Abstracts & Bios

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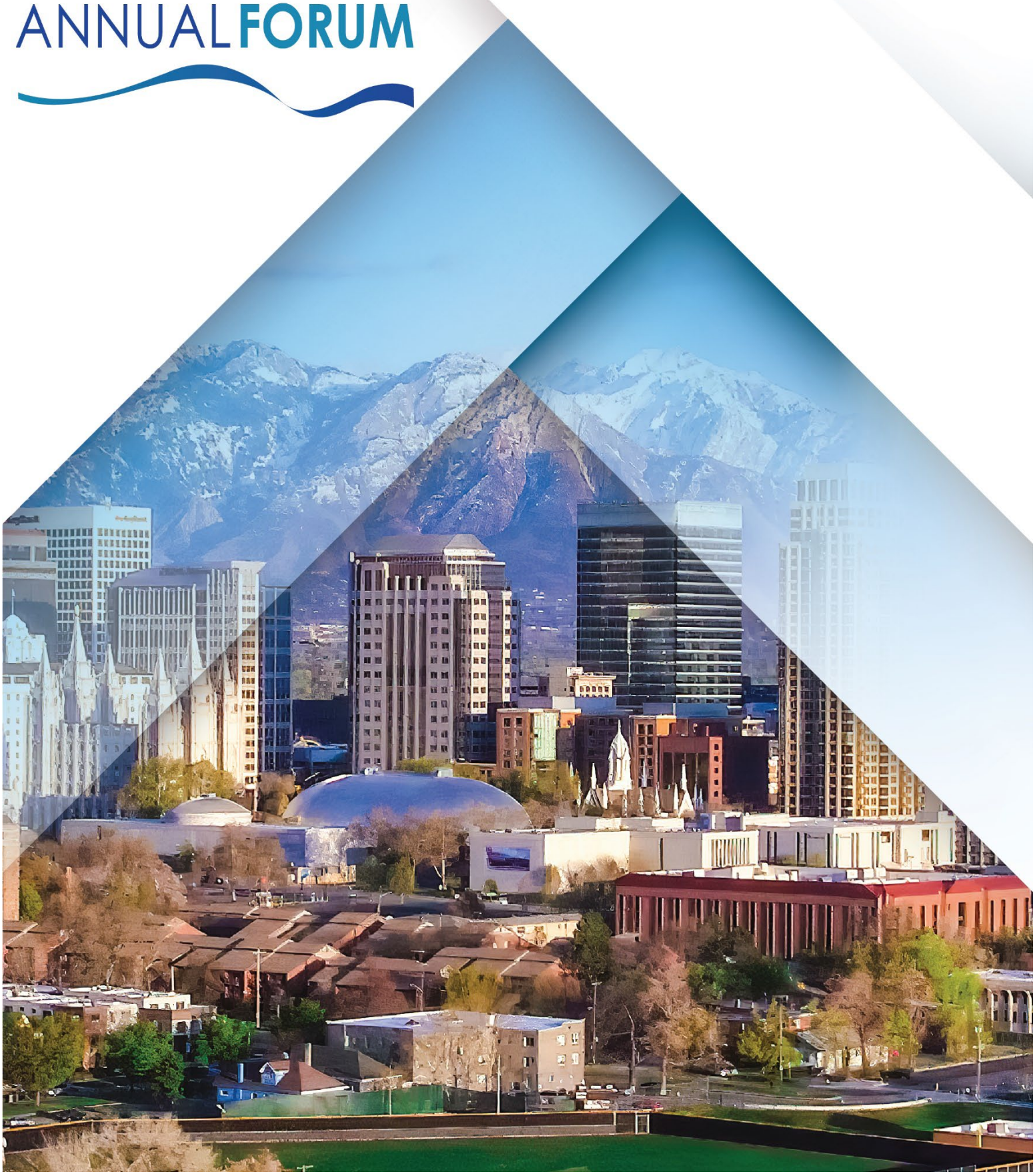

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Carbon Capture & Storage

US DOE Update on CarbonSAFE Commercial Storage Facilities

DOE is supporting the development of commercial carbon storage facilities through both the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative. The CarbonSAFE initiative began in 2016 with the goal to characterize, permit, and construct commercial-scale storage facilities, each with the capacity to store 50+ million tonnes of CO2. Today, there are 22 carbon storage projects in development in the U.S. with at least 10 pursuing storage in saline formations. But to meet the Administration's decarbonization targets, investments in building the infrastructure for dedicated carbon storage and transport must be accelerated over the next decade. These early investments are necessary to establish the foundation for the industry needed to support the full decarbonization of carbon-intensive industrial sectors. The DOE FECM will make key investments supported by the Infrastructure Investment and Jobs Act (IIJA). DOE FECM plans include investments in large-scale transport and storage facilities, and regional hubs that will require connected by future intra-and inter-regional transport networks that include pipelines. Expansion of the CarbonSAFE initiative with the $2.5 billion provided throguh the IIJA, including development of storage hubs anchored with CarbonSAFE facilities, storage facilities that are significantly larger than 50 million tonnes of CO2, and incorporating diverse types of CO2 sources, will help to catalyze the rapid deployment of carbon storage necessary to meet decarbonization goals. Underpinning the infrastructure development is the development of enabling technologies to improve performance and reduce the cost of gigatonne scale carbon storage. This presentation will provide an overview of these investments in commercial storage facilities.

John Litynski | Director, Carbon Transport an Storage | US DOE FECM

John currently serves as the Director for Carbon Transport and Storage in the Department of Energy's Office of Carbon Management. He previously served as the Program Manager for Carbon Capture at Department of Energy, the Technology Manager for Carbon Sequestration at the National Energy Technology Laboratory and as a senior team lead on environmental compliance and assessment with the U.S Army. He has over 25 years of experience working on environmental compliance and technology development for the energy industry and Department of Defense. He received his B.S. in Civil Engineering from Virginia Polytechnic Institute and State University and M.S. from Johns Hopkins University in Environmental Engineering and Science.

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Carbon Capture & Storage

Ensuring States are 'Carbon Capture Ready': Building the Supportive Policy Environment for Commercial-Scale CO2 Storage

Commercial interest in carbon management technologies and projects is growing rapidly, with nearly 90 publicly announced projects throughout the United States. More than 70 percent of these announced projects intend to store captured carbon dioxide in saline geologic formations, requiring the use of Class VI wells. As projects move forward, the need for expanded permitting capacity by federal and state authorities could dramatically increase, whether through shared commercial infrastructure or carbon hubs, or through individual Class VI well permits.

The rapidly evolving federal policy landscape for carbon management means that states and the EPA must ramp-up allied efforts to ensure that projects are permitted responsibly and efficiently so that carbon management technologies -- carbon capture, removal, transport, utilization and storage -- can scale to help meet midcentury climate goals, strengthen and decarbonize domestic energy, industrial production and manufacturing, and retain and expand a high-wage jobs base.

Matt will give an overview of the supportive policy environment for project deployment, including $75 million over a five-year period to EPA to permit Class VI wells and review state primacy applications. Effective implementation of these modest but vital permitting resources could be transformative in ensuring that federal investments through the bipartisan infrastructure law and the 2018 bipartisan reform and expansion of the federal 45Q tax credit can achieve their full climate potential.

Matt's presentation will also discuss how states are advancing the policy and regulatory framework needed to support carbon management deployment. Through the Regional Carbon Capture Deployment Initiative, eight states have formed an MOU and committed to establishing and implementing a regional CO2 transport infrastructure action plan. In October 2021, released an action plan, which discusses the critical role that states can play in supporting the development, permitting, and financing of carbon management projects to ensure that states are 'carbon capture ready'.

Matt Fry | Senior Policy Manager - Carbon Management | Great Plains Institute

Matt Fry joined the Great Plains Institute in 2021 as the Senior Policy Manager, supporting the Carbon Management program. Matt has over 20 years of experience in natural resource management, regulation, and policy in both the public and private sectors. Matt served as a Senior Policy Advisor to Wyoming Governor, Matt Mead, where he focused on natural resource, energy and CCUS policy. Additionally, he developed and managed the Wyoming Pipeline Corridor Initiative (WPCI), which is a project that authorized a statewide network of pipeline corridors in Wyoming that is intended to facilitate deployment of CO2 pipeline infrastructure in order to incentivize CCUS project deployment.

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Carbon Capture & Storage

Carbon Sequestration Injection Well Permitting in Wyoming, USA

Describe the permitting process for a Carbon Sequestration Injection Well, also known as an Underground Injection Control Class VI well, in the State of Wyoming

Lily Barkau | Groundwater Section Manager | Water Quality Division, Wyoming Department of Environmental Quality

Lily R. Barkau is the Groundwater Section Manager of the Water Quality Division at the Wyoming Department of Environmental Quality. She oversees the Underground Injection Control Program, CERCLA cleanup projects in the Federal Facilities Program, Groundwater Pollution Control Legacy Sites and special projects associated with groundwater issues across the state. She is a professional geologist and received a bachelor's degree in geology from Wichita State University and a master's degree in environmental science and engineering from the Colorado School of Mines.

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Carbon Capture & Storage

CCS Opportunities in the Upper Midwest

Summit Carbon Solutions (SCS) is executing a carbon capture and storage (CCS) project in the upper Midwest that will be the largest project of its kind in the world. The current project involves the capture of CO2 from more than 30 ethanol plants located in five states (IA, MN, ND, SD, and NE) and transmission through approximately 2,000 miles of pipeline to a permanent sequestration facility in North Dakota. Once operational, the project will be capable of storing up to 12 million metric tons of CO2 each year.

This presentation will provide an overview of the project, the regulatory framework within which SCS operates, stakeholder engagement and collaboration, and the opportunities CCS at this scope and scale can provide the United States in meeting its climate goals while supporting agriculture.

