DOE F 4600.2
(03/11)
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U.S. Department of Energy
FEDERAL ASSISTANCE REPORTING CHECKLIST
AND INSTRUCTIONS FOR RD&D PROJECTS

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		
☒ SF-425 Federal Financial Report	Q, FG	FITS@NETL.DOE.GOV
D. CLOSEOUT REPORTING		
☒ Patent Certification	FC	FITS@NETL.DOE.GOV
☒ SF-428 & 428B Final Property Report	FC	FITS@NETL.DOE.GOV
☐ Other		
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

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Prepared by Lynn Watney
Date of Report: November 4, 2014
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 9/30/2016

Twelfth Quarterly Report

Period Covered by the Report: July 1, 2014 through September 30, 2014

Signature of Submitting Official:

W. Lynn Watney
Digitally signed by W. Lynn Watney
DN: cn=W. Lynn Watney, o=The University of Kansas, ou=Kansas Geological Survey, email=lwatney@kgs.ku.edu, c=US
Date: 2014.11.04 07:25:16 -06'00'

EXECUTIVE SUMMARY

Project Objectives

The objectives of this project are to understand the processes that occur when a maximum of 70,000 metric tonnes of CO_2 are injected into two different formations to evaluate the response in different lithofacies and depositional environments. The evaluation will be accomplished through the use of both *in situ* and indirect MVA (monitoring, verification, and accounting) technologies. The project will optimize for carbon storage accounting for 99% of the CO_2 using lab and field testing and comprehensive characterization and modeling techniques.

CO_2 will be injected under supercritical conditions to demonstrate state-of-the-art MVA tools and techniques to monitor and visualize the injected CO_2 plume and to refine geomodels developed using nearly continuous core, exhaustive wireline logs, and well tests and a multi-component 3D seismic survey. Reservoir simulation studies will map the injected CO_2 plume and estimate tonnage of CO_2 stored in solution, as residual gas, and by mineralization and integrate MVA results and reservoir models shall be used to evaluate CO_2 leakage. A rapid-response mitigation plan will be developed to minimize CO_2 leakage and provide comprehensive risk management strategy. A documentation of best practice methodologies for MVA and application for closure of the carbon storage test will complete the project. The CO_2 shall be supplied from a reliable facility and have an adequate delivery and quality of CO_2.

Scope of Work

Budget Period 1 includes updating reservoirs models at Wellington Field and filing Class II and Class VI injection permit application. Static 3D geocellular models of the Mississippian and Arbuckle shall integrate petrophysical information from core, wireline logs, and well tests with spatial and attribute information from their respective 3D seismic volumes. Dynamic models (composition simulations) of these reservoirs shall incorporate this information with laboratory data obtained from rock and fluid analyses to predict the properties of the CO_2 plume through time. The results will be used as the basis to establish the MVA and as a basis to compare with actual CO_2 injection. The small scale field test shall evaluate the accuracy of the models as a means to refine them in order to improve the predictions of the behavior and fate of CO_2 and optimizing carbon storage.

Budget Period 2 includes completing a Class II underground injection control permit; drilling and equipping a new borehole into the Mississippian reservoir for use in the first phase of CO_2 injection; establishing MVA infrastructure and acquiring baseline data; establishing source of CO_2 and transportation to the injection site; building injection facilities in the oil field; and injecting CO_2 into the Mississippian-age spiculitic cherty dolomitic open marine carbonate reservoir as part of the small scale carbon storage project.

In Budget Period 3, contingent on securing a Class VI injection permit, the drilling and completion of an observation well will be done to monitor injection of CO_2 under supercritical conditions into the Lower Ordovician Arbuckle shallow (peritidal) marine dolomitic reservoir. Monitoring during pre-injection, during injection, and post injection will be accomplished with MVA tools and techniques to visualize CO_2 plume movement and will be used to reconcile simulation results. Necessary documentation will be submitted for closure of the small scale carbon storage project.

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.

<u>Project Deliverables by Task</u>

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

1. 1st formal meeting on August 20th with Region 7 EPA in Lenexa, KS and tele-connection with Washington office to discuss the Wellington Class VI application.

Introduce Wellington team and reaffirm tight schedule and commitment to work closely with EPA to meet requests.

2. Completed review of Berexco subcontract and permission received from DOE on September 22nd to begin field activities associated with BP2.

3. **15 seismometers seismic array from IRIS-PASSCAL are installed and operational.**

Installation completed using KGS funds prior to start BP2 and system is now operational. DOE funds are being used to install cellular network and for acquisition and processing of the microseismic data. Resolution of recording appears to be excellent.

