U.S. Department of Energy
FEDERAL ASSISTANCE REPORTING CHECKLIST AND INSTRUCTIONS FOR RD&D PROJECTS

DOE F 4600.2
(03/11)
All Other Editions Are Obsolete

1. Identification Number: **DE-FE0006821**	2. Program/Project Title: **Small Scale Field Test Demonstration CO2 Sequestration**	
3. Recipient: **University of Kansas Center for Research, Inc.**		
4. Reporting Requirements:	Frequency	Addressees
A. MANAGEMENT REPORTING		
☒ Research Performance Progress Report (RPPR)	Q	FITS@NETL.DOE.GOV
☒ Special Status Report	A	FITS@NETL.DOE.GOV
B. SCIENTIFIC/TECHNICAL REPORTING		
(Reports/Products must be submitted with appropriate DOE F 241. The 241 forms are available at www.osti.gov/elink)		
Report/Product — Form		
☒ Final Scientific/Technical Report — DOE F 241.3	FG	http://www.osti.gov/elink-2413
☒ Conference papers/proceedings* — DOE F 241.3	A	http://www.osti.gov/elink-2413
☐ Software/Manual — DOE F 241.4		
☐ Other (see special instructions) — DOE F 241.3		
** Scientific and technical conferences only*		
C. FINANCIAL REPORTING		FITS@NETL.DOE.GOV
☒ SF-425 Federal Financial Report	Q, FG	
D. CLOSEOUT REPORTING		
☒ Patent Certification	FC	FITS@NETL.DOE.GOV
☒ SF-428 & 428B Final Property Report	FC	FITS@NETL.DOE.GOV
☐ Other		mailto:FITS@NETL.DOE.GOV
E. OTHER REPORTING		
☒ Annual Indirect Cost Proposal	O	See block 5 below for instructions.
☐ Audit of For-Profit Recipients		
☒ SF-428 Tangible Personal Property Report Forms Family	A	FITS@NETL.DOE.GOV
☒ Other – see block 5 below	A	FITS@NETL.DOE.GOV

FREQUENCY CODES AND DUE DATES:

- A - Within 5 calendar days after events or as specified.
- FG- Final; 90 calendar days after the project period ends.
- FC- Final; End of Effort.
- Y - Yearly; 90 calendar days after the end of the reporting period.
- S - Semiannually; within 30 calendar days after end of project year and project half-year.
- Q - Quarterly; within 30 days after end of the reporting period.
- Y180 – Yearly; 180 days after the end of the recipient's fiscal year
- O - Other; See instructions for further details.

5. Special Instructions:

Annual Indirect Cost Proposal – If DOE is the Cognizant Federal Agency, then the proposal should be sent to FITS@NETL.DOE.GOV . Otherwise, it should be sent to the Cognizant Federal Agency.

Other – The Recipient shall provide all deliverables as contained in Section D of Attachment 2 Statement of Project Objectives.

QUARTERLY PROGRESS REPORT

To

DOE-NETL

Brian Dressel, Program Manager

Award Number: DE-FE0006821

SMALL SCALE FIELD TEST DEMONSTRATING CO_2 SEQUESTRATION IN ARBUCKLE SALINE AQUIFER AND BY CO_2-EOR AT WELLINGTON FIELD, SUMNER COUNTY, KANSAS

Project Director/Principal Investigator:
W. Lynn Watney
Senior Scientific Fellow
Kansas Geological Survey

Ph: 785-864-2184
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Joint Principal Investigator:
Jason Rush

Date of Revised Report: February 13, 2012

DUNS Number: 076248616

Recipient: University of Kansas Center for Research &
Kansas Geological Survey
1930 Constant Avenue
Lawrence, KS 66047

Project/Grant Period: 10/1/2011 through 9/30/2015

First Quarterly Report

Period Covered by the Report: October 1, 2011 through December 31, 2011

Signature of Submitting Official:

Willard Lynn Watney

Digitally signed by Willard Lynn Watney
DN: cn=Willard Lynn Watney, o=The University of Kansas, ou=Kansas Geological Survey, email=lwatney@kgs.ku.edu, c=US
Date: 2012.02.14 11:25:44 -06'00'

EXECUTIVE SUMMARY

Project Objectives

The objectives of this project are: (1) inject under supercritical conditions approximately 40,000 metric tons of CO_2 into the Arbuckle saline aquifer; (2) demonstrate the application of state-of-the-art MVA (monitoring, verification, and accounting) tools and techniques to monitor and visualize the injected CO_2 plume; (3) develop a robust Arbuckle geomodel by integrating data collected from the proposed study area, and a multi-component 3D seismic survey; (4) conduct reservoir simulation studies to map CO_2 plume dispersal and estimate tonnage of CO_2 sequestered in solution, as residual gas and by mineralization; (5) integrate MVA data and analysis with reservoir modeling studies to detect CO_2 leakage and to validate the simulation model; (6) develop a rapid-response mitigation plan to minimize CO_2 leakage and a comprehensive risk management strategy; and (7) establish best practice methodologies for MVA and closure. Additionally, approximately 30,000 metric tons of CO_2 shall be injected into the overlying Mississippian to evaluate miscible CO_2-EOR potential in a 5-spot pilot pattern. The CO_2 shall be supplied from the Abengoa Bioenergy ethanol plant at Colwich, Kansas who has operated the facility since 1982 demonstrating reliability and capability to provide an adequate stream and quality of CO_2. The project shall install compression, chilling, and transport facilities at the ethanol plant for truck transport to the injection site.

Project Goals

The proposed small scale injection will advance the science and practice of carbon sequestration in the Midcontinent by refining characterization and modeling, evaluating best practices for MVA tailored to the geologic setting, optimize methods for remediation and risk management, and provide technical information and training to enable additional projects and facilitate discussions on issues of liability and risk management for operators, regulators, and policy makers.

The data gathered as part of this research effort and pilot study will be shared with the Southwest Sequestration Partnership (SWP) and integrated into the National Carbon Sequestration Database and Geographic Information System (NATCARB) and the 6th Edition of the Carbon Sequestration Atlas of the United States and Canada.

Project Deliverables by Task

1.5	Well Drilling and Installation Plan (Can be Appendix to PMP or Quarterly Report)
1.6	MVA Plan (Can be Appendix to PMP or Quarterly Report)
1.7	Public Outreach Plan (Can be Appendix to PMP)
1.8	Arbuckle Injection Permit Application Review go/no go Memo
1.9	Mississippian Injection Permit Application Review go/no go Memo
1.10	Site Development, Operations, and Closure Plan (Can be Appendix to PMP)
2.0	Suitable geology for Injection Arbuckle go/no go Memo
3.0	Suitable geology for Injection Mississippian go/no go Memo
11.2	Capture and Compression Design and Cost Evaluation go/no go Memo
19	Updated Site Characterization/Conceptual Models (Can be Appendix to Quarterly Report)

21 Commercialization Plan (Can be Appendix to Quarterly Report).
30 Best Practices Plan (Can be Appendix to Quarterly or Final Report)

ACCOMPLISHMENTS

ONGOING ACTIVITIES –

TASK 1. PROJECT MANAGEMENT AND REPORTING

Subtask 1.1. Finalize Program Management Plan

PMP Preparation and Completion Update.

This task shall include all work elements required to maintain and revise the PMP, and to manage and report on activities in accordance with the plan. The PMP includes necessary activities to ensure coordination and planning of the project with DOE/NETL and other participants. PMP also includes a funding profile, project milestones, project schedule, organizational structure, and a project specific quality assurance program. The completed PMP will contain the contract agreement and plan to procure the CO_2 for the injection test that guarantees that the CO_2 will be available for the injection project.

The PMP is a living document and will be reviewed and modified at the beginning and end of each task/milestone. The PMP shall be adapted to future activities as necessary. The initial updated PMP was submitted in December 2011. A revised final PMP is still pending due to discussions on developing additional options and schedule for CO2 injection at Wellington Field should a Class VI permit application with EPA be unsuccessful. The final PMP will include a copy of the infrastructure requirements for CO_2 injection, access documents (surface and subsurface), and a completed contract and commitment for supplying CO_2. This information is near completion.

Alternatives CO2 Injection Strategies Considered in December 2011

Concerns over permitting the small-scale injection of CO2 in the saline aquifer based on new guidelines for EPA Class VI injection well raised concerns over long permitting process and uncertainty in project viability facing default requirements for bonding and monitoring for this experimental injection. Options were evaluated including 1) injecting in the top of the Arbuckle were locally the Arbuckle is in contact with a oil-bearing and locally producing Simpson sandstone (occurs locally as thin lenses in the Simpson Shale), 2) eliminating the saline aquifer CO2 disposal aspect of project and direct activities on CO2-EOR in the Mississippian oil reservoir. Discussions among parties including EPA in January 2012 led to the decision by DOE to revise project plan to begin injection in the Mississippian oil reservoir while allowing the project to pursue a Class VI permit to dispose of CO2 in the lower saline Arbuckle aquifer as originally proposed. This decision is based on mutual confidence in a strong application for the permit based on an excellent subsurface database at Wellington and major anticipated refinements in the geomodel. The latter should lead to robust simulations to predict the CO2 plume development and fate in the saline aquifer to support the details to be presented in the Class VI permit application.

Review of the alterative option to inject into the CO2 into the top of the Arbuckle next to an adjacent oil zone in the Simpson Group provided additional perspective of the caprock interval. The Renn-Erickson #1 well is the lone well in Wellington Field that produces oil from the Simpson sandstone (Figures 1 and 2).

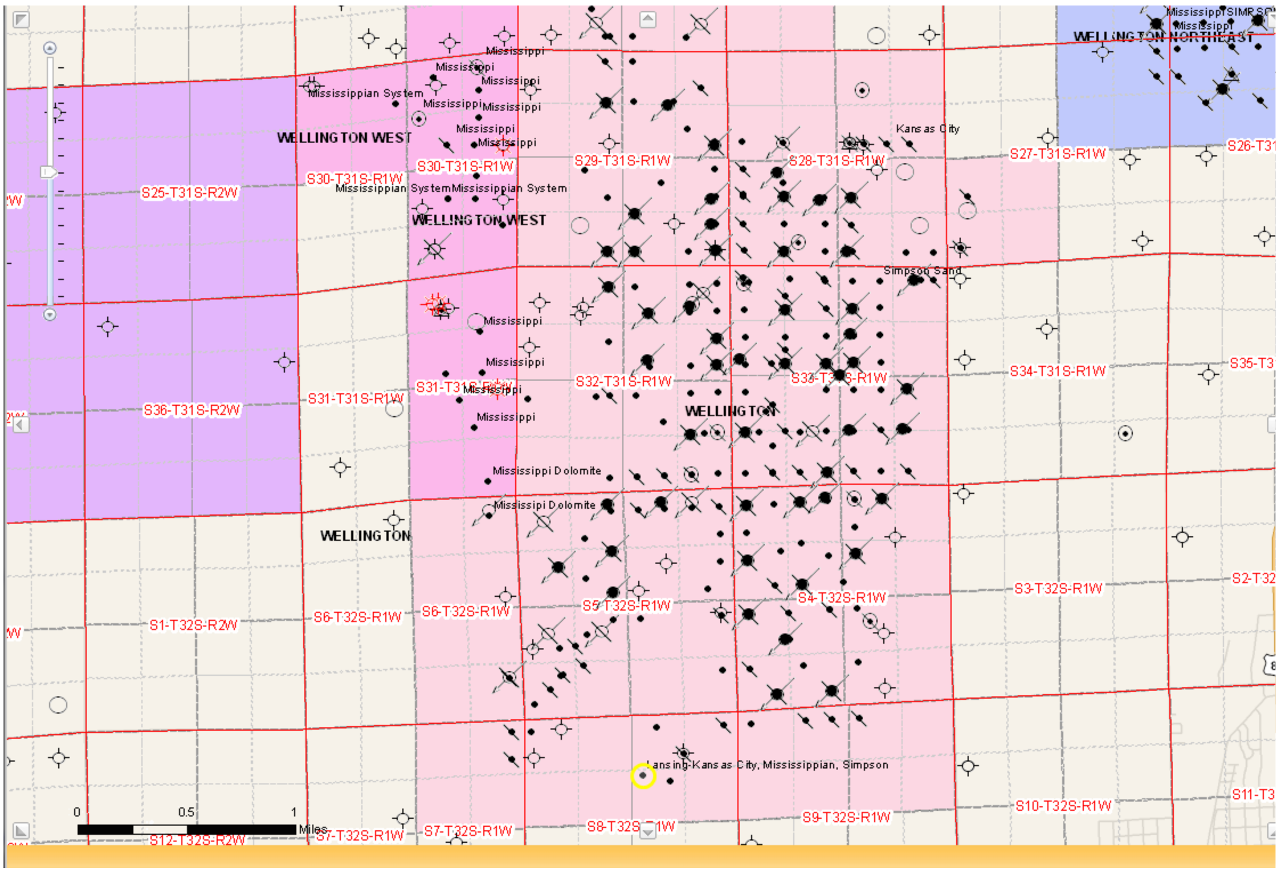

Figure 1. Base map of Wellington Field. Green arrow shows location of Renn-Erickson #1, the only well in Wellington Field that produces from Simpson sandstone overlies the Arbuckle saline aquifer. Well is over two miles south of the site of proposed CO2 injection in the Arbuckle in SW quarter of Section 28.

