test data from North Central Texas domestic groundwater wells to characterize hydraulic properties of under-utilized Paleozoic aquifers for novel Barnett Shale water supply.

Evaluated emerging regulations for CO<sub>2</sub> EOR projects in Texas to inform effective groundwater management strategies.

Wrote two proposals presented by Michael Young at the recent Latin American Forum in Cartagena, Columbia for collaborative research with Mexican government water management agencies, CONAGUA and IMTA, in groundwater depletion of aquifers along the Texas border and arsenic contamination related to unsustainable agricultural groundwater production in Northeast Mexico.

Prepared proposal for collaborative, applied research with the Texas State University River Systems Institute on improving the Lower Colorado River Authority's groundwater management approach for rice farms on the Gulf Coast.

Outside of regular work hours, I have done substantial writing for three publications: (1) I have revised an article submitted to Water Resources Research, (2) Completed and circulated a co-authored review draft of a paper for submission to GSA's Geosphere, and (3) Integrated initial co-author review comments for a second paper from my postdoctoral research that will be submitted to Hydrogeology Journal in collaboration with Andrew Love and Craig Simmons.

Research Fellow, Earth Sciences Department, Flinders University, Adelaide, Australia (2008 - 2010). Created hydrogeologic conceptual model of regional aquifer and spring complex in Great Artesian Basin western margin to guide groundwater development and preserve spring discharge. This work has important implications for groundwater management because I identified a very low recharge aquifer previously unreported in the open literature that will now be managed actively.

Submitted and currently revising a paper for Water Resources Research on a novel analytical model that uses thermal spring discharge rate and temperature to estimate aquifer source depth without using complicated and error-prone geothermometry.

Integrated initial co-author review comments for a paper that will be submitted to Hydrogeology Journal that discusses sustainable groundwater management approaches in very-low recharge, sole source aquifers with increasing mining groundwater extraction and groundwater-dependent ecosystems.

Developed the first GIS geospatial database for the Central Australian study area by synthesizing diverse stratigraphic, structural, hydrochemical, and environmental tracer data.

Provided monitoring and management recommendations to regulatory agencies for optimum management of very low recharge Central Australian aquifers to provide sole-source groundwater for economically important mines while preserving groundwater-dependent, spring-fed ecosystems.

Used geophysical surveys of gravity and time domain electromagnetics to evaluate ephemeral stream recharge in an ungauged central Australian river that provides the only modern aquifer recharge.

Independent Technical Support Consultant, AOA Geophysics, Moss Landing, California (2006 - 2007). Provided technical support as an independent contractor for a legacy gravity geophysical processing software package I used for my Ph.D. research.

Intern with Dr. Vincent C. Tidwell, NM Sandia Water Initiative, Sandia National Laboratories, Albuquerque (2005 - 2005). Developed a basin-scale, groundwater-surface water simulation model for a generic basin to evaluate water supply alternatives among competing water uses and presented results at a state groundwater conference.

Geohydrologist, Geoscience Support Services, Inc., Claremont, California (2002 - 2004). Acquired and evaluated pumping test data to estimate aquifer parameters.

Sampled groundwater in monitoring and municipal production wells to assure compliance with federal and state drinking water standards and regulations.

Investigated rural and suburban groundwater aquifer storage and recovery (ASR) sites that were the first in Southern California to use treated effluent sources.

Designed and oversaw installation of groundwater monitoring and production wells for novel brackish and high-nitrate groundwater demineralization facilities.

Wrote numerous well completion and groundwater monitoring reports.

Wrote or co-wrote proposals resulting in over \$200,000 in new project work.

Hydrogeologist, Montgomery Watson Harza, Inc., Pasadena, California (1999 - 2002). Created hydrogeologic conceptual models, evaluated groundwater production, and assessed artificial recharge in Southern California aquifers using surplus canal water from the Colorado River.

Developed initial well depths based on exploratory Carrizo aquifer boreholes in support of the San Antonio Water System's Twin Oaks ASR facility well field.

Contoured sand tops in a GIS environment supporting the design of an ASR well field for the City of Laredo, Texas that would inject surplus water.

Installed soil lysimeters to assess storm water recharge into sub-grade storm water infiltration galleries - the first of their kind in Southern California.

Wrote a community relation plan for the U.S. Army Corps of Engineers investigating perchlorate-contaminated groundwater at a weapons depot near McGregor, Texas located between tributaries of the Brazos River.