4. **cGPS installed and operational as instrumentation**

cGPS is necessary to obtain baseline x-y-z ground motion to calibrate InSAR.

Milestone Status Report

Task	Budget Period	Number	Milestone Description
Task 2.	1	1	Site Characterization of Arbuckle Saline Aquifer System - Wellington Field
Task 3.	1	2	Site characterization of Mississippian Reservoir for CO2 EOR - Wellington Field
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

Task 2 -- Arbuckle model framework was requested and shared with EPA to rebuild an independent simulation of the CO2 injection. EPA consultant will use software from DOE’s Pacific Northwest National Lab.

Task 3 – Mississippian geomodel and simulations slightly modified and three alternative locations of the Class II Mississippian injection well were obtained including original location. Original location confirmed for Class II well.

Task 10 – Fifteen seismometers and cGPS are installed and operational. Installation of first two groundwater monitoring wells is underway to establish background analyses in AOR for EPA Class VI application.

Project Schedule

Detailed planning for the Mississippian CO2 injection is underway (**Figure 1)** and described in following list.

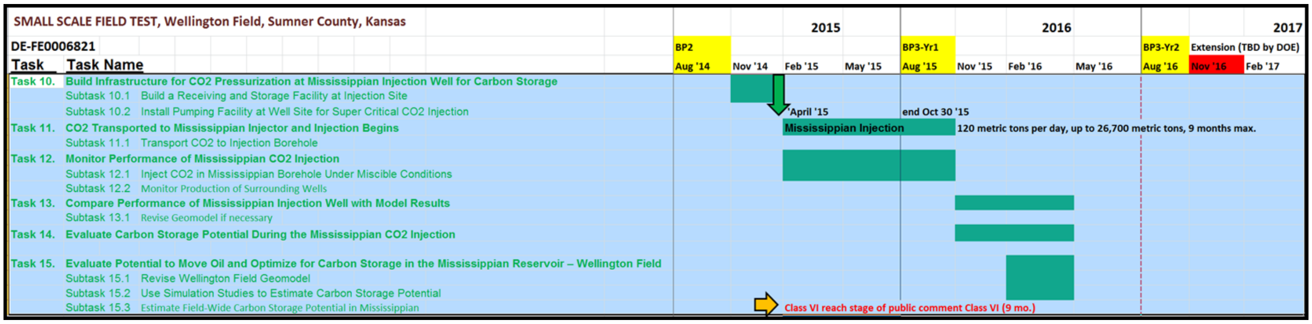


Figure 1. Budget period 2 begin with preparations to injection CO_2 into the Mississippian oil reservoir.

BP2 activities are underway or planned as summarized below:

a) MVA implementation – seismometer array (installed Sept 2014), cGPS (installed Sept 2014), shallow USDW wells (Oct-Nov. 2014), soil gas (late 2014), re-pressuring Mississippian and sampling producing wells (~March 2015)
b) Class II application (to be filed Nov. 2014) and Public Outreach (Dec 2014)
c) Drill Mississippian injection well, #2-32 (~Feb 2015)
d) Inject CO2 (~April 2015) 120 metric tons per day, up to 26,000 metric tons, 8 months max.
e) EPA permit (March 2015)
f) Order fabrication of CASSM and U-Tube 8-9 months lead time (March 2015)
g) Drill #2-28 Arbuckle monitoring well (summer 2015)
h) Equip #2-28 with CAASM and U-Tube, and #1-28 for injection (Oct-Nov 2015)
i) Inject CO2 in #1-28 (Nov 2015) -- 120 metric tons per day; up to 26,000 tonnes, 7.5 months max.
j) Post injection monitoring begin (July 2016) DOE project currently ends Sept 2016; extension for post injection site care defined by EPA using remaining funds

The SOPO was revised and the full schedule of the project was modified to fit the end date of funding, September 30, 2016. The portion of the schedule with the Arbuckle injection is shown in **Figure 2**.

