Aquifer Management & Underground Injection
February 9-11, 2015
Austin, TX – Radisson Hotel & Suites Downtown
Register at www.gwpc.org

Sessions: Monday: 10:00a-5:00p & 5:30 Reception
Tuesday: 8:00a-5:00p
Wednesday: 8:00a-4:00p

Draft Preliminary Agenda – GWPC UIC Conference Austin, TX – Feb. 9-11, 2015 *(specifics subject to changes)*

Monday February 9, 2015			
10:00-5:00 – open *Riverside S* *Well Integrity Workshop Abstract* Spotlight series	12:30-3:00 – closed *Riverside N,W,E* *Induced Seismicity Working Group Meeting* SOGRE State Oil and Gas Regulatory Exchange	3:30-5:30 – closed *Riverside N,W,E* *FracFocus Working Group Meeting*	3:30-5:30 – closed *IPO Room* *UIC National Technical Workgroup*
5:45-7:00 *The 20th Annual GWPC UIC Conference Reception* *Mezzanine*			

Event Sponsors: *THANK YOU for caring about Groundwater*

Major Event Funding Provided by:

Tuesday, February 10, 2015		
8:00-10:00	*Evolution of the UIC Program -- Over 3 decades of a effective waste management and environmental protection* *Riverside S* **Leslie Savage** – GWPC President & Railroad Commission of Texas (Panel) **Dale Kohler** – Texas Commission on Environmental Quality (Moderator) **Bruce Kobelski** – USEPA Office of Ground Water and Drinking Water **Bob VanVoorhees** – Underground Injection Technology Council **John Veil**, Veil Environmental - New Information on Produced Water Volumes and Management Practices **Bill Rish**, Hull Risk Analysis Center - EVERYTHING OLD IS NEW AGAIN: 40 Years of Assessing Risks of Underground Injection of Waste *Abstract*	
10:00-	Break	
10:20- 12:20	*Induced Seismicity by Underground Injection* *Riverside S* **Glen Brown** - Continental Resources **Phillip Dellinger** – USEPA Region 6 Latest Developments in Best Practices and Mitigation Efforts for Induced Seismicity - **Ernest Majer** Lawrence Berkley National Laboratory *Abstract* A Proactive Approach to Induced Seismicity: Can the Oil and Gas Industry Manage Induced Seismicity and Work in Cooperation With the Regulatory Agencies? - **Thomas E. Tomastik**, and J. Daniel Arthur, ALL Consulting *Abstract* **Rick Simmers** – Ohio Oil Department of Natural Resources, Oil and Gas Division	
12:20-1:30	*The 20th Annual GWPC UIC Conference Luncheon* *Riverside N,W,E* **Peter Grevatt**, PhD, Director USEPA Director of Office of Groundwater & Drinking Water **Leslie Savage** – GWPC President & Railroad Commission of Texas	
Tuesday, February 10, 2015 (continued)		
1:40-3:40	*Oil & Natural Gas Water Management* *Riverside S* **Joe Lee**, PA DEP, O&G Division (moderator) Brine Disposal Reservoirs in the Appalachian Basin: Injection Performance and Geological Properties - **Joel Sminchak**, John Miller, and Neeraj Gupta. Battelle, Columbus, Ohio *Abstract* New Information on Produced Water Volumes and Management Practices - **John Veil**, Veil Environmental *Abstract* Shale Energy Produced Fluids Management and UIC Well Disposal Trends - **David Yoxtheimer**, Penn State University Class II Saltwater Disposal Wells in Ohio: Understanding the Avenue to Success - **J. Daniel Arthur**, Thomas E. Tomastik, and David Overstreet, ALL Consulting *Abstract* Dual Permitting of Class II and Class V Wells for the Injection of Drinking Water Treatment Residual Wastewaters - **Phil Dellinger**, EPA Region 6, **Tim Baker**, Oil and Gas Director, OK Corporation Commission, and **Saba Tahmassebi**, OK DEQ *Abstract*	
3:40-	Break	
4:00-6:00	*Riverside N,W* *State/EPA UIC Issues Roundtable* (State & EPA Only)	*IPO Room* *Industry Issues Roundtable*