Developed labor-and cost-loaded schedules for over \$300,000,000 water infrastructure capital improvement projects as a special consultant to the Metropolitan Water District of Southern California.

## Professional Registrations and Certificates

Texas Professional Geologist #11787; California Professional Geologist #7494

## Theses

Comparison of snow distribution methods in the Echaurren Basin, Chilean Andes

## Dissertations

Hydrogeology of the Cuatrociénegas Basin, Coahuila, Mexico: an integrative approach to arid karst aquifer delineation

## Continuing Education Courses Taken

Geochemist's Workbench: Australian National University, Canberra, Australia, June 2009

Sustainability Teaching Workshop: Carnegie Mellon University, Pittsburgh, Pennsylvania,

August 2007

Exxon Mobil: Sequence Stratigraphy; Integrated Basin Analysis: The University of Texas at Austin, Department of Geological Sciences, Austin, Texas, Spring 2007

Structure and Stratigraphy, Monterrey Salient, Sierra Madre Oriental, Mexico: The University of Texas at Austin, Department of Geological Sciences, Randall Marrett, Austin, Texas, Spring 2007

3-D Seismic Field Trip: Burlington Resources, College Station, Texas, Winter 2006

## Areas of Expertise

### Areas of Expertise

Applied research in sustainable groundwater management for people and the environment: Groundwater flow, transport, and recharge processes.

Carbon dioxide (CO<sub>2</sub>) sequestration: Characterization, risk assessment, and monitoring of storage in mature reservoirs for enhanced oil recovery (EOR) and in saline formations for sequestration.

Ecohydrology: Surface-groundwater interactions, springs, and groundwater-dependent ecosystems.

Water, energy, and minerals: Effective groundwater management for energy and mining.

## Awards

### Awards and Honorary Societies

GAAC Publication Award for article, "Potential economic impacts of instream flows for Central Texas freshwater mussels", 2013

Author Achievement Award, Bureau of Economic Geology, 2012

Houston Geological Society (HGS), Calvert Scholarship, 2006 - 2007

BHP Billiton Geoscience Scholarship, 2007

Gulf Coast Association of Geol. Soc. (GCAGS), Research Grant, 2005 - 2006

Geological Society of America (GSA), Research Grant, 2006

Jackson School of Geosciences, Field Research Scholarships, 2005

Tinker Foundation, Inc., Field Research Grant, 2005

Fulbright Scholar in Environmental Sciences, Santiago, Chile, 1996 - 1997

## Service

### External Committees Participation

Co-Chair, Water Issues of the Gulf Region--Use, Availability, and Unconventional Needs, 2012  
Gulf Coast Association of Geological Societies Annual Convention, 2012

Member, New Hire Committee, Bureau of Economic Geology, 2012

Reviewer, Environmental Earth Sciences, 2007 - 2011

Reviewer, Ground Water, 2007 - 2011

Reviewer, Hydrogeology Journal, 2007 - 2011

Vice President, Austin Geological Society, 2006 - 2007

### Published Interviews

Wolaver, B. D., 2011, Teams search farm for carbon 'fingerprints,' in Leader-Post, Regina,

Saskatchewan, Canada (Romanak quoted heavily)

Wolaver, B. D., Romanak, Katherine, and Nikkel, G., 2011, Researchers to find truth on Kerr farm, Weyburn Review, Weyburn, Saskatchewan, Canada (Wolaver quoted)

## Outreach Activities

Carbon sequestration demonstration: presented at Explore UT, Austin, Texas, March 3, 2012.

Sustainable groundwater management that balances needs of agriculture and groundwater-dependent ecosystems in Northeast Mexico: presented in Spanish to Segundo Congreso de Investigadores de Cuatrociénegas, Cuatrociénegas, Mexico, 2007.

## Proposal Review Panels Participation

GCAGS and SEPM Gulf Coast Section (Transactions Volume), 2012

Hydrogeology Journal (Article), 2012

## Teaching and Advising

### University Courses Taught

Potential economic impacts of instream flows for central Texas freshwater mussels: presented at BEG Colloquium, Austin, Texas, November 16, 2012.

Two seminars on Australian postdoctoral research and selected projects from professional consulting experience: presented to Suzanne Pierce's introductory hydrogeology class, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas, 2011.

Collection of groundwater level and conductivity data to evaluate groundwater salinization from irrigated agricultural practices along the Murray River of South Australia: presented at Earth Sciences Field Camp, Flinders University, Adelaide, Australia, 2009.