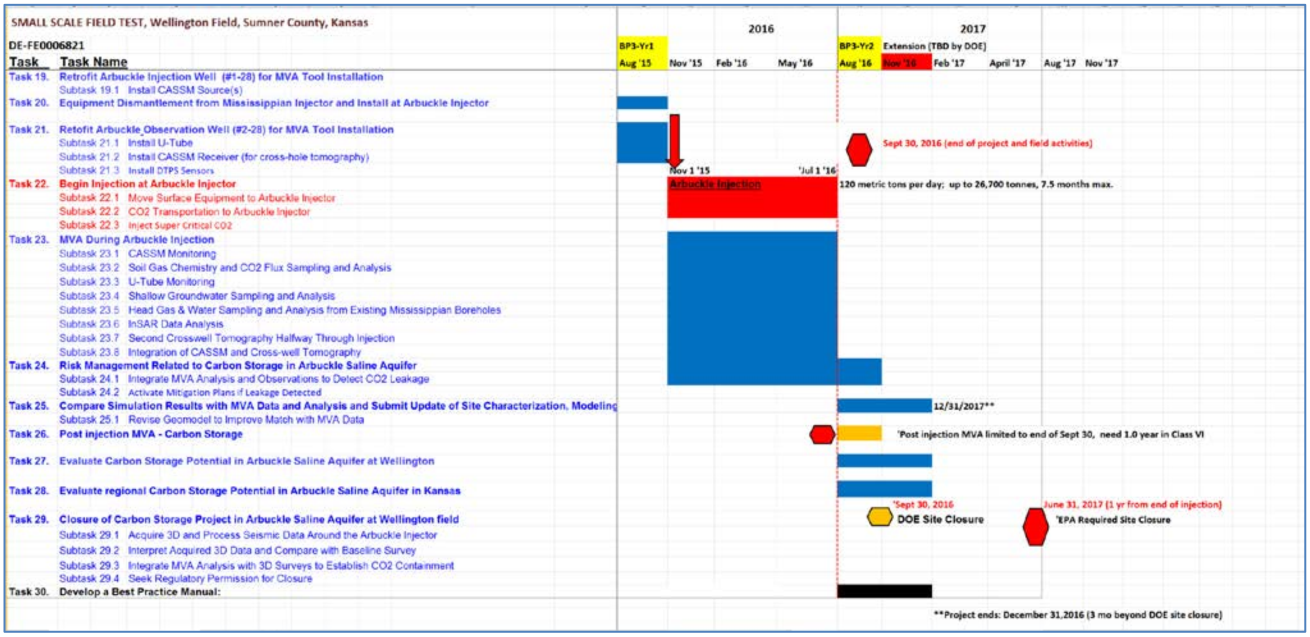


Figure 2. Project schedule for pre- and post-Arbuckle injection at Wellington Field.

Activities of Lawrence Berkeley National Lab

Recent discussions with Tom Daley and Barry Freifeld at LBNL involve moving from soil gas assessment to soil gas analysis to save on cost. These analyses will insure basic characterization of CO_2 in soil in the immediate vicinity of the Arbuckle injection well. LBNL is also developing installation details and diagrams tailored to Arbuckle injection and monitoring wells so that this can be reviewed by Berexco and used to update costs for fabrication of materials for CASSM and U-Tube.

ONGOING ACTIVITIES

TASK 1. PROJECT MANAGEMENT AND REPORTING

Scheduled activities include –

- Hold kickoff meeting on October 15
- Establish invoicing protocol – cost center billing for Berexco accepted by Berexco, KGS, DOE, KUCR
- Hold scheduled conference calls with team (bimonthly)
- Press release -- to be reviewed by key parties
- Project fact sheet – draft being reviewed
- Increase visibility of the project on the website

- Meet with landowners to discuss the project closer to time when the Mississippian well will be drilled
- Meet with public in Wellington town hall meeting to discuss the project and answer questions
- Complete USDW wells
- Install cellular network for remote communication with seismometers
- Install 3 accelerometer/broadband seismometers.

Subtask 1.7. Public Outreach Plan

A public information circular, project fact sheet, and press release in development and will be released next quarter. Informal meetings planned with local landowners prior to formal public meeting.

Subtask 1.8. Arbuckle Injection Permit Application Review go/no go Memo

EPA is reviewing application and questions being addressed are on the topics of financial assurance, quality of the USDW in the AOR of the Arbuckle CO_2 injection. We have coordinated with EPA to approve plans to drill two tests of the USDW this fall. Wells will be both completed in November 2014. Domestic well water from the aquifer in the area will also be sampled and analyzed.

State regulators at Kansas Corporation Commission and Kansas Department of Health and Environment have been asked to review the Class VI application. Request has been made to again have a face-to-face meeting with Region 7 EPA.

TASK 2. SITE CHARACTERIZATION OF ARBUCKLE SALINE AQUIFER SYSTEM - WELLINGTON FIELD (GO/NO-GO DECISION #3)

Additional analysis of the geomodel continues to refine the smaller scale heterogeneity in the Arbuckle, but not significant changes have been made.