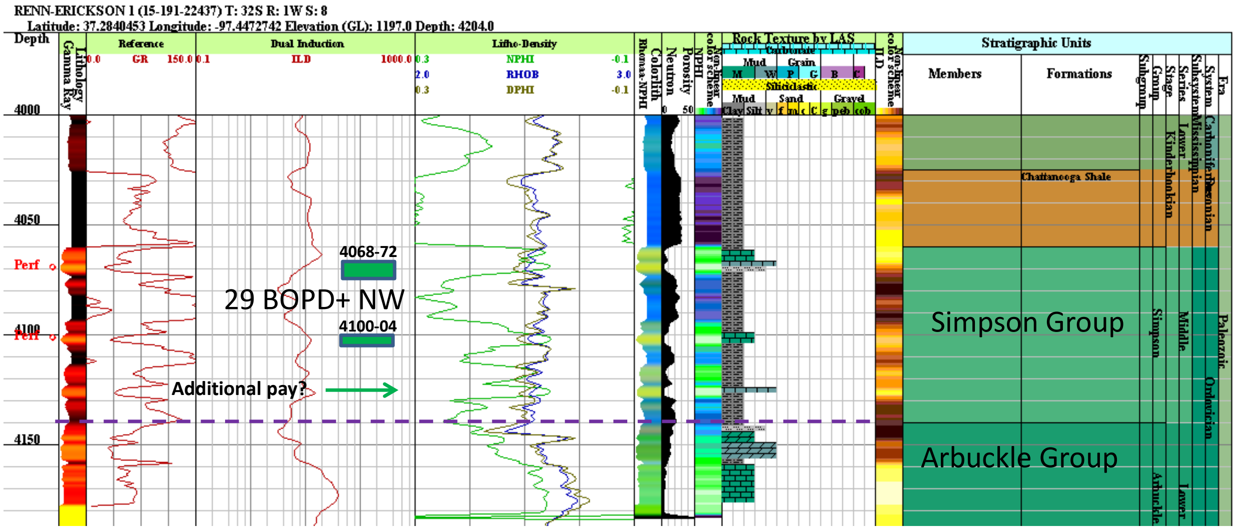

Figure 2. Renn-Erickson #1 well profile showing two perforated intervals in the Simpson sandstone. Producing sands are separated from the top of Arbuckle by shales.

The sample log description of the lower Mississippian to upper Arbuckle interval in the KGS #1-32 (Figure 3) and corresponding well logs (Figures 4 and 5) indicate that the Simpson sandstones are also present above the injection site, but the sands are cemented with low porosity distributed as beds within Simpson Shale.

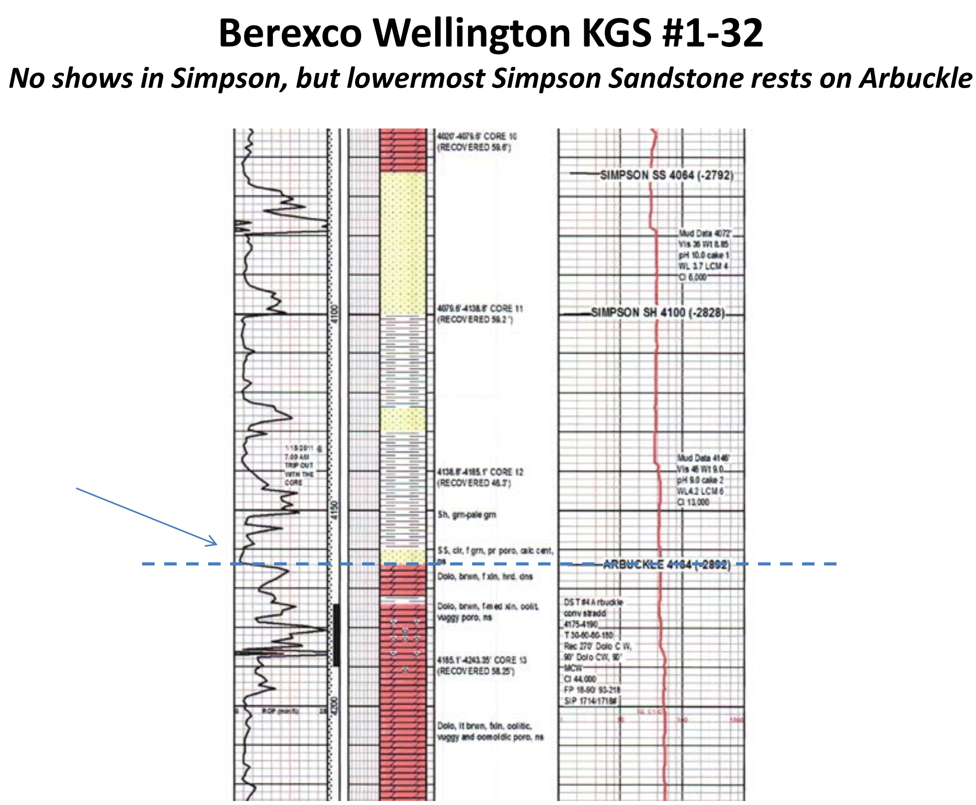

Figure 3. Sample description of interval from lower Mississippian to upper Arbuckle in KGS #1-32. Simpson Group is primarily shale.

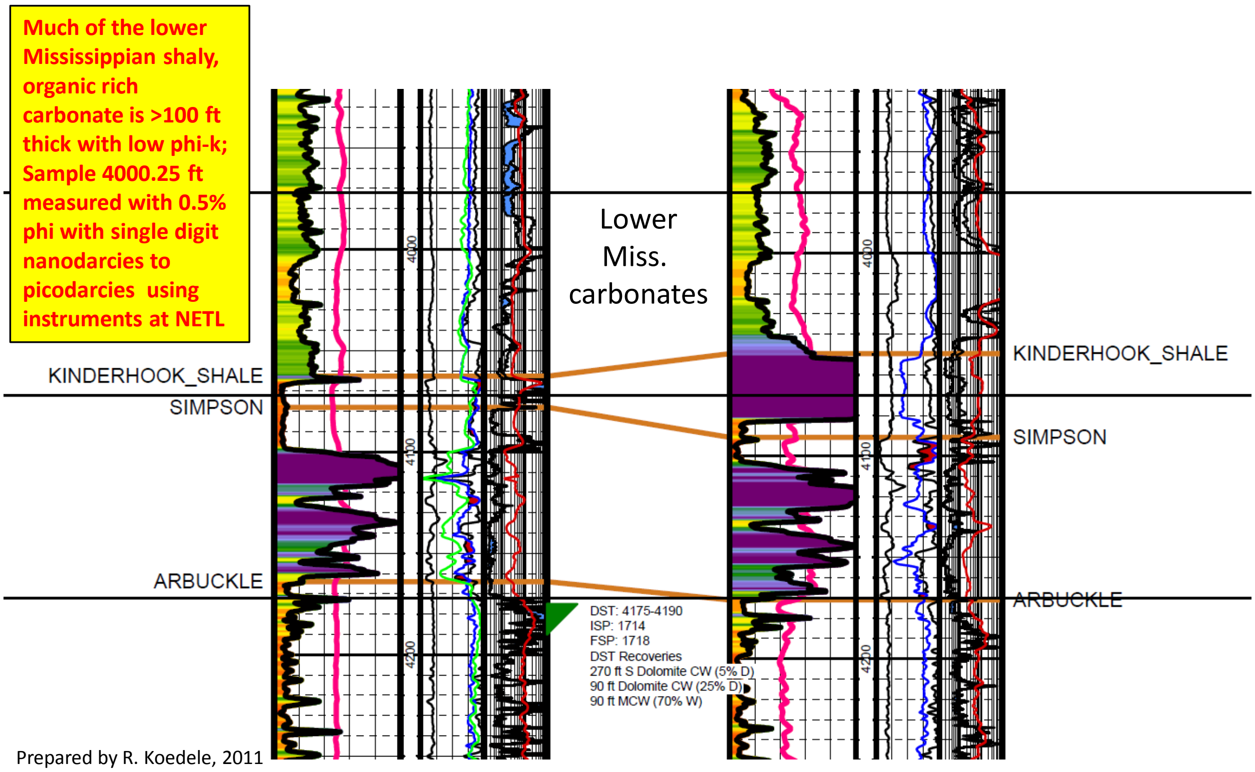

Figure 4. Stratigraphic cross section datumed on top of Arbuckle including wells KGS #1-32 (left) and KGS #1-28 (right). Wells were drilled during the characterization phase of Wellington Field under DOE Project FE0002056. Stratigraphic interval shown extends from lower Mississippian to upper Arbuckle. While upper Simpson Sandstone is thick, it is tight and lower sands are thin within the Simpson Shale. Kinderhook/Chattanooga Shale thins from #1-28 to #1-32 while lower shaly tight carbonates in the lower Mississippian are persistent strata throughout Wellington Field. The lower Mississippian argillaceous organic rich carbonates have been evaluated as caprock lithofacies. Measurements to date confirm this.

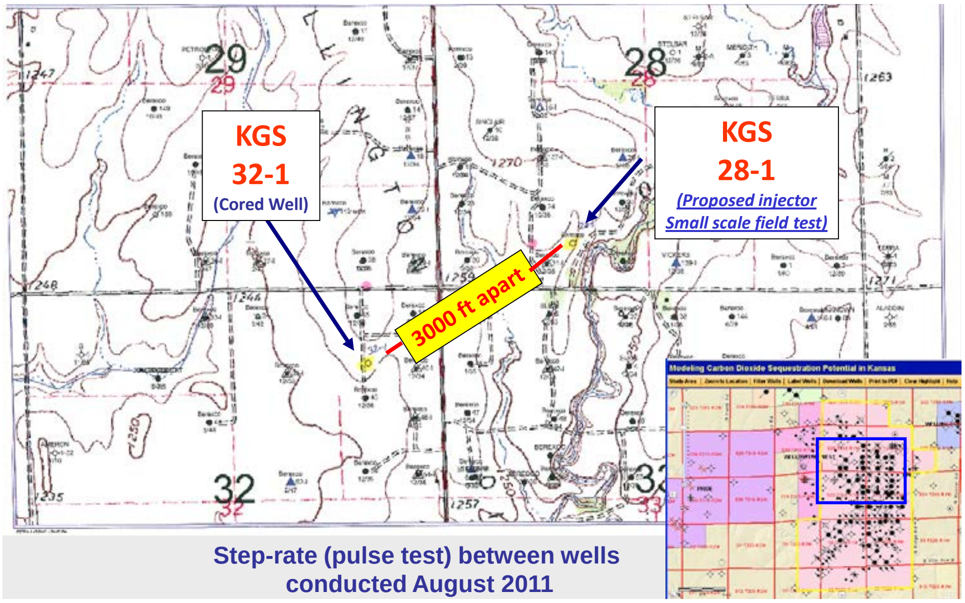

Figure 5. Index map for cross section shown in Figure 4. Two wells drilled in FE0002056 are highlighted.

Primary caprock directly overlying the Arbuckle includes Lower Mississippian carbonates and shale, Devonian shale, and Upper Ordovician shales of the Simpson Group. Caprock on top of the Mississippian oil reservoir are shales in the Cherokee Group. Both are illustrated in Figure 6.

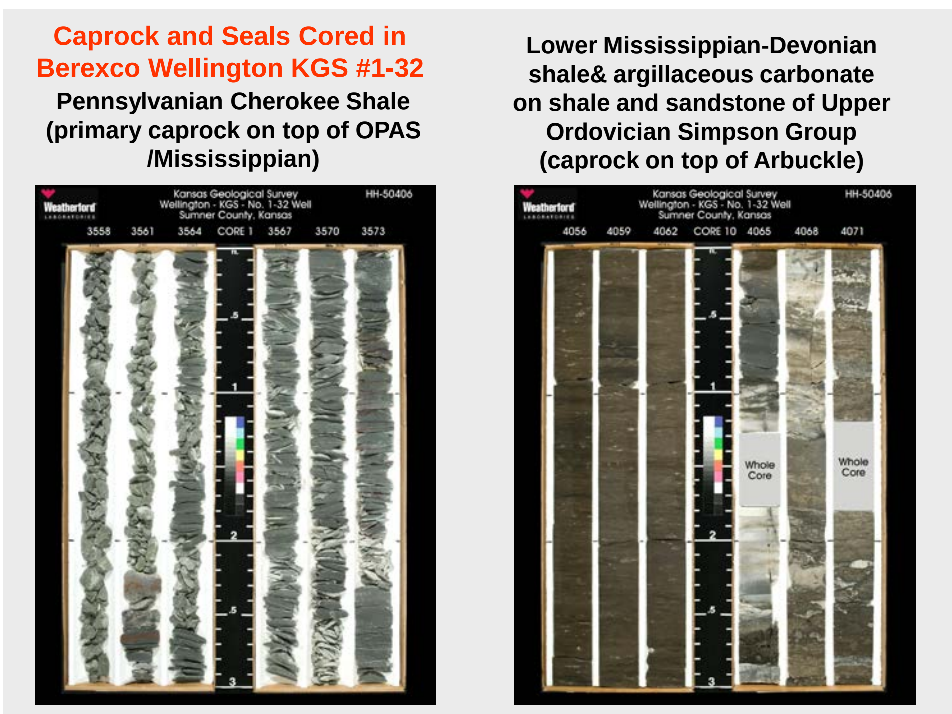

Figure 6. Shales in Cherokee Group overlie the Mississippian oil reservoir and serve as its caprock. Lower Mississippian carbonates and shale, Devonian shale, and Upper Ordovician shales serve as the primary caprock overlying the Arbuckle saline aquifer.