John Satterfield | Environmental Programs Manager | Summit Carbon Solutions

John Satterfield is responsible for environmental programs and regulatory affairs at Summit Carbon Solutions. He has almost 30 years of experience addressing EHS compliance assurance issues, collaborating in the development of regulatory policy, and strategic planning. Prior to joining Summit Carbon, he worked at various oil and gas E&P and pipeline companies and began his career as an EHS consultant. John holds a Bachelor of Science in Environmental Science from East Central University in Ada, Oklahoma.

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Carbon Capture & Storage

Flue Gas Injection as an Alternative to CO2 Capture: Subsurface Risk Considerations and Financial Tradeoffs

The cost of capturing CO2 from dilute waste streams has proven financially prohibitive to the widespread deployment of geologic carbon sequestration and represents a parasitic load on current point source emitters. Capture through amine towers is designed to conserve pore volume for greenhouse gases and to mitigate pressure-driven risks. However, the most recent data show ample pore volumes exist to manage carbon emissions during the 21st century energy transition, including between 2 and 22 trillion tons of storage in US saline aquifers alone. Practical strategies such as lower injection rates through multiple wells can be used to reduce pressure buildup. We explore the technical differences between pure CO2 injection in a saline aquifer and flue gas injection, comparing on the basis of equal volumes of CO2 sequestered. Subsurface considerations include the flue gas's fluid compressibility as a function of composition, injectate solubility at the brine interface, and rock-fluid interactions that lead to higher pressure buildup. Pressure-driven risks increase as the concentration of CO2 decreases relative to N2, and a geomechanical model is proposed that shows the impact of changing flue gas concentration on pressure buildup. The cost of carbon capture is compared to the cost of compressing and transporting an equal volume of CO2 as a function of CO2 composition in the waste stream. We explore managing pressure-driven risk due to increased volumes during flue gas injection as a function of increased well spacing and increased number of injection wells to distribute the injectate volume appropriately. We find that for projects where the cost of compression is low compared to the cost of capture, flue gas injection represents an opportunity for increased implementation of carbon sequestration.

Brandon Schwartz | Assistant Research Professor | The Pennsylvania State University

Brandon Schwartz is currently an Assistant Research Professor in the Department of Energy and Mineral Engineering at Penn State University with expertise in the areas of experimental geomechanics and dynamic rock physics modeling. His interests are in characterizing the deformation-driven impacts of fluid injection, flow, and storage on rock and fluid properties with application to carbon sequestration, geothermal reservoirs, and hydrogen storage.

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Carbon Capture & Storage

Practical Considerations for Carbonated Brine Injection

Carbon dioxide geologic storage research has considered carbonated brine injection (CBI) as a potential method for geologic sequestration. Injecting water near saturation with carbon dioxide has potential advantages including mitigating risks associated with potential migration of buoyant CO2. Studies have examined the technical feasibility and performance of CBI without examining how projects might fit within relevant underground injection control (UIC) regulatory frameworks.

This presentation identifies the key questions in determining how CBI might fit within existing UIC regulatory frameworks in the US, including how constructive and beneficial interpretations of existing requirements might facilitate the implementation of CBI geologic storage projects. Within the context of some regulatory frameworks, the source of the captured CO2 would affect the applicability of specific classifications of injection wells available for injection of the carbonated brine. In other cases, the composition of the stream to be injected could affect whether and how the project would be viewed within an existing regulatory framework.

In particular, the analysis addresses the regulatory frameworks in the United States, both onshore and offshore, considering which UIC injection well classes could be appropriate for storage injection. In most cases, operators potentially could use a variety of well classes for such projects, and different federal and state regulatory agencies would regulate those wells. For offshore, the regulatory framework is less well developed, but recent legislation establishes a foundation for and mandates promulgation of new regulations which could apply to carbonated brine storage projects. The analysis will develop an analytical template for identifying the questions to answer and considerations for constructing, revising, and interpreting regulatory frameworks that allow flexibility and adaptability to accommodate emerging technologies and methodologies for carbon storage.

Bob Van Voorhees | Principal | Robert F Van Voorhees PLLC

Bob Van Voorhees is a lawyer and consultant who has been working with energy and environmental regulation of underground injection for many years. He currently works with government regulators and other stakeholders on developing legislative and regulatory frameworks for CCUS and with project developers to obtain permits and approvals.

He currently serves as the Co-Chair of the Ground Water Protection Council (GWPC) Class VI Workgroup with Kevin Frederick of Wyoming to facilitate state primacy and implementation of Class VI permitting.

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Carbon Capture & Storage

FECM Perspectives on Carbon Management

This presentation will provide an overview of the US Department of Energy's Office of Carbon Management (an arm of the Office of Fossil Energy and Carbon Management) and its approach to carbon management. The Office of Carbon Management's mission is to facilitate a just and environmentally sustainable transition toward a net-zero carbon economy. How do we do this? By focusing on carbon dioxide -- its storage, containment, and capture. We address emissions associated with the power and industrial sectors, as well as legacy emissions in the atmosphere, and we seek to permanently store and/or convert carbon dioxide (CO2) to reduce negative climate impacts. Activities to deliver the Office's mission center on investments in technological readiness and analysis. To do so, our department researches a portfolio of carbon management approaches, with an emphasis on facilitating development of approaches that meet our technical, justice, and sustainability requirements for commercialization. Our goals are to improve their performance, reduce costs, and scale the deployment of the technologies to decarbonize the power and industrial sectors and to remove CO2 from the atmosphere.

Emily Grubert | Deputy Assistant Secretary, Carbon Management | US Department of Energy

Dr. Emily Grubert is the Deputy Assistant Secretary for the Office of Carbon Management in the Office of Fossil Energy and Carbon Management (FECM). In this role, she oversees FECM's Carbon Management program, which focuses on minimizing the climate and environmental impacts of fossil energy through technology pathways including carbon capture, carbon dioxide (CO2) removal, CO2 conversion into products, reliable CO2 storage, and hydrogen production with carbon management.

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Carbon Capture & Storage

Fiber-optic Monitoring of CO2 Storage Wells: State-of-the-Art Review

The technology for fiber optic sensing has been a game changer in recent years in the upstream oil and gas sector. Fiber optic solutions such as Distributed Temperature Sensing (DTS) and Distributed Acoustic Sensing (DAS) and DAS-VSP (Vertical Seismic Profile) can be utilized to assess carbon storage capacity, monitor the CO2 plume, monitor induced seismicity, evaluate injection zone/profile and wellbore and cap-rock integrity.

This brief overview will cover how DTS, DAS and DAS-VSP data from distributed fiber-optic sensing can be applied in a CO2 storage project from both a CO2 conformance (i.e., storage performance aligns with expectations regarding injectivity, capacity and CO2 behavior inside the storage reservoir) and a containment (i.e., stored CO2 is secure and protects human health, groundwater resources, hydrocarbon resources and environment and meets regulatory requirements) perspective.

Talib Syed | Consulting Petroleum Engineer/CCUS/H2 Consultant | TSA, Inc.

Talib Syed, P.E. holds a B-Tech (Chemical Engineering - Univ. of Madras, India) and an M.S. in Petroleum Engineering (Univ. of Oklahoma), is a Registered Petroleum Engineer in Colorado and Wyoming. Talib started his oilfield career with ARAMCO - Saudi Arabia and has U.S. and international experience both onshore and offshore. Talib is a Society of Petroleum Engineers (SPE) Distinguished Lecturer on Life Cycle Well Integrity (2020 - 2021) and currently serves as SPE Member-at-Large Carbon Capture, Utilization and Storage (CCUS) Technical Section. Talib is a member of SPE, American Association of Drilling Engineers (AADE), European Association of Geoscientists and Engineers (EAGE), Interstate Oil and Gas Compact Commission (IOGCC) and Ground Water Protection Council (GWPC).

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Carbon Capture & Storage

Early Phase Execution for Carbon Capture & Sequestration "CCS" Projects Today

Given decades of academic study, legislative acts and regulatory promulgation, media coverage and federal funding, one might think that geologic sequestration of CO2 is fully understood and routinely practiced across the USA, however only one Class VI well is presently injecting CO2. Recognizing this early phase of CCS commercialization, we enter 2022 with optimism and momentum for private industry to significantly pick up the pace. This presentation provides a unique perspective and status for what is taking place in today's quest for CCS. Insights are provided for what it takes to successfully permit a UIC Class VI well and execute a viable project. Topics will include:

- CO2 Sources (Industrial, Power Generation, Gas Processing, Ethanol, Fertilizer)
- Storage Location (Geologic Reservoir, Pore space)
- Specialized Equipment (CO2 Capture, Processing, Pipeline, Injection and Monitoring wells)
- Permitting (UIC Class II and VI)
- Funding (Private, Public, Federal)
- People (Technical, Legal, Commercial)

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PFAS

PFAS 101 Evaluating PFAS in Wyoming

The WDEQ Presentation will provide a PFAS 101 including the properties of PFAS, potential sources, health effects, sampling and analytical concerns, and potential treatment options. In addition, the WDEQ will review the process the state has implemented to conduct a statewide survey for PFAS in groundwater.

Nicole Twing | WDEQ WQD Groundwater Section Geology Supervisor | Wyoming DEQ Water Quality Division

Nicole Twing, P.G. is the Geological Supervisor for the State of Wyoming Department of Environmental Quality (WDEQ) Water Quality Division Groundwater Section's Groundwater Pollution Control Program (GPC), Federal Facilities program, and Special Projects. She received her B.S. in Geology from the University of Minnesota Duluth and an M.S. in Civil Engineering from the South Dakota School of Mines and Technology. Prior to joining the GPC, she worked in the WDEQ Underground Injection Control Program. Before joining the WDEQ in 2012, she worked in environmental consulting in Texas and Wyoming overseeing various environmental clean-up projects across the US.