TASK 3. SITE CHARACTERIZATION OF MISSISSIPPIAN RESERVOIR - WELLINGTON FIELD (CLASS II APPLICATION & GO/NO-GO DECISION #4)

The Mississippian model was updated after slight modification of the seismic interpretation and recognition of small (~50 ft or less displacement) faults that affect the lateral continuity of the flow units that comprise the Mississippian reservoir (**Figures 3-8).** Original location of injection well was confirmed. The porosity model now includes small faults that trend NE that modify the porosity and permeability distribution (**Figures 3 and 4**). The zone of faulting also delineates the basic flow unit structure of the reservoir, aggrading east half and a progradational west half. It is important to note that the overlying seismic reflectors are continuous, indicating the caprock is undisturbed. Thus, the fault system is an inherited feature (**Figure 5**). The simulated CO2 plume reflects a preferred NE-trend geometry controlled by both the flow unit distribution, where progradational units strike in this direction, but also the permeability anisotropy (**Figure 6**). The isopach map of the small faults is noted in the lower portion of **Figure 6**. Note that the southern blue thick has been removed after a modification of the seismic correlation. However, the remaining portion of the map has not changed. The CO2 will be closely monitored with the geophysics, InSAR, and geochemistry of producing wells surrounding the injection well to test the simulation model.

Alternative site for CO2 injection into the Mississippian reservoir are illustrated in **Figures 7 and 8**. The consensus is to stay with the initial area.

Area in vicinity of CO_2 will be re-pressurized to obtain optimal miscibility, between 1600-1700 psi. Pressure will be near the original of 1650 psi. To raise pressure, will shut down surrounding wells and may increase injection in water wells. The Miss injection well will be drilled before we start to pressurize the reservoir. Then we can directly measure the pressure as soon as it is drilled. We will likely want to run Step Rate Test before the injection begins. It will be important to continue discussion of the geomodel before Mississippian injection)

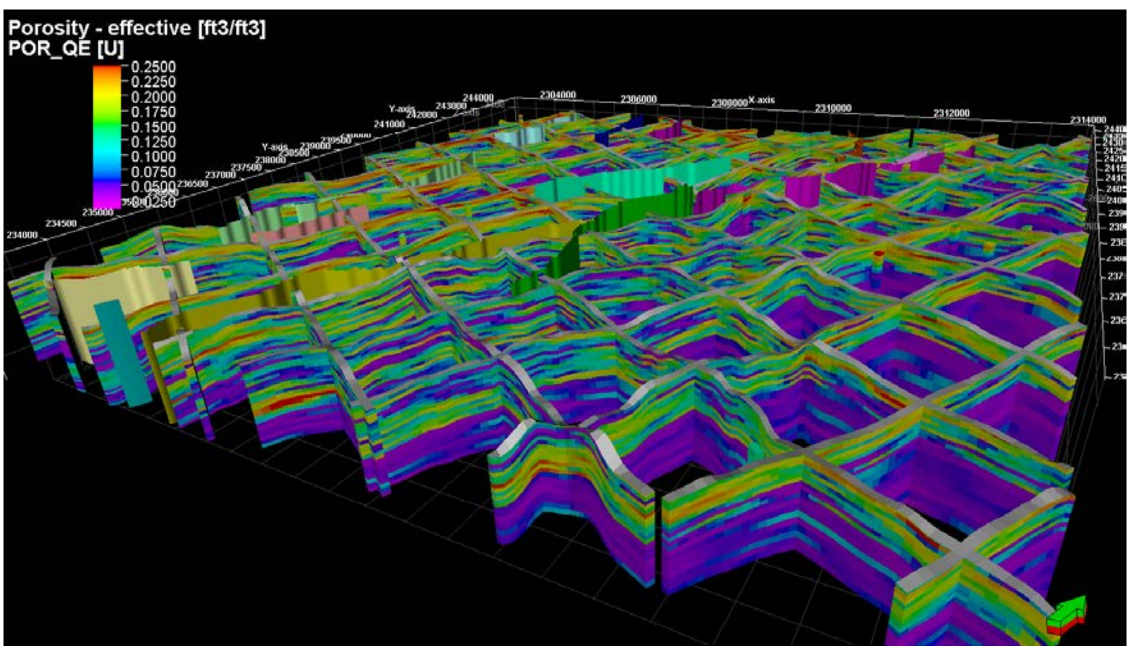


Figure 3. Porosity fence diagram from Petrel for Mississippian reservoir showing small faults cutting SW-NW (Holubnyak, 2014). Near side (east side of Wellington) is

aggradational while far side (west side) is progradational to the west suggesting flexural bend along area of faulting.