Wednesday, February 11, 2015	
8:00-9:00	*Managed Aquifer Recharge* *Riverside S* Examples of Managed Aquifer Recharge in New Mexico - **Bob Marley**, Daniel B. Stephens & Associates, Inc. *Abstract*
9:00-9:40	*Aquifer Exemptions* *Riverside S* **Peter Grevatt**, PhD, Director USEPA Director of Office of Groundwater & Drinking Water to provide education and outreach regarding aquifer exemptions to the regions, states and the regulated community on the record of decision memo/document checklist that will be used by the regions to document aquifer exemption decisions.
9:40-10:00	**Bob VanVoorhees**, UITC to discuss the legal aspects/evolution of the Aquifer Exemption concept, including the origin/need for Aquifer Exemptions, the initial AE approvals as part of the program delegation process, the program modification process, and key definitions such as the evolution of USDW concept, current and future use, etc.
10:00-12:00	Panel discussion of various viewpoints/ perspectives on aquifer exemptions. - USEPA Region representative – **Kurt Hildebrandt**, USEPA Region 7 - State program with Class II delegation – **Leslie Savage**, Railroad Commission of Texas - State program with delegation for Classes (I, III, V, and VI) – **Dale Kohler**, TCEQ - Drinking water representative – **Fred Aus**, TX Rural Water Association - Class II Operator - TBA - Class III Operator – **Mark Pelizza**, Uranium Resources, Inc. - Environmental NGO - **Lynn Thorp**, Clean Water Action
12:00-1:20	Lunch on your own
1:20-4:00	*Oil and Natural Gas Environmental* *Riverside S* Quality and Age of Shallow Groundwater in the Bakken Formation Production Area, Williston Basin, Montana and North Dakota - **Peter McMahon**, USGS *Abstract* A Status Update on the Marcellus Shale Coalition Dissolved Methane Method Study – **Debby Yost**, Chesapeake Energy State Oil & Gas Regulations Designed to Protect Water Resources: Reflecting the Continuing Progress of States – **Mike Nickolaus**, GWPC Evaluating Key Sources of Groundwater Quality Variability in Residential Water Wells for Pre-Drill Sampling - **Stephen D. Richardson**, GSI Environmental, Inc. *Abstract* Regulatory Developments in Baseline Water Quality Testing and Monitoring – **Kate Konschnik**, Harvard Law Methane Occurrence and Water-Quality Characteristics Found in Groundwater of the Appalachian Basin – **Bert Smith**, Chesapeake Energy *Abstract* Smart-Monitoring to Address Risks of Unconventional Gas Development - **Jon Fennell**, Integrated Sustainability Consultants Ltd. *Abstract* RBDMS, FracFocus, The National Oil and Gas Gateway, Water Tracker, and the Wellfinder APP: Providing the tools to access information on oil, gas and UIC activities **Paul Jehn**, GWPC

Abstract

LIFE CYCLE WELLBORE INTEGRITY – DRILING, STIMULATION, PRODUCTION WORKSHOP

This course will focus on two critical components of wellbore integrity – CASING DESIGN and CEMENTING. Key aspects of casing design will be discussed so that course attendees will gain a firm understanding of why a good casing design is critical to ensure that the well retains its structural integrity throughout its life cycle. The importance of obtaining a good primary cement job also will be covered, including good cementing practices and evaluation utilizing current cement bond logging techniques – ultra sonic imaging tool (USIT), circumferential acoustic scanning tool (CAST) and segmented bond tool (SBT) – in addition to conventional CBL/VDL techniques.

Although the types of wells that will be covered are primarily oil and gas production and injection wells (water-flood, EOR, CO2 and WAG – water-alternating gas wells) the casing design and cementing principles are equally applicable to Class I and II disposal wells. Well integrity considerations for hydraulically fractured wells also will be covered. However, it is not a primary objective of this course to have attendees become experts in casing design and cementing, or in the interpretation of cement bond logging techniques. Rather, the objective is to enable them to have a strong and clear understanding of these two critical well integrity components

TOPICS COVERED

- Well Integrity – Definition and why Well Integrity is Important
- Basic Well Construction and Completion Principles
- Well Integrity – Barriers and Philosophy
- Well Integrity – Issues and Challenges
- Basic Casing Design Principles
- Casing Design Example Problems
- Casing Design Considerations for HP/HT, ERD and HF wells
- Casing Failure Examples: Multi-Stage HF wells
- Cementing and Squeeze Cementing
- Evaluation of Cement Job/Quality/Bond Logs
- Current CBL Techniques/USIT/CAST-V/SBT/Isolation Scanner
- Review of Macondo Blowout
- Wellbore/Mechanical Integrity Testing Methods
- Hydraulic Fracturing and Drinking Water Issues
- Selected Well Integrity Cases from Shale Reservoirs
- National and Regional/State Perspectives
- Q&As, Summary and wrap-up