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Laurel Morrow, P.G., WDEQ WQD UIC Program Natural Resources Program Principal

PFAS

Elimination of PFAS at Landvills Via Class I Injection

On February 26,2020, the United States Environmental Protection Agency (US EPA) released their updated Per-and Polyfluoroalkyl Substances (PFAS) action plan which highlights the U.S. EPA's aggressive and unprecedented efforts to address PFAS in the environment. In the fall of 2021, U.S. EPA laid out a strategic roadmap to the agency's approach to PFAS which the agency seeks to deliver from 2021 to 2024. U.S. EPA's integrated approach to PFAS is focused on three central directives: Research, Restrict, and Remediate.

Key Industries with significant documented discharges include PFAS production and processing, metal finishing, airports, pulp and paper, landfills, and textile and carpet manufacturing. Landfill leachate, which is typically trucked for treatment at a Public Owned Treatment Works (POTW) has been identified as a likely source of PFAS. Many landfill operators across the U.S. are starting to look at alternative leachate disposal options, which includes Class I non-hazardous injection wells.

The advantage of drilling and completing a Class I non-hazardous injection well at the landfill is that it eliminates the trucking and the disposal cost of leachate at the POTWs and addresses U.S. EPA's intentions for eliminating PFAS from the environment. Not only would Class I injection at landfills remove the risk of PFAS entering the environment, but it would also reduce carbon emissions by elimination of the trucking of the leachate from the landfill for offsite disposal.

For years now, Class I injection has allowed for the disposal of non-hazardous and hazardous wastes thousands of feet below the ground surface with multiple layers of steel casing and cement to ensure protection of drinking and ground waters in a safe and environmentally sound method.

Tom Tomastik | Chief Geologist and Regulatory Specialist | ALL Consulting LLC

Mr. Tomastik is a certified petroleum geologist with over 40 years of diverse expertise and experience in the energy sector, government, and consulting. Tom obtained his BS and MS in geology from Ohio University in 1979 and 1981. He has been involved in the planning, drilling, permitting and development of oil and gas and Class II saltwater disposal wells, Class I feasibility studies and permitting, injection well audits, stray gas investigations, natural gas and natural gas liquids storage, groundwater contamination investigation cases, induced seismicity, seismic monitoring and installation, and expert witness testimony. Tom also has been involved with oversight of the permitting, drilling, conversion, and completion of Class II disposal wells, which included all aspects of the permit process, AFE development and contractor coordination, drilling, cementing, geophysical logging, acidizing, mechanical integrity testing, injectivity testing, and well workovers.

As a chief geologist at ALL Consulting, Mr. Tomastik has experience and expertise not only in the energy sector, but previously as a state regulator, with 25-1/2 years as a senior geologist with the Ohio Department of Natural Resources (ODNR), where he oversaw the planning, permitting, drilling, and conversion of hundreds of Class II and Class III injection wells using hydrogeology, geology, and engineering specialization for well construction, completion, and surface facility operations. At ODNR, as lead geologist, Tom also conducted several hundred groundwater and stray gas investigations related to oil and gas, industrial

minerals, and coal mining operations in Ohio and testified on numerous occasions as an expert witness before various commissions and in the county court system. Additionally, over his career, Tom has published 61 articles or presentations on oil and gas, secondary oil recovery, salt-solution mining, cavern storage, Class II disposal, groundwater, and stray gas investigations, CCUS, hydraulic fracturing, induced seismicity, and regulatory issues.

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PFAS

The Role of Underground Injection in Management of Aqueous PFAS

There has been an increasing interest in underground injection to manage PFAS compounds. The EPA interim guidance of PFAS destruction and disposal listed class 1 Hazardous and Non-Hazardous Underground Injection as the technologies of "least uncertainty." The presentation will delve into the factors which will help determine the use and value of UIC for aqueous PFAS such as regulations on PFAS, UIC permits, capacity, current and future risk, limitations, vulnerable populations, and financial considerations.

Frank Marine | Marketing & Communications Consultant | Texas Molecular

Frank has been with Texas Molecular for 17 years of which 15 years he served as its President. Frank holds a BS ChE from Newark College of Engineering. He has presented papers on underground injection and/or PFAS to industry and State organizations. Frank leads Texas Molecular's PFAS Program. Texas Molecular has managed about 80 million gallons of hazardous and non-hazardous PFAS water from a variety of sources and industry over the last 4 years.

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PFAS

Implications of PFOA and PFOS on Class V UICs

USEPA is committed to adopting MCLs for PFOA and PFOS in the next two years. While most work and analysis are focussed on the impact of adopting an MCL on public water systems, the federal Safe Drinking Water Act also regulates UICs and the protection of underground drinking water sources. The impact of adopting MCLs for PFOA and PFOS on Class V wells will be presented based on analysis of data from New Hampshire.

Brandon Kernen | Administrator, Drinking Water and Groundwater Bureau | NHDES

Brandon Kernen is the Administrator of the Drinking Water and Groundwater Bureau at the New Hampshire Department of Environmental Services. He has over 30 years of professional experience and a graduate degree in Civil and Environmental Engineering from Tufts University and an undergraduate degree in Hydrology and Water Resources from the University of Arizona. He is a licensed Professional Geologist.

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Aquifer Storage & Recovery

More Managed Aquifer Recharge (MMAR) - A Solution to Combat Droughts and Climate Change in the West

In 2005, Utah declared Aquifer Storage and Recovery (ASR) as a critical element in most conjunctive management practices as part of their Utah State Water Plan. In 2017, Governor Herbert commissioned a Recommended State Water Strategy where public comments included Vigorously pursue aquifer storage and recovery projects yet few ASR programs have been implemented since. Recently, in the 2021 Water Resource Plan ASR and other managed aquifer programs received little attention. This presentation will cover the increasing water challenges and drought situation in Utah and surrounding western states due to in large part climate change. The presentation will also discuss the successes and challenges of existing and potential ASR programs in Utah.

R. Jeffrey Davis | Principal Hydrogeologist | Integral Consulting

Jeff has 27 plus years of experience with hydrogeology and civil and environmental engineering. Jeff is a Certified Groundwater Professional as well as a Professional Engineer licensed in several states. A Utah native, he has worked on numerous groundwater-related projects in Utah, as well as across the country and globally. Jeff has developed and applied numerous groundwater models for municipalities, states, and industrial clients, and serves on the board of directors for the National Ground Water Association's Scientists and Engineers Section, as well as on the board of the Utah chapter. Jeff has managed aquifer-storage projects for the City of Provo and other clients in Utah. On a personal note, Jeff loves trail running in the mountains and is an avid mountaineer.

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Aquifer Storage & Recovery

Aquifer Characterization for Brackish Groundwater Production and Aquifer Storage & Recovery (ASR), a Case Study on the Carrizo-Wilcox Aquifer in Central Texas

Alternative water supply strategies in Texas state water planning include desalination of brackish groundwater and seawater, wastewater reuse, and aquifer storage & recovery (ASR). In the last two years, the Texas Water Development Board has completed two aquifer characterizations of the Carrizo-Wilcox aquifer in central Texas in support of alternative water supply development. The first was a regional brackish groundwater study covering all or parts of 14 counties. The second was a sub-regional ASR study covering parts of three counties which overlapped with the regional brackish groundwater study. Having two similar studies completed for different objectives provides an opportunity to compare them as a case study and discuss the differences between their objectives and methodologies. Similarities between the studies include that they were legislatively mandated & funded, prioritized based on state water planning, and mapped to portray the stratigraphy, lithology, and groundwater salinity using similar methodologies. Differences between the studies include the groundwater supply objectives, scale, timeline, data volume and density, stakeholder directives, conclusions, and the ancillary information that was provided in each report. Every aquifer characterization study has unique objectives; therefore, the type of data collection and analysis must be carefully chosen to best fit the study's scope of work. The new, more detailed study for the ASR project was a natural evolution from the regional brackish groundwater study, which provided an excellent starting framework and enabled a shorter timeline for the ASR-directed aquifer characterization. This shorter timeframe allowed the second study to focus on the specific characteristics of the aquifer that were critical to ASR project development. These investigations provide crucial data to stakeholders who are interested in developing new groundwater resources and both studies resulted in new detailed, publicly available information about the Carrizo-Wilcox aquifer in Texas.

Andrea Croskrey | ASR Discipline Lead | Texas Water Development Board

Andrea Croskrey is a licensed professional geologist in the Innovative Water Technologies (IWT) group at the Texas Water Development Board (TWDB). She has been mapping Texas aquifers since 2013 and currently serves as the IWT aquifer storage & recovery (ASR) discipline lead, a role in which she guides technical aspects of the program and implements legislative directives. Additionally, she is on the Groundwater Protectional Council (GWPC) Managed Aquifer Recharge (MAR) workgroup leadership team. Her educational background is a Bachelor of Science in Comprehensive Geology from Northwest Missouri State University and a Master of Science in Geosciences from Western Kentucky University.

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Aquifer Storage & Recovery

Statewide Mapping of California's Aquifers with Airborne Electromagnetics

The state Department of Water Resources is conducting airborne electromagnetic (AEM) surveys in California's high- and medium-priority groundwater basins, where data collection is feasible, to assist local water managers as they implement the Sustainable Groundwater Management Act (SGMA) to manage groundwater sustainably. The AEM project provides state and federal agencies, groundwater sustainability agencies (GSAs), stakeholders, and the public with basin-specific geophysical data, tools, and analyses. AEM data are collected using geophysical instruments on a hoop that is towed beneath a helicopter traveling 50 miles per hour approximately 200 feet above ground surface. The geophysical method being employed is time domain electromagnetics, and a current is generated in large hoop that sends an electromagnetic pulse into the subsurface. The response of the subsurface materials is measured in a receiver mounted on the helicopter. The measured response is related to the electromagnetic properties of the subsurface materials. Typically, materials that are electrically conductive are interpreted for fine-grained materials, like silts and clays, or can be interpreted as groundwater with high salinity. Materials that are electrically resistive are interpreted to be coarse-grained materials, like sands and gravels. The process has been compared to taking an MRI of the subsurface. The data collected is used to create continuous images that are interpreted for the underlying geology. The resulting information will provide a standardized, statewide dataset that improves the understanding of aquifer structures. It can also assist with the development or refinement of hydrogeologic conceptual models and can help identify areas for recharging groundwater. The AEM method can image the subsurface to depths of up to about 1,000 feet, depending on the electrical properties of the subsurface materials. The method is limited to areas without buildings or infrastructure. All the statewide AEM survey data is being made publicly available through a public web portal.