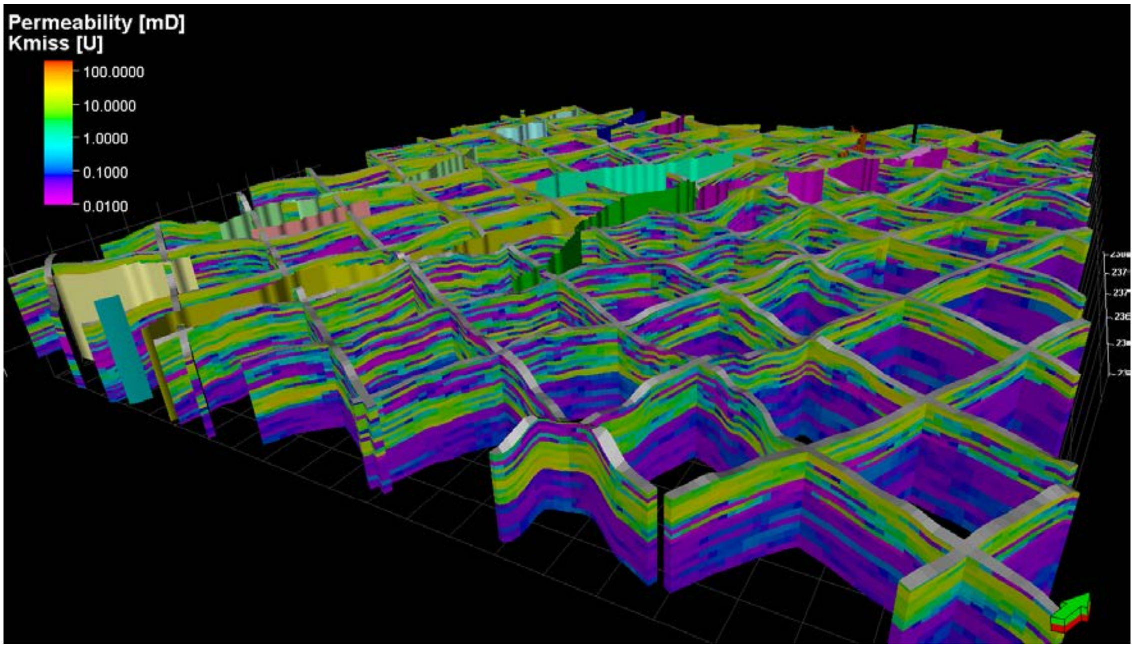


Figure 4. Permeability model of the Mississippian reservoir. See explanation in Figure 3. (Holubnyak, 2014)