The basement test KGS #1-32 was cored from the shales of the Cherokee Group to the base of the Arbuckle saline aquifer. That was followed up by running an extensive set of wireline logs as illustrated in Figure 7. The logging was done to the surface including logging of shallow 200 ft thick evaporites that lie beneath the surface aquifer.

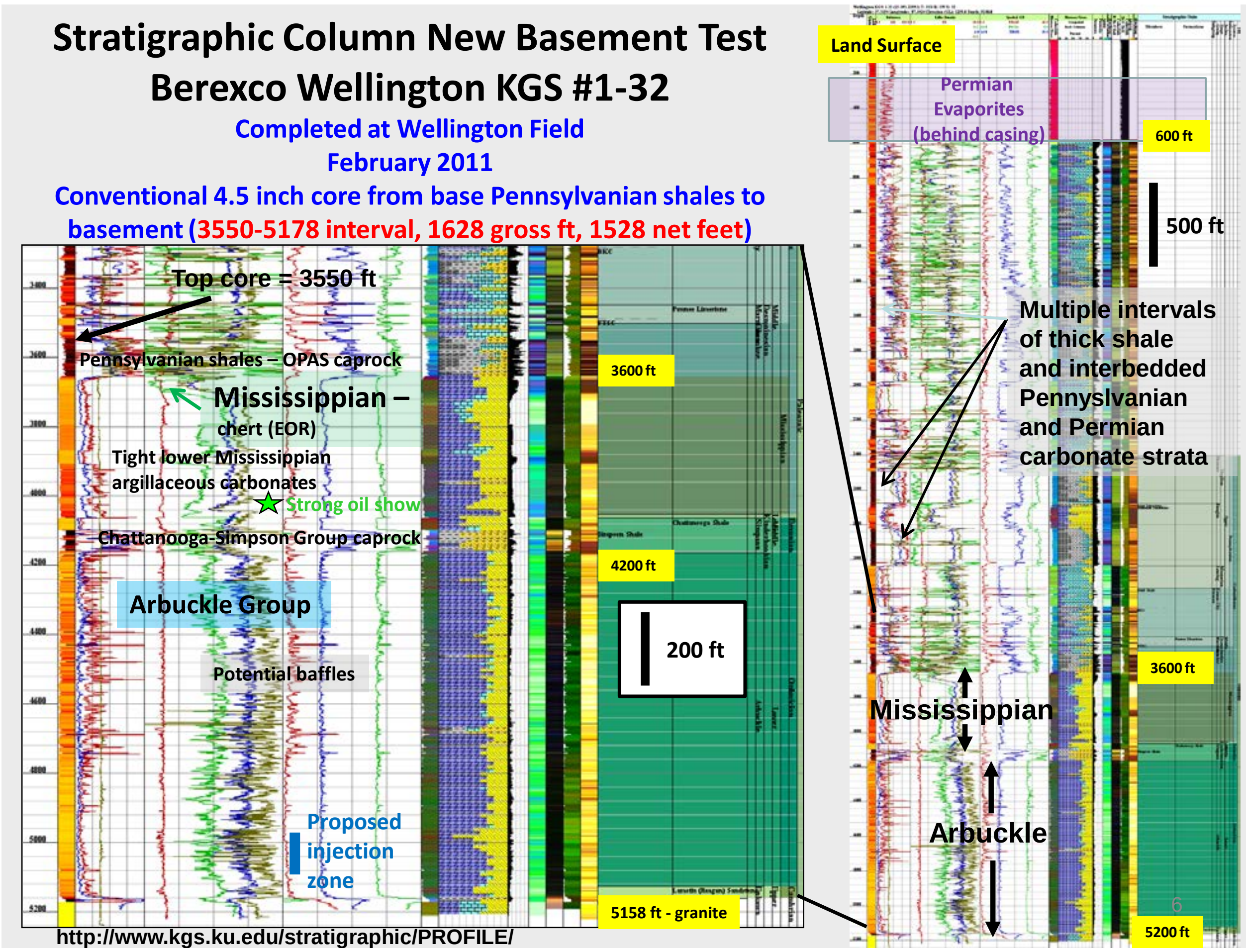

Figure 7. Composite view of the stratigraphy at KGS #1-32 showing interpreted lithologies from the base of the Arbuckle to the land surface. Arbuckle saline aquifer and overlying Mississippian oil reservoir are highlighted on the left. Shallow evaporites are delimited on the upper right.

Schedule and Budget Update

Schedule -- It was a mutual agreement by DOE at the end of January to continue to pursue a Class VI injection permit with EPA for deep saline aquifer injection. The decision was after encouraging discussions with EPA on the use of robust modeling and data serving as an important factor in the recommendations to reduce default monitoring requirements. With that decision made, it was determined that we would modify the project schedule to put field operations for the Mississippian CO2 injection ahead of the Arbuckle to provide longer time for the Class VI permit to be reviewed (Figure 8). Details of the moving the Mississippian CO2 injection ahead of the Arbuckle continue to be discussed including drilling considerations and downhole monitoring. A contingency for not receiving the Class VI permit is also being developed to ensure that the MVA is fully deployed in the context of the Mississippian CO2-EOR option.

A second factor in the modification of the schedule was the delay to finalize the larger subcontracts. Those budgets are nearly completed and should permit field operations to begin in earnest. Contracts are expected to be finalized in February 2012 with subsequent approval by DOE to permit field operations to begin shortly thereafter.

A third factor in the modifying the schedule as been to additional time to complete seismic processing and interpretation to that will be used in the application for the Class VI injection permit. That work and resulting Petrel geomodel and CMG simulations to be constructed from them will not be completed until late March 2012. The refined model will make us better able to use modeling to address our specific objectives in the Class VI permit to reduce excessive default monitoring and bonding. We will leverage the extensive work that has already been done at Wellington Field to work toward a successful final outcome in the permitting.

The provisional schedule for Budget Period 1 is included in Figure 8. The field activities would begin as early as March 2012 with work focused on the Mississippian CO2 injection and surface monitoring activities.

Expenses -- The total expenditure for the project in the first quarter is only $326.84 covering travel and F&A. The delays in initializing field activities due to ongoing contract negotiations and finalizing the Tiraz Birdie subcontract have held expenditures to a minimum. Second quarter spending includes staff time, work performed by Birdie, and anticipated costs for field activities when they get underway. Updating of geomodels and simulations are expensed from separate funding (DE-FE0002056).

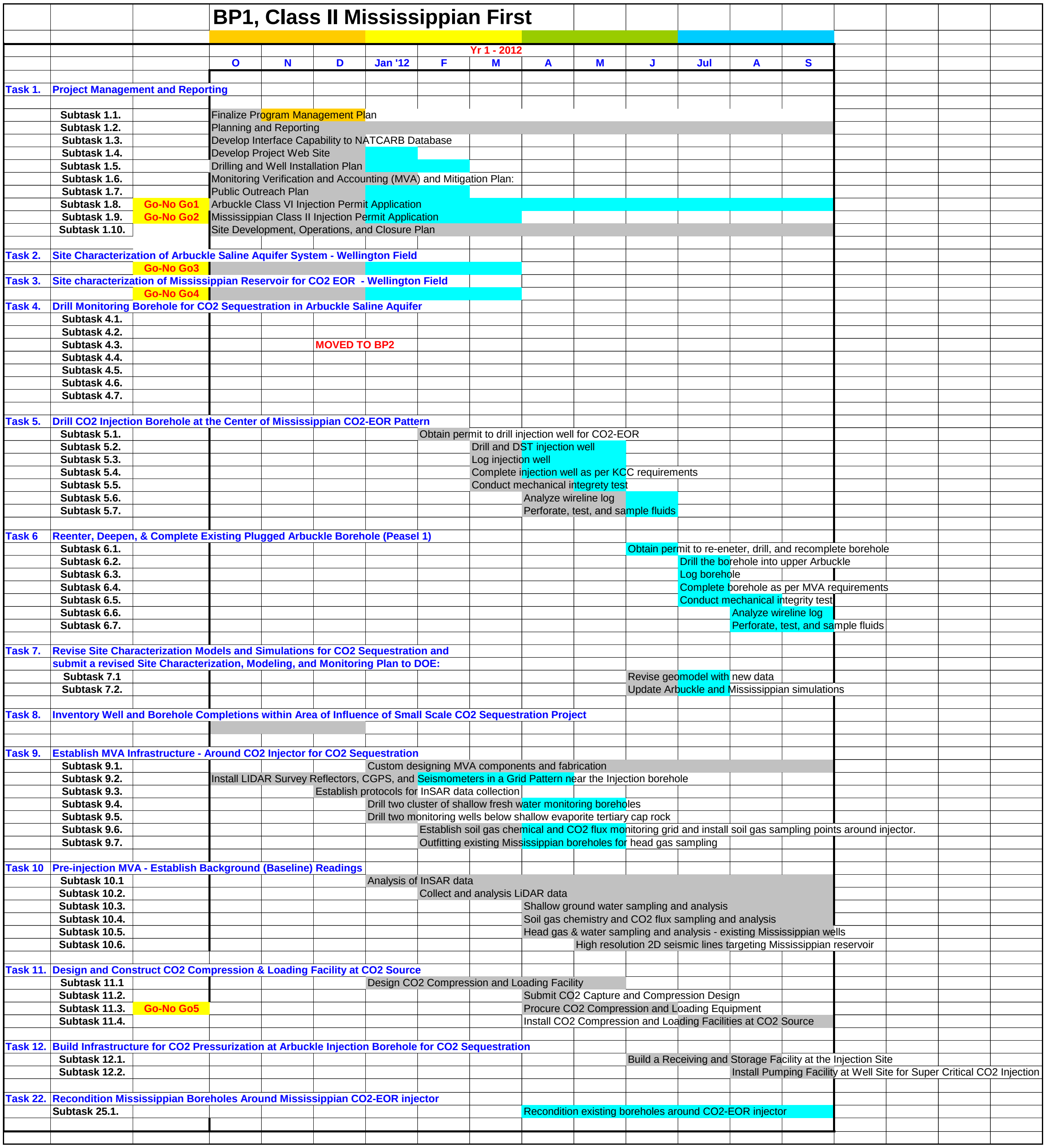

Figure 8. Gantt Chart for BP1. Provisional schedule adjusting for delays in start of field activities.

Project Organization

The PMP includes an organizational chart (Figure 9). The staff, affiliations, and primary responsibility are noted. The selection of the team is based on proven expertise, dependable supplier of CO2, operator of Wellington Field, and a general longer-term interest in the testing and utilization this technology. The assembled team will evaluate cost-effective methodologies that could be later used to implement this technology in this region. Much of the characterization work has been and is being performed under a separate DOE-NETL contract, FE0002056. The existing work will continue in parallel with this contract until August 2013 and refinements to the geomodel and simulations will, in part, be derived from this work. The objective is to avoid overlap and duplication of costs. Moreover, the two years of existing work on Wellington Field has provided the growing wealth of information that has put this field on such as firm base to apply for permits and to optimize the CO2 injection strategy.

Project Team
Small Scale Field Test – Wellington Field (FE0006821)

Name	Project Job Title	Primary Responsibility
Lynn Watney	Project Leader, Joint Principal Investigator	Geology, information synthesis, point of contact
Tiraz Birdie	Consulting Engineer	Reservoir engineer, dynamic modeling, synthesis
Jason Rush	Joint Principal Investigator	Geology, static modeling, data integration, synthesis
John Doveton	Co-Principal Investigator	Log petrophysics, geostatistics
Dave Newell	Co-Principal Investigator	Fluid geochemistry
Rick Miller	Geophysicist	2D seismic aquire & interpretation
		LiDAR support, water well drilling/completion
TBN	Geology Technician	Assemble and analyze data, report writing
TBN	Engineering Technician	Assemble and analyze data, report writing
	KU Department of Geology	
Michael Taylor	Co-Principal Investigator	Structural Geology, analysis of InSAR and LiDAR
TBN	Graduate Research Assistant	Structural Geology, analysis of InSAR and LiDAR
	Kansas State Unversity	
Saugata Datta	Principal Investigator	
TBN	Graduate Research Assistant	Aqueous geochemistry
TBN	3- Undergraduate Research Assistants	
	Lawrence Berkeley National Laboratory	
Tom Daley	Co-Principal Investigator	Geophysicist, analysis of crosshole and CASSM data
Jennifer Lewicki	Co-Principal Investigator	Hydrogeology, analysis of soil gas measuremnts
Barry Freifeld	Co-Principal Investigator	Mechanical Engineer, analysis of U-Tube sampler
	Sandia Technologies, Houston	
Dan Collins	Geologist	Manage CASSM and U-Tube operation
David Freeman	Field Engineer	Manage field install of CASSM and U-Tube
	Berexco, LLC	
Dana Wreath	VP Berexco	Engineering, Manager of Wellington Field
Randy Kouedele	Reservoir engineer	Enginering
Staff of Wellington Field		field operations
Beredco Drilling team		Mississippian and Arbuckle drilling operations
	Abengoa Bioenergy Corp. - Colwich, KS	
Christopher Standlee, Danny Alllison		CO2 supply – Colwich Ethanol Facility

Figure 9. Organizational chart of project team.