Timothy K. Parker, PG, CEG, CHG | Principal Hydrogeologist | Ramboll

Tim Parker is a technical consultant and groundwater sustainability expert with Ramboll in California providing strategic water and groundwater consultation, water supply assessment, groundwater resources development and groundwater management services to public and private sector clients. He is a California licensed Professional Geologist (PG), Certified Engineering Geologist (CEG) and Certified Hydrogeologist (CHG), with over 35 years of experience in the water and groundwater resources and contaminant industries. Tim is the licensed professional geologist responsible for statewide airborne electromagnetic surveys currently being conducted by Ramboll in California to map the states priority aquifers. He previously worked for Schlumberger, and prior to that for the California Department of Water Resources. Tim's interests include conjunctive use of surface water and groundwater for supply resiliency, climate variability adaptations for supply, sustainable groundwater management, current and developing tools and technologies for improved hydrogeologic conceptualization and modeling, stakeholder assessment and facilitations for improved outcomes. He serves as Chair of the International Association of Hydrogeologists USA Chapter, and Director on the National Groundwater Association as the Scientist's and Engineer's Section Chairman, and Chairs the

NGWA MAR Work Group and SCOTUS Functional Equivalent Task Force. Tim is a principal writer on ISMAR9 Call to Action - Sustainable Groundwater Management Policy Directives (2016), Sustainability from the Ground Up, Groundwater Management in California (ACWA 2011), and co-authored Potential Groundwater Quality Impacts Resulting from Geologic Carbon Sequestration (WRF 2009), and California Groundwater Management (GRA 2005).

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Aquifer Storage & Recovery

Managed Aquifer Recharge for Sustainable Groundwater-Irrigated Agroecosystems Utilizing Riverbank Filtration and Groundwater Transfer and Injection

In the Delta region of Mississippi, long-term declines in groundwater levels in the Mississippi River Valley alluvial aquifer (MRVAA) indicate that groundwater-use practices are unsustainable. A pilot facility using managed aquifer recharge (MAR) is being tested to assess the potential for this technology to mitigate groundwater depletion, supporting irrigated agriculture as well as sustaining natural ecosystems. In partnership with local stakeholders and the U.S. Army Corps of Engineers, the USDA Agricultural Research Service is conducting the Groundwater Transfer and Injection Pilot (GTIP) project near Greenwood, Mississippi, which combines riverbank filtration and aquifer storage to capture water from the Tallahatchie River for direct injection into the MRVAA. The system consists of one extraction well, a 1.8-mile pipeline, and two injection wells, with a design capacity of 1,500 gallons per minute. Groundwater is filtered by passing through sands adjacent to the Tallahatchie River and subsequently is extracted, transferred, and then injected into a depleted section the MRVAA. Operation began in April 2021, and an initial 3-month test injecting a total of 550 acre-feet of water has been completed. Data collection at 17 observation wells and the extraction and injection wells includes continuous groundwater level and temperature and monthly water samples for analysis of major ions, metals, and nutrients. A second test injection period commenced February 2022 and will continue for an additional 3 to 6 months. Changes in water chemistry during riverbank filtration indicate increased mineralization attributable to rock-water interactions and biogeochemical oxidation-reduction processes. In observation wells screened above, within, and below the injection zone, little change in water chemistry was observed, but increases in groundwater levels up to approximately 6 feet occurred within 150 to 350 feet. Knowledge acquired during the GTIP project will be used to assess feasibility of a full-scale implementation of MAR technology in the Delta.

Andy O'Reilly | Research Hydrologist | USDA Agricultural Research Service

Andy O'Reilly is a Research Hydrologist with the U.S. Department of Agriculture, Agricultural Research Service, National Sedimentation Laboratory, in Oxford, Mississippi. He earned a Bachelor and Master of Civil Engineering from Auburn University and Ph.D. in Civil Engineering/Water Resources from University of Central Florida. Previously he was as a Hydrologist with the U.S. Geological Survey Florida Water Science Center and Assistant Professor of Geological Engineering with University of Mississippi. Andy's current research focuses on sustainability of groundwater-irrigated agroecosystems, including subsurface hydrology, contaminant transport and fate, data-driven and physics-based modeling, and engineering solutions including managed aquifer recharge and green infrastructure.

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Aquifer Storage & Recovery

The ASCE/EWRI Standard Guidelines for Managed Aquifer Recharge

In recent decades, Managed Aquifer Recharge (MAR) projects have been successfully implemented for water management around the world. However, many water resources professionals remain unaware of the benefits, techniques, standard practices and potential applications of MAR. Over the past 30-plus years much has been learned regarding how to design and implement a successful, cost-efficient MAR project and what pitfalls exist that prevent MAR success. Although there are extensive resources about various specialized aspects of MAR in the scientific literature, the US water resources sector has lacked an up-to-date, comprehensive document describing the state of the practice for MAR projects.

In 2005, the American Society of Civil Engineers/Environmental and Water Resources Institute (ASCE/EWRI) formed the Guideline Development Subcommittee for MAR. The purpose of this Subcommittee was to provide a thorough and up-to-date document that describes the state of the practice for MAR projects. The subcommittee decided to completely rewrite the existing standard guidelines for Artificial Recharge of Groundwater (EWRI/ASCE 34-01; 2001) to reflect current standards of practice from conceptualization to operation of MAR projects. The Standard Guidelines for Managed Aquifer Recharge includes details on the planning, design, construction, operation and monitoring of MAR projects. It also contains background information on groundwater and MAR concepts, an extensive discussion on data collection and analysis for each phase of a MAR project, a listing of representative MAR regulations, a glossary of MAR-related terms, and case studies.

The Standard Guidelines for Managed Aquifer Recharge was published by ASCE/EWRI in June 2020. The editor of the document and lead author of several its chapters will describe the Guidelines development process and will provide an overview of the key sections.

Gordon McCurry | Principal Hydrologist | McCurry Hydrology, LLC

Dr. McCurry, P.G., has more than 35 years of experience in hydrology, including the investigation, analysis and modeling of aquifer systems, and assessment of hydrologic impacts. His areas of expertise include the quantitative analyses of flow and solute transport, stream/aquifer interactions, water rights, regulatory permitting, aquifer remediation, and litigation support. He was editor and lead author of several chapters of the ASCE/EWRI's Standard Guidelines for Managed Aquifer Recharge.

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Energy & Groundwater

Energy-Water Nexus - Where we are and where we need to be?

The Water-Energy Nexus is a priority topic these days. There is a lot of research in action currently focused on this. This presentation will highlight WRF's participation in this space, including all the research we have funded over time as well as our current plans for future research and funding opportunities.

Ashwin Dhanasekar | Research Program Manager | The Water Research Foundation

Ashwin Dhanasekar is a Research Program Manager at The Water Research Foundation. He currently manages the Energy and Biosolids research portfolios at WRF. He has over 15 years of experience working in the Energy-Water Nexus on various projects ranging for produced water management, beneficial reuse as well as Energy from and for Water. He has a B.S in Chemical Engineering from Anna University, India and an M.S in Environmental Engineering from Colorado State University.

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Energy & Groundwater

Geothermal Opportunities in Low Temperature Formations

The world needs Terawatts of 24/7 clean renewable electricity and geothermal is the answer. Geothermal is a baseload energy everywhere beneath our feet. Technologies are needed to unlock geothermal at lower temperatures to make it cost competitive with wind, solar, and natural gas.

Sage Geosystems is targeting geothermal at these lower temperatures (100-250Â°C) and have unique technologies to optimize both the subsurface (well) and surface (power plant).

Our single well Enhanced Geothermal System (EGS) will drive down the well cost for a hot dry rock completion while improving the ability to direct fluid through the rock. Our supercritical CO2 technology will double the efficiency of converting heat to electricity and reduce the cost of the power plant.

If we can solve the low temperature geothermal challenge, we can change the profile of the utility grid and also provide secured energy for critical infrastructure everywhere such as military bases and hospitals.

Cindy Taff | COO | Sage Geosystems

Cindy D. Taff has over 35 years in the O&G industry, leaving Shell at the end of 2020. Her last role at Shell was VP of Shell's global Unconventional Wells & Logistics operations. Cindy joined Sage Geosystems in January 2021 as their COO.

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Energy & Groundwater

Exploratory Data Analysis for Critical Minerals and Recoverable Elements in Produced Water

Brines are co-produced with oil and gas, sometimes at high rates and with high TDS concentrations. Because of high TDS, produced waters have historically been deleterious substances and disposed into UIC wells. However, oil field brines are now recognized as a potential resource because critical minerals could be recovered from the brine. The USGS describes critical minerals as mineral commodities that are vital for economic growth and national security. In most cases, 100% of the critical mineral resource is imported, so we need to find domestic sources. A sub-set of critical minerals are referred to as rare earth elements. Critical minerals are most often elements, rather than minerals, and have no viable substitutes. Many of these and other industrial elements are used in medical, computer, and energy technologies and are needed to transition from fossil fuels to renewable energy sources.