ABOUT THE INSTRUCTOR

Talib Syed, P.E. holds a B-Tech (Chemical Engineering – Univ. of Madras, India) and an M.S. in Petroleum Engineering (Univ. of Oklahoma) and is a Registered Professional Petroleum Engineer in CO and WY and a member of SPE (since 1977) and AIME. He has more than 38 years of domestic and international experience in oil and gas production operations (both offshore and onshore) and in well integrity projects in some of the largest oilfields in the world (Saudi Arabia – Ghawar/Safaniya and Alaskan North Slope). His current areas of interest include well integrity projects, CO2 – EOR and CO2-GS, slurry fracture injection, and hydraulic fracturing of tight oil and gas reservoirs (drilling and completion).

PROFESSIONAL DEVELOPMENT HOURS CREDITS

A total of 8 hours of Profession Development Hours will be noted in a certificate that will be made available to each participant.

Abstract

EVERYTHING OLD IS NEW AGAIN: 40 Years of Assessing Risks of Underground Injection of Waste

William Rish Ph.D., Hull Risk Analysis Center

Dr. Rish directs the Hull Risk Analysis Center, a team of experts that apply science and communication skills to support risk-based decisions. In the late 1990's, Bill prepared a risk analysis that was included in USEPA's 2001 study of the risks associated with Class I underground injection wells He is currently serving as chair of the Marcellus Shale Coalition work group on hydraulic fracturing risks and as a member of the GWPC/SOGRE work group on induced seismicity. Bill earned his doctorate in Engineering and Public Policy from Carnegie-Mellon University.

Abstract

In 1974, responding to concerns about underground injection practices, EPA issued a policy statement asking for "strict control and clear demonstration that such wastes will not interfere with present or potential use of subsurface water supplies, contaminate interconnected surface waters or otherwise damage the environment." This presentation summarizes the past 40 years of assessments of risk associated with underground injection of waste. The latest new risk issues and perceptions are also discussed.

Abstract

Latest Developments in Best Practices and Mitigation Efforts for Induced Seismicity

Ernest Majer (LBNL); Stefan Wiemer (ETH); Austin Holland (OGS); Bill Foxall (LBNL); Katie Freeman (LBNL)

As more attention from both the public and private sector is being focused on induced seismicity, there is a need for a set of Protocols andbest practices. A critical element of any best practices is a mitigation procedure. It is clear that there is no universally accepted set of best practices that satisfies the public, the private sector, regulators or policy makers. Presented will be suggested fundamental elements of best practices based upon existing and developing best practices, and experiences to date in the energy industry. Examples of best practices, pros and cons to various approaches and examples from field application will be given. Emphasis will be placed on mitigation procedures such as improved stoplight methods.

Bio: Ernest Major

Ph.D., Geophysics, University of California at Berkeley

Employment: LBNL, Earth Sciences Division (1978- present)

Current Position: Senior advisor to the Director and Fundamental Program lead

High resolution seismic imaging (active and passive) for geothermal, petroleum, and gas reservoirs as well integration of geophysical methods. Examples are induced seismicity, hydrofracture monitoring, vertical seismic profiling (VSP,) single well seismic imaging and seismic stimulation of fluid flow and direct fluid imaging. Recent (15 years) activity has been in understanding the relation between induced seismicity and fluid injections in geothermal and oil and gas environments. The goal being to develop mitigation practices, protocols/best practices as well as a basic understanding of induced seismicity and permeability enhancement.

Abstract

A Proactive Approach to Induced Seismicity: Can the Oil and Gas Industry Manage Induced Seismicity and Work in Cooperation With the Regulatory Agencies?

Thomas E. Tomastik, Senior Geologist and Regulatory Specialist, ALL Consulting
and J. Daniel Arthur, P.E., SPEC, ALL Consulting

Allegations of induced seismicity associated with the oil and gas industry has become a national issue in the United States. Many states, including Arkansas, Kansas, Ohio, Oklahoma, and Texas, have developed or are developing regulations to address concerns regarding alleged induced seismicity related to oil and gas development. The main focus has been directed at Class II saltwater disposal operations (SWD). The term "induced seismicity" is defined as earthquake events associated with man-made activities such as: surface and underground mining, geothermal energy, oil and gas operations, dams and artificial lakes, underground nuclear tests, groundwater extraction, and underground injection. The first documented case of induced seismicity occurred at a dam/reservoir in Algeria in 1932. Seismic events associated with oil and gas activities and injection wells were well documented in the early 1960s in Colorado at the Rocky Mountain Arsenal and at the Rangely Oilfield. The United States Geological Survey (USGS) believes the rise in seismicity in the central and eastern United States since 2009 coincided with increased injection activities in Arkansas, Colorado, Ohio, Oklahoma, and Texas. The USGS believes induced seismicity related to the energy industry occurs when there is a change in pore pressure or a change in stress, or both, near faults that are stable, but under critical stress.

