2012 Fayetteville Shale Symposium

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Abstracts and Biographies

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Scott Ausbrooks

Abstract

Disposal of Hydrofracking-Waste Fluid by Injection into Subsurface Aquifers Triggers Guy-Greenbrier Earthquake Swarm in Central Arkansas

Scott Ausbrooks, Arkansas Geological Survey, Scott.Ausbrooks@arkansas.gov
Stephen Horton, The Center for Earthquake Research and Information at the University of Memphis, shorton@memphis.edu

Waste-water, a by-product of hydraulic fracturing, is being injected under pressure into subsurface rocks in an expanding number of disposal wells across the United States. Since the first waste disposal (UIC) well became operational in April 2009, central Arkansas has experienced an increase in the rate earthquakes. The area has a long history of seismic activity including earthquake swarms in the early 1980's and 2001, so the current earthquake-rate increase may simply reflect another peak in a natural cycle. However, a spatial and temporal correlation between post 2009 earthquakes and the start of injection at some UIC wells motivated us to install a temporary seismic array in early September 2010, to monitor for potential induced earthquakes in the vicinity of two newly activated (July and August, 2010) UIC wells. Intense earthquake activity within 6 km of both wells began around September 23, 2010. A previously unknown fault, the Guy-Greenbrier fault, has now been illuminated by over a twelve-hundred earthquakes (**M**≤4.7). Plausible hydraulic connectivity exists between the injection depths at waste-disposal wells and the nearby Guy-Greenbrier fault. Earthquake frequency along the fault indicates a strong correlation with the volume and pressure of injection at the wells and is the most probable cause of the current seismicity.

Biography

Education:
University of Arkansas at Little Rock, Little Rock, Arkansas
Bachelor of Science, Geology
Degree: August 2001
University of Arkansas at Little Rock, Little Rock, Arkansas
Bachelor of Science, Surveying and Land Information Systems
Degree: August 2001
University of Central Arkansas, Conway, Arkansas
Associate of Arts, General Studies
Degree: December 1997

Training and Professional Courses:
Earthquake Non-Structural Mitigation Course by Central United States Earthquake Consortium (CUSEC)
ATC – 20: Post Earthquake Evaluation of Buildings Course by Central United States Earthquake Consortium (CUSEC)
Training seminar on "New Knowledge of Earthquake Hazard in the Central United States and Implications for Building Seismic Design Practice" by the Applied Technology Council (ATC) and the United States Geological Survey (USGS)
Training workshop on *"Earthquake Ground Motions in Mid-America"* by the Mid-America Earthquake Center (MAEC)

Appointments:
Mr. Ausbrooks is Chairman of the Arkansas Governor's Earthquake Advisory Council

Research Activities:
Scott Ausbrooks is a Registered Professional Geologist who currently serves as the Geo-Hazards and Environmental Geology Supervisor for the Arkansas Geological Survey. Currently he is co-investigator on the Guy-Greenbrier earthquake swarm and its potential relationship to induced/triggered seismicity from nearby SWDs. He assisted in the installation of the temporary seismic stations in the Guy-Greenbrier area. Mr. Ausbrooks served as project leader and provided oversight during installation of the Arkansas Seismic Network. He also drafted the Earthquake Response Plan and the Clearinghouse Annex for the Arkansas Geological Survey. He is also project leader to update the geology on approximately two-hundred (200) 7.5-minute geologic worksheets in Northeast Arkansas. Mr. Ausbrooks conducts numerous "Earthquake 101" and "Overview of the NMSZ" presentations to various groups and organizations, while working with several agencies and organizations involved in NMSZ research and mitigation projects. He is currently drafting the Earthquake Response Plan and the Clearinghouse Annex for the Arkansas Geological Survey. Mr. Ausbrooks' previous experience includes geologic mapping; quality control sampling for quarries; preparation of geological reports for bridge replacement projects; landslide studies; drill core inspections; monitoring well driller; technical writing; geotechnical logging; surveying; and environmental consulting.

Recent Publications:
Dart, R.L. and Ausbrooks, S.M., 2011, Earthquakes in Arkansas and Vicinity 1699-2010: U.S. Geological Survey Open-File Report 2011-1118
Ausbrooks, S.M., Johnston, D., 2010, Arkansas Seismic Network, AGC/AGS Series GH-EQ-ARSLM-002
Ausbrooks, S.M., 2010, Recent and Historic Earthquakes of North-Central Arkansas, AGC/AGS Series GH-EQ-Media-NCAR-001
Ausbrooks, S.M., Johnston, D., 2010, Recent Earthquakes in North West Arkansas, AGC/AGS Series GH-EQ-Media-NWAR-002
Ausbrooks, S.M., Doerr, E., 2010, Liquefaction Susceptibility Map of North East Arkansas, AGC/AGS Series GH-EQ-LSM-007
Ausbrooks, S.M., Doerr, E., 2009, Seismic Stations in Arkansas, AGC/AGS Series GH-EQ-ARSLM-001

Ausbrooks, S.M., Doerr, E., 2009, Modified Mercalli Intensities – Enola Swarm Seismic Event: Magnitude 4.5 – 20 January 1982: AGC/AGS Series GH-EQ-MMI-AR-0001
Ausbrooks, S.M., Doerr, E., 2009, Modified Mercalli Intensities – Enola Swarm Seismic Event: Magnitude 4.1 – 24 January 1982: AGC/AGS Series GH-EQ-MMI-AR-0002
Ausbrooks, S.M., Modified Mercalli Intensities, 2009 – Faulkner County Arkansas – Earthquake Swarm Seismic Event: Magnitude 4.5 – 20 January 1982: AGC/AGS Series GH-EQ-MMI-CO-0003
Ausbrooks, S.M., Doerr, E., 2008, New Madrid Seismic Zone of Northeast Arkansas: AGC/AGS Series GH-EQ-NMSZ-005
Ausbrooks, S.M., Doerr, E., 2008, Modified Mercalli Intensities Deer Seismic Event: Magnitude 3.6 – 06 September 1985: AGC/AGS Series GH-EQ-MMI-AR-0004
Ausbrooks, S.M., Doerr, E., 2008, Liquefaction Susceptibility Map of Arkansas, AGC/AGS Series GH-EQ-LSM-006
Ausbrooks, S.M., Doerr, E., 2008, Soil Amplification Map of Arkansas, AGC/AGS Series GH-EQ-SW-SAM-011
Ausbrooks, S.M., Doerr, E., 2008, Soil Amplification Map of North East Arkansas, AGC/AGS Series GH-EQ-SW-SAM-012
Ausbrooks, S.M., Doerr, E., 2008, Seismicity Maps for ten Arkansas counties: Seismic Events that have occurred from 1699 to 2008, AGC/AGS Series Digital Maps
Ausbrooks, S.M., Doerr, E., 2007 and 2008, Three Centuries of Arkansas Earthquakes: AGC/AGS Series GH-EQ-ARK-001
Ausbrooks, S.M., Doerr, E., 2007, Enola Swarm Area of Faulkner County, Arkansas: AGC/AGS Series GH- EQ-Enola-002
Chandler, A., Ausbrooks, S.M., 2010, Geology of the Pea Ridge and Garfield Quadrangles, Benton County, Arkansas: Arkansas Information Circular 41

Scott M. Ausbrooks
Geohazards and Environmental Geology Supervisor
Arkansas Geological Survey

Brad Austin

Abstract

Impact Of Natural Gas Wells On Periphyton And Metabolism In Headwater Streams In North Central Arkansas

Recovery of natural gas has increased significantly in recent years. Construction of natural gas wells (NGWs) increases the potential for sediment erosion into streams, which could negatively influence periphyton communities. Ten streams with varying catchment densities of NGWs (0-32 wells/1000ha) were sampled during winter and spring of 2010 and 2011 to examine NGW impacts on periphyton and metabolism. Dissolved nutrients, light, and land use were also measured across sites since these can also affect stream periphyton and metabolism. Increasing number of wells positively influenced chlorophyll *a* during both winter sampling events (2010 r^2=0.83, p<0.01; 2011 r^2=0.39, p=0.05). Gross primary production (GPP) was positively related to increasing well density during winter 2011 (r^2=0.78, p=0.02), and was best explained by well density and turbidity in spring 2010 (overall model r^2=0.72, p=0.02). Nutrients and light transmittance were not positively related to chlorophyll *a* or GPP. Therefore, other factors such as grazing pressure may change across the NGW density gradient. Our findings suggest that primary production is influenced by NGWs, supporting the use of primary production metrics as indicators of NGW impact on streams.