Some elements have great potential for development at typical concentrations in US produced waters. This project explores data for various recoverable elements in produced waters, calculates the gross value on a dollar per barrel basis, and maps areas with potential for resource recovery from brine. For example, bromide in produced water samples had median concentrations of about 400 ppm in Oklahoma and 4000 ppm in Arkansas. So, with a 2020 value of $2.40 per kg, produced waters of Oklahoma and Arkansas had median gross values of about $1 and $10 per barrel, respectively. Lithium had a 2020 value of $8.00 per kg and a median concentration of over 100 ppm in Arkansas, so the median gross value was >$1 per barrel. Gross values for the relatively high value magnesium, copper, iodine, cesium, and rubidium can be assessed using analytical results. Unfortunately, few produced water samples have been analyzed for the very high value platinum-group metals or rare earth elements.

Kyle Murray | Principal Scientist | Murray GeoConsulting, LLC

Dr. Kyle E. Murray is the Principal Scientist at Murray GeoConsulting, LLC in Norman, Oklahoma. He has 25 years of experience working as a consultant or researcher on water resources, environmental protection, water management, energy production, seismicity, and carbon management. He has been evaluating produced water quality and assessing the viability of resource recovery from produced water and other brine and wastewater resources. Dr. Murray also pursues industrial and commercial partnerships related to the water and energy nexus, where companies are promoting the value chain of water and energy resources.

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Energy & Groundwater

Geoenvironmental Assessment of Undiscovered Uranium Resources: Proof of Concept in the Texas Coastal Plain

This presentation depicts a summary of the method of conducting a geoenvironmental assessment of developing undisovered uranium resources in the Texas Coastal Plain that were identified during U.S. Geological Survey mineral resource assessment. The geoenvironmental assessment depicts areas where, if contaminants were present, they could occur and persist in air, surface water and groundwater resources.

Katherine Walton-Day | Research Hydrologist | U.S. Geological Survey

Katie Walton-Day is a Research Hydrologist and Water Quality Specialist for the USGS Colorado Water Science Center, Denver, Colorado. Her primary research area has been hydrologic and geochemical processes affecting metal mobility in wetlands, streams, soils, and groundwater affected by acid mine drainage and mining processes. Her research involves applying reactive transport and geochemical models, stable isotope analysis, and various geochemical analytical techniques to understand metal mobility in the environment. She has worked with the U.S. Geological Survey since 1984.

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Class VI UIC

Sensitivity of Aquifer Chemistry to Changes in Carbon Dioxide Partial Pressure: Implications for Design of Groundwater Monitoring Protocols

In Carbon Sequestration and Storage (CSS) projects, great care is taken in the design and operation of the injection of carbon compounds to ensure that the sequestration is effective and permanent. Each injection site also has permitting requirements for groundwater monitoring in any overlying aquifer as a protective measure. Because the duration of the injection and sequestration periods are long, it is essential for CSS projects to have a cost-effective groundwater monitoring program with a robust sensitivity to detect any leakage. In this study, we have examined the sensitivity of aquifer chemistry (major and minor cations and anions) to the partial pressure of carbon dioxide using an aqueous speciation/solubility/sorption model. We examined a number of hydrochemical facies, both natural and synthetic, to determine which geochemical parameters are most likely to be affected by changes in the partial pressure of carbon dioxide. We anticipate that the regulatory framework and practice for CSS will be similar to that of Municipal Solid Waste (MSW) and Coal Combustion Residue (CCR) disposal sites. Prior to the injection of carbon compounds the overlying aquifer will be characterized and background values for key parameters will be established. During the injection and post-injection phases of the project there will be periodic monitoring of the groundwater parameters, which we anticipate will be compared to the established background. When Statistically-Significant Increases (SSIs) are found, an Alternate Source Demonstration (ASD) will have to be prepared that attributes the SSIs to the CSS operation or to some other source. By establishing a groundwater monitoring protocol that is specific to the site, sensitive to changes in the partial pressure of carbon dioxide, and relative insensitive to natural variability and hydrochemical facies changes, an optimal and cost-effective groundwater protection can be implemented.

Kacey Garber | Staff Professional | SCS Engineers

Ms. Garber is an experienced groundwater project manager for active and closed landfills, including routine groundwater monitoring and statistical analyses; reports and permit applications; designing sampling and analysis plans; special groundwater studies; and conducting groundwater well construction planning and design. She has also been involved in PFAS work groups. Ms. Garber has a Masters degree in Geoscience.

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Class VI UIC

Addressing the Challenges of CCUS and Pursuing a Plan to Success

Some of the most significant challenges facing Carbon Capture, Utilization, and Storage (CCUS) is identifying and evaluating geologic formations suitable to handle significant volumes of CO2 while adequately addressing the regulatory difficulties involved in the Class II enhanced oil recovery (EOR) transition or conversion to CCUS, Class VI permitting, and the competition for injection pore space. These challenges combined with growing concerns regarding the possibility of injection-induced seismicity caused by large scale CO2 injection requires the ability to maneuver through these difficulties. ALL Consulting (ALL) has extensive experience with these challenges both on the state and federal level and has been able to assist clients in achieving the regulatory goals.

In regard to injection-induced seismicity, ALL has been at the forefront of analyzing Class II seismicity in the U.S. ALL has performed predictive and technical assessment of injection-induced seismicity, fault slip potential (FSP) modeling, preparation of seismic monitoring and mitigation planning, and the successful design and installation of local seismic monitoring networks.

This presentation will examine how to plan and approach these challenges and how to address and overcome any potential hurdles.

Tom Tomastik | Chief Geologist and Regulatory Specialist | ALL Consulting LLC

Mr. Tomastik is a certified petroleum geologist with over 40 years of diverse expertise and experience in the energy sector, government, and consulting. Tom obtained his BS and MS in geology from Ohio University in 1979 and 1981. He has been involved in the planning, drilling, permitting and development of oil and gas and Class II saltwater disposal wells, Class I feasibility studies and permitting, injection well audits, stray gas investigations, natural gas and natural gas liquids storage, groundwater contamination investigation cases, induced seismicity, seismic monitoring and installation, and expert witness testimony. Tom also has been involved with oversight of the permitting, drilling, conversion, and completion of Class II disposal wells, which included all aspects of the permit process, AFE development and contractor coordination, drilling, cementing, geophysical logging, acidizing, mechanical integrity testing, injectivity testing, and well workovers.

As a chief geologist at ALL Consulting, Mr. Tomastik has experience and expertise not only in the energy sector, but previously as a state regulator, with 25-1/2 years as a senior geologist with the Ohio Department of Natural Resources (ODNR), where he oversaw the planning, permitting, drilling, and conversion of hundreds of Class II and Class III injection wells using hydrogeology, geology, and engineering specialization for well construction, completion, and surface facility operations. At ODNR, as lead geologist, Tom also conducted several hundred groundwater and stray gas investigations related to oil and gas, industrial minerals, and coal mining operations in Ohio and testified on numerous occasions as an expert witness before various commissions and in the county court system. Additionally, over his career, Tom has published 61 articles or presentations on oil and gas, secondary oil recovery, salt-solution mining, cavern storage, Class II

disposal, groundwater and stray gas investigations, CCUS, hydraulic fracturing, induced seismicity, and regulatory issues.

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Class VI UIC

Design of a science-based testing and monitoring plan to meet the requirements of UIC Class VI permits

In this presentation I will present a methodology and examples for design and evaluation of a testing and monitoring (T&M) plan to meet the requirements of Class VI permits for injection of CO2. T&M plans should be tailored to the injection plan considering the site geology, so no one prescriptive plan is optimum. The T&M design should systematically reduce risk over the life of the project, allowing documentation of secure storage, no hazard to USDW, and closure of the site at project end. I will illustrate mechanisms of linking T&M and fluid flow modeling to reduce risk and discuss how much monitoring is sufficient to meet the objectives of USDW protection and demonstrating storage permanence and storage value. Examples from both commercial projects and controlled release experiments will be show to illustrate the process.

Susan Hovorka | Senior Research Scientist | Bureau of Economic Geology, The University of Texas at Austin

Susan Hovorka is a sedimentologist who works on fluid flow in diverse applications. She has led a team working geologic storage of CO2 since 1998, with a focus on field studies, monitoring, and capacity estimation. Projects include saline injection at the Frio Test site and Cranfield Field and EOR studies at SACROC oil field, Cranfield, Hastings and West Ranch industrial CO2 utilization projects and GoMCARB offshore charaterization study. She specializes in monitoring to document retention. She has a BA from Earlham College and a PhD in Geology from The University of Texas at Austin.

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Groundwater Data & Characterization

Water Quality Site Selection and Database Management of Wells and Springs in Utah for the National Ground Water Monitoring Network

The Utah Geological Survey (UGS) has established a groundwater monitoring network in Utah to contribute to the National Ground-Water Monitoring Network (NGWMN). The UGS has created a widespread and comprehensive monitoring network of approximately 100 wells and springs, courtesy of lab analysis provided by the U.S. EPA. The primary goal of this project is to document water-quality changes over time by sampling annually. Additional goals are to document water resources in a well administered and maintained database and integrate our state-level data with a national-level database.

Our site selection criteria follows guidelines of the Framework Document (Subcommittee on Groundwater); the primary site selection criteria are accessibility and representativeness of aquifers of interest. Most of the sites in the UGS Network are designated for trend monitoring, where samples are collected on a yearly basis. The priority is to characterize the water quality of key aquifers in Utah. To ensure high accessibility, most of the wells in our network are regularly pumped and privately owned. We chose wells with well logs or sufficient aquifer information to ensure that they are representative of the aquifer of interest. We sample about 35 springs throughout the state, ranging from smaller springs in mountain blocks or mountain fronts to large regional springs. Selected springs are (1) accessible sampling points that represent major aquifer chemistry where no nearby well is available, (2) large springs that represent the integrated aquifer chemistry for an entire drainage basin, or (3) springs in mountain areas that represent chemistry of waters recharging the adjacent aquifers.