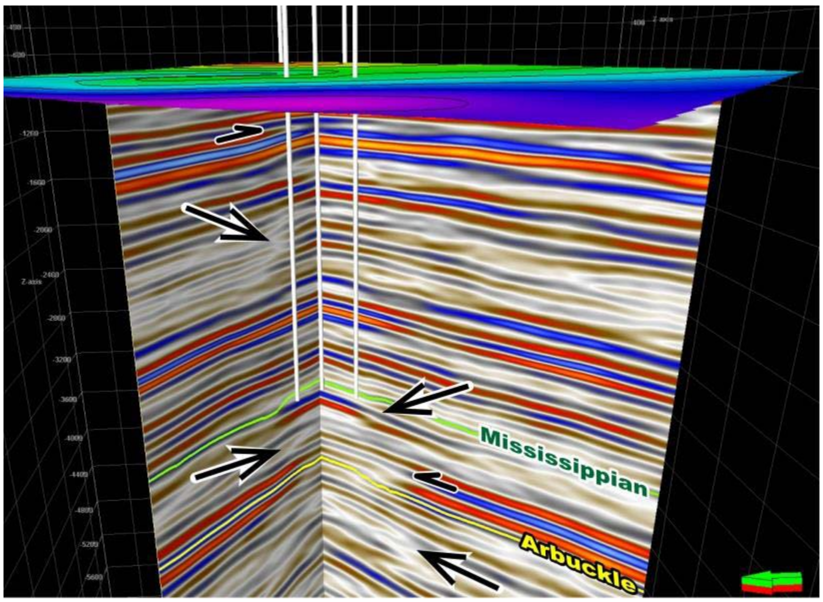
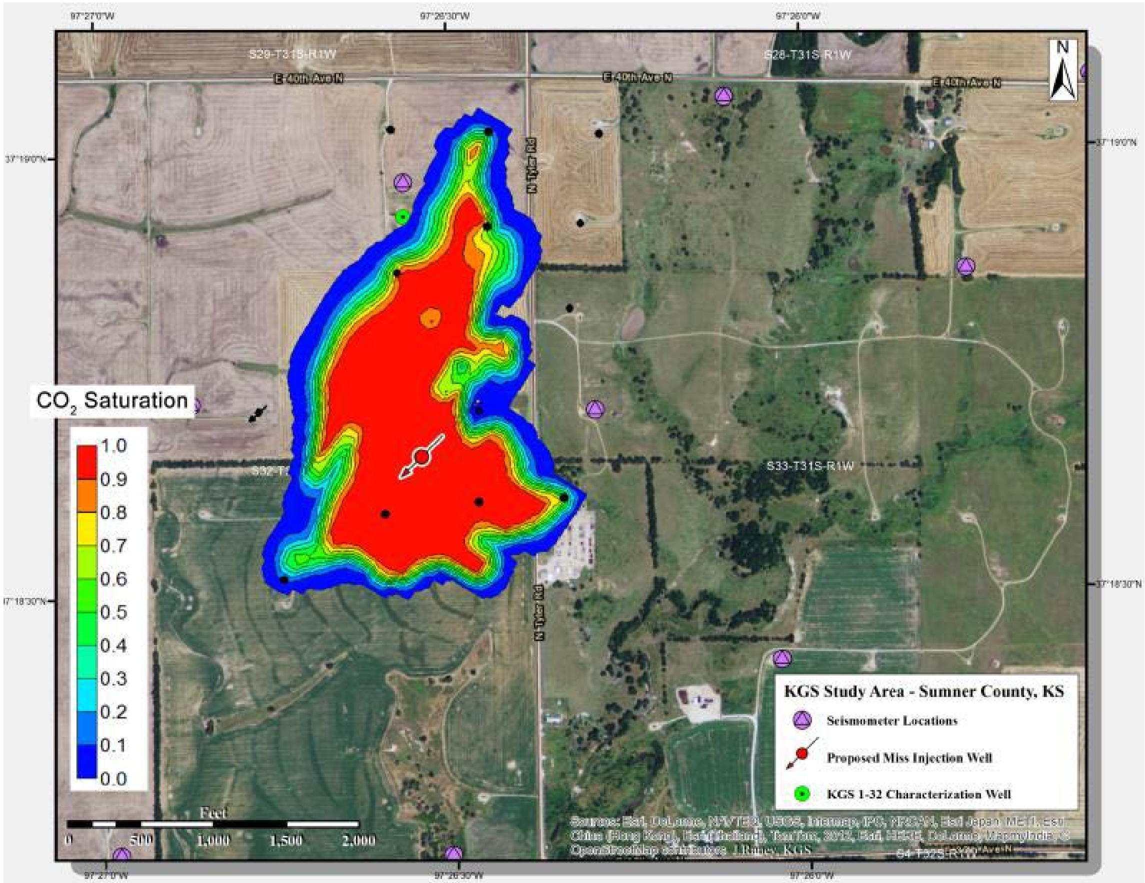


Figure 5. Slices from a pre-stack depth-migrated seismic amplitude volume in Wellington Field highlighting suspected faults based on termination of seismic reflections. A 5-spot well injection pattern is shown that is impacted by the two faults (right) (Holubnyak, 2014)



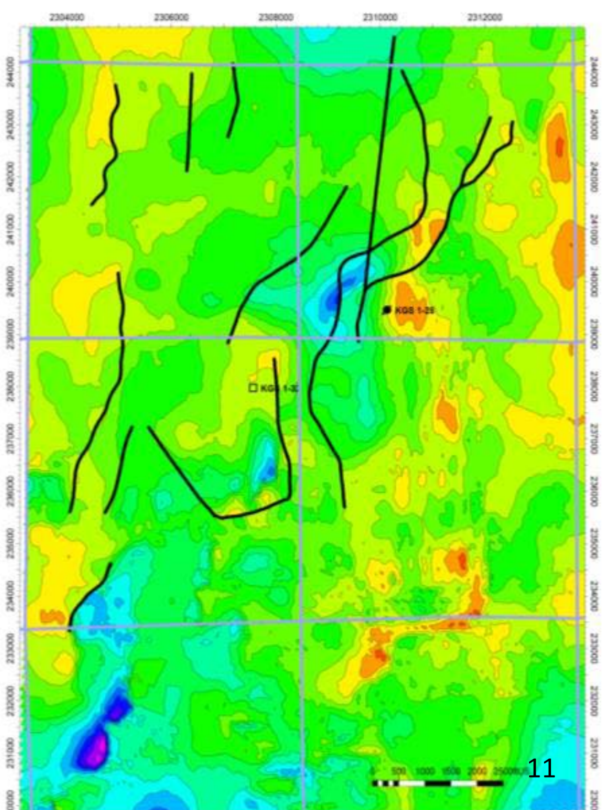


Figure 6. CO2 spatial distribution in the accepted case where the injector location coincides with structural elements (See Figure 4 and 5). Isopach map with mapped faults for the Wellington Field with warmer colors representing higher structures and cooler – lower structures (below). KGS #1-32 (on southwest) and KGS #1-28 (on northeast) are identified on the map. Holubnyak (2014).