In response to the growing concerns of induced seismicity related to the oil and gas industry, two workgroups were formed to better understand seismicity related to SWDs, share data and experiences, and review case studies. The U.S. EPA UIC National Technical Work Group, which is comprised of U.S. EPA UIC staff from ten regions and headquarters and UIC regulators from six states, formed a subgroup in June of 2011 to initiate a study of Class II injection wells and induced seismicity. This report has been written, peer reviewed, and is awaiting final release by the U.S. EPA. The second workgroup, Induced Seismicity by Injection, was formed in early 2014 and this workgroup includes 13 states, oil and gas industry representatives, environmental groups, and the scientific community. Additional discussions within these work groups have centered on the development of a regulatory decision model and a traffic light system to address induced seismicity.

Since 2012, the Ohio Department of Natural Resources, Division of Oil and Gas Resources Management (DOGRM) has been proactively approaching the issue of induced seismicity associated with oil and gas development.. DOGRM is now monitoring in real-time 30 portable seismic stations (19 of their own and 11 managed by the oil and gas industry) and has access to the 53 USGS TA regional stations through the Earthworm system. ALL Consulting, LLC is also proactively approaching induced seismicity and is actively involved in seismic unit installation and monitoring for oil and gas clients in Ohio and in other oil and gas producing states.

Even though induced seismicity related to the oil and gas activity is rare, it is a nationwide issue and is not going away anytime soon. It is crucial for the oil and gas industry to approach induced seismicity proactively with sound science and work in cooperation with regulatory agencies to address the issue of induced seismicity.

Abstract

Brine Disposal Reservoirs in the Appalachian Basin: Injection Performance and Geological Properties

Joel Sminchak, John Miller, and Neeraj Gupta Battelle

Many different reservoirs are utilized for Class II brine disposal in the Appalachian Basin. Understanding the geology and injection well operational history of these zones may be used to support safe, reliable, and environmentally responsible brine disposal in the region. For the purposes of the research, the study area was defined as eastern Kentucky, Ohio, Pennsylvania, and West Virginia. Brine injection in the study area has increased from approximately 6-7 million barrels per year in the early 2000s to 17.6 million barrels in 2012, mostly due to shale gas activity. To define geologic properties of injection zones, 690 geophysical well logs from injection wells were analyzed. In addition, local-scale geocellular models were developed for several key injection zones. Operational data on injection rates and pressures were compiled for 2008-2012 for over 200 Class II brine disposal wells. Several Class II brine disposal wells were monitored with continuous wellhead pressure loggers to estimate reservoir permeability from pressure fall-off cycles. Geomechanical analysis was also completed to determine the potential for injection induce fracturing in the subsurface. Project results provide a catalog of injection rates for the various formations, which range from 100s of barrels per month to more than 100,000 barrels per month. Some reservoirs exhibit geologic boundaries which appear to limit long-term injection as reflected in operational data. Injection simulations suggest there is little potential for long-term migration of brine due to low permeability of the reservoirs and relatively minor contrast in density of formation and injection fluids. This project was supported by the Research Partnership to Secure Energy for America unconventional onshore program project #11122-73.

Joel Sminchak works in the Energy and Environment department at Battelle Memorial Research Institute. He has been active in research on hydrogeologic, engineering, regulatory, and risk issues associated with the deep-well injection for enhanced oil recovery, CO_2 storage, and brine disposal.

Abstract

New Information on Produced Water Volumes and Management Practices

John Veil – Veil Environmental, LLC

Abstract In 2009, Argonne National Laboratory published a report that estimated produced water volumes from all oil and gas wells in the United States during 2007 (21 billion bbl) and gave general trends on how the produced water was managed (nearly all onshore produced water is reinjected, and nearly all offshore produced water is treated and discharged). That report (Clark and Veil, 2009) has been cited thousands of times.

That information is now more than five years old. Since 2007, the U.S. oil and gas industry has changed dramatically with the rapid expansion of unconventional oil and gas production. Unconventional production was not a large percentage of total national production in 2007, whereas in 2012 unconventional production was considerably higher. The total volumes and changes over time in water production profiles are generally different for conventional wells and unconventional wells. Therefore, the data from 2012 may be different from data from 2007.