Biography

Brad Austin is a graduate research assistant at the University of Arkansas in Fayetteville, in the department of Biological Sciences. He obtained his masters in Biology from the Department of Biological Sciences at Fort Hays State University in Hays, KS, looking at the effect of stream desiccation on nitrification and denitrification. His current research at the University of Arkansas focuses on the impacts of anthropogenic disturbances on stream metabolism and primary production.

Mark Boling

Abstract

Hydraulic Fracturing Operations – What Is Really Going on Down There?

If the full potential of America's unconventional oil and gas resources is to be realized, it is essential to ensure public trust and acceptance of hydraulic fracturing operations. To achieve this objective, the debate concerning the environmental impact of hydraulic fracturing must be refocused from the current fear-based, emotional "war of words" to a science-based analysis of the real obstacles to the responsible development of this resource. My presentation will address recent efforts to refocus the debate as it relates to the impact of hydraulic fracturing operations on underground water resources, including the collaborative effort between certain energy companies and environmental NGO's to develop a Model Regulatory Framework for Hydraulic Fracturing Operations.

Biography

Mark K. Boling is the Executive Vice President and General Counsel of Southwestern Energy Company.

Prior to joining Southwestern in January of 2002, he was in private practice in Houston, Texas, specializing in oil and gas transactional work. Mr. Boling was a partner with the law firm of Fulbright & Jaworski L.L.P. where he practiced in the firm's Oil & Gas/Real Estate Section from 1982 to 1993. Mr. Boling holds a Juris Doctorate degree from Southern Methodist University and a Bachelor of Science degree in Geology from DePauw University.

Mr. Boling is a frequent speaker on a variety of topics relating to unconventional oil and gas developments and hydraulic fracturing operations. He participated in the preparation of the Atlantic Council report titled "European Unconventional Gas Developments – Environmental Issues and Regulatory Challenges in the EU and the U.S." and he was recently appointed by Governor Andrew Cuomo to serve on the New York Advisory Panel on High-Volume Hydraulic Fracturing. Mr. Boling also initiated and continues to lead the effort by Southwestern Energy Company to collaborate with the Environmental Defense Fund and other environmental NGOs to develop a Model Regulatory Framework for Hydraulic Fracturing Operations.

Mr. Boling is a member of the American (Environment, Energy and Resources and Business Law Sections), Arkansas (Natural Resources Law Section) and Texas (Oil, Gas & Mineral Law and Corporate Counsel Sections) Bar Associations.

Donald Campbell

Abstract

Overview Of USGS Studies Related To Shale Gas Extraction And Hydraulic Fracturing

The U.S. Geological Survey (USGS) assesses conventional and continuous oil and gas resources throughout the United States, and studies surface and subsurface impacts of hydraulic fracturing and gas drilling. The USGS has completed assessments for a number of unconventional oil and gas provinces and continues work on a number of others. For its extraction impact studies, the USGS is (1) establishing baselines for water availability and quality, (2) analyzing the composition of flowback and produced waters and their potential contaminants of concern, (3) assessing the sources and potential migration of stray gases, (4) developing an assessment methodology for water use associated with unconventional oil and gas development, (5) assessing the effects of landscape alteration and infrastructure development on sediment transport and biological resources, and (6) studying the potential for induced seismicity by produced water deep injection. Examples will be presented demonstrating the utility of groundwater modeling and geochemical approaches such as stable isotopes, groundwater age-dating, and dissolved-gas analyses for determining sources and migration of solutes in the subsurface environment. Data obtained as part of these studies adds to the publicly available information describing subsurface geologic and hydrogeologic frameworks, and contributes to our studies on regional and national water resources and availability. This expanding knowledge will be useful as our Nation moves forward to extract needed energy resources while minimizing potential impacts on other natural resources; it may also contribute to improved assessments for the disposal and injection of some of our wastes, including geologic carbon sequestration.

Biography

Don is the Central Branch Chief for the USGS Water Mission Area's National Research Program in Denver and Boulder, Colorado. Most of his career with USGS he was a research hydrologist studying topics such as atmospheric deposition, watershed biogeochemistry, and effects of climate variability on availability and quality of water.

James Campbell

Abstract

USGS Activities to Assess the Effects of Shale-Gas Development on Water Resources in Pennsylvania

The U.S. Geological Survey (USGS) is conducting long-term monitoring, baseline water-quality studies, and research to help managers evaluate the effects of shale-gas development in Pennsylvania. These activities are in cooperation with Federal, State, and local partners, as well as with the gas industry.

Monitoring activities include the installation of seven streamgages and ten continuous water-quality monitors, and improvements to the Pennsylvania Water-Quality Network (WQN). The streamgages are used by industry and managers to determine if streamflow is sufficient in small watersheds to accommodate withdrawals for hydraulic fracturing. New continuous monitors measure temperature, dissolved oxygen, specific conductance, and pH in the Ohio River Basin, where water-quality problems have been documented. Eleven new stream-sampling sites were added to the WQN, and both the frequency of sample collection and number of constituents analyzed was increased.

Baseline studies of water quality are being conducted in some areas to provide data against which future changes can be assessed. Synoptic water-quality surveys have been conducted at National Park units, the USGS Northern Appalachian Research Laboratory, and Williamsport Municipal Water Authority. To provide information on natural variability of the quality in streams supplying the Altoona Water Authority system, periodic monitoring is being conducted for (1) baseline stream chemistry, (2) Channel geomorphology, (3) benthic macroinvertebrates, and 4) fish assemblages;

In southwestern Pennsylvania, USGS is working with EPA on their study of the potential impacts of hydraulic fracturing on drinking water resources, by conducting a tracer study during hydraulic fracturing, and by providing water-quality sampling for a broad suite of parameters before, during, and after gas-well drilling. Research in cooperation with U.S. Fish and Wildlife will quantify the exposure of freshwater mussel populations to discharges of highly saline an industrial wastewater plant.

The USGS Comprehensive Plan is a collection of integrated Federal/State collaborative studies to evaluate the potential environmental effects of Marcellus Shale gas production in the Susquehanna, Delaware, and Ohio River Basins. The plan would also provide a baseline of scientific information across the landscape and recommend an environmental monitoring strategy that resource managers will need to protect natural resources and citizens of the region into the future. The plan is organized around a set of potential and/or already observed environmental effects resulting from deep-well gas extraction and waste injection development. The goal is to both (a) understand the effects of energy development sufficiently to support environmentally-sound practices and policies, and (b)

identify sensitive environments where energy development should be avoided or alternative practices applied.

The key effects to be addressed by the research, surveys, and monitoring proposed are:

- Characterization of the hydrogeologic framework
- Changes in water availability (groundwater and surface water)
- Changes in water quality (groundwater and surface water)
- Changes in air quality (stray gas and dust)
- Induced seismicity
- Changes in landscape and habitat condition
- The compounded effects of these changes on biological resources.

Biography

James B. Campbell, Director
Pennsylvania Water Science Center
United States Geological Survey
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http://pa.water.usgs.gov

Professional Experience:
Director of the Pennsylvania Water Science Center

U.S. Geological Survey, New Cumberland, PA
The Pennsylvania Water Science Center (PAWSC) provides unbiased scientific and technical information needed for the best use and management of Pennsylvania's water resources. Responsibilities include technical direction and management of the Pennsylvania Water Science Center's cadre of nearly 80 scientists, technicians, and support staff in New Cumberland, Exton, Pittsburgh, and Williamsport, PA. The PAWSC works in cooperation with numerous Federal, state, and local agencies to collect scientific data and conduct interpretive studies of the source, distribution, quantity, quality, ecology, and use of the Commonwealth's water resources. The results of these activities in some way affect every citizen, every day in the State of Pennsylvania.

Previous assignments include: Associate Director, Pennsylvania Water Science Center (2006-2009); Director Rhode Island State Office, Massachusetts/Rhode Island Water Science Center (1996-2006); Hydrologic Investigations Chief, Virginia Water Science Center (1992-1996); Hydrologic Surveillance Chief, New York Water Science Center, (1988-1992); Research Hydrologist, New Jersey Water Science Center (1976-1988).

Education:
Drexel University, Water Resources Engineering
B.S. 1976, Pennsylvania State University, Civil Engineering/Environmental Science

Doug D. Carlton, Jr.