We are cooperating with the USGS to maintain a connection between the UGS Water-Quality Network and the NGWMN, and we are providing the NGWMN with selected sites and related quality controlled data.

Janae Wallace | Senior Scientist | utah geological survey

Janae Wallace is a Utah licensed professional geologist and Senior Scientist for the Utah Geological Survey. She received her B.S. in geology from University of Utah in Salt Lake City and M.S. in geology from Northern Arizona University in Flagstaff. She has been employed with the UGS in the Groundwater Program since 1996. Her principal duties include groundwater-quality projects, with an emphasis on petitioning and classifying aquifers across the state, elevated nitrate concentrations in rural valleys, septic-tank density recommendation maps, environmental tracer analysis, pesticide sensitivity and vulnerability maps, and water well-cuttings analysis.

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Groundwater Data & Characterization

Ohio EPA's Ambient Ground Water Quality Characterization Program (AGWQMP)

Ohio-EPA maintains an Ambient Ground Water Quality Monitoring Program (AGWQMP) to characterize general water quality conditions in Ohio. The primary objective of the AGWQMP is to provide state-wide ground water quality data (from raw, untreated water) to characterize the water quality across Ohio. The goals are to enhance water resource planning and to help prioritize protection activities. The AGQWMP prioritizes on collecting data representative of aquifers used as source water by public water systems. The program was originally established in 1973 to measure seasonal and annual water quality changes in the State's major aquifers. The program underwent significant updates in 1986 and 1994 to improve geographic distribution and provide better representation of the primary aquifers in Ohio. The current distribution of AGWQMP wells across Ohio is by lithology/aquifer type. Of the 200 plus active wells, 92 percent are public water systems. Of the active wells, 60% are in unconsolidated aquifers, 23% are in limestone aquifers, and 17% are in sandstone aquifers. Raw water samples are analyzed for inorganics every 6, 18, or 36 months depending on the total number of samples that have been collected, and the stability of the geochemistry of major elements at the site. Inorganic samples are analyzed for 31 parameters and organic samples are analyzed for 61 VOC parameters. All data are reviewed in a quality control process before being entered into a database. Ohio ground water data can be viewed in three ways as time series, as summary data, and as detailed, individual well information. These well summaries can be viewed on the Ohio EPA website through an interactive map.

Katharine Schleich | Environmental Specialist 2 | Ohio Environmental Protection Agency

Katharine joined the Division of Drinking and Ground Waters at the Ohio EPA in 2021 where she works on water quality issues across the state, including coordinating the Ambient Ground Water Quality Monitoring Program. Prior to joining the Ohio EPA, Katharine spent seven years with the Illinois State Geological Survey where she worked on issues ranging from wetland water quality to highway and stormwater runoff. Katharine received a Bachelor's degree in Geological Sciences from the College of Wooster and a Master of Science with a concentration in environmental geochemistry from Ohio University.

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Groundwater Data & Characterization

Alabama WaterSTAR: A New Tool for Groundwater Assessment and Data Storage and Sharing

The Geological Survey of Alabama Groundwater Assessment Program (GSA-GAP) began development of the Alabama WaterSTAR database in conjunction with the Groundwater Protection Council and Coordinate Solutions in 2021 as an upgrade for the RBDMS-Environmental database that currently serves as a repository for well location, construction, water level, and hydrochemical data. Alabama WaterSTAR provides all the storage benefits of RBDMS-Environmental, with enhanced search, filtering, and analytical features creating a more useful research tool for groundwater assessment. It includes an interactive geospatial display, multiple layer capability, the ability to filter, search, and display site and project information, plus the ability to graph water level and hydrochemical data using a variety of plots. The application will include an electronic submission form for well driller reports, which have historically been submitted on paper. Drillers will be able to complete the form on site or in the office and submit them directly to the database. Real-time water level information from the GSA-GAP network will be served to the USGS National Groundwater Monitoring Network through the Alabama WaterSTAR application. The application can display statistical variations of water levels obtained from wells in the GSA-GAP monitoring networks, allowing for evaluation of water level changes in response to natural and anthropogenic stresses. Alabama WaterSTAR has been used to perform a statewide search for groundwater levels measured during a specific time interval with results exported in Excel format for upload into ArcGIS. It has also been used as part of our initial efforts to establish a saltwater encroachment monitoring network by identifying and displaying wells in a defined search area and filtering the data based on salinity, chloride, bromide, and conductivity concentrations. Collectively, Alabama WaterSTAR enhances our abilities to assess existing data and upload new data on the state's groundwater resources.

Gregory Guthrie | Director, Groundwater Assessment Program | Geological Survey of Alabama

Mr. Guthrie is the Director of the Groundwater Assessment Program and former chief of the Mineral Resources Section at the Geological Survey of Alabama. He is a member of the University of Alabama Graduate Faculty and a Registered Professional Geologist with almost 40-years' experience as a geologist and hydrologist with the state of Alabama and as a consultant. He has authored more than 50 reviewed publications and professional conference presentations on research topics ranging from groundwater availability and groundwater flow in fractured rocks to the genesis of gold and marble deposits. His current research involves hydrochemical development in selected aquifers and aquifer recharge throughout Alabama's hydrogeologic provinces.

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Class II UIC & Gas Storage

New Mexico's Closed Loop Gas Capture Pilot Program

The presentation will provide information regarding the New Mexico Oil Conservation Division's actions and processes which allow a new innovative pilot program providing a controlled environment to capture natural gas that would otherwise be vented or flared permanently wasting the resource. The pilot program permits the gas to be temporarily injected down a production well and then be produced back up the well which properly captures and utilizes the resource. This process is also being closely monitored to see if it is also providing enhanced production to injected well and nearby wells similar to gas stimulations or gas flood scenarios.

Adrienne Sandoval | Division Director | New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division

Adrienne Sandoval was named the Director of the Oil Conservation Division in April of 2019. During her time at EMNRD Director Sandoval has led the Division's modernization efforts and implementation of the natural gas waste rule. Prior to the Oil Conservation Division, Ms. Sandoval worked within the oil and gas industry and spent previous years in the Marathon Petroleum's Denver office working on federal regulatory affairs and legislative matters. Prior to that she worked for the Williams Companies out of Tulsa, OK. She holds a Master of Engineering in Chemical Engineering and a Bachelor of Science in Chemistry from the University of Tulsa.

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Class II UIC & Gas Storage

A State-Wide Automated Web-Based Tool for Estimating Injectate Migration from Class II Wells in Texas

Brackish groundwater (TDS < 10,000 mg/L) is planned to supply up to two percent (more than 150,000 acre-feet/year) of the projected water demand in Texas by the year 2070. Therefore, it is important to closely assess and protect brackish groundwater sources. The Brackish Aquifer Characterization System (BRACS) team at the Texas Water Development Board (TWDB) is directed to assess potential brackish groundwater sources in Texas and the TWDB designates Brackish Groundwater Production Zones (BGPZs). As part of this program, the TWDB cannot designate BGPZs in strata used or designated for wastewater injection, and production from BGPZs cannot cause a significant impact on freshwater supplies. Given these criteria, the BRACS team chose to buffer Class II injection wells. In the past, the BRACS team used a 15-mile buffer distance due to a lack of injectate migration data. Therefore, the TWDB contracted a study to develop processes for estimating injectate migration from Class II wells in the State. In this presentation, we provide details about the study and its results. We will demonstrate an automated web-based tool that was developed to analyze the migration of injectate from the Class II injection wells in Texas. Procedures were developed to streamline and automate: (1) compilation of injection well data from the Railroad Commission of Texas databases; (2) obtaining hydrogeologic and hydrostratigraphic information from available BRACS studies; and (3) model the migration of injectate within the BRACS study aquifers. Three analytical and one numerical modeling techniques were analyzed and the Bear and Jacobs (1965) analytical model was found to be the most appropriate for the study. The procedures based on analytical methods provide generic and robust computations in their application for deep well injection analysis. The web-based tool, incorporating the analytical solution, is suitable for regional-scale analyses and provides efficient screening-level assessments that can identify areas that may need site-specific focused studies. Additionally, the procedures are sufficiently flexible and can be easily adopted for similar analyses of injectate migration for other well classes in various aquifer systems or in computing extraction well capture zones within the brackish zones. Texas Commission on Environmental Quality (TCEQ) has also developed a web-based tool based on the same analytical technique to assess aquifer storage and recovery projects.

Rohit Goswami | Independent Engineer | RRG Professional Engineering, LLC

Dr. Rohit R. Goswami, Ph.D., PE (TX) has over 14 years of experience in the water resources and environmental field. Dr. Goswami has experience as a technical lead on various hydrological, hydrogeological, and environmental projects for industrial, municipal, and governmental entities. His expertise includes the development of conceptual and numerical models for evaluating water quantity and quality, environmental data review and analysis, evaluating groundwater-surface water interactions, groundwater flow and transport modeling, well-field design, estimating groundwater recharge potential, and stakeholder outreach and communication.

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Class II UIC & Gas Storage

Induced Seismicity in the Permian Basin - Current Understandings, Relationships and Mitigating Actions

Since 2016, seismicity levels over magnitude (M) 2.0 have continued to increase across a large swath of the Permian basin in Texas and Southern New Mexico. In 2017, the USGS recorded 51 M2.0+ events, in 2021, the USGS reported 589 M2.0+ events. This increase in overall seismicity has also been accompanied with an increase in larger (M3.5+) events and the two largest ever recorded events in the basin. A magnitude 4.9 event that occurred in March of 2020 in Culberson County and a magnitude 4.6 event that occurred in December 2021 in Martin County. Accompanying the increase in seismicity, research has been directed at looking into what is behind the increase in events across the Permian Basin. Research groups from the University of Texas Austin, Stanford, USGS and other research groups have published research indicating that oil and gas operations, and even more so, the disposal of produced water via saltwater disposal wells (Class II UIC wells), appear to be the most likely causation of earthquakes in the Permian Basin. Regulatory agencies in Texas, New Mexico, along with industry and research groups are working collaboratively to further understand causal factors of seismicity and what operational and regulatory steps should be taken to address seismicity issues within the Perriman Basin.