This presentation describes the approach used to collect data, the results of both the produced water generation volume estimate and how the produced water was managed in 2012, and the assumptions, caveats, estimation and extrapolation approaches used to fill gaps in the data.

John Veil is the President of Veil Environmental, LLC, which he founded upon his retirement from Argonne National Laboratory in 2011. Veil has published numerous reports on produced water and has lectured around the world on water and energy subjects. He holds degrees in Earth and Planetary Science, Zoology, and Civil Engineering. He is also an avid saltwater fisherman.

Abstract

Shale Energy Produced Fluids Management and UIC Well Disposal Trends

David Yoxtheimer, Penn State University

David Yoxtheimer, P.G. is a hydrogeologist and extension associate with Penn State University's *Marcellus Center for Outreach and Research* and serves as a liaison to advise stakeholders on key environmental issues. He earned his B.S. in Earth Science from Penn State, where he is currently completing his Ph.D. in Geosciences. Previous to joining MCOR he spent 18 years as a consulting hydrogeologist with expertise in water supply development, karst hydrogeology, geophysical surveying, environmental permitting, shale energy geology, and integrated water resource management.

Shale energy production in the United States has been increasing significantly over the last decade, especially from the Bakken (North Dakota), Marcellus (Pennsylvania/West Virginia), Utica (Ohio/Pennsylvania), Eagle Ford (Texas) and Niobrara Formations (Colorado). Although shale energy is a promising and abundant energy source, environmental challenges exist with its development, especially with management of produced brine fluids. Large volumes of produced brines are generated after a well has been hydraulically fractured, typically ranging from 5 to 10 barrels of brines per million cubic feet of gas or for each barrel of oil produced. Total dissolved solids (TDS) concentrations of produced brines from unconventional wells often exceed 100,000 mg/L, with elevated levels of strontium (Sr), bromide (Br), sodium (Na), calcium (Ca), barium (Ba), chloride (Cl), and radionuclides originating from the shale formation, as well as fracturing additives. Managing these produced brines requires environmentally-sound, long-term approaches for treatment, reuse or disposal. Recent data from Pennsylvania suggest nearly 90% of produced brines from shales were treated and reused for hydraulic fracturing operations using a variety of both in-field and centralized facility treatment and management techniques. The remaining Pennsylvania shale brines were disposed of primarily through use of Class II-D underground injection control (UIC) wells, most of which are located in Ohio and require significant and costly transport. Data indicate that produced brines from many other shale plays around the U.S. are primarily disposed of via UIC wells rather than recycled, mostly due to the availability and relatively low cost of using brine disposal wells in these regions. The recent drop in oil and gas prices may decrease drilling and fracturing activities in the U.S. in the short term and therefore reduce brine recycling initiatives thus resulting in increased use of brine disposal UIC wells. This presentation will explore the volumes of produced fluids generated from major shale energy plays and examine treatment and disposal practices including UIC well use and implications for future disposal reservoir capacity as shale energy production continues into the future.

Abstract

Class II Saltwater Disposal Wells in Ohio: Understanding the Avenue to Success

J. Daniel Arthur, P.E., SPEC, President, ALL Consulting;
Thomas E. Tomastik, Geologist, ALL Consulting; and David Overstreet, Vice-President, ALL Consulting

The rapid development of oil and natural gas resources from the Marcellus and Utica shales has led to a big demand for Class II disposal of oilfield fluid wastes in the Appalachian Basin. With the small number of Class II disposal wells and lack of primacy in Pennsylvania and New York and the limited number of commercial Class II disposal wells in West Virginia, only Ohio remains as being well suited to handle the increase in Class II saltwater disposal well activity in the Appalachian Basin area.

Ohio received primacy of its Class II program from U.S. EPA in 1983 and has seen a dramatic rise in Class II disposal well applications since 2010. Ohio currently has 237 Class II disposal wells permitted and has injected over 16,000,000 barrels through the third quarter of 2014, with most of the increase coming from the development of the Utica-Point Pleasant play in Ohio. Along with this big increase in disposal wells and injection volumes, Ohio has seen a renewed rise in environmental activism, has dealt with induced seismicity related to Class II injection, and has passed new regulations addressing well construction, injection well testing, and seismic monitoring.