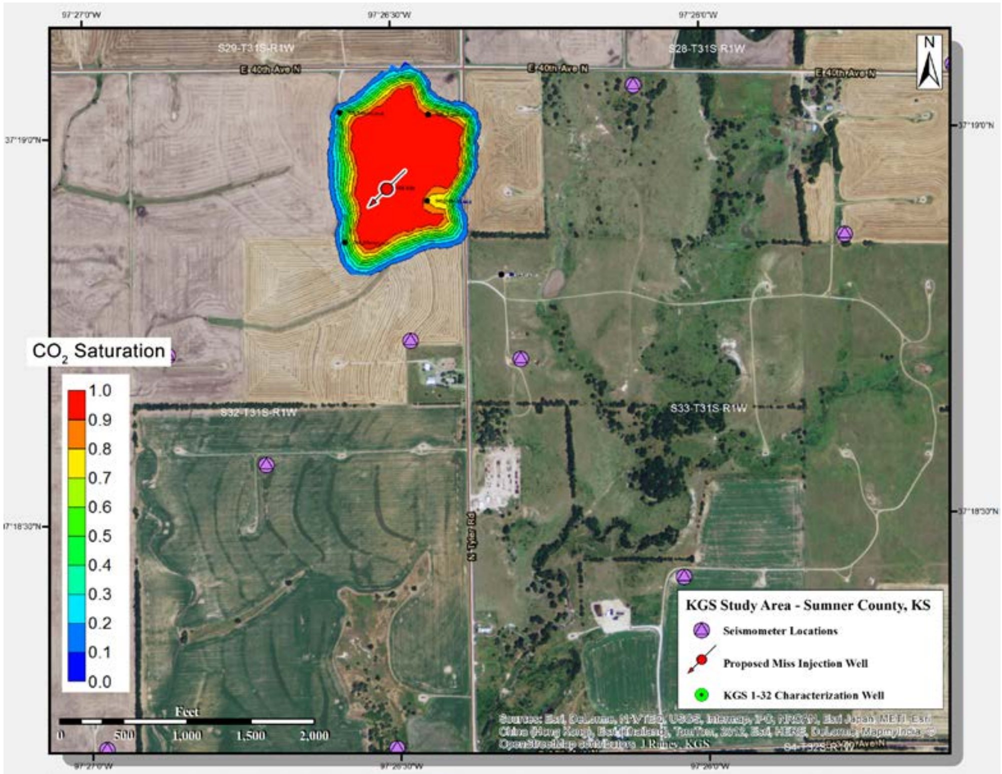


Figure 7. Alternative Mississippian CO_2 injection site near KGS #1-32.