This presentation will go over the increase in seismicity across the Permian, understanding of EQ event locations, implications for causality and current regulatory / industry work to address seismicity issues.

Cody Comiskey | Earth Science Advisor | Chevron

I am currently an Earth Science Advisor for Chevron's Mid-Continent Business Unit responsible for induced seismicity operational understanding, planning and research. I have been in the industry for 10 years (2 at Chevron and 8 at Anadarko Petroleum Corp) and I hold a B.S. in Geophysics from Texas Tech University and a M.S. in Seismology from Baylor University.

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Class I UIC

Microbially Influenced Corrosion in Injection Wells - A Case Study in a Class I Well for Coal Combustion Residuals

Microbially influenced corrosion (MIC) is known as a direct cause of mechanical integrity failure in injection wells. While premature failures of expendable components, such as casing and packers, are both inconvenient and expensive, this is not the only reason to proactively address downhole biological issues. Stringent control and mitigation of biological activity is imperative to minimizing bore hole fouling and subsequent plugging of an injection reservoir. If left untreated, the long-term reservoir health and operational efficiency of a well may be jeopardized.

This presentation will summarize a case study of MIC-related failure in a Class I injection well used for disposal of leachate from a coal combustion residuals facility. The well failed to maintain internal mechanical integrity just six months after it was commissioned. We'll walk through the investigation process which included annular pressure testing, downhole caliper logging, casing thickness detection, injection fluid analysis, and metallurgical analysis to identify the cause of failure. Following replacement of the injection casing and packer, injection tests were conducted to assess the potential impacts of MIC on the reservoir's ability to accept injected fluids. A proactive disinfection plan was customized based on the unique investigative results and implemented to prevent future MIC-related issues.

Stephanie Hill | Project Director | SCS Engineers

Stephanie Hill is a hydrogeologist, program leader for SCS Engineers' Carbon Sequestration and Deep Well Injection practice, and licensed Professional Geologist. She earned a BS in Geosciences with emphasis in hydrogeology and geomorphology at the University of Texas. Stephanie's early career focused on environmental compliance for mineral and fossil fuel industries at the Texas Commission on Environmental Quality (1996 to 2000) and the Railroad Commission of Texas (2000 to 2012). Currently she leads a team of geologists and engineers to advise clients of various industries on geologic storage options for carbon neutrality and disposal solutions for liquid residuals.

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Class I UIC

Proactively Preventing Class I Hazardous and Non-Hazardous Injection Well Failures Via Tracking Annulus Fluid Levels

Ohio EPA has found that in some cases by monitoring the annulus fluid levels in the sealed surface storage tanks for Class I injection wells, that tubing and casing leaks can be detected and well mechanical failure anticipated. Prior to conducting this study, it was believed that Class I injection well failures could only be detected at the time the incident occurred. In this presentation, three case studies will be presented where unusual and consistent loss of annulus fluid signaled a leak in the casing or tubing. In all case studies, the injection well(s) in question had passed required and requested mechanical integrity tests (MIT's), which include annulus pressure tests and radioactive tracer tests. The injection well casing or tubing failures subsequently occurred shortly after the MITs were performed. Ohio EPA is continuing to develop this technique for predicting the loss of mechanical integrity including incorporating corrosion monitoring data and other data to enhance the predictability of the method.

Tim Hampel | Geologist 3 | Ohio EPA

I have been working with the Ohio Environmental Protection Agency's (OEPA) Underground Injection Control (UIC) Unit since February of 2017.

I earned my Master's in Mineralogy, Petrology, and Geochemistry from Washington State University in August of 2012 and my Bachelor of Science degree in Geology from Bowling Green State University in May of 2009.

In addition to my responsibilities of regulating Class I hazardous and non-hazardous underground injection control wells, I develop models, synthesize information from multiple sources, and work with the regulated community to proactively prevent injection well failures.

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Produced Water

Produced Water Treatment and Reuse: Solar Thermal Desalination with Combined Heat & Power Cycle, and High Salinity Carbonated Water Flooding

Approximately 24.4 billion barrels of produced water weregenerated in the USA in 2017. This volume is more than 70 times the volume of all the liquid hazardous wastes generated in thecountry. The estimated produced water treatment cost for reuse,and/or disposal ranges from $0.57 to $7.49 per barrel. Typicallyproduced water salinity ranges from a few thousand to 463,000ppm TDS. Processing and disposal of high salinity produced waterposes a significant environmental and economic burden for theindustry and communities.

Thermal desalination technologies are one class of the methodsused to treat produced water. But, the high-energy demand andthe associated cost are a major concern for the technologies. Thehigh-energy requirement is mainly due to the high latent heat ofvaporization and inefficient boiling process especially due to 'boiling crisis'. Produced water can also be reinjected into the oilreservoirs for waterflooding purposes. However, high salinitybrine flooding is known to be not as efficient for oil recoverycompared to low-salinity water flooding (LSWF), therefore, thehigh salinity brine should be diluted using freshwater.

Prem Bikkina | Dr. | Oklahoma State University

Dr. Bikkina is currently an Associate Professor and Harold Courson Chair in Petroleum Engineering at Oklahoma State University. He has B.S. and M.S. degrees in Chemical Engineering from NIT Warangal and IIT Guwahati, India, respectively, and Ph.D. degree in Petroleum Engineering from the University of Tulsa. He worked as a postdoctoral fellow at Lawrence Berkeley National Laboratory. He also worked for various chemical and petroleum industries. His research work on enhanced hydrocarbon recovery, geological sequestration, and gettability-based nucleate boiling and dissolved gas separation resulted into high-impact journal publications and patents. His research projects have been funded by various private and government funding agencies. He has been a peer reviewer for more than 17 international journals, ACS PRF, DOE, and NSF EPSCoR proposals. Dr. Bikkina received the~2016 Outstanding Reviewer Award' from theJournal of Environmental Chemical Engineering, ~2016 SPE Mid-Continent Regional Service Award', ~2017 SPE Distinguished Petroleum Engineering Faculty Award', and 2019 CEAT Excellent TeacherAward. He is a professional member of SPE, AIChE, ACS, and ASME, and serving as an Associate Editor of Petroleum Science and Technology journal.

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- Dr. Clint Aichele, Associate Professor, Oklahoma State University

Produced Water

Produced Water Reuse - From An ESG and Production Enhancement Standpoint

Over the past decade, the oil and gas industry has made great strides using produced water in place of fresh ground or surface water in oil and gas operations, particularly those operations associated with hydraulic fracturing as the modern day hydraulic fracturing of a multi-mile long horizontal wellbore requires copious quantities of water. Over this short span of time, the industry has moved from a point where the chemical additives available for use in completion operations (hydraulic fracturing) would only work when mixed in fresh water to now having a diverse assortment of products available for virtually any water quality. This innovation in completion additives and in the treatment needed to ready a produced water for use has largely been driven by the economics of produced water disposal is some areas and by the scarcity of fresh water in others.

In this presentation, the author will tout the increase in produced and brackish water in the oil and gas industry but will demonstrate that there is room for even greater usage. Using produced water as an offset to freshwater usage will be promoted from an Environmental, Social and Governance (ESG) standpoint. Additionally, the author will make the case that produced water may provide a greater benefit through less reservoir impairment and will utilize three case histories to defend this claim. Lastly, market drivers that "force" freshwater use over produced water will be discussed with thoughts on how these forces might be weakened or disrupted.

Rick McCurdy | VP - Innovation & Sustainability | Select Energy Services

Rick currently serves as VP of Innovation and Sustainability for Select Energy Services, a US-based service provider active in the water sourcing, treatment, reuse and chemical application spaces. Rick is focused on minimizing fresh water use in the oil and gas industry and in evaluating the beneficial use of treated produced water. He has served as a technical expert to US EPA on potential impacts of hydraulic fracturing on water resources and has presented to the National Academy of Sciences, the GAO, DOE, and EIA regarding water use in the Energy Sector. Rick has an AAS degree in Petroleum Technology.

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Produced Water

Trends in the Fit-for-Purpose Treatment and Reuse of Produced Water

In November 2019, the US Environmental Protection Agency (USEPA) asked the New Mexico Produced Water Research Consortium (Consortium) to collaborate with the Ground Water Protection Council (GWPC) to lead fit-for-purpose treatment and reuse efforts in produced water for the National Water Reuse Action Plan (WRAP). New Mexico and the GWPC were selected because of an established history of coordination and science and technology research on the growing use of non-traditional water resources, including produced water, to supplement fresh water supplies needed to meet growing water demands inside and outside the oil and gas sector.

The Consortium was formed in September 2019 as a result of the 2019 New Mexico Produced Water Act that established the New Mexico Environment Department as the regulatory and policy authority for the oversight, management, and treatment of the reuse of produced water outside of the oil and gas sector. The role of the Consortium is to coordinate a science and technology program in collaboration with state and federal environmental and natural resource agencies, academia, industry, non-governmental organizations (NGOs) and user associations to identify and develop the analytical tools, socio-economic models, and treatment technologies needed to support science-based policies and regulation for the treatment and fit-for purpose reuse of produced water.

This presentation will highlight some of the emerging trends and information on treatment and reuse of produced water, emerging health and safety issues, directions in produced water characterization and analysis, state-of-the-science risk and toxicology characterization research techniques, and economic development and quantitative ESG modeling and analysis of produced water reuse. We will also highlight collaboration with a coalition of oil and gas producing states to collaborate on regional and national research funding opportunities to address emerging fit-for-purpose produced water treatment and reuse challenges.