How the organizational structure will facilitate the performance of the project

There are six subcontracts in this project -- 1. LBNL, 2. KSU, 3. Sandia Technologies, 4. BEREXCO, 5. Abengoa, and 6. Tiraz Birdie. The KUCR team consists of investigators from the KGS and KU. KUCR investigators include: John Doveton (KGS), Rick Miller (KGS), Dave Newell (KGS), Jason Rush (Joint PI-KGS), Mike Taylor (KU-Geology Dept.), and Lynn Watney (Joint PI-KGS). Watney is the contact PI and function as Project Leader. Rush will assist in project supervision as required. Additionally, Watney will work on regional assessment, reservoir characterization, top seal studies, and commercialization. Rush will conduct reservoir characterization and geocellular modeling. Doveton will perform log analysis. Miller will drill and complete shallow aquifer wells for groundwater sampling and will also design, acquire, and analyze shallow 2D seismic surveys for baseline and detection of CO2 at the depth range of the Mississippian oil reservoir. Newell will analyze soil samples. Taylor will design, install, and analyze LiDAR/INSAR surveys, continuous GPS, and seismometers.
The LBNL Team consists of Tom Daley, Jennifer Lewicki, and Barry Freifeld. Daley will manage the LBNL Team and provide integrative MVA expertise including borehole seismic monitoring (CASSM) and crosswell tomography. Lewicki will analyze soil CO2 flux and soil gas geochemistry. Freifeld (U-tube patent holder) will design monitoring program for multiple U-tube monitoring devices and fiber-optic distributed temperature sensors and wellbore heaters (DTPS) and analyze and interpret data. D. Collins (Sandia Technologies) will provide field supervision during installation of U-tube and borehole seismic (CASSM) monitors. S. Datta (involved in current DOE project FE0002056) from KSU will collect and analyze formation water geochemistry. BEREXCO (D. Wreath) as lease operator will manage and supervise all field-related activities. Abengoa will provide CO2 to the project. The CO2 compression, chilling, and loading unit will be designed and built by Abengoa.

Tiraz Birdie will 1) develop well permitting, drilling, and completion/installation plans, working with other subcontractors, 2) develop Monitoring Verification and Accounting (MVA) and Mitigation Plan as specified by DOE, 3) Site Development, Operations, and Closure Plan (and its updates) as specified by DOE, 4) file permit from KDHE and EPA for the new Arbuckle monitoring well, 5) file permit from KDHE and EPA to convert new drilled well #1-28 to become an Arbuckle CO2 injection well, 6) prior to CO2 injection, update existing simulations for Arbuckle Saline Aquifer and the overlying Mississippian Reservoir at Wellington Field in the vicinity of the CO2 injection wells,) 7) oversee integration of data from MVA operations to characterize CO2 plume movement and monitoring for CO2 leakage, 8) update simulations to match observed plume development using MVA data and evaluate uncertainties and risks, 8) prepare necessary documentation for closure of small scale CO2 sequestration project.

Many of the participants and organizations within Kansas have successfully worked together on past projects as well as the ongoing project at Wellington. We will build an effective partnership and program with the LBNL organization, which has a proven record of working with other organizations on CO2 projects including MVA. PIs at the KGS will supervise the project and ensure objectives are met and results are properly integrated into assessments and best practice manuals.

Description of which elements of the organization are responsible for the individual tasks with their credentials and contact information

The chart below lists tasks and the primary investigator responsible. Tasks frequently have multiple subtasks with different investigator responsible. For information regarding credentials, please review their CVs provided with the original proposal.

Discussion of how communication and decision-making will occur within the context of the organizational structure

Investigator	Task(s)	Element	Institution	Contact Information
Christopher Standlee	11,15,24,30	CO2 source	Abengoa	636-728-0508
Tiraz Birdie	1,2,3,4,5,6,7,8,9,16,17,18,19,20,21,25,26,27,28,29,30	simulation,synthesis, permitting	Birdie Consulting	785-760-3297
Tom Daley	9,10,13,14,16,17,18,19,20,29,30	MVA	LBNL	510-486-7316
Saugata Datta	9,10,16,17,18.19,20,29,30	MVA	KSU-Geology	785-532-2241
Barry Freifeld	9,10,13,14,16,17,18,19,20,29,30	MVA	LBNL	510-486-4381
Jennifer Lewicki	9,10,16,17,18,19,20,29,30	MVA	LBNL	510-495-2818
Rick Miller	9,10,17,18,19,20,29,30	MVA	KGS	785-864-2091
Jason Rush	1,2,3,4,5,6,7,8,9,16,17,18,19,20,21,25,26,27,28,29,30	geomodeling	KGS	785-864-2178
Mike Taylor	9,10,16,17,18,19,20,29	MVA	KU-Geology	785-864-5828
Lynn Watney	1,2,3,4,5,6,7,8,9,16,17,18,19,20,21,25,26,27,28,29,30	project leader	KGS	785-864-2184
Dana Wreath	1,2,3,4,5,6,7,9,12,13,14,15,17,18,22,23,24,25,26,27,28,29	field operations	Berexco	316-265-3511
John Doveton	1,3,4,5,6,7,19,21,25,26,27,28,30	petrophysics	KGS	785-864-2100
David Newell	1,8,16,17,18,19,20,21,29,30	geology, geochemistry	KGS	785-864-2183
Dan Collins	13,14,30	well installation	Sandia Technology	832-286-0471

The bulk of the scientific staff, especially those synthesizing the MVA findings, is located at the University of Kansas campus, which will facilitate effective daily communication. The PIs will coordinate with D. Wreath (BEREXCO) to ensure efficient and successful implementation of on-site objectives. Once field operations have commenced, daily field operation reports will be issued by BEREXCO via e-mail to all investigators and relevant service companies. BEREXCO will handle contracts with traditional oil & gas service companies (e.g., Halliburton, Weatherford) and send call-out sheets. Daily reports will also list upcoming field operations, so the relevant investigator can mobilize equipment and make travel arrangements. PIs will ensure data is appropriately integrated, modeled, and simulated before confirming final injection location and monitoring sites. PIs will follow-up with service companies and subcontractors (Co-PIs) to confirm objectives and schedule. Bi-monthly teleconferences with investigators will be held to communicate project status and to reiterate upcoming deliverables. BEREXCO will contact Abengoa for the delivery of CO2. Abengoa will be responsible for constructing the compression, chilling, and delivery of the CO2. Throughout the project, Watney will ensure effective communication with investigators as well as the DOE Project Manager and will provide written quarterly reports and weekly E-mail updates.

Risk Management

Technical risks include the ability to 1) successfully drill and complete boreholes including installation of equipment for injection and monitoring within budget and timeframe, 2) detect and locate upward migration of CO2 from the plume, 3) sufficiently address environmental, health, and safety impacts in the event of a leak, 3) evaluate and monitor remediation efforts should a leak occur, and 4) provide sufficient evidence that the project can be brought to closure.

<u>Drilling and completion</u> -- Berexco is the industrial partner in the current project who has shown considerable skill in drilling, coring, and completing new wells. The new 1500 ft of core was acquired with a conventional core barrel involving 42 trips in and out of the borehole over the course of 35 days. It was a remarkable feat to recover that amount core (it's the most core recovered by the seasoned coring specialist) and maintain the borehole conditions and progress

under harsh winter weather. Berexco staff arranged to keep core from freezing and handled the cutting and marking of the core in the aluminum liners. With assistance and experience of Sandia Technologies, the installation of the complex downhole equipment in the proposed project should be successful.

Detect and locate CO_2 -- Migration of CO_2 upwards from the plume could occur via an open fracture system. Fractures as observed in core and inferred from well logs are predominately discontinuous and more zonal in nature and appear to be associated with porous cleaner lithofacies of the Arbuckle (Figure 10). In contrast, the primary caprock consisting of an interval from the top of Arbuckle into the Lower Mississippian has fewer fractures (Figure 6). If an open fracture does breach the primary caprock, the CO_2 should be trapped in the significantly underpressured Mississippian reservoir that is blanket-like in distribution over the injection site and surrounding field (Figures 11 and 12). Existing Mississippian boreholes will be monitored to detect the CO_2 and a 2D seismic line will be acquired to image the gas (Figure 13). If the overlying seals/caprocks are breached, the 200 ft thick halite/anhydrite evaporite bed at 400 to 600 ft below the surface will likely prevent CO_2 from reaching the surface drinking water (Figure 6). Shallow wells and soil gas probes should intercept any CO_2 that reaches the surface.

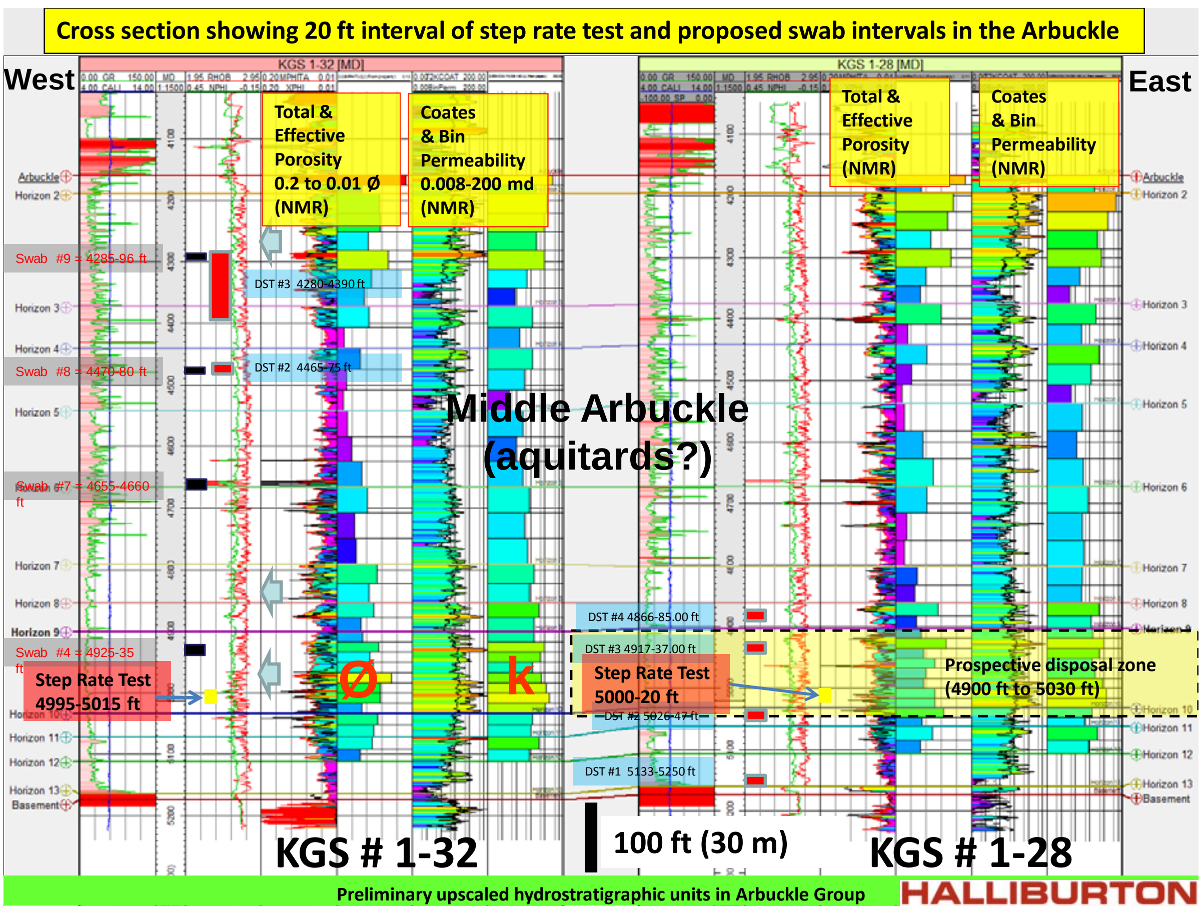

Figure 10. Stratigraphic cross section showing well logs in the Arbuckle saline aquifer. Color blocks are upscaled stratigraphic units with horizontal size proportional to the amount of porosity and permeability as estimated by the nuclear magnetic resonance logging tool. The lower high porosity interval is the proposed injection zone. Middle units in the Arbuckle

have generally lower porosity and permeability and may act as barriers or baffles to vertical CO2 migration.