Abstract

Turbidimetric Method for the Quantitation of Barium in Private Well Water from the Barnett Shale Region

High quality drinking water is a universal standard of living. Governmental policy regulates surface and public drinking water quality, however, there is no authority monitoring groundwater cleanliness, a resource received by approximately 15% of Americans. Recent expansion of natural gas extraction from the Barnett Shale in North Texas has warranted an assessment of possible environmental impacts. Over 100 privately-owned water wells have been sampled in the Barnett Shale region and screened by multiple analytical techniques for an array of non-native compounds, possibly introduced by the hydraulic fracturing process. Barium is a species originating from bentonite which is currently used in high concentrations in drilling mud for various drilling applications. It is found naturally, but at much lower levels than that found in drilling mud or waters mixed with drilling mud. A turbidimetric method has been utilized to quantitate barium in the well water samples. A unique feature of the method is the use of a 96-well plate which greatly reduces analysis time for large sample populations. Experiments to examine contributions from the natural sample matrices have been necessarily addressed to maintain high accuracy and precision for the determinations. In general, the presence of a high concentration of barium in groundwater could hint to potential contamination by hydraulic fracturing processes. Here, we report these efforts, as well as general efforts to examine potential problems for private well water owners in the Barnett Shale region of North Texas.

Biography

Doug Carlton is currently in his 3rd year of the Ph.D. program at the University of Texas at Arlington. His degree plan is Analytical Chemistry, with research specialties in chromatographic separations and mass spectrometry applications. His research interests include environmental monitoring, along with studying a variety of non-covalent binding systems by mass spectrometry.

Sarah Chitwood / Kyle Clark

Abstract

Permits and Mitigation in the Fayetteville Shale Play

The Corps of Engineers (Corps) Regulatory Division is dedicated to protecting the chemical, physical and biological integrity of the waters of the United States in the Fayetteville Shale Play region while balancing the economic benefits. Pursuant to Section 404 of the Clean Water Act, Fayetteville Shale activities that involve a discharge of dredged or fill material into waters of the United States requires a Department of the Army (DA) permit from the Corps. Since June 2006, the Corps Regulatory Division has been involved with activities in the Fayetteville Shale geographic region. The Fayetteville Shale Play region is located within 33 counties in Arkansas. It covers areas in Little Rock, Memphis, and Vicksburg Districts.

Section 404 of the Clean Water Act discharges that typically require DA authorization associated with the Fayetteville Shale gas industry include infrastructure development and drilling operation projects specifically associated with access roads, pipeline crossings, interstate gas lines, well pad construction, construction of dams on streams to pond water for use in the fracturing of shale, and intake structures with cofferdams. Section 10 of the Rivers and Harbors Act authorizations could likely be associated with water pumps. The Corps has worked to establish procedures that balance the economic development and environmental impacts of the gas industry.

The Little Rock District Corps has approved one compensatory mitigation bank and is in the process of approving additional compensatory mitigation banks to provide viable compensatory mitigation. The Regulatory Division has approved permittee-responsible consolidated mitigation areas.

Biography

Ms. Sarah Chitwood is a Project Manager in the US Army Corps of Engineers Little Rock District Regulatory Division. She has a Bachelor of Science in Civil Engineering from the University of Arkansas at Fayetteville and is a registered professional engineer in the state of Arkansas. Ms. Chitwood has been with the Corps since 2001.

Mr. Kyle Clark is the Enforcement Branch Chief of the US Army Corps of Engineers Little Rock District Regulatory Division. He has a Bachelor of Science in Wildlife Management from the University of Arkansas at Monticello and is a registered forester in the state of Arkansas. Mr. Clark has been with the Corps since 2000.

Jackson Cothren

Abstract

Modeling the Effects of Non-Riparian Surface Water Diversions on Flow Conditions in the Little Red Watershed

Natural gas production in the Fayetteville shale area might create critical levels of water discharge due to diversion of surface water used for horizontal hydraulic fracturing. In fact, each well requires between 3 and 7 million gallons of water for hydraulic fracturing and the number of wells is expected to grow in the future. This usage, combined with drinking and farming needs, could pose water resource management concerns. Furthermore, the continuous construction of small ponds has taken place within this area. These water bodies are designed to retain water for agriculture, however, little is known about their effects on water balance components and water availability when related to the natural gas operations.

This presentation will show current hydrology simulation results obtained by applying the Soil and Water Assessment Tool Model (SWAT) and using specific georeferenced landscape input layers. Several physical processes are simulated and different land use and water use management issues are taken into account. Some scenarios based on Best Management Practices were generated to support strategies to help the gas industry and the regulatory agencies facing the related water management problems. The overall goal is to support future water resources planning in the Fayetteville shale area and eventually in other watersheds with similar conditions. Preliminary results indicate that, when managed correctly, surface water diversions related to hydraulic fracturing do not create extraordinary low-flow conditions in affected tributaries.

Biography

Dr. Cothren is the Director of CAST at the University of Arkansas and an Associate Professor in the Department of Geosciences at the UA. His research interests include various aspects of digital photogrammetry including sensor modeling, feature extraction and matching for orientation, integration of images and LiDAR point-clouds, reliability analysis of adjustment models and integration with enterprise-scale Geographic Information Systems. Some of his recent work involves development of web-based geospatial analysis tools using both commercial and free and open source software.

Robert Cross

Abstract

Air Pollution and Greenhouse Gas Effects of Drilling in Shale Areas

Pad construction, drilling, and well completion in the shale areas in the United States produce significant air pollution with much of the emissions contributing to our greenhouse gas (GHG) problem. Published information about this issue is limited but the few studies available will be reviewed and discussed. The major contributor to pollution and the GHG problem is the venting and/or flaring of a well during the completion phase of the process. As much as 20 MM cubic feet of methane could be vented to the atmosphere from one well or an equivalent amount of CO_2 if flaring is carried out. Other contributors to emissions include operation of machinery, engines to provide power at the pad, heavy truck traffic, and leakage. A life cycle analysis has been carried out at Cornell University showing that the carbon footprint of natural gas from shale operations is 1.2 to 2.1-fold greater than coal over a 20-year time frame. While methane and CO_2 are the major contaminants, other pollutants such as entrained fracturing chemicals, and compounds from the shale layer such as naturally occurring radioactive materials (NORM) may be emitted during the flowback phase of the well completion process. Processes are available that will reduce emissions and these will be reviewed. One of these, i.e. "green completions" is now required in Colorado and Wyoming and has been proposed by EPA to be used nationwide. As yet, no processes to reduce air emissions are in the GMP's used in Arkansas.

Biography

Prof. Cross is currently a Professor Emeritus of the Ralph E. Martin Department of Chemical Engineering at the University of Arkansas and is the President of the Ozark Society. He is a graduate of the University of Arkansas and received an M.S. in Chemical Engineering at the Massachusetts Institute of Technology. He worked in industry for 30 years before returning to the UofA to teach. His technical specialties include separation processes for gases and liquids as well economic analyses of chemical and physical processes.

Ian Duncan

Abstract

Is Hydraulic Fracturing of Shale Gas Responsible for Observed Water Well Contamination Issues?

The talk will review observed water well contamination in area of shale gas plays and compare these data to observations of water well contamination in areas not subject to hydraulic fracturing. The talk will also review isotopic data of dissolved methane in groundwater and present an analysis of the constraints this data places on the origin of this methane.

Biography

Dr Ian Duncan is a research scientist at the Bureau of Economic Geology at the University of Texas at Austin. Ian's PhD is from the University of British Columbia and he has been on the Geology faculty at SMU and Washington University in St Louis. His current research focuses on the **s**cientific, environmental and public policy aspects of unconventional natural gas production, the water-energy nexus, and carbon capture and storage. He has a particular interest in risk analysis, decision making, and legal/regulatory issues related to fracing, CO2 sequestration, CO2-EOR, and energy production.

Ian Duncan
Research Scientist, Bureau of Economic Geology ,University of Texas at Austin

Randy Easley

Abstract

Changes to Monitoring Protocol in Response to Natural Gas Development

The presence of natural gas well/drilling operations in a municipal drinking water supply watersheds are listed by the Environmental Protection Agency and the Arkansas Department of Health as “Potential Sources of Contamination” (PSOCs) in Source Water Protection Plans (SWAPs).

This presentation chronicles: The monitoring activities of the Fort Smith Utility Watershed/Water Quality program; Identifies some of the natural gas/drilling operations that are considered PSOCs; and details modifications to the monitoring program in attempt to detect and potential negative impacts from these PSOCs.

Biography

Randy Easley is the Environmental Manager for the Fort Smith Utility in Fort Smith, Arkansas. Mr. Easley has held his current position for 25 years. His current responsibilities include the management of: the City’s Analytical Laboratory (which is certified by the Arkansas Department of Health and accepted Environmental Protection Agency), Environmental Monitoring Program and Water Quality / Watershed Management Program. These separate functions comprise the Fort Smith Utility Environmental Quality Department.

A Biologist by training, Mr. Easley has 32 years experience in environmental management. In addition to the time spent in his current position, he has also worked for the U.S. Fish and Wildlife Service, the U.S. Forest Service, the Arkansas Game & Fish Commission, and in the private sector.