Doctoral research on Northeast Mexico groundwater management: presented to the School of Earth and Environmental Sciences, The University of Adelaide, Adelaide, Australia, 2009.

Possible collaborative research between the BEG and Mexican agencies in groundwater depletion and arsenic mobilization: presented in Spanish to Instituto Mexicano de Tecnología del Agua and Comisión Nacional del Agua, Mexico City, Mexico, 2008.

Doctoral research on Northeast Mexico groundwater management: presented in Spanish to Asociación Geohidrológica Mexicana, 6th Congreso Nacional de Aguas Subterráneas, Puerto Vallarta, Mexico, 2007.

Doctoral research on Northeast Mexico groundwater management: presented to Department of Earth & Environmental Sciences, The University of Texas at Arlington, Arlington, Texas, 2007.

Doctoral teaching assistantships: Physical Hydrogeology & Aquifer Testing, Graduate-Level Hydrogeology Field Methods, Living with a Planet, Climate: Past, Present, and Future: The University of Texas at Austin, Austin, Texas, 2007.

Doctoral teaching assistantships: Physical Hydrogeology & Aquifer Testing, Graduate-Level Hydrogeology Field Methods, Living with a Planet, Climate: Past, Present, and Future: The University of Texas at Austin, Austin, Texas, 2006.

Initial doctoral research results: presented in Spanish to Foro Nacional de Cuatrociénegas, Instituto Mexicano de Tecnología del Agua, Mexico City, Mexico, 2006.

Initial findings of doctoral research: presented to Department of Geography and the Environment, The University of Texas at Austin, Austin, Texas, 2006.

Doctoral teaching assistantships: Physical Hydrogeology & Aquifer Testing, Graduate-Level Hydrogeology Field Methods, Living with a Planet, Climate: Past, Present, and Future: The University of Texas at Austin, Austin, Texas, 2005.

Doctoral teaching assistantships: Physical Hydrogeology & Aquifer Testing, Graduate-Level Hydrogeology Field Methods, Living with a Planet, Climate: Past, Present, and Future: The University of Texas at Austin, Austin, Texas, 2004.

San Antonio Water System (SAWS) Carrizo Aquifer storage and recovery (ASR) program: a Texas water resources solution: presented at Hydrogeology Department Brown Bag Seminar, Department of Geological Sciences, The University of Texas at Austin, Austin, Texas, 2004.

## Presentations

### Invited Presentations

Developing aquatic ecosystem science to inform environmental performance: presented to Water-Energy Regulatory Environment and Trends Session, presented at The University of Texas at Austin/Exxon Mobil 2018 Energy-Water Workshop, Austin, Tex., December 3, 2018.

Aligning Science with Conservation: Texas Terrestrial and Aquatic Examples: presented to U.S. Fish and Wildlife Service, presented at Species Status Assessment, Framework Implementation Summit, Tucson, Ariz., November 13, 2018.

Ecological vulnerability of groundwater-dependent ecosystems in unconventional oil and gas plays: presented to Ecological Society of America, presented at Annual Meeting, New Orleans, August 8, 2018.

Monitoring and Hydrogeologic Evaluation of Trans-Pecos Texas Springs and Groundwater: presented to Texas Parks and Wildlife Department (TPWD). Trans Pecos Oil and Gas Response Work Group, presented at TPWD, Austin, Tex., November 8, 2016.

Monitoring and Hydrogeologic Evaluation of Trans-Pecos Texas Springs and Groundwater: presented to Texas Parks and Wildlife Department, presented at Trans Pecos Oil and Gas Response Work Group, Austin, Texas, November 8, 2016.

Land use, land development, and mitigating environmental and biological footprints (presented in Spanish): presented to Mexican Association of Hydrogeologists (AGM), presented at workshop: Shale oil and gas: U.S. lessons learned on environmental monitoring, land use, water resources, fracking and regulations, National Autonomous University of Mexico (UNAM), Mexico City, November 11-13, 2015.

Potential economic impacts of environmental flows for aquatic species: presented at Tulane University, Department of Earth and Environmental Sciences, New Orleans, Louisiana, November 2013.

### Presentations

Multispecies watershed-based conservation of native fishes in the Devils River, Texas: presented to Southern Division of the American Fisheries Society, presented at Annual Meeting, Galveston, Tex., January 24-27, 2019.