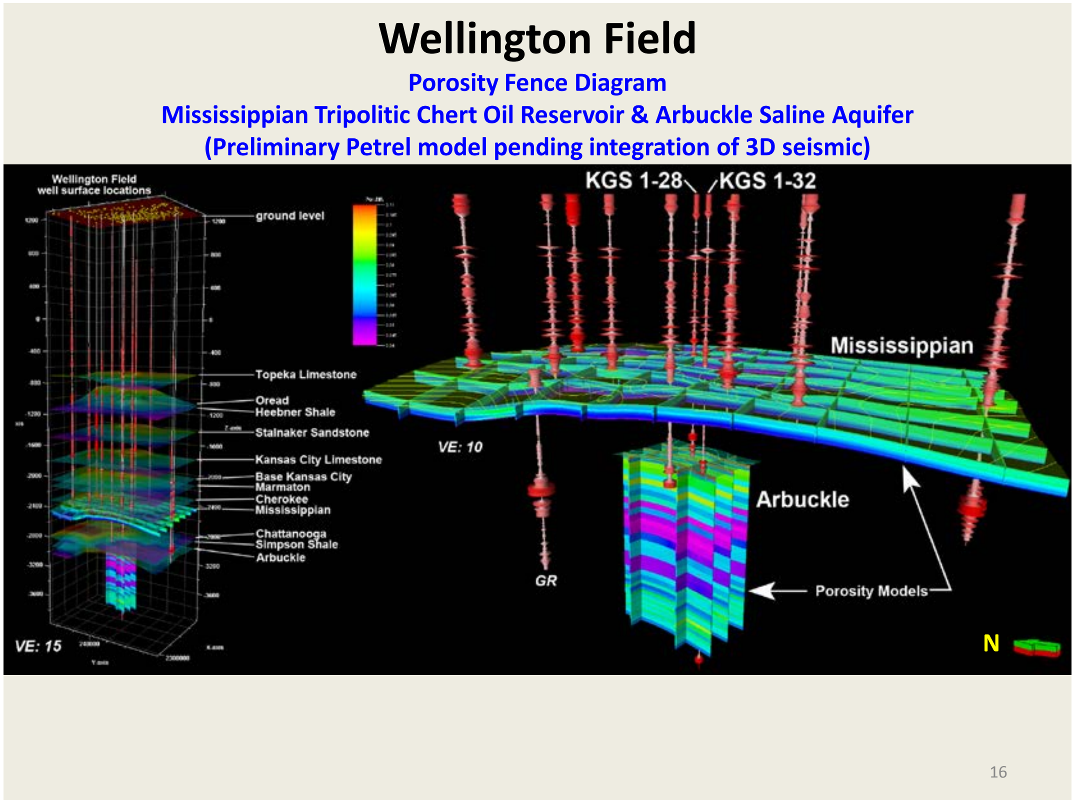

Figure 11. 3D diagram looking east depicting porosity in the Mississippian oil reservoir showing rather uniform distribution over Wellington Field. Arbuckle porosity cube based on newly drilled wells lies below the Mississippian. Intervening strata includes caprocks.

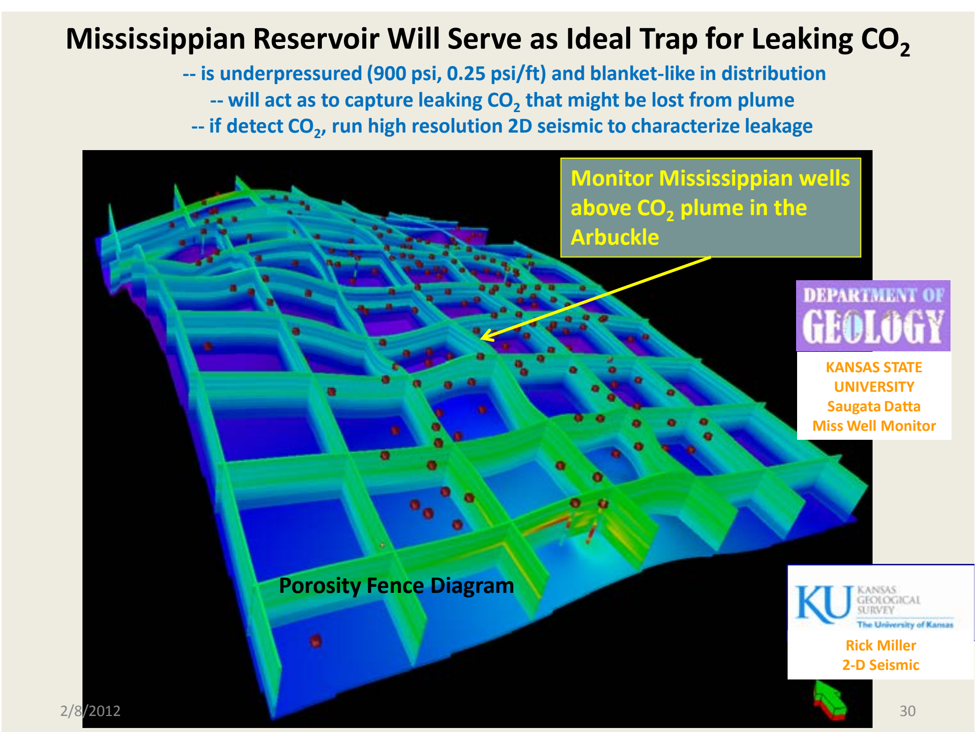

Figure 12. Block diagram of porosity in the Mississippian oil reservoir showing Mississippian well locations. Interval is blanket-like and underpressured overlying area of proposed injection into the underlying Arbuckle.

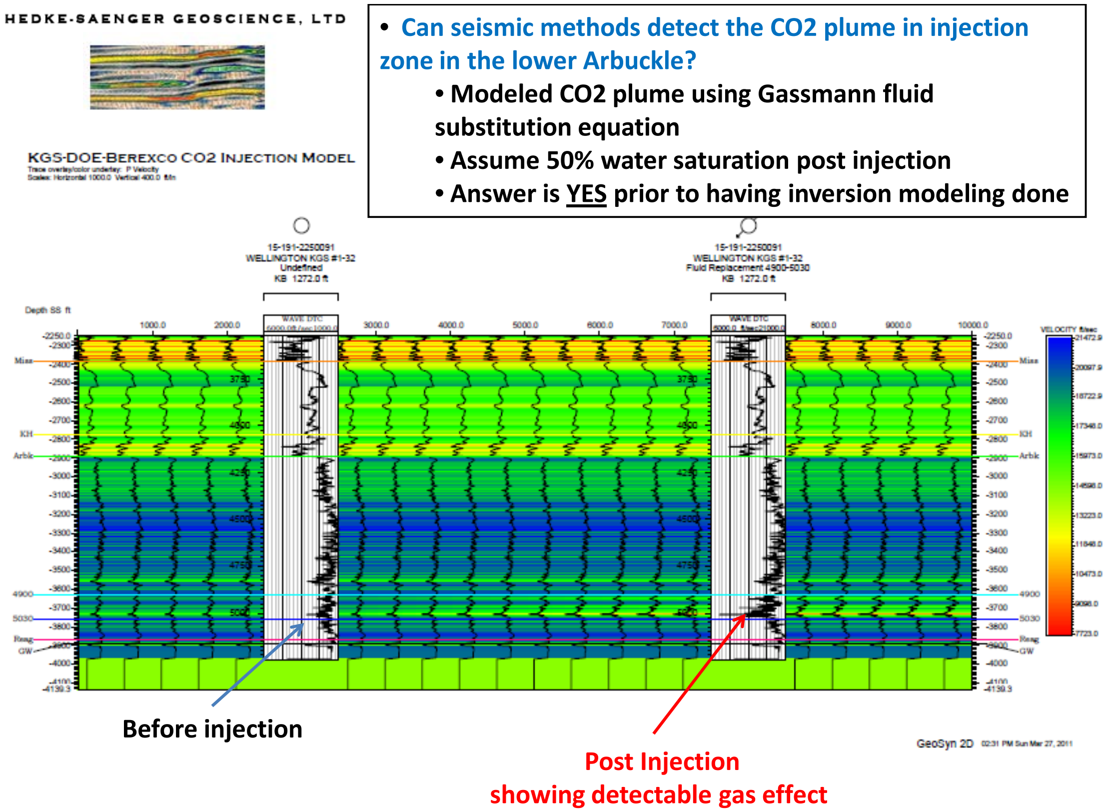

Figure 13. Simulation in seismic effect of injecting supercritical CO2 into the lower Arbuckle depicted on a synthetic seismogram of well before and after injection. Gas effect is noted. 3D seismic survey would be used to assess the CO2 plume during consideration of the bring the project to closure. Accumulation of CO2 in the shallower underpressured Mississippian should similarly be recognizable using high resolution 2D acquisition.

<u>Address environmental, health, and safety impacts in event of leak</u> – Surface leakage of CO2 would be characterized through soil gas and water well analysis to determine concentrations and compare with levels that would be deleterious to nearby residents and livestock. Environmental officials would be alerted immediately to assist in determination of the impact to environment, health, and safety. A 3D view of Wellington Field from surface to the Precambrian basement with the intervening Mississippian oil reservoir and Arbuckle saline aquifer highlighted shows the proportionate distance between surface drinking water and the zone into which CO2 is proposed to be injected (red arrows) Figure 14. The intensity of the red columns along the well traces is proportional to natural gamma ray that indicates the amount of shale. The strata overlying the Mississippian are dominated by shale, which in general, is an ideal caprock/seal. Figure 14 also shows the location and type of monitoring that will be done in this project to measure the CO2 plume and its properties including in situ U-tube fluid sampling in active plume (Figure 15) and cross hole seismic and continuous cross hole seismic (Figure 16). U-tube, in situ seismic and surface based InSAR and LiDAR (Figure 17) will be sued to monitor plume development, compare to simulations as a guide and recognize any anomalous development. These techniques will work together to permit rapid response to any anomalies.

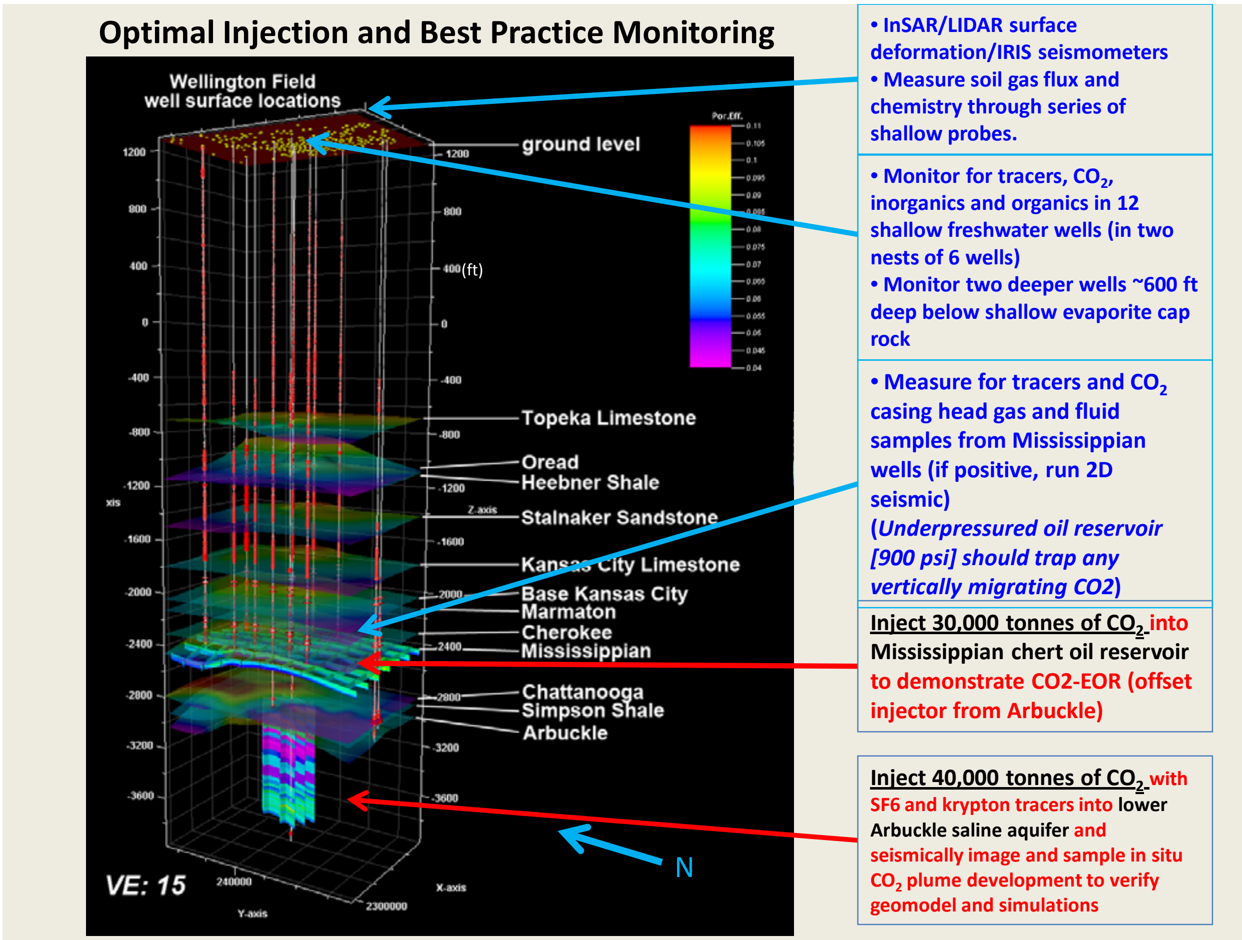

Figure 14. Three dimensional Petrel geomodel of Wellington Field annotated with types of monitoring that will be done prior, during, and after CO2 injection.