Sally Entrekin

Abstract

Effects of Natural Gas Development on Stream Turbidity in the Fayetteville Shale, Arkansas

Advances in natural gas drilling and extraction have resulted in rapid expansion of wells in shale basins. The rate of gas well installation in the Fayetteville shale is ~774 wells/ year since 2005. The Fayetteville shale covers 23,000 km^2 although gas well development is concentrated within 8,000 km^2. Rapid and concentrated activity and wells placed close to streams increases potential for negative effects on surface waters. We quantified turbidity and suspended sediment during eight storms in 10 stream catchments with a gradient of gas well densities. We predicted catchments with higher well densities to have higher turbidity and suspended sediments. Turbidity was positively related to gas well activity during four and negatively related to gas well density during one storm. Turbidity from three storms was related to road density, drainage area, or woody/herbaceous land. Inorganic sediment concentration was also positively related to well density during three storms, while in other storms it was related to woody/herbaceous land or road density.

Biography

Sally Entrekin in an Aquatic Ecologist and has been an assistant professor at University of Central Arkansas for four year. Her research has focused on ecosystem-level responses to disturbance and is currently assessing effects of land use in north-central Arkansas on sediment transport and invertebrate community structure. She earned a PhD from the University of Notre Dame in Biology; MS in Entomology at University of Georgia, and BS from Georgia Southwestern University.

Steve Filipek

Abstract

Potential Impacts to Fish Communities and Aquatics from Natural Gas Development in the Fayetteville Shale Play, Arkansas

Steve Filipek, J. Quinn, B. Wagner, T. Bly, M. Schroeder, B. Posey and S. O'Neal
Arkansas Game & Fish Commission, #2 Natural Resources Dr., Little Rock, AR 72205

Natural gas development in the Fayetteville Shale Play in central, north-central Arkansas has increased exploration and development of deep, shale strata by hundreds of percent in the past 4-7 years in Arkansas. Development of this energy source has economic benefits to the state, the landowners and the nation. The Fayetteville Shale is found in the Boston Mountains and Arkansas River Valley ecoregions of Arkansas. The Boston Mountains are a steep, mountainous region characterized by clear water streams and springs (< 10 NTUs turbidity low flow) flowing over clean bedrock, cobble and gravel substrates and with biotic communities that have evolved in this relatively sediment-free environment. The Arkansas River Valley has somewhat different and erodible soils yet water quality is relatively low in turbidity and substrates high in gravel/cobble aggregates. Natural gas development in shale plays is characterized by 3-8 acre cleared well pads, millions of gallons of water needed to fracture each well, a wide range of chemicals (acids, biocides, lubricants) added to the frac water, miles of access roads, and miles of both gathering lines, and transmission pipelines. In such development in the Boston Mountains and Arkansas River Valley, biologists, hydrologists, ecologists and groundwater specialists begun researching the potential impacts of such development on the surface and groundwater resources of the shale plays around the United States, from the western part of the country (Wyoming, Montana) to the eastern United States (Pennsylvania). These include but are not limited to: increased sedimentation and turbidity in associated streams and waterbodies, water quality impacts to wells and surface water from fracking fluids, instream or environmental flow regime modifications, watershed water budget issues, increases in methane release in groundwater, habitat fragmentation, and impacts in biotic communities (diversity and abundance). Hydraulic fracturing for natural gas development was approved on the Arkansas Game and Fish Commission's Gulf Mountain Wildlife Management Area near Scotland, Arkansas through which flows the South Fork Little Red River. The South Fork is home to 2 federally listed aquatic Threatened and Endangered Species, the speckled pocketbook (mussel), *Lampsilis streckeri*, and the yellowcheek darter (fish), *Etheostoma moorei*, and one proposed T and E species, the rabbitsfoot (mussel), *Quadrula cylindrical,* all species sensitive to sedimentation. AGFC's responsibility, to minimize any possible negative impacts from this gas extraction, meant that the gas company contracted to drill for gas would use advanced BMPs (Best Management Practices) for gas extraction. Selected sites on the main stem South Fork Little Red were physically typed (baseline data), water chemistry and discharge data collected following US Geological Survey (NAWQA) protocols (30+ parameters). The fish community was sampled using boat and

backpack electrofishing equipment (2009, 2010, 2011) and will continue to be monitored throughout the gas extraction process (through 2018+). Preliminary results are summarized in this presentation, which is one component of a larger comprehensive study of the natural gas development on the WMA.

Biography

Steve Filipek is the Assistant Chief of Fisheries for the Arkansas Game and Fish Commission where he has worked for 33 years. He works with and supervises rivers and streams biologists, malacologists, herpetologists, nongame aquatic biologists and stream team coordinators. Prior to that 9 year position, Steve worked as the Arkansas Stream Team Coordinator, as a Statewide Fisheries Research Biologist for AGFC, District Fisheries Biologist, Asst. District Biologist, and Fish Culturist for the AGFC. Steve has also worked for the Washington Department of Fisheries, California Department of Fish and Game and Colorado Division of Wildlife. Steve has a B.S. in Fishery Biology from Colorado State University.

Steve is a Certified Fisheries Scientist by the American Fisheries Society and has been active at every level of the Society. He was President of the Southern Division, American Fisheries Society. He was Chairman of the Warmwater Streams Committee and served on that committee for years. Steve organized the development of the Arkansas Chapter, American Fisheries Society in 1986, served as its second president and received the Chapter's first Outstanding Achievement Award. Other awards include the AGFC Employee of the Year (1988), Southeastern Fish & Wildlife Agencies Director's Award for the Outstanding Fisheries Biologist in a 16 state region (1996), and the Water Conservationist of the Year award from the Arkansas Wildlife Federation (1994). He has given over 100 presentations on stream conservation/fisheries biology and authored over 2 dozen technical and popular aquatic articles. Steve currently leads a citizen's group volunteer program called the Arkansas Stream Team Program consisting of 800 stream teams throughout the state and close to 20,000 volunteers monitoring the water quality, improving the habitat and cleaning up around our 100,000 miles of streams in Arkansas. Steve is married, has two sons, and spends most of his spare time in the outdoors with his family fishing, canoeing, camping, hiking, and playing various kinds of ballgames and dog games.

Jaysson Funkhouser

Abstract

Surface Water Data Collection in the Fayetteville Shale

The U.S. Geological Survey (USGS) Arkansas Water Science Center is collaborating with numerous partners, government and private, to monitor and understand the potential effects that shale gas exploration and extraction in the Fayetteville Shale have on the water resources in north-central Arkansas. The hydraulic fracturing of one natural gas well in Arkansas can use as much as 6 million gallons of water. Because this area of the State does not have an aquifer that produces a high yield of groundwater, the companies developing the gas use surface water as their main source of water supply for hydraulic fracturing. To “produce” this freshwater source, impoundments are built to capture a part of the runoff that occurs during rainfall events. The terrain where these shale gas exploration and extraction activities are taking place in Arkansas is fairly rugged and very sparsely populated. Little infrastructure is available to move equipment from site to site, and no infrastructure is in place to transfer the developed gas to users. As such, the companies have had to build numerous gravel roads to access the job sites and pipelines to transfer the gas to users. These infrastructure projects, coupled with preparing the site with a 5 – 10 acre pad to hold the drilling equipment, have the potential to mobilize large amounts of sediment to nearby streams during rainfall events. Currently, the USGS Arkansas Water Science Center has installed streamflow gaging stations and continuous water-quality monitors and is sampling streams in the area for sediment concentration to examine the potential sediment runoff and water-use effects on streams. Data from these monitoring activities are also being used by the USGS to compile a watershed model to simulate the possible effects on a major public water-supply stream that is located in the middle of the shale gas exploration and extraction activities. The results of this model will be used by numerous agencies, including the USGS, to assess the cumulative effects of construction of well pads, gravel roads, and impoundments on surface water in north-central Arkansas.

Biography

Currently, I am in charge of the USGS streamgaging program and water-quality program in Arkansas. I currently serve as the Arkansas Water Science Center's Assistant Director and Chief of the Hydrologic and Surveillance and Analysis Program (Data Chief). I also serve on the USGS National StreamStats Advisory Committee and serve as the Flood Specialist for the Arkansas Water Science Center and I am the President of the Arkansas Section of the American Society of Civil Engineers. I have worked for the USGS Arkansas Water Science Center since 1993. I started my career as a student where I was assigned several streamgaging and water quality field trips and since then have conducted numerous complex surface-water investigations on streams in Arkansas including studying and analyzing time-of-travel of streams in Arkansas, multi-dimensional flow models, flood

frequency analyses, water-quality investigations and regional low-flow regression studies for streams in the State of Arkansas. Since 2010, I have been the main USGS point of contact with State, Federal and local agencies, as well as the industry, concerning water resources in the Fayetteville Shale area in Arkansas where natural gas development is occurring.