The challenges facing injection well applicants and operators in Ohio can be overwhelming. These challenges include: Finding and locating open spaces for siting of injection wells; conducting title searches and addressing mineral rights issues; dealing with areas of dense population; addressing public and local political activists opposed to injection well development; finding adequate geologic formations for high capacity disposal operations; understanding proper well construction, cementing, and completion methodology; selecting the right option for surface facility development and pre-treatment programs; dealing with TENORM testing and solid waste disposal issues; and working with the regulatory agency on seismic unit installation and monitoring requirements.

Proper consideration of all of these challenges can lead to the successful permitting, drilling, construction, completion, and operation of a commercial Class II saltwater disposal facility in Ohio. ALL Consulting is actively engaged in assisting oil and gas clients in Ohio by understanding how to maneuver in the disposal well landscape and how to address these challenges. This presentation will explore the challenges faced by an Ohio applicant or operator and provide solutions to addressing the issues.

Abstract

Dual Permitting of Injection Wells

Saba Tahmassebi, Oklahoma DEQ
Tim Baker, Oklahoma Corporation Commission
Phil Dellinger, EPA Region 6

Oklahoma DEQ and Oklahoma Corporation Commission with cooperation from EPA Region 6 have developed a pathway for residual wastewaters from drinking water treatment operations to be disposed in Class II-D wells. Because of the drought, fresh water resources have become scarce and the flow of water in streams is low. Drinking water treatment facilities that treat surface water and/or groundwater are finding it more and more difficult to discharge the concentrated residual wastewater in streams and meeting the provisions of their discharge permits. Through an agreement between the two state agencies, existing Class II-D wells can now be dually permitted as Class V injection wells for the purpose of disposing these residual wastewaters. With this process in place, previously untapped sources of brackish groundwater may be developed for domestic use. This process will also provide relief to municipalities that are having difficulty meeting the provisions of their exiting discharge permits.

Tim Baker: Graduate of Kansas University in 1976, B.S. Geology. Following graduation Tim went to work for the Oklahoma Water Resources Board as a geologist. Tim spent most of his time working on ground water supplies and contamination problems. In 1979 Tim went to work for the Industrial and Solid Waste Division of the Oklahoma State Dept. of Health where he worked on Class I Industrial waste disposal wells and industrial waste disposal sites. In 1980 Tim went to work for the Oil and Gas Conservation Division of the Oklahoma Corporation Commission. During his tenure at the OCC Tim has worked as Manager of Field Operations, Manager of Technical Services, and Manager of Underground Injection Control (UIC). Since 1989 Tim held the position of Manager of Pollution Abatement, which oversees much of the environmental areas of jurisdiction of the Oil and Gas Conservation Division including the UIC Department and remediation of oil field sites. During his tenure as Manager of Pollution Abatement he has worked on various working groups with the Ground Water Protection

Council, the Interstate Oil and Gas Commission, and the Environmental Protection Agency. Tim became Director of the Oil and Gas Conservation Division July 1, 2014. In Oklahoma Tim has worked on state working groups concerning water supply, water quality, and environmental issues related to the Oil and Gas industry.

Saba Tahmassebi: Saba Tahmassebi is the Agency Chief Engineer for the Department of Environmental Quality. He has been with the DEQ for over 20 years and has served in several environmental programs in various capacities over the years. Saba has a BS in Chemical Engineering from the University of California at San Diego, an MS degree in Petroleum Engineering from USC and a Ph.D. in Petroleum Engineering form OU. He is a Certified Public Manager and teaches statistics and environmental science courses at the University of Phoenix.

Abstract

Implementation of Managed Aquifer Recharge Systems in New Mexico

Robert Marley, Senior Hydrogeologist
Daniel B. Stephens & Associates, Inc.

Bob Marley is a Senior Hydrogeologist at Daniel B. Stephens & Associates. He received his B.S. in Geology from Northern Arizona University and M.S. in Hydrology from the University of Arizona. His work focuses on development of alternate water sources, water reuse applications, and water treatment. His efforts include implementation of managed aquifer recharge (MAR) and aquifer storage and recovery (ASR) programs within New Mexico for Rio Rancho, Las Vegas (NM), U.S. Bureau of Reclamation, and the Albuquerque Bernalillo County Water Utility Authority.

New Mexico water providers have consistently identified managed aquifer recharge (MAR) as an important tool for conjunctive management of surface-water, groundwater, and reclaimed water sources. The overarching goals are to improve water supply reliability and long-term sustainability. Potential water sources available for recharge operations include inter-basin transferred surface water, storm water, and highly treated reclaimed wastewater sources that can require minor to extensive treatment pre-recharge and post-recovery. So far MAR systems have been slow to take root in the state partly due to rigorous demonstration requirements, groundwater quality protection concerns, and ongoing water right uncertainties. This presentation will highlight efforts of multiple water providers to develop MAR systems and describe ongoing technical, financial, and regulatory challenges for large-scale implementation.