Green Water and Vulnerable Ecosystems in Unconventional Energy Plays: presented to Soil Science Society of America, presented at International Soils Meeting, San Diego, Calif., January 6-9, 2019.

Current Status of the Plains Spotted Skunk in Texas (presented by Robert C. Dowler, J. Clint Perkins, Alexandra A. Shaffer, Jon Paul Pierre, and Brad D. Wolaver): presented to The Wildlife Society, presented at 25th Annual Conference, Cleveland, Ohio, October 7-11, 2018.

Current Distribution and Phylogenetic Relationships of *Holbrookia lacerata* in Texas (Authors: Toby Hibbitts, Wade Ryberg, Dalton Neuharth, Connor Adams, Drew Dittmer, Johanna Harvey, Gary Voelker, Ben Labay, John Paul Pierre, Brad Wolaver, Travis LaDuc): presented to American Society of Ichthyologists and Herpetologists (ASIH), presented at ASIH Annual Meeting, New Orleans, Louisiana, July 8, 2016.

Structural and hydrogeologic evolution, Putumayo Basin and fold-thrust belt, Colombia:

presented to Bureau of Economic Geology Research Seminar, The University of Texas at Austin, Austin, TX, August 17, 2015.

Potential economic impacts of environmental flows following a possible listing of endangered Texas freshwater mussels: presented at University of Texas at Austin Hydro Brown Bag, Austin, Texas, September 2013.

Potential economic impacts of instream flows for central Texas freshwater mussels: presented to HDR Engineering, Inc., Austin, Texas, April 2013.

Potential economic impacts of instream flows for central Texas freshwater mussels: invited talk presented to U.S. Fish & Wildlife Service Austin Field Office, Austin, Texas, January 10, 2013.

Water-energy-economics nexus: water and economics: presented to San Antonio Geophysical Society, San Antonio, Texas, November 27, 2012.

A hydrologic characterization approach for Texas aquatic species studies: presented at Gulf Coast Association of Geological Societies Annual Convention, Austin, Texas, October 23, 2012.

Water-energy-economics nexus: water and economics of upstream oil and gas and power industries: invited paper presented at BEG Center for Energy Economics Think Day--A Research Forum for Energy Futures and Strategies: Gas/Power Linkages, Houston, Texas, May 25, 2012.

Water needs of the upstream segment of the oil and gas industry: presented at the TCEQ Environmental Trade Fair & Conference, Austin, Texas, May 2, 2012.

Water use for production of shale and tight formations as well as for drilling and water floods: presented at TCEQ Environmental Trade Fair and Conference, Austin, Texas, May 2, 2012.

Trans-Pecos springs hydrogeology and ESA considerations: invited talk presented to office of State Comptroller of Texas, Austin, Texas, December 16, 2011.

Estimating aquifer depths from hot spring measurements of outflow temperatures and flow rates: presented at National Groundwater Conference, Canberra, Australia, 2010.

Geophysical investigation of an ephemeral recharge event, Finke River, Northern Territory: presented at Australian Society for Limnology Annual Meeting, , Australia, 2009.

Hydrogeophysical investigation of an isolated recharge event on a central Australia ephemeral river: presented at Geological Society of America Annual Meeting, Portland, Oregon, 2009.

An integrative approach to sustainable ground water and associated ground water-dependent system management in arid karst aquifers: Cuatrociénegas Basin, Mexico: presented at 35th Congress, International Association of Hydrogeologists, Lisbon, Portugal, 2007.

Aquifer delineation for groundwater management in a developing arid karstic basin: Cuatrociénegas, Coahuila, Mexico: presented at Geological Society of America Annual Meeting, Denver, Colorado, 2007.

Ground water model development in regional aquifer systems with sparse hydrogeologic data: Cuatrociénegas Basin, Coahuila, Mexico: presented at National Ground Water Association (NGWA) Groundwater Summit, Albuquerque, New Mexico, 2007.

Ground water recharge evaluation in semi-arid northeast Mexico in response to projected climate change: presented at American Geophysical Union Annual Meeting, San Francisco, California, 2007.

Analyzing ground water flow paths in a karstic basin using cross-plots of major ions: Cuatro Ciénegas Basin, Coahuila, Mexico: presented at Geological Society of America Annual Meeting, Philadelphia, Pennsylvania, 2006.