Mike Hightower | Director, NM Produced Water Research Consortium | NM Produced Water Research Consortium

Mike is Program Director of the New Mexico Produced Water Research Consortium, a joint effort by the NM Environment Department and New Mexico State University. Mike is retired from Sandia National Laboratories where he worked for 38 years in the areas of aerospace, weapons, energy, and natural resources research, analysis, and engineering. Mike holds Bachelor's and Master's degrees in civil and environmental engineering from New Mexico State University. For the past three decades he has focused on the development of innovative distributed energy and water treatment and desalination technologies to improve critical infrastructure and natural resource security, resiliency, and sustainability.

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Additional Authors: Pei Xu, Research Director, and Deborah Dixon Research Fellow, NM Produced Water Research Consortium

Produced Water

Alternative Produced Water Management Strategies in a Seismically Restricted World â€“ Issues and Opportunities

Despite elevated oil prices, saltwater disposal restrictions due to increased seismic activity threaten E&P expansion in the Delaware Basin. As increased seismic activity has been observed in west Texas and southern New Mexico, regulators have begun restricting regional disposal volumes, specifically focusing on Deep SWDs injecting into the Devonian and Silurian formations. As a growing number of Deep SWD operations face restrictions, alternative water management approaches such as evaporation, recycling, and shallow are becoming more lucrative options. Although each approach is technically feasible, they also face various technical, regulatory, and stakeholder challenges that must be overcome. This presentation will discuss the pros and cons of the alternative approaches, the various issues faced by each, and how those issues might be overcome.

Nate Alleman | UIC and Water Infrastructure Specialist | ALL Consulting

Mr. Alleman is a partner at ALL Consulting and has been in the oil and gas industry for almost 15 years where he has served many roles associated with regulatory development and water management. For approximately 10 years he worked directly with upstream oil and gas operators across the country to develop and implement regulatory processes and procedures to maintain compliance with local, state, and Federal regulations and laws. He currently serves as ALL Consulting's UIC Team Lead and manages the planning, design, permitting, and construction of water supply wells, brine wells, water recycling and treatment systems, injection wells, and carbon sequestration wells. In this role, he has conducted due diligence audits on over 200 SWD facilities and managed the permitting of over 100 SWDs throughout numerous basins. Mr. Alleman has testified as the regulatory expert in over 25 hearings related to permitting and operation of UIC wells.

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Source Water

The Bipartisan Infrastructure Law and Source Water Protection

The Bipartisan Infrastructure Law (BIL) is an historic investment in key programs and initiatives implemented by the U.S. Environmental Protection Agency to build safer, healthier, cleaner communities. It includes $50 billion to the EPA to strengthen the nation's drinking water and wastewater systems the single largest investment in water that the federal government has ever made. Most of this funding will be administered through the existing Clean Water and Drinking Water State Revolving Funds (CWSRF and DWSRF), which each have opportunities for funding source water protection. As states assess their SRF programs considering this unprecedented investment from Congress, there is opportunity to think broadly and consider new ways to invest in water quality improvement and source water protection. Now is a great time to learn about these opportunities and the steps to take to leverage these funds to protect drinking water sources. This presentation will cover the basics of the SRF programs, including the DWSRF set-asides, the new investments from the BIL, opportunities for protecting drinking water sources with the SRFs, and how to get started.

Kara Goodwin | Physical Scientist | US EPA

Kara is a physical scientist with EPA's Drinking Water Protection Division in the Office of Ground Water and Drinking Water in Washington, DC, and is a member of the Source Water Protection Team. In this role she builds and strengthens connections among environmental programs to protect drinking water sources. Kara has a M.S. in Environmental Science from Washington State University and a B.A. in Biology with a concentration in environmental studies from Bryn Mawr College.

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Source Water

Mo' Money for Groundwater by way of SDWA and on to CWA 319: A Tour of Nebraska's new Drinking Water Protection Management Plans

Ever lay awake at night wondering how you can utilize CWA 319 funds to protect groundwater in your state? Luckily for you in this presentation we'll walk through Nebraska's new Drinking Water Protection Management Plan guidance document including the resources, literature, modeling, and attitude you'll need to draft a plan of your own. Nebraska's groundwater contaminant focus is nitrate, but this approach can be applied to your contaminant de jour to unlock new opportunities to protect drinking water in your communities.

Tatiana Davila | Hydrogeologist, Wellhead Protection Coordinator, Source Water Protection Coordinator | NE Department of Environment and Energy

Tatiana is a hydrogeologist in the Drinking Water and Groundwater Division of the Nebraska Department of Environment and Energy (NDEE). She coordinates two statewide programs that assist communities in protecting their drinking water and spends much of her time traveling across the state to collaborate with stakeholders. Tatiana is passionate about science communication and empowering citizens with data by demystifying complex processes such as groundwater modeling. Before coming to NDEE she worked in the oil and gas industry in Denver, CO. She holds a BS in Geology and is currently completing a MS in Hydrological Sciences at UNL.

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Source Water

AWWA Stormwater Management for Water Utility Standard

Water utilities strive to have a well-run water system that protects public health. As stormwater becomes more important to water professionals, AWWA Standards Council has authorized the development of a new Utility Management Standard, namely Stormwater Management for Water Utility Standard. A committee has been working on the standard and the new standard has been approved in January 2022. The new standard is targeting drinking water utilities and addressing issues such as water quality, water quantity, design, operation and maintenance, emergency preparedness and response, and public outreach and communication. The purpose of this paper is to present the content of the new standard and open up discussions regarding effective mechanisms to implement the standard.

Chi Ho Sham | VP & Chief Scientist | ERG

Chi Ho Sham is a Vice President and the Chief Scientist of ERG in Lexington, MA. Over the past three decades, he has worked extensively in drinking water protection and water quality issues. He is an active members of the Ground Water Protection Council since 1992. He is also an active member of the American Water Works Association (AWWA) since 2000 and has been the President from 2021 to 2022. He received his B.A. from the University of Regina in Canada and his M.A. and Ph.D. from the University at Buffalo. Currently, he is an adjunct professor and a research fellow at Clark University in Worcester, Massachusetts.

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Source Water

Perryville, Missouri - Karst Capital of the World?

Perry County, Missouri is home to over 700 caves, including 4 of the 5 longest in the Missouri. The City maintains easements to over 330 sinkholes and accepts responsibility for more every year. Several years ago, US Fish & Wildlife designated Perry County's own Grotto Sculpin as an endangered species. The community went to work to develop a plan of self-policing with a host of Federal, State and local partners. Our efforts have been featured in the Missouri Conservationist and L-A-D foundation documentary. We have learned a great deal about ourselves, this rare little fish and how to best maintain and improve (when necessary) naturally occurring sinkholes.

- The first is an article in the Missouri Conservationist. https://mdc.mo.gov/magazines/missouri-conservationist/2022-02/cave-country
- The 2nd is a documentary commissioned by the L-A-D Foundation. https://ladfoundation.org/perry-county-karst/

Brent Buerck | City Administrator | City of Perryville

Brent Buerck is the City Administrator of Perryville, Missouri (population of about 8,500). He has been blessed to serve his hometown in this capacity for the past 12+ years. He has a Bachelor of Science in Criminal Justice from Southeast Missouri State University and a Master of Public Administration from the University of Missouri. Brent is also an alumni of the Delta Leadership Institute and completed the 2022 Biography for Karst Presentations Brent Buerck is the City Administrator of Perryville, Missouri (population of about 8,500). He has been blessed to serve his hometown in this capacity for the past 12+ years. He has a Bachelor of Science in Criminal Justice from Southeast Missouri State University and a Master of Public Administration from the University of Missouri. Brent is also an alumni of the Delta Leadership Institute and completed the Harvard Kennedy School Program: Leadership for the 21st Century.

Perryville has been widely recognized for its strong economy, high quality local workforce and tremendous number of caves and sinkholes. Over the years, Brent has given numerous presentations on economic development issues, best practices for sinkhole maintenance and a host of other topics. Prior to his time in Perryville, Brent spent 13 years working for the Missouri Division of Youth Services (DYS). DYS's Missouri Model is nationally recognized for its therapeutic approach to treating juvenile offenders and their families. His finished his career in DYS's Central Office in Jefferson City. There he was responsible for several areas of statewide import, including: Policy Council, Medical Services, Emergency Management, Judicial and Legal Liaison, Interstate Compact and Case Management.

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Additional Authors: Denise Vaughn was the author of the article and director for the documentary.

Induced Seismicity

Induced Seismicity: What Has Changed and What Is Important for Decision Making?

The Regional Induced Seismicity Collaborative (RISC) was created to improve the ways data and ideas are shared across the geological surveys of states in the southern midcontinent of the United States (e.g., Texas, Oklahoma, New Mexico, Kansas, and Arkansas) and how these collaborations have impacted regulatory practices in each state.

This panel-style special session will focus on the coevolution of research and regulation in states that are experiencing induced seismic events.

Goals of this session include:

(1) To better understand recent seismicity and the injection-related data that the states collect, synthesize, and make available to the public.

(2) To understand how data are used by regulators in their decisions related to SWD wells and how emergent seismogenic regions have impacted the decision-making process.

(3) To find commonalities and differences between approaches used to mitigate seismicity and risk.

Elizabeth Horne | Lily Horne, RISC PI and Structural Interpretation Specialist for the Center for Integrated Seismicity Research (CISR), Bureau of Economic Geology, UT Austin | Bureau of Economic Geology, The University of Texas at Austin

Elizabeth A. Horne (Lily) is a structural geologist at the Bureau of Economic Geology, UT Austin. She has a geology M.S. from Colorado School of Mines and a geology B.S. from Utah State University. She is the lead PI for the Regional Induced Seismicity Collaborative (RISC) and structural interpretation specialist for the TexNet Seismic Monitoring and Center for Integrated Seismicity Research (CISR) consortium.

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