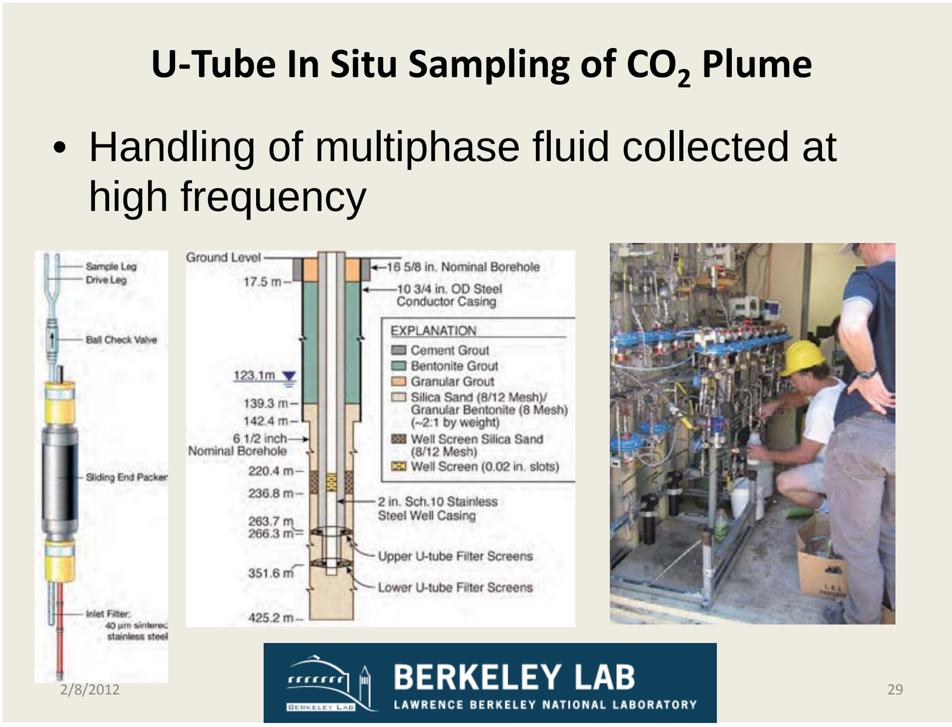

Figure 15. U-Tube sampling installed in monitoring well placed to intercept CO2 plume to obtain compositions of the fluids and compare to simulations.

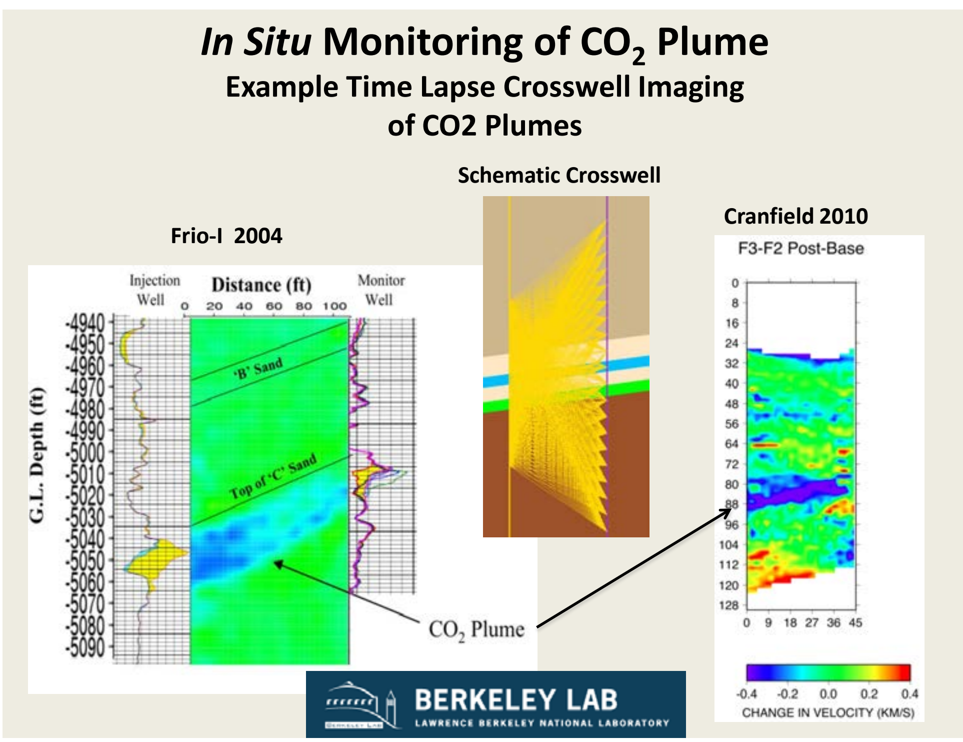

Figure 16. CO2 plume will be monitored in manner done at other CO2 injection sites to compare observed location with that predicted through simulation.

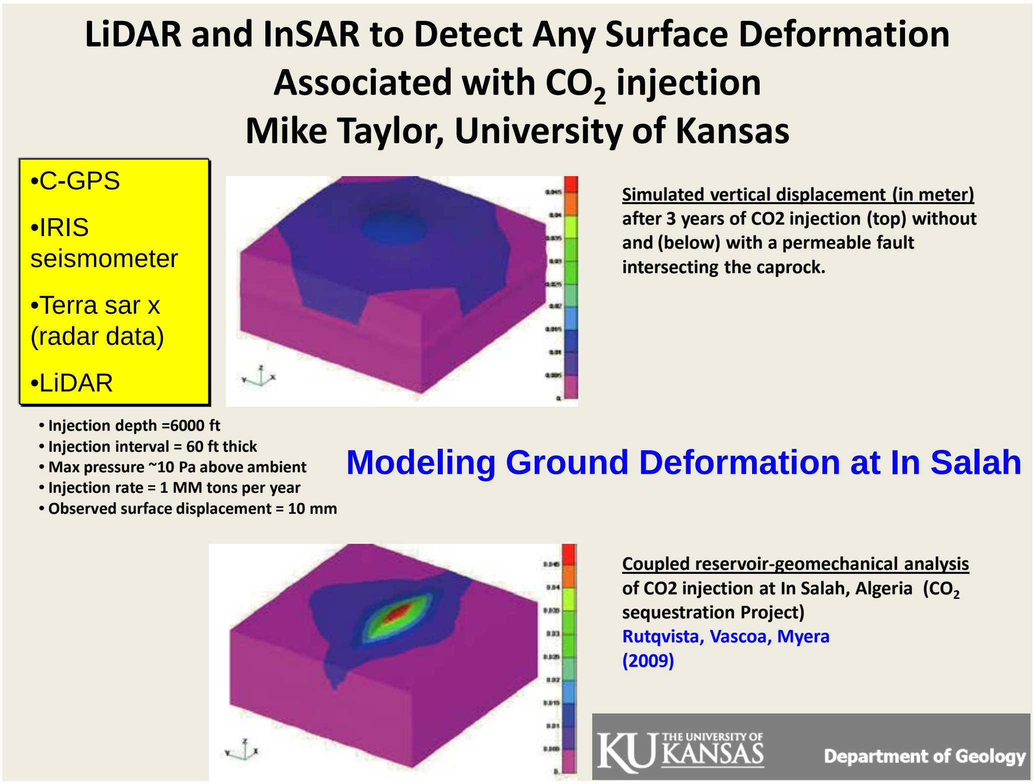

Figure 17. An important part of the monitoring program will be the installation of continuous GPS and seismometers to be able to detect ground motion very accurately. Seismometers will measure instantaneous movement such as microearthquakes. Ground-based LiDAR surveys will be used to measure slight surface ground deformation from plume development as has been noted in large CO2 project at In Salah, Algeria. Satellite based radar (InSAR) will be used to provide another means to examine surface deformation and the combination will resolve this deformation on the scale of millimeters using target that are installed in the vicinity of the injection site.

Evaluate and monitor remediation efforts should a leak occur – If CO2 is detected in the underpressured Mississippian reservoir, the injection will be terminated and the CO2 plume will be blown down in a controlled manner through the injector and observation well. Mississippian monitoring wells will also be used to release any CO2 that has leaked into the reservoir. If CO2 migrates to the base of the shallow evaporite caprock (Figure 18), the gas will be released in the monitoring wells. Shallow freshwater wells will also be used to vent gas that has reached the surface aquifer.

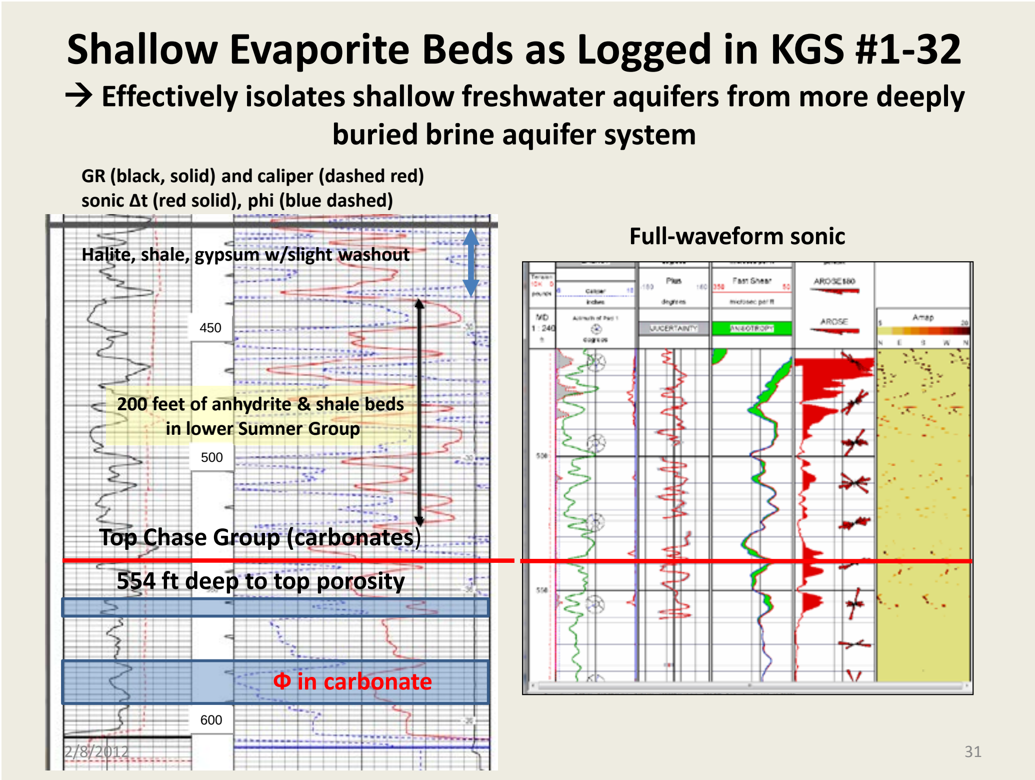

Figure 18. Shallow evaporite beds were characterized by well logs run in the KGS #1-32 and #1-28. Total thickness of the halite, shale, gypsum, and anhydrite is ~200 feet at depth ranging from ~350 feet to 530 ft. Shallow freshwater aquifer overlies evaporite zone and a brine aquifer lies beneath in the Lower Permian Chase Group. Shallow observation wells will be installed in both the shallow freshwater and in the shallow saline aquifer to measure for CO2 directly or indirectly through chemical changes.

<u>Provide sufficient evidence that the project can be brought to closure</u> – If no leaks of CO2 have been observed or when leaks have led to venting and release of the CO2, the acquisition of the repeat 3D seismic survey (Figures 19 and 20) should determine if any gas is observed outside of the volume of the plume to demonstrate containment. Gas remaining in the vicinity of the injection and observation well will then be vented to bring the project to a close.