Gravity geophysical analysis of spring locations in a karstic desert basin, Cuatro Ciénegas Basin, Coahuila, Mexico: presented at GCAGS Annual Meeting, Lafayette, Louisiana, 2006.

Regional flow system delineation in arid karstic basins with sparse hydrogeologic data: Cuatro Ciénegas Basin, Coahuila, Mexico: presented at American Geophysical Union Annual Meeting, San Francisco, California, 2006.

Ground water recharge in the Cuatro Ciénegas Basin, Mexico: Insights from strontium isotope and trace element analyses: presented at American Geophysical Union Annual Meeting, Salt Lake City, Utah, 2005.

Water resource modeling using system dynamics: A modular simulation approach: presented at New Mexico Water Research Symposium, 4th Annual Meeting, Socorro, New Mexico, 2005.

Energy balance snowmelt modeling in the Echaurren Basin, Chilean Andes: presented at Sixth International Conference on Southern Hemisphere Meteorology and Oceanography, Santiago, Chile, 1999.

Comparison of snow distribution methods in the Echaurren basin: presented at American Geophysical Union Annual Meeting, San Francisco, California, 1998.

Water for Texas aquatic species: Economics of environmental flows for freshwater mussels, poster presented at Austin Geological Society, Austin, Texas, May 2014

Adventures and careers in geology, presented to Senior Engineering class, Saint Stephens Episcopal School, Austin, Texas, April 2014

Water for Texas aquatic species: economics of environmental flows for freshwater mussels, poster presented at BEG Industry Day, Austin, Texas, April 2014

## Activities of a Professional Nature

### Professional Societies

American Geophysical Union

Geological Society of America

International Association of Hydrogeologists

National Ground Water Association

### Activities of a Professional Nature

Review of the "Draft Species Status Assessment Report for the Central Texas Mussels: False Spike (*Fusconaia mitchelli*), Texas Fatmucket (*Lampsilis bracteata*), Texas Fawnsfoot (*Truncilla macrodon*), Texas pimpleback (*Cyclonaias petrina*). Version 1.0. April 2018." for the U.S. Fish and Wildlife Service, Region 2, Albuquerque, NM (May 1-16, 2018)

Review of the "Species Status Assessment Report for the Texas Hornshell Version 1.0, July 2016" for the U.S. Fish and Wildlife Service, Region 2, Albuquerque, N.Mex. (July 31, 2016)

Appearance in video on YouTube, IPAC-CO2: The Kerr Investigation, documenting the work of the IPAC-CO2 led team of international experts investigating the source of carbon dioxide on the Kerr Property, 170 km southeast of Regina, Saskatchewan, uploaded December 7, 2011. <http://www.youtube.com/watch?v=wcxIXpl21IQ&context=C20924AD0EGsToPDskKWX2eABkFNHfA4JLauAFv7>

As a practicing hydrogeologist, wrote numerous technical reports and proposals, including groundwater demineralization, desalination, and watershed water-quality investigations, artificial-recharge evaluations (storm, ground, and surface water), surface and groundwater monitoring and management plans, well specifications, well reports, and water-treatment-plant construction schedules (labor & cost) for projects in U.S. & Mexico, 1999-2004.

Associate in Entrepreneurship, 1999.

Reconnaissance-level hydrogeologic characterization of the Hastings field, Brazoria County,

Texas: GCCC Internal report, 2011.

Service developing new employee onboarding strategies with BEG New Hire Committee, 2012.

Volunteer at Explore UT, 2012.

## Funding

### Research Support

Principal Investigator: Airborne Lidar bathymetry survey and aquatic habitat evaluation for Devils River minnow and Texas hornshell mussel in the Devils River, Texas Parks and Wildlife Department (2018-2020; \$484,646).

Principal Investigator: Hydrogeologic evaluation of Balmorhea-area springs in Trans-Pecos Texas and development of karst hydrogeology maps and recommendations for ongoing infrastructure development in the area, confidential industry client (January 1, 2018-December 31, 2019; \$2,400,634).

Co-Principal Investigator: Monitoring hydrologic effects of saltcedar control efforts in the upper Brazos River basin, Texas, Texas Parks and Wildlife Department (2017-2019; \$200,000).

Advisor and Conceptual Model Review: Develop Conceptual Model for the Cross Timbers Aquifer. Statement of Qualifications. Response to TWDB RFQ No. 580-18-RFQ0079. RTI Proposal No. 0281900.318, Texas Water Development Board (TWDB) (December 20, 2018).