Gary M. Hanson

Abstract

Water Resource Management in Shale Oil and Gas Plays: Finding Common Ground through Institution Building and Adaptive Management Approaches

As oil and shale gas development spreads across the U.S. and internationally, a proven model for water management has been developed that is based on utilizing sound science to establish water resource needs and availability, but just as important has been the establishment of pragmatic and sustainable venues where local, state and federal agencies are brought together with industry operators to establish adaptive approaches and, if need be, new legislation (Louisiana) to plan for and implement fair utilization of regional surface and groundwater resources. These shale booms typically overwhelm local and state agencies and/or the public tends to react strongly due to lack of knowledge of industry practices and development scenarios. The petroleum industry is highly competitive, just like most industries. However, their competition tends to be played out in the arena of the natural environment, in some cases where people live, and recreate. Water resources needed for these plays are significant, but not necessarily excessive. Many water related factors such as climate, hydrology, suburbia and water use by other industries, agriculture, municipalities and rural communities have driven backlash by the public in some areas of the country. Historically, drilling wells to supply water for drilling and stimulation has been seen as an appropriate source by industry and the local public. Resistance to the use of hydraulic fracturing, with claims that it will negatively impact drinking water supplies has reached the level of hysteria in some areas. What are the facts? Involvement in congressionally driven studies will be reviewed.

Biography

Gary Hanson is Director of the Red River Watershed Institute LSU Shreveport, Resident Hydrologist and holds the Don and Earlene Coleman Professorship. B.S Geology Louisiana Tech University, M.S. Earth Sciences University of New Hampshire and post-graduate studies University of Arkansas, Environmental Dynamics Program. He chairs the Water Resources Committee of Northwest Louisiana, co-chairs Water Energy Working Group (Haynesville Shale), member Louisiana Ground Water Management Advisory Task Force and subject matter expert Haynesville Shale Task Force (Governor's Office of Homeland Security and Emergency Preparedness). Served as expert member of Water Research Foundation Hydraulic Fracturing Workshop and Theme Lead "Water Use and Sustainability" EPA Hydraulic Fracturing Study Water Management Workshop. He has extensive industry experience (environmental and petroleum) and brought regional, state and federal stakeholders together with industry to solve water related issues in Louisiana. Professor Hanson is a sought after regional and national speaker on water resource management and energy issues.

Jimmy Hart

Abstract

Environmental and Economic Effects to Counties

Biography

A lifelong resident of Conway County, Jimmy Hart resides in Springfield, Arkansas with his wife of 33 years, the former Nancy Davidson. They have four children, three sons and a daughter. He graduated from Morrilton High School in 1976 and has a background in running the private family dairy farm operation for 25 years. It was started by his grandparents in 1949 and is now a fourth-generation dairy operation.

In 1991, Hart was instrumental in developing an Arkansas based dairy marketing cooperative. He has served as a past board member of:

- Dairy Max, a five state regional advertising and promotion agency for dairy farmers
- Conway County Agriculture Stabilization and Conservation Service
- Conway County Farm Bureau
- Arkansas Dairy Cooperative Association: V.Pres, Secretary,and Finance Committee

In November of 2000, Jimmy Hart was elected Conway County Judge and began in January 2001 learning how best to serve the people of his county. He is currently serving as a member of:

- Conway County Economic Development Corporation
- Past Chairman of West Central Arkansas Planning and Development District, Inc.
- West River Valley Regional Solid Waste Management District
- County Judge's Association: 1st Vice President
- CEO elected official of Local West Central Arkansas Workforce Investment Board
- Ex Offico of Morrilton Area Chamber of Commerce Board
- Universal Housing Executive Board
- Kiwanis Club of Morrilton Member

Immediately after being elected for his first political term, he initiated a very aggressive program to clean up his county. With the cooperation and assistance of the incorporated cities, county fire departments and community volunteers, Conway County is beginning to see a Conway County Pride developing.

Hart has announced and validated his intentions to serve Conway County for a seventh political term as Conway County Judge.

Rheannon Hart

Abstract

Determining the Effects of Gas-Well Activities on a Drinking-Water Source in Central Arkansas

Brewer Lake, an impoundment of Cypress Creek located in central Arkansas, is the source of drinking water for the city of Conway and the residents of Conway County. The Cypress Creek watershed is located within the Fayetteville Shale play and activities related to shale-gas exploration, including impounding small streams to form water-storage ponds, are occurring within the basin. Up to 6 million gallons of water are used in a typical gas-well drilling and hydraulic fracturing operation; these water-storage ponds provide the water needed for such operations. The water-supply ponds often are larger than 3 acres and may cumulatively attenuate streamflow downstream, possibly reducing high- and low-flow characteristics. In addition, these ponds likely act as sediment traps. To determine the effects of ponds on streamflow and sedimentation along Cypress Creek and into Brewer Lake, water-quality and streamflow data are being collected on Cypress Creek and Brewer Lake for use in a Hydrologic Simulation Program—FORTRAN (HSPF) watershed model that is being developed. Water-quality samples are being collected quarterly and during five storm events at the gaging station on Cypress Creek; streamflow and selected water-quality data are being collected continuously. Water-quality samples also are being collected quarterly and during one storm event at two locations on Brewer Lake. The watershed model will be calibrated to current conditions, and then a set of scenarios will be designed to simulate the effects of gas-well activities on Brewer Lake. These scenarios include, but are not limited to: (1) simulating the creation of a number of large water-supply ponds in the watershed, (2) simulating increasing the number of gas-well pads within the watershed, in turn affecting land use characteristics and potentially increasing impervious area, (3) simulating the creation of a number of large water-supply ponds and increasing the number of gas-well pads, and (4) simulating the conversion to 1949 land use conditions (prior to construction of most ponds in the watershed).

Biography

Rheannon M. Hart is a hydrologist for the U.S. Geological Survey Arkansas Water Science Center. Rheannon holds a Bachelor of Science and a Master of Science in Geology from the University of Arkansas at Little Rock. Since joining the USGS in 2001, Rheannon has been involved in collecting water levels and creating potentiometric surfaces; characterizing the local recharge area of a spring that is habitat to the endangered Hell Creek Cave crayfish; developing the hydrogeologic framework for the Mississippi embayment aquifer system for use in the Mississippi Embayment Regional Aquifer Study (MERAS) groundwater flow model; simulating climate change scenarios using the MERAS model based on future projections of precipitation and temperature; developing a Hydrologic Simulation Fortran Program (HSPF) model of Little Rock's drinking water supply watershed; and developing a HSPF model of Conway's drinking water supply watershed.

Work Experience:
February 2007 - present, Hydrologist, U.S. Geological Survey, Little Rock, Arkansas
Develop HSPF model of Conway's drinking water supply watershed
Develop HSPF model of Little Rock's drinking water supply watershed
Develop hydrogeologic framework of Mississippi Embayment Regional Aquifer Study (MERAS) groundwater flow model
January 2001 - February 2007, SCEP Hydrologist, U.S. Geological Survey, Little Rock, Arkansas
Analyzed spring discharge data and stable and radioactive isotopes to determine local recharge area
Analyzed spring water-quality data and water-quality parameters to determine geologic origin
Used flourescent dye trace data to determine spring-water source and recharge characteristics
Developed potentiometric surfaces for the Tokio and Nacatoch aquifers in Arkansas

Publications:
Clark, B.R., Hart, R.M., and Gurdak, J.J., 2011, Groundwater availability of the Mississippi embayment: U.S. Geological Survey Professional Paper 1785, 62 p.

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Nicki Jensen

Abstract

Macroinvertebrate Communties along a Gradient of Gas Well Densities in North-Central Arkansas

Access to natural gas has increased in the Fayetteville shale play, resulting in 8,000km2 of land developed for natural gas extraction in north central Arkansas. Few studies have addressed the effects of drilling associated with shale development on aquatic macroinvertebrates. A potential effect to surface water quality is increased turbidity from sediment runoff that could alter macroinvertebrate communities. Macroinvertebrates were collected from 10 stream drainages within the Fayetteville shale, representing a gradient of gas well densities in the catchments. Results from multiple linear regressions concluded that macroinvertebrate density and biomass variables were not related to natural gas activities in 2010, but the proportion of taxa (range 0.03-0.06; R2=0.49, p=0.03) that complete their lifecycle in one year was negatively related to gas well density. In 2011, the average macroinvertebrate biomass (362-3,651 mg/m2; R2=0.58, p=0.01) was negatively related to gas well density within the stream drainage. Natural gas drilling in north central Arkansas is projected to continue and this study can be used to inform can inform management of natural resources.