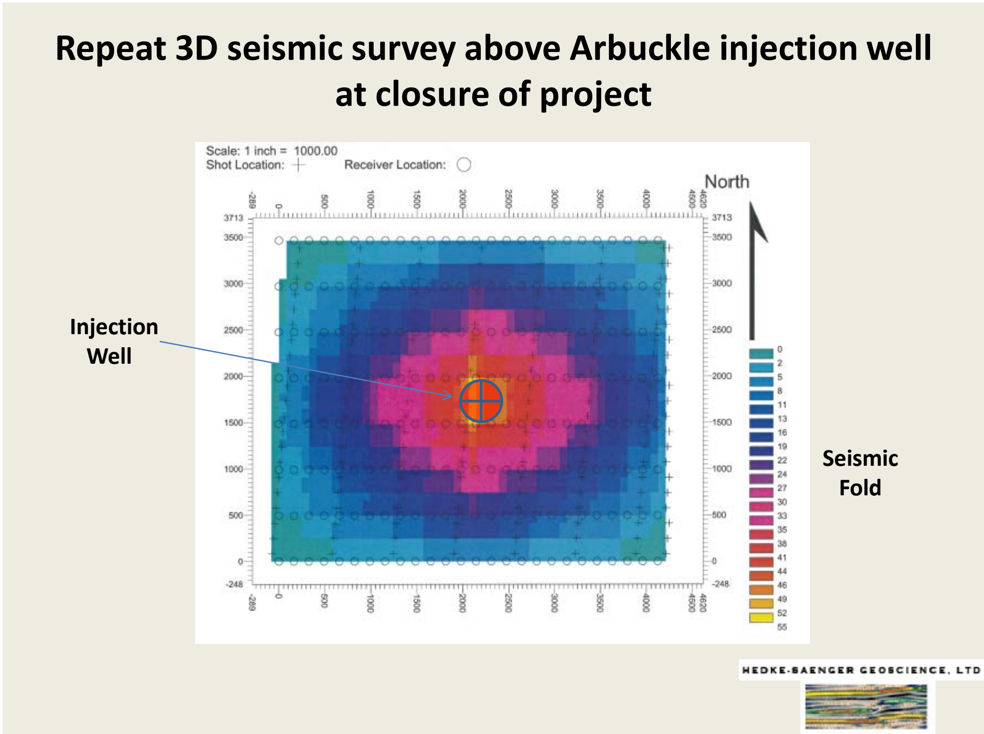

Figure 19. Fold map of scheduled repeat 3D seismic survey at Wellington above the site where CO2 plans to be injected into the Arbuckle saline aquifer. Acquisition parameters will be the same as those used to in original survey so that seismic images can be compared via differencing detect the presence of any remaining CO2 plume. Prior experiments in gas substitution and synthetic seismogram modeling indicate that CO2 can be imaged by this seismic methodology (Figure 12).

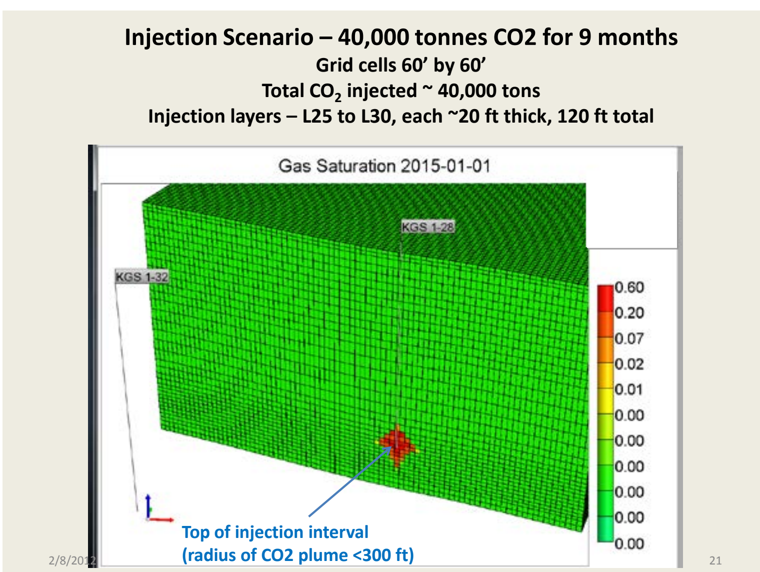

Figure 20. Anticipated size of the CO2 plume based on early modeling is less than 300 feet radius from the injection well and that the CO2 is contained within the lower Arbuckle due to the aquitards overlying the more porous and permeable injection zone. A repeat 3D seismic survey of a square mile should easily capture the plume dimensions within the area of maximum seismic fold (Figure 19).

Process risks include 1) obtaining access to the pore space for CO2 sequestration in the saline aquifer, 2) liability associated with conducting the small scale CO2 injection in the Arbuckle saline aquifer, 3) possible disruptions to the supply and quality of CO2 that could jeopardize the experiment and demonstration and invalidate the refinement of the models.

Access to pore space – A disposal lease and easement agreement has been signed by the landowner and the operating company Berexco to allow Berexco to dispose of CO2 into the Arbuckle formation as part of investigating and determining the feasibility of the subsurface disposal, and actual subsurface disposal of CO2 into the Arbuckle formation.

Liability associated with conducting the small scale CO2 injection in the Arbuckle saline aquifer – Berexco has accepted the liability to inject 40,000 tonnes of CO2 into the Arbuckle and 30,000 tonnes of CO2 into the Mississippian for the purpose of testing and has signed the liability waiver.

Possible disruptions to the supply and quality of CO2 – The primary named source of CO2 for this small scale injection is Abengoa Bioenergy Corporation's ethanol plant in Colwich, Kansas located ~50 miles from the injection site. The plant has been in operation since 1985 is has been upgraded to a modern well equipped plant that has established a solid track record operated 24-7. It is capable of producing approximately 200 tonnes of raw CO2 per day and will deliver up to 70,000 tonnes of CO2 for the small scale injection. Abengoa has signed a commitment letter.

Technical Approach and Understanding

Risks have been classified in the following manner and summarized in the illustration below called Risk Assessment. Those associated with (1) field operations including drilling and wellbore instrument installation, (2) borehole integrity, (3) adequacy of reservoir and top seal characterization, (4) injector location and spacing relative to observation wells, (5) CO_2 procurement and transportation, (6) cost over-runs, and (7) legal issues related to pore space. Potential operational risks are considered minimal. **Risk Group 1**: Over 200 Mississippian wells have been successfully drilled at Wellington Field. This year, the KGS and Berexco successfully drilled two boreholes (KGS 1-28 & KGS 1-32) to the basement as part of the DOE-sponsored site characterization. All proposed downhole instrumentation has been successfully deployed in other projects and no problems are anticipated. **Risk Group 2**: Borehole integrity risks are minimal. Only the two KGS boreholes reach the proposed injection depth in the Arbuckle. A three-stage cement job consisting of CO_2-resistant cement was performed on both boreholes in anticipation of a CO_2 pilot demonstration. The only other nearby Arbuckle well is Peasel-1, which penetrates the uppermost 25-ft approximately 900-ft above the injection depth. Regardless, the Peasel-1 will be deepened and recompleted as an observation well. The wells in the Mississippian are part of an active oil field. These wells have been in place since 1929 with most of the wells drilled in the 1930s and 40s. There is no indication of any leaks from these wells or the reservoir. **Risk Group 3**: Reservoir and top seal characterization have adequately determined sequestration potential and indicate an exceedingly low risk of geologic leakage. A very extensive logging, coring, and drill stem testing program was undertaken for the two research wellbores (KGS 1-28 & KGS 1-32). This data has permitted description of reservoir and top seal architecture, including fracture characterization and preliminary identification of flow layers. Seismic interpretations, reservoir characterization, top seal correlations, and presence of an overlying oil-bearing reservoir indicate sub-Mississippian strata in the greater Wellington Field area are free of surface-intersecting conductive fractures. The sealing nature of the overlying caprock above the Mississippi is proven with the presence of the oil accumulation over geologic time. Besides numerous shales above the oil reservoir and beneath the shallow surface freshwater aquifer, approximately 200 feet of shallow anhydrite and shale beds are present. **Risk Group 4**: Preliminary simulations indicate injection of 40,000 metric tons of CO_2 will create a plume with a maximum radius of 300-ft after 5-years. A new Arbuckle observation borehole (KGS 2-28) is proposed 300-ft updip of the planned injector (KGS 1-28). This borehole will be outfitted with multiple *in situ* instruments to monitor CO_2 plume dispersal. Wells in the overlying Mississippian oil reservoir will be monitored for any CO2 leakage. The underpressured Mississippian reservoir layer should act as a pressure sink to trap any leakage. Any well that detects CO2 will be followed up by acquisition of high-resolution 2D seismic imaging to determine extent of the CO2. **Risk Group 5**: Abengoa Bioenergy's Colwich ethanol plant located ~50 miles from Wellington Field will provide CO_2 for the project. The Colwich ethanol plant has been in continuous operation for many years without any significant disruption in service. The composition of the CO2 does not significantly vary between operation cycles, and the source is 99% CO_2. Costs are included in the budget for constructing compression, chilling, and loading units at the facility. The CO_2 will have to be trucked from the facility to the injection site. A 3000-3500 psi pump will be used for injecting. **Risk Group 6**: Significant cost over-runs are not anticipated. Berexco, service companies, and subcontractors have a proven record of honoring existing agreements with the KGS in the ongoing project. **Risk Group 7**: Legal issues have been resolved. Berexco assumes all liability involving CO_2 injection. Berexco has agreements with landowners/pore space owners for disposal of CO2 within the Arbuckle. The Kansas Corporation Commission (KCC), Kansas Department of Health and Environment (KDHE), and Region 7 EPA in Kansas City have been kept informed during the entire DOE-sponsored Wellington project. Initial meeting with these regulators have taken place to discuss project's applications for multiple injection permits.

The following approach will be used to manage and address liability issues after operations and after the project has concluded. Post-injection monitoring will be used to confirm expected plume geometry and conformance to simulation scenarios. Downhole instruments (e.g., CASSM, cross hole seismic tomography, multi-horizon U-tube fluid samplers) in offsetting boreholes and surface monitoring equipment (e.g., 3-D seismic, soil gas probes, and InSAR & LiDAR) will be used to verify plume movement. Just prior to project completion, a repeat 3-D seismic survey will be undertaken and compared with initial survey to verify plume conformance. Berexco the field operator is a highly regarded local Kansas company that has a proven record of going above and beyond State disposal and environmental regulations. Upon conclusion of the project, Berexco will carry out appropriate site and wellbore abandonment as outlined by the EPA and will continue wellsite oversight and maintenance as part of its field operations. Berexco has also accepted liability for long-term storage of the CO_2 and has secured liability insurance policies and agreements with land/pore-space owners and the KCC. Berexco will operate the project under existing health and safety rules and regulations (i.e., OSHA) associated with the oil & gas industry as well state environmental regulations (i.e., KCC) and will continue its role as responsible field operator upon completion of project.

This proposed injection pilot leverages the ongoing DOE-funded Wellington site characterization that includes extensive geocellular modeling and simulation studies. Two wells have been drilled to basement. The logging program was exhaustive (e.g., triple combo, MRIL, micro-imager, dipole sonic). Continuous core was cut from the Mississippian to basement section. This core is currently undergoing computer axial tomography scanning to identify typical pore throat geometries (from touching vug to micropore scale) and to constrain MRIL interpretations of permeability. Routine and special core analysis will be performed. Core description and analysis will be used to derive the appropriate stratigraphic architecture, rock fabric-based permeability functions, and combined with image analysis for fracture characterization and subsequent discrete fracture network (DFN) modeling. Multi-component 3D seismic was recorded and interpreted during year 1 of existing project. Horizons have been mapped and volumetric curvature has been calculated to determine the potential of surface intersecting conductive fractures. No leakage pathways have been identified in the proposed pilot area. Geocellular and simulation models are updated as new data arrives to ensure simulations can adequately predict injectivity and storage capacity and to support risk assessment. Models will be kept evergreen with new borehole data and refinements (e.g., upscaling, anisotropy) to adequately reflect results from the extensive monitoring program. Risk management is summarized in Figure 21.