Principal Investigator: Monitoring the effects of groundwater level on spring and stream discharge, stream temperature, and habitat for *Dionda diaboli* in the Devils River, Texas Parks and Wildlife Department (September 1, 2015-August 31, 2018; \$149,592.44).

Co-Principal Investigator: Species Status Assessment for Spot-Tailed Earless Lizard (*Holbrookia lacerata*), Texas Comptroller of Public Accounts (June 23, 2014-March 31, 2018; \$1,277,463.71, original proposal and two contract addenda).

Co-Principal Investigator: Monitoring springs in Trans-Pecos Texas, The Nature Conservancy (2017-2018; \$18,040).

Principal Investigator: Surface water-groundwater interactions in the upper Brazos River basin of Texas and quantitative relationship to smalleye and sharpnose shiner reproductive success, Texas Parks and Wildlife Department (2016-2018; \$99,935).

Co-Principal Investigator: Habitat assessment and fragmentation, population surveys, and genetic analyses for the Plains Spotted Skunk (*Spilogale putorius interrupta*), Texas Comptroller of Public Accounts, Economic Growth and Endangered Species Management (September 30, 2014-July 31, 2017; \$248,799).

Co-Principal Investigator: Gulf Coast Carbon Center (GCCC): GCCC Industrial Associates, various Industrial Associates (2011-2017; \$142,766).

Co-Principal Investigator: Assessment of habitat, current anthropogenic threats, habitat fragmentation, and distribution surveys for the Western Chicken Turtle (*Deirochelys reticularia miaria*), Texas Comptroller of Public Accounts, Economic Growth and Endangered Species Management (September 1, 2014-June 30, 2016; \$199,993).

Principal Investigator: An evaluation of potential economic impacts resulting from flows for freshwater mussels: an update using best available science and modeling, Texas Comptroller of Public Accounts (2016; \$247,306).

Co-Principal Investigator: Time series of landscape fragmentation from energy exploration in the Eagle Ford and Permian Basins, Texas, JPMorgan Chase Foundation (2015-2016; \$112,194).

Principal Investigator: Structural and hydrogeologic evaluation on the eastern flank of the South American Andes, confidential industry client (July 2013 - June 2014, \$560,000).

Principal Investigator: An evaluation of potential economic impacts of environmental flows following a possible listing of endangered Texas freshwater mussels, Texas Comptroller of Public Accounts, Economic Growth and Endangered Species Management (June 1, 2012-March 31, 2014; \$150,000).

Participant: During the Ecopetrol Unconventional Resources Forum in Bucaramanga, Colombia October 2-4, 2013, J.P. Nicot and Brad Wolaver met with Ecopetrol Clean Technologies staff from the Instituto Colombiano del Petróleo (ICP) to plan proposal efforts for collaborative research in CO<sub>2</sub> capture and storage source-sink studies as part of the Gulf Coast Carbon Center (GCCC). This meeting, in conjunction with planned GCCC membership, resulted in an invitation to return to Bucaramanga in spring 2014 to (1) hold a framing session for the development of a proposal for technical collaboration between GCCC and ICP, and (2) the writing of a detailed proposal for the management of Ecopetrol CO<sub>2</sub> emissions through geological carbon storage technologies., (October 2 2013 - October 4 2013).

Participant: J.P. Nicot and Brad Wolaver presented invited talks and posters on environmental issues related to unconventional resource development at the Ecopetrol Unconventional Resources Forum held in Bucaramanga, Colombia October 2-4, 2013. They also participated in working groups addressing key aspects of water and environmental issues related to unconventional resource development., (October 2 2013 - October 4 2013).

Co-Principal Investigator: Monitoring, verification, and accounting of CO<sub>2</sub> sequestration at West Hastings Field, Texas, Denbury Resources, Department of Energy (2011; \$144,846).

## Publications

### Peer Reviewed Journal Articles

Hernández-Espriú, A., Wolaver, B. D., Arciniega-Esparza, S., Scanlon, B. R., Young, M. H., Nicot, J.-P., Macías-Medrano, S., and Breña-Naranjo, J. A., 2019, A screening approach to improve water management practices in undeveloped shale plays, with application to the transboundary Eagle Ford Formation in northeast Mexico: *Journal of Environmental Management*, v. 236, p. 146-162, <http://doi.org/10.1016/j.jenvman.2018.11.123>.