Biography

Nicki Jensen received her B.S. in Biology from the University of Arkansas at Fayetteville in 2009 and a Master's degree in Biology from University of Central Arkansas in spring of 2010. The focus of her thesis was effects of multiple land uses on macroinvertebrates in north-central Arkansas. She is currently employed at GBMc & Associates.

Steven W. Johnson

Abstract

ADEQ's Oil & Gas Program Regulatory Responsibilities as Related to Natural Gas Production in the Fayetteville Shale Play Area

As natural gas activities in the Fayetteville Shale Play Area began to boom, the Arkansas Department of Environmental Quality Water Division inspectors were eventually overwhelmed by an increasing number of complaints concerning water quality issues related to drilling and production activities. At this time, reserve pit authorizations were being issued in lieu of reserve pit permits. As natural gas exploration and production rapidly escalated, the need for an efficient and effective means for permitting and regulating reserve pits on natural gas drilling sites became evident. In 2008, reserve pit permits were utilized to better permit and regulate environmental concerns associated with natural gas drilling in Arkansas. Nonetheless, the limited number of Water Division Inspectors was unable to routinely inspect natural gas sites in additional to their normal duties and conducted investigations primarily in response to complaints only. Then in 2010, the Department received funds that enabled the hiring of Inspectors specifically for the purpose of inspecting natural gas sites in the Fayetteville Shale Play Area. The additional Water Division staff allowed for more frequent and routine inspection of these sites instead of reactionary response to complaints. As inspection frequency increased, the compliance rates improved. The new inspectors are monitoring compliance and performing inspections on drilling pads and lease roads, gathering line projects, well injection sites and land application sites as well as monthly water route sampling and responding to complaints, emergency responses and performing occasional water quality investigations.

Biography

I am a native Arkansan having been born in Heber Springs and residing in the Natural State for the majority of my life. I have lived and worked in Mountain Home, Northwest Arkansas, and Little Rock metropolitan area and lived and worked for a few years in the Florida Keys. I received a Bachelor of Science Degree in Physical Science from the University of Central Arkansas with degree hours in Biology.

I have enjoyed employment for more than 20 years as an environmental compliance professional, working exclusively for state governmental agencies. My career in environmental protection began while working in the environmental health protection field with the Arkansas Department of Health as the Sanitarian for Baxter County. I then accepted a position with the Arkansas Department of Environmental Quality in the Regulated Storage Tank Division working out of the Springdale field office. Eight years of my career were spent working in the Florida Keys for the Florida Department of Environmental Protection. I was employed as an Environmental Manager for the FDEP

Water Division and served as the Technical Director for the NELAC laboratory in the Marathon Office. In October 2010, I returned to Arkansas to accept the ADEQ Oil and Gas Inspector Supervisor position where I am presently employed. I currently oversee the Oil and Natural Gas Section inspection program as well as supervise the Water Division Inspectors for the north ½ of the State. This duty consists of supervising the activities of 15 Inspectors in field offices, as well as in our central office in North Little Rock.

Steven W. Johnson
Arkansas Department of Environmental Quality
North Districts Water Division Inspector Supervisor
Oil and Gas Section Inspector Supervisor

Julie Kelso

Abstract

Differences in Macroinvertebrate Communities in Intermittent and Perennial Streams within the Fayettville Shale

Increased urbanization and surface water withdrawals have altered the natural flow regime in headwater streams, causing increased stream drying, local extinctions, and declines in water quality. The hydrology of perennial streams may become more similar to that of intermittent streams as a result of increased stream drying and flow variability. We predicted that the macroinvertebrate community of intermittent streams would have a greater proportion of taxa with drought resistant traits than the perennial macroinvertebrate community. We quantified the density of macroinvertebrates with traits such as size at maturity, dispersal abilities, maximum crawling rate, desiccation resistance, and rheophily in perennial and intermittent streams in the South Fork Little Red River watershed. We will show how drought-tolerant traits facilitate the macroinvertebrate community's persistence during and after stream drying. Scientists and managers can use intermittent streams to understand how stream biota will respond to projected changes in flow regime and increased drought.

Biography

Julie Kelso is a Master's student at the University of Central Arkansas. She has been working with Sally Entrekin and collaborators at University Arkansas Fayetteville on monitoring the effects of natural gas drilling on stream biota since fall 2010. Her research explores the ability of macroinvertebrates to survive stream drying.

John A Kind

Abstract

Evaluating "Action" Levels for Methane in Ground Water – What "Action" Should be taken?

On a volume basis, methane comprises approximately 95% to 99% of the volume of natural gas from the Fayetteville shale. Sources of methane in the subsurface may be petrogenic, biogenic, or a mixture of both sources. Due to increased concerns over hydraulic fracturing in natural gas production, States have begun adopting regulations that require evaluation of the methane concentration of well water. In some cases, these concentrations may be lower than the limit of methane solubility in water (7 mg/L, State of Pennsylvania). We question the value of setting "action" levels for methane in water on the basis of its possible flammability or human health effects. We will model methane concentrations released from water during various uses (showering, dishwashing, and others) into indoor air using USEPA and other models. Modeled concentrations will be compared to levels of concern for methane in air. Using these data, we will examine the relevance and value of determining methane concentrations in groundwater as an indicator of concern for the generation of methane in the subsurface environment.

Biography

Dr. Kind is the Director of Toxicology at CTEH. He has been involved in assessing potential health impacts from oil and gas exploration and production at many locations across the country.

Dr. Nye is one of the founding partners at CTEH. He is a nationally recognized expert in human health risk assessment and has over 20 years experience in the field. Dr. Nye has special expertise in assessing the risks associated with exposure to petroleum hydrocarbons.

John Kind Ph.D.
Senior Toxicologist
Director of Toxicology
Center for Toxicology and Environmental Health
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North Little Rock Arkansas 72223
www.cteh.com<http://www.cteh.com/>

Tim Kresse

Abstract

Assessing Potential Water-Quality Effects on Shallow Groundwater from Unconventional Gas Production in the Fayetteville Shale in Arkansas

The Fayetteville Shale of late Mississippian age is an active source of unconventional natural gas production in north-central Arkansas. The drilling footprint for this gas production occupies a surface area of approximately 3,000 square miles, and over 4,300 gas wells have been drilled to date in the Fayetteville Shale. The gas-producing zone resides in the lower section of the Fayetteville Shale and ranges in thickness from 50 to 300 feet. Production wells can range in depth across the footprint from 1,500 to 6,500 feet, with average depths ranging from 2,500 to 3,500 feet. News articles and non-reviewed publications have documented known and potential environmental problems related to degradation of surface and groundwater quality. Documented environmental problems normally are found at the surface and include inadequate sediment-control practices, leaking water pipes, and overflowing holding ponds.

Shallow groundwater in this area of the State occurs in fractured bedrock of Pennsylvanian-aged sandstone and shale formations. Numerous households in the area rely on shallow groundwater as a source of domestic supply; for some areas, no other water source is available. Depths of domestic wells range from approximately 50 to 300 feet, with an average of approximately 100 feet. Concerns have been raised by local residents in the Fayetteville Shale production area about the potential threat of hydraulic fracturing to the quality and quantity of domestic well-water supplies, and claims have been made related to problems with production, turbidity, taste, and overall degradation of the quality of water from individual domestic water wells. The USGS has been working in cooperation with counties, State and Federal agencies, private entities, and Duke University to assess shallow groundwater quality in more than 150 wells in the Fayetteville Shale production area. Analyses include major ion and trace metal chemistry, oxygen, hydrogen, and strontium isotopes, and methane gas. All analyses to date are within the range of concentrations listed for historic samples taken previous to 1983 in the area, and methane concentrations were less than 4 mg/L with isotopic analysis suggesting a shallow biogenic source, as opposed to a deeper thermogenic source of methane.

Biography

Tim Kresse has over 25 years experience in conducting groundwater-related investigations. His career began in the consulting area, managing groundwater contamination and remediation projects under various EPA regulatory programs. He spent 15 years with the Arkansas Department of Environmental Quality, where he managed the Groundwater Protection Program; responsibilities which included statewide ambient monitoring,

contaminant investigations, and special research programs (including impacts from confined animal operations, source and distribution of pesticides, saltwater intrusion, and was the first to document source and distribution of arsenic contamination in the Mississippi River Valley alluvial aquifer). Currently, Mr. Kresse is Water Quality Specialist with the USGS Arkansas Water Science Center, where he assists in various water-quality programs across all disciplines, but also continues his work in the groundwater arena. He has authored or co-authored greater than 50 reports and publications.