Abstract

Quality and Age of Shallow Groundwater in the Bakken Formation Production Area, Williston Basin, Montana and North Dakota

Peter B. McMahon
U.S. Geological Survey
Denver, Colorado

The quality and age of shallow groundwater in the Bakken Formation production area were characterized using data from 30 randomly distributed domestic wells screened in the upper Fort Union Formation. Comparison of inorganic and organic chemical concentrations to health based drinking-water standards, correlation analysis of concentrations with oil and gas well locations, and isotopic data give no indication that energy-development activities affected groundwater quality. It is important, however, to consider these results in the context of groundwater age. Most samples were recharged before the early 1950s and had carbon-14 ages ranging from <1,000 to >30,000 years. Thus, domestic wells may not be as well suited for detecting contamination associated with recent surface spills as shallower wells screened near the water table. Old groundwater could be contaminated directly by recent subsurface leaks from imperfectly cemented oil and gas wells, but horizontal groundwater velocities calculated from carbon-14 ages imply that the contaminants would still be less than 0.5 km from their source. For the wells sampled in this study, the median distance to the nearest oil and gas well was 4.6 km. Because of the slow velocities, a long-term commitment to

groundwater monitoring in the upper Fort Union Formation is needed to assess the effects of energy development on groundwater quality. In conjunction with that effort, monitoring could be done closer to energy-development activities to increase the likelihood of early detection of groundwater contamination if it did occur.

Pete McMahon is a Research Hydrologist with the U.S. Geological Survey Colorado Water Science Center. He has a Ph.D. in Geology from the University of South Carolina-Columbia and an M.A. in Geology from the University of Texas-Austin. He has more than 30 years of experience conducting groundwater-quality investigations.

Abstract

State Oil and Gas Regulations Designed to Protect Water Resources

Mike Nickolaus, Ground Water Protection Council

In step with dramatic industry growth over the past five years, states have substantially improved groundwater protection laws and regulations governing oil and natural gas production. State regulatory strategies differ in response to unique local circumstances and characteristics; over time, they evolve to address public concerns about the safety and environmental impact of oil and gas development, as well as rapidly changing technologies, new field discoveries, revised leading operational practices, internal and external reviews, and regulatory experience.

This presentation will include a discussion of how rules have evolved since an initial review in 2009, and considerations for regulators and policymakers derived from leading practices adopted or proposed in various states. We will introduce several emerging issues that merit more detailed consideration in future state regulatory evaluations including sampling and analysis of water resources potentially impacted by the oil and gas well drilling, completion and operation activities, and treatment operations and waste stream management related to the use of brackish and/or saline groundwater. We will also highlight some practices adopted by oil- and gas-producing states to enhance transparency, efficiency, and effectiveness in regulatory implementation.

Mike Nickolaus received his Bachelor's degree in Geology from Indiana University and has been an Indiana Licensed Professional Geologist since 1986. He is also a member of the Society of Petroleum Engineers.

Abstract

Evaluating Key Sources of Groundwater Quality Variability in Residential Water Wells for Pre-Drill Sampling

Stephen D. Richardson, GSI Environmental, Inc.,
Lisa J. Molofsky, GSI Environmental, Inc.
Ann P. Smith, GSI Environmental, Inc.
John A. Connor, GSI Environmental, Inc.

The media and general public have expressed significant concerns regarding the potential impact of shale gas extraction on surrounding drinking water resources. Determining whether changes in groundwater chemistry (methane, salts, etc.) are natural in origin or caused by drilling operations can be difficult, particularly when i) inconsistent sampling and analytical methodologies are employed and ii) water quality can vary naturally over time due to various factors (e.g., intensity of residential water use, well construction, aquifer geochemistry, precipitation events, changes in temperature). Understanding the sources of variability in concentrations of dissolved gases and other water quality parameters, and the isotopic signature of dissolved gases in residential water wells is critical to discerning natural changes in water quality from those associated with oil and gas extraction activities.