Hibbitts, T. J., Ryberg, W. A., Harvey, J. A., Voelker, G., Lawing, A. M., Adams, C. S., Neuharth, D. B., Dittmer, D. E., Duran, C. M., Wolaver, B. D., Pierre, J. P., Labay, B. J., and LaDuc, T. J., 2019, Phylogenetic structure of *Holbrookia lacerata* (Cope 1880) (Squamata: Phrynosomatidae): one species or two?: *Zootaxa*, v. 4619, no. 1, p. 139-154, <http://doi.org/10.11646/zootaxa.4619.1.6>.

Robertson, W. M., Allen, J. T., Wolaver, B. D., and Sharp Jr., J. M., 2019, Aridland spring response to mesoscale precipitation: implications for groundwater-dependent ecosystem sustainability: *Journal of Hydrology*, v. 570, p. 850-862, <http://doi.org/10.1016/j.jhydrol.2018.12.074>.

Abolt, C., Caldwell, T., Wolaver, B., and Pai, H., 2018, Unmanned aerial vehicle-based monitoring of groundwater inputs to surface waters using an economical thermal infrared camera: *Optical Engineering*, v. 57, no. 5, p. 053113-1--053113-9, <http://doi.org/10.1117/1.OE.57.5.053113>.

Pierre, J. P., Wolaver, B. D., Labay, B. J., LaDuc, T. J., Duran, C. M., Ryberg, W. A., Hibbitts, T. J., and Andrews, J. R., 2018, Comparison of recent oil and gas, wind energy, and other anthropogenic landscape alteration factors in Texas through 2014: *Environmental Management*, v. 61, no. 5, p. 805-818, <http://doi.org/10.1007/s00267-018-1000-2>.

Wolaver, B. D., Pierre, J. P., Ikonnikova, S., Andrews, J. R., McDaid, G., Ryberg, W. A., Hibbitts, T. J., Duran, C. M., Labay, B. J., and LaDuc, T. J., 2018, An improved approach for forecasting ecological impacts from future drilling in unconventional shale oil and gas plays: *Environmental Management*, v. 62, no. 2, p. 323-333, <http://doi.org/10.1007/s00267-018-1042-5>.

Wolaver, B. D., Pierre, J. P., Labay, B. J., LaDuc, T. J., Duran, C. M., Ryberg, W. A., and

Hibbitts, T. J., 2018, An approach for evaluating changes in land-use from energy sprawl and other anthropogenic activities with implications for biotic resource management: *Environmental Earth Sciences*, v. 77, no. 5, p. 171, <http://doi.org/10.1007/s12665-018-7323-8>.

Arciniega-Esparza, S., Breña-Naranjo, J. A., Hernández-Espriú, A., Pedrozo-Acuña, A., Scanlon, B. R., Nicot, J.-P., Young, M. H., Wolaver, B. D., and Alcocer-Yamanaka, V. H., 2017, Baseflow recession analysis in a large shale play: Climate variability and anthropogenic alterations mask effects of hydraulic fracturing: *Journal of Hydrology*, v. 533, p. 160-171, <http://doi.org/10.1016/j.jhydrol.2017.07.059>.

Pierre, J.P., Young, M. H., Wolaver, B. D., Andrews, J. R., and Breton, C., 2017, Time series analysis of energy production and associated landscape fragmentation in the Eagle Ford Shale Play: *Environmental Management*, v. 60, no. 5, p. 852-866, <http://doi.org/10.1007/s00267-017-0925-1>.

Ryberg, W. A., Wolaver, B. D., Prestridge, H. L., Labay, B. J., Pierre, J. P., Costley, R. A., Adams, C. S., Bowers, B. C., and Hibbitts, T. J., 2017, Habitat modeling and conservation of the Western Chicken Turtle (*Deirochelys reticularia miaria*): *Herpetological Conservation and Biology*, v. 12, no. 2, p. 307-320.

Wolaver, B. D., Coogan, J. C., Horton, B. K., Bermudez, L. S., Sun, A. Y., Wawrzyniec, T. F., Zhang, T., Shanahan, T. M., Dunlap, D. B., Costley, R., and de la Rocha, L., 2015, Structural and hydrogeologic evolution of the Putumayo basin and adjacent fold-thrust belt, Colombia: *AAPG Bulletin*, v. 99, no. 10, p. 1893-1927, <http://doi.org/10.1306/05121514186>.

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