Timothy M Kresse
Water Quality Specialist
U.S. Geological Survey
Arkansas Water Science Center
401 Hardin Road
Little Rock Arkansas 72211

Bob Launhardt

Abstract

Hydraulic Fracture-Height Growth: Real Data

Much public discourse has taken place regarding hydraulic-fracture growth in unconventional reservoirs and whether fractures could potentially grow up to the surface and create communication pathways for frac fluids or produced hydrocarbons to pollute groundwater supplies. Real fracture-growth data mapped during thousands of fracturing treatments in unconventional reservoirs are presented along with the reported aquifer depths in the vicinity of the fractured wells. Basic Microseismic Measurement theory is described to aid in understanding how the data is collected.

Biography

Bob Launhardt is the Business Development Manager for Pinnacle, a Halliburton Service in Oklahoma City. Bob has spent 32 years in the Oil & Gas services business; the majority of this time with Halliburton. Bob graduated from Pacific Lutheran University with a BS in Engineering-Physics in 1980. He spent the first 3 years of his Oilfield Services career as a Wireline Logging Engineer with Schlumberger and then joined Halliburton (Welex) in their Wireline Product Line in 1983. Bob held various staff, sales, and Management positions within Halliburton until he left to open a business development office for Pinnacle in 2007. Bob continued with his responsibilities at Pinnacle after the company was acquired by Halliburton in 2008. Bob is a member of Society of Petroleum Engineers.

Bob Launhardt
BD Manager - Pinnacle Midcon
Pinnacle - a Halliburton Service

Douglas Melton

Abstract

Methane Gas Unassociated with Petroleum Industry Operations in Searcy County, Arkansas
A reconnaissance study of north-central Arkansas has identified the presence of methane gas in groundwater wells in southern Searcy County, Arkansas. There is a lack of records or documentation of methane gas that is unassociated with petroleum exploration and production operations and most of the existing information is anecdotal. The study area is significant in that the methane has been present and publicized since the 1960's and because it is nearly 20-miles from the nearest exploration and production activities associated with the ongoing Fayetteville Shale development program. Several wells and springs have been identified as containing methane, hydrogen sulfide and other naturally occurring contaminants that present obstacles to the development of area aquifers as sources of drinking water. Carbon isotope values when compared with ground surface to Fayetteville Shale profiles indicate that the methane is decidedly biogenic in origin. The presence of this accumulation of methane appears to be controlled by regional geologic features and these interpreted geologic controls could be useful in delineating areas of water quality concern across northern Arkansas and in delineating areas of methane unrelated to petroleum industry operations.

Biography

Doug Melton is Manager of Special Projects with Southwestern Energy in Conway, Arkansas and leads the Strategic Solutions team in providing engineering and geologic resolutions to corporate issues across the Southwestern Energy operating area. Doug is a registered engineer and geologist in the United States and Canada and holds a Bachelor and Masters degree in Geology and a Bachelors degree in Civil Engineering. He has previously held positions with Southwestern as Arkoma Geologic Operations Manager and Arkoma Asset Team Manager.

Roger Miller

Abstract

Groundwater Data in the Fayetteville Shale Gas Play

A new ADEQ ambient groundwater monitoring area was established in the Fayetteville Shale gas play in 2010 and 2011 using 74 wells and springs along 3 transects transverse to the geology. Samples for general chemistry parameters (major ions, nutrients, TOC, and trace metals) were collected during the dry season and repeated the following spring to assess seasonal variability. VOC analyses were also included during the second round. The various goundwater types identified during the study will be examined in comparison to a previous groundwater assessment of the area and in relation to well construction factors, formation lithology, and structural and topographic controls.

Biography

Mr. Miller completed a Bachelor of Science in Geology and a year of graduate studies in geohydrology and geochemistry at the University of Arkansas, Fayetteville. He oversees the Ambient Groundwater Monitoring program at ADEQ and funding assistance shared with other state-run groundwater protection programs. Previously he was Geology Supervisor in the AR Dept. of Health's Public Water Supply Program, coordinating Source Water Assessment and Wellhead Protection program tasks including well capture zone calculations, specifications for sanitary construction of Public Supply wells, and GIS analyses and database management. In the private sector, he held technical and supervisory positions on mineral exploration projects in the US, Canada, and Australia, and on RCRA and Superfund projects at various industrial sites and defense installations, after which he was an environmental project manager for an engineering and geological consulting firm with offices in the eastern states.

Wayne Miller

Abstract

State and Local Government Benefits and Costs from Natural Gas Extraction

The natural gas industry in Arkansas has grown from only a few wells in 2004 to approximately 3,800 wells and production of over 900 million MCF in 2010. This increased production has brought benefits in the form of increased employment, income, value added for state and local economies and additional tax revenue for state and local governments. While these benefits may be large, there are challenges and costs associated with this production. To identify some of these costs and challenges and how communities had dealt with these challenges, a survey was conducted of community leaders in natural gas producing regions of Arkansas, Oklahoma and Texas. This presentation will compare some of the actual benefits and costs with prior projections. Also, the findings of the survey of community leaders will be presented which identify some strategies that have been used to generate revenue and minimize costs associated with natural gas extraction.

Biography

Dr. Miller is an agricultural economics professor with the Community and Economic Development program and the Department of Agricultural Economics and Agribusiness, UA Division of Agriculture.

He obtained his graduate degree in natural resource economics and has international experience in agriculture, public policy and natural resource issues. He has worked in Arkansas on public policy and economic development issues for the past 22 years. His work entails developing educational programs and conducting research on economic development, public finance and natural resource issues.

Anna Nottmeier

Abstract

Groundwater Quality Assessment in the Central Arkansas Area Overlaying the Fayetteville Shale Gas Play

The purpose of this study is to establish a spatially distributed data set for domestic water wells throughout the Fayetteville Shale Gas Play (FSGP) in central Arkansas, defining background groundwater-quality across this geologically heterogeneous area. Residents in central Arkansas have expressed concerns about the potential impact the extensive development and extraction of natural gas may have on their well water quality. Complaints over the FSGP, some water well owners, allege that their well water quality has already been negatively impacted. Due to a paucity of data and information on domestic water quality in central Arkansas, an up-to-date spatial groundwater-quality analysis was conducted through the extent of the Fayetteville Shale Gas Play (FSGP).

Water samples from approximately 100 wells were collected across six counties. Wells in this area withdraw water from freshwater aquifers within relatively shallow geologic units (0-300ft) that are not laterally extensive. The aquifers are comprised of fractured sandstones, siltstones, limestones, shales, karstic limestone, and dolomite aquifers. Aquifers in this region are plagued with extreme variable yields and poor water quality, often associated with the local geology. Water quality is impacted by elevated Iron (Fe), Manganese (Mn), total dissolved solids (TDS), and Sulfate (SO4),among others. Comparison of geology and water-quality data shows a distinct relationship between groundwater-quality and the geology of the region. The data will help to address concerns by providing a water quality basis to which complaints can be compared and resolved.

Biography

Anna Nottmeier has received two Bachelors degrees, geology and earth science, from the University of Arkansas, where she is currently a graduate research assistant pursuing a Masters in geology. She has conducted research in central Arkansas looking at water quality in domestic water wells, environmental site assessments for the Santee Sioux Nation in Nebraska, and has assisted in the instruction of undergraduate students in a variety of field techniques and the regional aspects of the geology in Western Montana. Her expected graduation is May 2012.

Michael Overbay

Abstract

Environmental Issues & Shale Plays in the South Central US

The development of unconventional shale resources has exploded in the last ten years, and along with it, many environmental issues have been raised by members of nearby communities. This presentation will offer information on topics such as water use, air emissions, impacts to surface and ground waters, seismicity, and other national issues of interest.

Biography

Michael Overbay is a geologist who has been employed by the U.S. Environmental Protection Agency since 1987. His experience has included two decades of experience at investigating soil and ground water contamination sites; developing technical guidance and policy documents; and providing technical assistance and training on ground water issues. In early 2010, he was asked to serve on the steering committee for the development of EPA's national study of potential impacts of hydraulic fracturing on water resources. He was subsequently asked to provide technical support for the implementation phase of the study, which is ongoing. Prior to joining EPA, Mr. Overbay worked for two years with an independent oil and gas production company in Ft. Worth.

Michael Overbay, P.G.
Regional Ground Water Center Coordinator
U.S. Environmental Protection Agency - Region 6

Preston Scroggin

Abstract

Environmental and Economic Effects to Counties

Biography

Preston Scroggin
I have been actively involved in public service and my community since 1992.