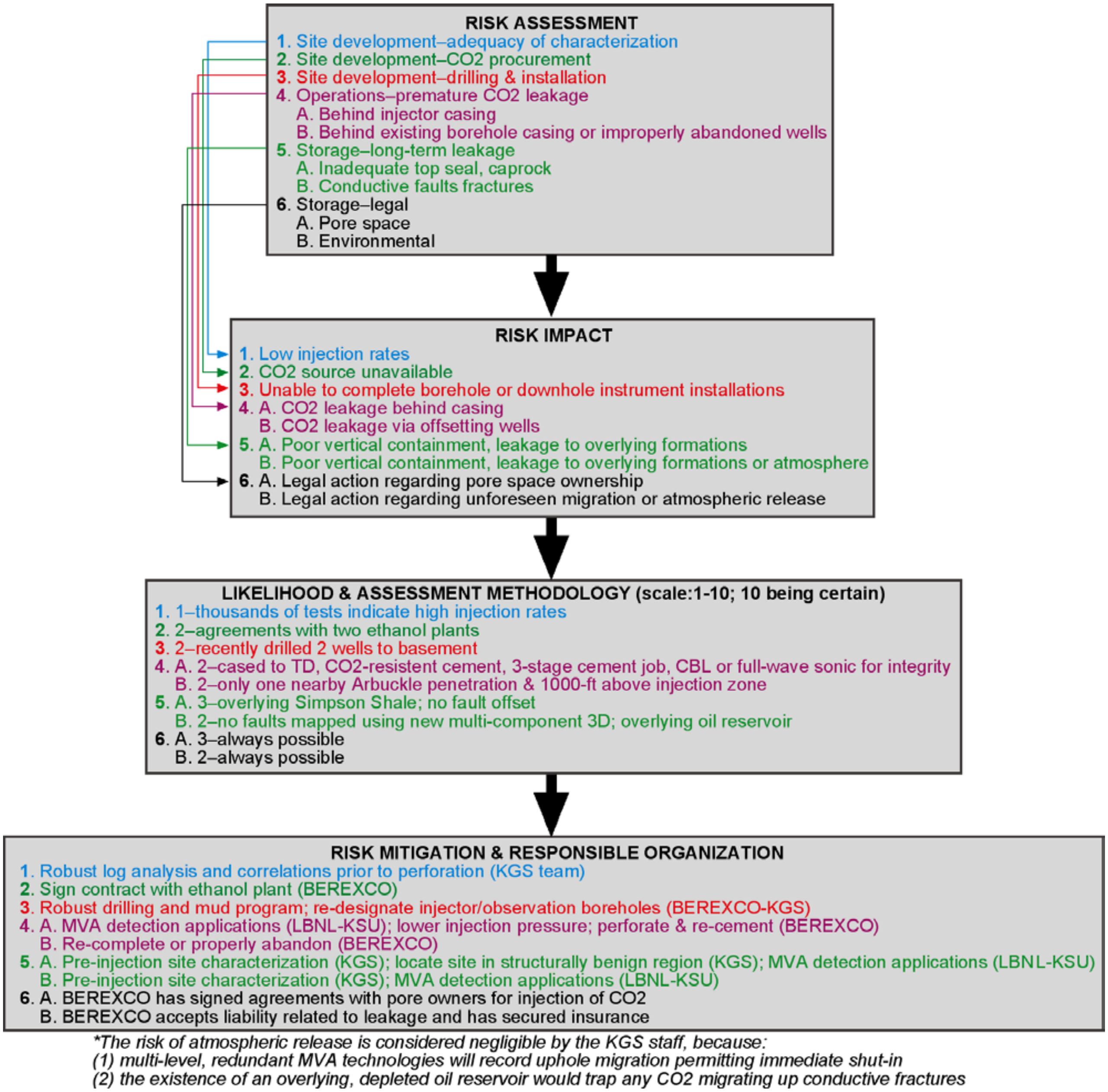

Figure 21. Outline and workflow of the Risk Management Plan described earlier.

Milestone Log

Milestones are under review as we redefine the schedule to start the pilot Mississippian CO2-EOR before the deep saline aquifer test in the Arbuckle.

Project Milestone Log (proposed revision 2-7-12)			
(2 per fiscal year)			
Task	**Budget Period**	**Number**	**Milestone Description**
Task 2.	1	1	Completed a public outreach plan and implement the plan
Task 3.	1	2	Submitted an application for a CO2 injection permit for the Arbuckle
Task 10.	2	3	Pre-injection MVA - establish background (baseline) readings
Task 13.	2	4	Retrofit Arbuckle Injection Well (#1-28) for MVA Tool Installation
Task 18.	3-yr1	5	Compare Simulation Results with MVA Data and Analysis and Submit Update of Site Characterization, Modeling, and Monitoring Plan
Task 22.	3-yr1	6	Recondition Mississippian Boreholes Around Mississippian CO2-EOR injector
Task 27.	3-yr2	7	Evaluate CO2 Sequestration Potential of CO2-EOR Pilot
Task 28.	3-yr2	8	Evaluate Potential of Incremental Oil Recovery and CO2 Sequestration by CO2-EOR - Wellington field

Table. 1. Milestones (in review).

Subtask 1.2. Planning and Reporting

Overall project management of the study is being done by the PI including execution of each phase of the project, subcontractor procurement and management, coordinating staff and outside resources, maintenance of the project budget and collaborating with individual stakeholders and the DOE.

The PI is ensuring compliance with the DOE project auditing requirements of recipients and sub recipients, compiling and submitting reports, including deliverables and periodic reports in accordance with the Federal Assistance Reporting Checklist, to the DOE and making formal presentations to DOE. The Recipient has participated and will continue to participate in annual project review meeting with the DOE.

Subtask 1.3. Develop Interface Capability to NATCARB Database

The Recipient has developed connections that shall allow period update to the NATCARB database with information generated from the project. The DOE project manager will be notified when data are added to the NATCARB database.

Subtask 1.4. Develop Project Web Site

A carbon sequestration web site has been created at the KGS -- http://www.kgs.ku.edu/PRS/Ozark/index.html. A special section of this website will be devoted to the project. This non-secured site is dedicated to apprising the public on the status of the on-going project as well as publishing the acquired data. The format of the site is directed toward both technical and non-technical audiences. Technical data is also conveyed via a web-based interactive mapper -- http://maps.kgs.ku.edu/co2/?pass=project. All presentations will be fully functional through an internet browser (e.g., IE, Firefox, Chrome, and Safari). Project related material which is to be posted on the web site shall be submitted to DOE for review and approval prior to the posting.

Subtask 1.5. Drilling and Well Installation Plan

Well Drilling and Installation Plans will be done for all of the wells and boreholes which describe the drilling and installation methods, the well-borehole designs (casing design, centralizer plan, cement design, etc.), method for determining perforation zones, contingencies for anticipated problems encountered during drilling such as loss circulation zones, completion and development plan. Additionally, the drilling and well installation plan shall include a description of mud logging, wire line logging, coring, swabbing and laboratory analysis of samples that shall be collected, and any other testing that may be performed on the well-borehole.

Components of the Drilling and Well Installation Plan have been considered in developing well costs and will form the basis of these plans. Preparation of the NEPA EQ statements for the wells is underway.

Subtask 1.6. Monitoring Verification and Accounting (MVA) and Mitigation Plan: An MVA plan has been scoped out as part of the application and continues to be refined. Related detail is being developed in an application for a Class VI (geosequestration) injection permit that describes potential leakage pathways, discussions on detection limits, risk assessment and management, MVA field activities, models being used and their application, and how monitoring methods and techniques will be used to document the amount of injected CO_2 and validate the containment of the injected $CO_{2.}$ Additionally, mitigation plans to control CO_2 leakage are being developed in consultation with KCC, industry partners, and DOE to effectively manage CO_2 leakage into shallower horizons and/or to the surface. Elements of the mitigation plan will include: a) immediate stoppage of CO_2 injection and release of *in situ* pressure by opening both the injection and observation boreholes. A wellbore management section shall also be included as part of this plan. This section of the MVA Plan shall describe a plan to mitigate potential risks from migration of CO_2 through new or old well bores.

Subtask 1.7. Public Outreach Plan

A detailed Public Outreach Plan is in development to document that describes workshops, presentations, and publications in technical and trade journals to be used to transfer lessons learned best practices, geomodels, simulation results, MVA data and observations to the public, regulators, legislators, and local industry.

Subtask 1.8. Go-No Go1 Arbuckle Injection Permit Application

An application for a Class VI underground injection control (UIC) permit for injecting CO_2 into the Arbuckle Group is underway and will be submitted in the second quarter. The final draft permit, after all negotiations are completed, shall be reviewed and a short report submitted to the DOE with a copy of the permit, indicating any potential implementation issues that may arise. This report shall be used to support a go/no go decision by the DOE on continuing this test injection into the Arbuckle.

Subtask 1.9. Go-No Go2 Mississippian Injection Permit Application

An application for a Class II underground injection control (UIC) permit for injecting CO_2 into the Mississippian Formation will be done in the second quarter. The final draft permit, after all negotiations are completed, shall be reviewed and a short report submitted to the DOE with a copy of the permit, indicating any potential implementation issues that may arise. This report shall be used to support a go/no go decision by the DOE on continuing the project.

Subtask 1.10. Site Development, Operations, and Closure Plan

This plan is underway to provide details of the site development, operations, and site closure for use in management of the infrastructure of the site. A list of available infrastructure in and around Wellington Field related to small scale CO_2 injection is being compiled as part of this plan. The plan will identify all major activities, roles of responsibility, and environmental health and safety issues that the Applicant will face during all stages of the project. Necessary permits and respective agencies needed for the project and a description of the information required for each permit are being identified. The plan will provide a schedule of when permit applications shall be submitted and anticipated approval dates. A list of responsible persons for completion and negotiation of the permits will be identified for each permit.

Task 2. Site Characterization of Arbuckle Saline Aquifer System - Wellington Field

The existing Site Characterization/Conceptual model will be updated with information gathered during this project for both the Arbuckle and Mississippian Reservoirs. The models will be updated to compare plume movement, lateral extent, and composition from the MVA and tracer analysis and historical information with the simulator-calculated plume geometry. Simulator-calculated plume composition (CO_2 and ionic concentration) and its variation over time will be compared with that obtained from analysis of U-tube samples. Simulator-calculated changes in formation fluids near the observation borehole shall be used to help validate the movement and amount of CO_2 moving between the injector and the observation boreholes in the Arbuckle and also the in situ chemical interactions between mineralogy, formation brine, and CO_2.

A geomodel for the Arbuckle Saline Aquifer system underlying the Wellington Field is being developed at the Kansas Geological Survey (KGS) as part of DOE project DE-FE0002056. Additional details shall be added to the existing geomodel such as the presence/absence of hydraulic communication in different Arbuckle flow-units, delineation of structural discontinuities and flexures, etc. Simulation studies shall be conducted using this model to determine the optimum location of the CO_2 injector and monitoring boreholes based on plume growth and movement, and the existing infrastructure. A summary report will be prepared to describe the geology of the selected area and confirm that it is suitable for CO_2 injection operations. This report shall be submitted to the DOE for review. This report shall be used to support a go/no go decision by the DOE on continuing the project.

Task 3. Site characterization of Mississippian Reservoir for CO2 EOR - Wellington Field

The geomodel constructed for the Mississippian Reservoir as part of DOE project DE-FE0002056 will be extracted and used for simulation studies to identify the optimum location of a 5-spot pattern flood to test CO_2-EOR in Wellington Field. The production history of the existing wells will be history matched to validate the model. Criteria used in the selection process for the wells include: 1) maximum use of existing infrastructure of Mississippian wells; 2) tonnage (approximately 30,000 metric tons) of CO_2 necessary to demonstrate incremental oil recovery within the project time frame; and 3) maximization of CO_2 sequestration. A summary report will e prepared to describe the geology of the selected area and confirm that it is suitable for CO_2 injection operations. This report shall be submitted to the DOE for review. This report shall be used to support a go/no go decision by the DOE on continuing the project.

New seismic processing and interpretations are underway and will be integrated in the second quarter for use in applications for the Class VI and Class II injection permits.

Task 8. Inventory Well and Borehole Completions within Area of Influence of Small Scale CO2 Sequestration Project

This inventory was accomplished during the proposal phase to assess need for workover and plugging for budgeting purposes. Berexco has operated the field for a number of years and have extensive information on the well and their completion history. Any concerns were addressed early on in considering this project. It was determined that one well, Peasel #1, will be recompleted and deepened to assume a monitoring role.

Subtask 9.2. Install LIDAR Survey Reflectors, CGPS, and Seismometers in a Grid Pattern near the Injection borehole.

This installation including other field activities are on hold until subcontracts for the other field activities are approved.

Presentations

Presentation to Joint Committee on Energy and Environmental Policy, Kansas Legislature: October 18, 2011 – "Geologic Carbon Sequestration -- Characterizing Pore Space & Managing CO2 Plume"

Joint meeting of state and Region 7 EPA regulators on classification of our CO2 test injection: November 10, 2011: Overview presentation and framework for discussion of injection permit

Kansas Geological Survey Advisory Council: November 18, 2011: Project Update.

Kickoff Meeting: Project Kick Off Meeting was held in Pittsburgh, PA at the Carbon Storage Infrastructure Annual Review Meeting on November 15-17, 2011. The presentation is online at the project website:
http://www.kgs.ku.edu/PRS/Ozark/Reports/2011/Watney_Small_Scale_Field_Test_overview_11-16-11.pdf

Wellington Town Hall Meeting: December 12, 2011: Public meeting was organized by local state legislator, Rep. Vince Wetta from Wellington to provide forum with industry and state representatives on an active horizontal drilling play in southern Kansas and carbon sequestration at Wellington Field. It was estimated 450 people were in attendance. Half hour presentation was given on proposed injection into Arbuckle saline aquifer and the Mississippian oil reservoir. State and federal regulators and other state legislators were in attendance. Presentation was successful in that it reached a many of the stakeholders including visit with landowners near the proposed injection site.

AGU Annual Fall Meeting: Oral presentation was made on December 8, 2011 in a session on carbon sequestration,
-- http://www.kgs.ku.edu/PRS/Ozark/Reports/2011/AGU2011_Watney_v3.pdf

Key Findings

We are in the early stages of revising geomodels, subcontract budgets, and preparing permitting applications.

Plans

1. Revise schedule and impacted planning for CO2 injection to be begin in the Mississippian while application for a Class VI permit is being reviewed by EPA. Revise PMP.

2. Revise geomodel and simulations for the Mississippian oil reservoir and Arbuckle saline aquifer.

3. Finalize large subcontracts for CO2 supply and drilling and CO2 handling at Wellington Field.

4. Submit NEPA EQ’s and prepare planning documents.

5. Meet with Biorecro AB on carbon credits for deep saline CO2 injection at Wellington

6. Finalize work on strategies for CO2 source-sink infrastructure in Kansas with the Clinton Climate Initiative, William J. Clinton Foundation.