Two field studies were conducted at a series of private residential water wells in northeast Pennsylvania. Study objectives were to i) investigate the effects of sampling methodologies on pre-drill water well quality and ii) to quantify the degree of variability in methane concentration, isotopic signature, and general water quality parameters over an 18-month period. Evaluation of various sampling protocols revealed that the selected sample container has a predictable, and in some cases significant, effect on dissolved methane concentrations, while the volume of water purged prior to sample collection does not exhibit an obvious relationship with dissolved gas concentrations. In addition, our data show that, over time, dissolved methane concentrations correlate with redox indicator parameters as well as concentrations of total dissolved solids and associated dissolved ions. These findings improve our understanding of the inherent variability in pre- and post-drill results and offer insight into methods for improving sample collection protocols and data interpretation.

Dr. Richardson is an Environmental Engineer with GSI with over eleven years of experience in soil and groundwater remediation, environmental site investigation, engineering design, and research and development. Dr. Richardson is a Licensed Professional Engineer in Texas, Louisiana, North Carolina, and Alberta, Canada. He holds a doctoral degree in environmental engineering from the University of North Carolina, a master's degree from Louisiana State University, and a bachelor's degree from the University of Waterloo. Currently, Dr. Richardson serves as the technical lead for a DOE-funded research project examining the environmental effects of shale gas operations, specifically air emissions, stray gas events, and flowback / produced water.

Abstract

Methane Occurrence and Water-Quality Characteristics Found in Groundwater of the Appalachian Basin

Bert Smith, Chesapeake Energy

Abstract: Review of analytical data from over 19,000 pre-drill groundwater samples collected on behalf of Chesapeake Energy Corporation from water wells in the Appalachian Basin indicates that methane is found naturally and is essentially ubiquitous in groundwater of the Appalachian Basin. The occurrence of methane is controlled by the water-bearing geological unit penetrated by the water well, the hydrochemical facies (e.g. Na-Cl, Na-HCO_3, or Ca-HCO_3 groundwater type), whether the well is located in a valley or an upland location, and whether the water well intersects restricted or confined saline zones. Methane gas can occasionally be found in the water well annular headspace and is often associated with draw-down based on water-well usage. No evidence was found that dissolved methane in groundwater occurs at higher concentrations in closer proximity to oil or gas wells. Chesapeake's dataset also shows natural pre-drilling exceedances of water-quality standards (excluding turbidity) occur in 62.1% of water well samples in NE Pennsylvania and 87.3% in a Western Area of the Appalachian Basin(Eastern Ohio, Northern West Virginia, and SW Pennsylvania).

Bert Smith has over 35 years of experience as a hydrogeologist and works for the EnviroClean Group, an oil-field consulting and remediation company. He has a BS Degree in Geology and an MS Degree in Engineering from Washington State University. Mr. Smith has been responsible for coordinating the evaluation of Chesapeake's pre-drilling water quality data collected in the Appalachian Basin.

Abstract

Smart-monitoring to address risks of unconventional gas development

Jon Fennell, M.Sc., Ph.D., Integrated Sustainability Consultants Ltd.

Given our current knowledge and innovative technologies, North America is well placed to move the emerging unconventional gas (UCG) sector forward. Given the trillions of cubic feet of shale and tight gas beneath Canada and the United States, development of these resources will generate significant economic benefit to our countries and provide a clean energy source for end users. On the other hand, concern is mounting regarding the potential impacts of such development (and the associated hydraulic fracturing activities) on potable groundwater resources and connected systems. The Government of Alberta has recognized this concern, and responded in kind by working to enhance the provincial groundwater observation well network in active and future development areas. This

presentation will showcase a multi-attribute risk analysis approach designed to assess subsurface risk and surface access opportunities, with the goal of identifying optimal monitoring locations across broad development areas to define baseline groundwater conditions and detect any changes resulting from UCG development activities.

Dr. Jon Fennell is a Principal Hydrogeologist, and Vice President of Geosciences and Water Security at Integrated Sustainability Consultants Ltd. He has over 28 years consulting experience in the natural resource sector, the majority of which directly related to water management in the conventional and unconventional oil and gas sector. Jon received his Bachelor's of Science degree in Geology from the University of Saskatchewan in 1985, his Masters degree. in Hydrogeology from the University of Calgary in 1994, and Doctorate degree in Geochemistry from the University of Calgary in 2008. His areas of specialization include physical and chemical hydrogeology, groundwater-surface water interactions, environmental forensics, water supply and waste disposal, risk assessment, and risk mitigation. Over the last 15 years, Jon has worked closely with industry and government agencies (both locally and abroad) to develop management frameworks and assessment tools to protect groundwater resources through risk modeling, monitoring system design, and adaptive management.

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