Educational
Bachelor of Science – Political Science and Economics at the University of Central Arkansas

City/County/State
Conway Development Corporation – Member
Conway Chamber of Commerce – Member
Vice President – Faulkner County Council on Aging
State Representative – 2001-2006
As a Representative I served on the following committees:

- Public Transportation
- Revenue and Taxation
- Joint Budget
- Legislative Audit
- Legislative Council
- Joint Performance Review
- Forestry
- Economic Development
- Agriculture

Faulkner County conservation District, Board of Directors
Independent Living Services, Board of Directors
Faulkner County Senior Citizens, Board of Directors
Fire and Rescue Officer – Faulkner County Office of Emergency Management Member
Recipient of the Jack B. Evans Regional Leadership Award – Metroplan, 2003
Faulkner County Farm Family of the Year – 1998
Vilonia Volunteer Fire Department, member/Secretary since 1992
Vilonia City Council Member – 4 yers
Faulkner County Judge – 2007 to present

Page Shurgar

Abstract

Stream Mitigation in the Fayetteville Shale Play

An overview of six stream restoration projects developed for compensatory mitigation to offset unavoidable impacts in the Fayetteville Shale Play is presented. Over 48,000 linear feet of streams and approximately 12 acres of wetlands are being restored and protected in perpetuity following mitigation guidelines developed by USACE and the EPA. Following geomorphic survey and design, restoration activities range from complete channel reconstruction to bank stabilization along an Extraordinary Resource Water. Vegetation management activities include baseline monitoring, prescribed burning and planting of over 150,000 native trees and shrub seedlings. All sites are monitored and maintained using adaptive management techniques.

Biography

Page Shurgar, co-owner and managing partner of Streamworks Mitigation Services, LLC, has been working for the environment for over 20 years, specializing in stream restoration. She received her Master's Degree from the University of AR in Biological and Agricultural Engineering and her BS in Natural Resources from the University of the South in Sewanee, TN. She is a founding member of the Kings River Watershed Partnership and serves on their Board of Directors. Upon return from an assignment as an agroforestry extension agent for the US Peace Corps in West Africa, she worked at the Nature Conservancy in both the Little Rock Field Office and the Ozark Highlands Office.

Page Shurgar
Streamworks Mitigation Services, LLC

Tim Snell

Abstract

Implementing Projects to Improve In-Stream Habitat and Water Quality in the Upper Little Red River Watershed

Since 2008, The Nature Conservancy (TNC) has partnered with private landowners and corporations, as well as local, state, and federal agencies to fund, design and implement on-the-ground projects to improve in-stream habitat and water quality for rare and endangered aquatic species in the upper Little Red River (ULRR) watershed. Implemented projects have included streambank stabilizations, unpaved road maintenance best management practices (BMPs), and reclamation of excessively-eroding roads. TNC recently completed an inventory and assessment of public unpaved roads in the ULRR to identify and prioritize sediment sources. TNC has also conducted three unpaved road BMP workshops targeting public road managers, private landowners, foresters, and gas companies and contractors to share some of the best available practices for improving road conditions and water quality of nearby streams. Moving forward, TNC is continuing to work with a range of partners in the ULRR to implement both in-stream and unpaved road projects. TNC is initiating a major stream restoration project in the city of Clinton along the Archey and South Forks. TNC will soon be implementing unpaved road BMPs at Gulf Mountain WMA to help minimize the impacts of heavy haul traffic during gas development.

Biography

Tim Snell is Associate State Director for Water Resources with The Nature Conservancy in Arkansas. His responsibilities include TNC's Water Resources Initiative, which develops strategies to protect the state’s aquatic habitats. He founded TNC's Ozark Highlands office in Fayetteville in 1998, and oversees the Ozark Karst and Rivers conservation programs at that location. Tim served TNC as director of Ozark conservation and karst programs before moving into his current position in 2008. Tim also serves on the boards of the Illinois River Watershed Partnership and the Northwest Arkansas Land Trust. Tim previously worked at the Kerr Center for Sustainable Agriculture in Poteau, Okla. He has served as president of the Rural Opportunity Fund, a revolving loan fund for farmers and agricultural businesses. Tim graduated from Louisiana State University’s school of forestry, wildlife and fisheries.

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Chris Soller

Abstract

Permitting and Tracking Non-Riparian Water Usage in the Fayetteville Shale

The Arkansas Natural Resource Commission is required to track and permit all non-riparian water usage in the state. This includes the fresh water used in the Fayetteville Shale play area. Through consistent steps the Commission reviews all applications and determines the amount of water that can be issued for non-riparian use. This includes tracking the volume used and insuring that the users stay in compliance by insisting they follow strict BMPs to help protect and maintain the environment.

Biography

Chris Soller is a professional engineer at the Arkansas Natural Resource Commission. He is currently leading the non-riparian water usage program at the commission. In addition to his role in the non-riparian program, he also monitors the state's compliance in multi-state compacts including the Arkansas River Compact and Red River Compact.

Loren Stearman

Abstract

Headwater Stream Fishes of the Fayetteville Shale

Natural gas extraction (NGE) related activities have the potential to be detrimental to headwater stream fish assemblages. The Fayetteville Shale encompasses geomorphologically variable headwater streams in several drainage basins. We conducted a two-year survey of 21 sites located throughout the Fayetteville Shale to determine both fish assemblage structure and factors that may influence structure. We sampled fishes quantitatively from multiple sub-plots per stream. We analyzed assemblage structure for each year using Nonmetric Multidimensional Scaling (NMS) ordination. In both years, NMS resolved a three axis solution, with the dominant axis relating strongly to catchment area, and subsequent axes relating to stream gradient and drainage basin endemic species (White River and Arkansas River). Stream size, stream gradient and drainage basin all appear to be related to assemblage structure in the Fayetteville Shale region. To assess potential impacts of NGE activities on stream fishes, we focused on the Redfin Darter (*Etheostoma whipplei*). The range of this species coincides largely with natural gas plays and aspects of its life history suggest spawning activities coincide with high water from spring rains and potential run-off from construction activities. We tested the hypothesis that recruitment would be lower in streams with higher amounts of NGE activities in their catchments using population structure data from the assemblage analysis. Spearman's rank correlation analysis revealed a strong negative relationship between the proportion of young fishes in a population and the density of gas wells in a stream's catchment, suggesting reproductive success may relate to NGE activity intensity.

Biography

Loren is an ecologist and student at the University of Central Arkansas in Conway. Though his research interests are broad and include evolutionary ecology, disturbance ecology, and life history patterns in small stream fishes; his current work has focused on two main topics: patterns in fish assemblages in central Arkansas, and the biology and ecology of the redfin darter. He enjoys few things more than teaching people about small stream ecosystems.

Edward Swaim

Abstract

Updating the State's Water Plan

Mr. Swaim will give a presentation on the introduction to the Arkansas Water Plan comprehensive update. The Plan, last updated in 1989, is Arkansas's comprehensive plan for the orderly development and management of the state's water and related land resources. Outcomes of the update will include detailed inventories of our surface and ground water and water infrastructure; a public outreach and education program; and public involvement to identify, assess, and recommend solutions (including draft legislation) to water issues. By late 2014, an executive summary of the issues and recommendations will be presented to Governor Beebe and the Natural Resources Commission for rulemaking. We will continue the public involvement, planning, and implementation process well beyond 2014.

Biography

Edward Swaim serves as chief of the Water Resources Management Division of the Arkansas Natural Resources Commission, formerly the Soil and Water Conservation Commission. The commission is the state agency responsible for soil conservation, water rights (ground and surface), dam safety, flood control, water resource planning, interstate water compacts, and non-point source pollution prevention. The commission also provides financial assistance for the development of water, wastewater, and solid waste projects within Arkansas. Prior to taking his present assignment, Mr. Swaim served as general counsel and associate general counsel for the commission and as an assistant Attorney General. Mr. Swaim is from England, Arkansas and received a bachelor's degree from Hendrix College and a law degree from the University of Arkansas School of Law. He also served in the Army Reserve Judge Advocate General's Corps for ten years.

Elisha Wright-Kehner

Abstract

Maintaining State Highways In the Fayetteville Shale Area; Elisha Wright-Kehner, Arkansas State Highway and Transportation Department.

This presentation gives the results of the Arkansas State Highway and Transportation Department's evaluation of the pavement damage that has been occurring in the Fayetteville Shale Area. Performance data were collected on all routes in the area. Traffic counts, including truck percentages, that documents the increase in traffic are reported. Photographs of the damage occurring in the area and the maintenance being performed are shown. Finally, the maintenance costs to date and cost estimates for complete repair are given. The funds collected from the severance tax and funds from the maintenance assessment fees are shown and compared to the needed rehabilitation cost estimates.

Biography

Elisha Wright-Kehner is the Staff Research Engineer in the Planning and Research Division of the Arkansas State Highway and Transportation Department. She began her career at the Department in 2000 as a summer intern, and started full time in May of 2002. Ms. Wright-Kehner is a 2002 graduate of Arkansas State University with a B.S.E. in Civil Engineering and Agricultural Engineering. She is a registered Professional Engineer in the state of Arkansas.