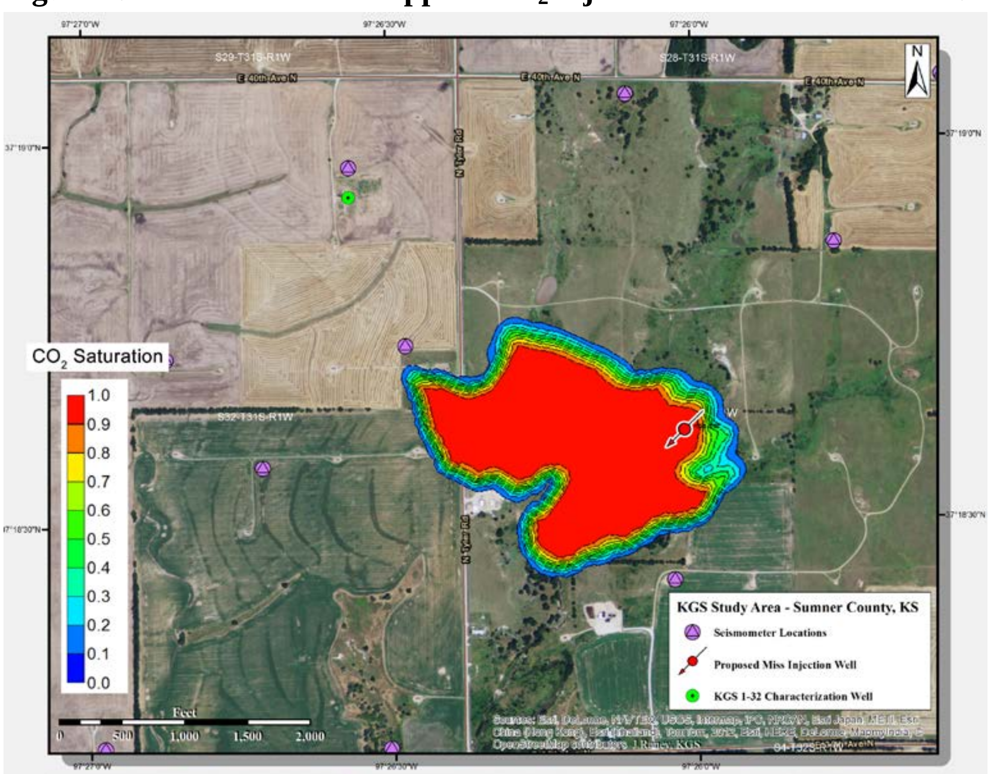


Figure 8. Alternative Mississippian CO_2 injection site in Section 33, east of preferred site.

TASK 5. SECURE CO2 SOURCE -- GO/NO-GO DECISION #5

Subtask 5.1 CO_2 Supply
Subtask 5.2 CO_2 Transportation

Mississippian injection continues to be planned for April 2015. CO2 delivery trucks have off road capability. Mississippian injection well will be drilled by late winter 2014/2015 with plans to drill Arbuckle monitoring well in Oct 2015. Final contractional agreement is needed between Berexco and Linde and Praxair who will be contacted in the coming weeks. We do not foresee any injectivity problems and Berexco is prepared for a flexible volume delivery and quantity stored on location.

TASK 6. ESTABLISH MVA INFRASTRUCTURE - AROUND CO_2 INJECTOR FOR CARBON STORAGE

Subtask 6.1. Design MVA Components and Fabrication (Contingent on Go Decision pts 1&3)

LBNL will get new price quotes on equipment including for CAASM - piezotube source installed in injection tubing above the injection zone in the injection well and the sensors installed in the monitoring well. CASSM will provide the opportunity to also monitor any vertical CO_2 movement above the injection zone.

CASSM is more of a sparse survey, which is useful when integrated with the crosswell survey. CASSM and crosswell were used at Cranfield (100,000 tonnes) and Frio (1500 tonnes). CO_2 showed up nicely in each. Seismic velocity changes were detected a few hundred meters around the borehole. The changes in velocity seen with CASSM are less than a microsecond. The changes that we should expect will be on the order of milliseconds. CASSM will be installed in the annulus on the injection well. Clamps will be all the way up the casing. U-tube is another line that is clamped to the tubing. Action: Share designs of U-Tube and CASSM tailored to Arbuckle wells.

The repeat 3D seismic survey will be used to close the Arbuckle injection by observing the difference in travel times. The resolution of this change will depend on the thickness of the plume. It can be difficult to see the reflection from the surface seismic, but would likely see from reflection of the downhole surveys at the level of the Arbuckle. The crosshole seismic will deploy 10-20 sources from a range of depths, and then move the phones to another depth. Action: Will need to update the fluid substitution model with a revised rock physics model using what we know now since original modeling done in 2011 just after the first 3D survey.

Installation of temperature and pressure gauges in the injection well is being considered versus using wireline to periodically measure temperature and pressure. Action: Investigate options for packers to insure that there will be no leaks and problems with the mechanical integrity tests. Based on successes in past, hydraulic packers may be the best option with pass-throughs.

Possible acquisition of a VSP was again discussed. Usually 100 sensors are needed for a VSP. Two hydrophones to be installed downhole in temporarily abandoned wells with internal KU funding applied are probably not enough to obtain useful data.

KGS will acquire a high resolution 2D seismic baseline, but VSP could also be accomplished using the same vibroseis. In any case, a check-shot survey with between 5-20 hydrophones useful for additional calibration. A check shot survey could also be run with the crosswell seismic survey. This would benefit all geophysicists. Distributed acoustic fiber optic may also be an option.

Subtask 6.2. Install CGPS and Seismometers near Injection Borehole

CGPS and seismometers have this installed, are recording, and being maintained by Rick Miller's team (**Figure 9**). Data will be shared internally among PI's of science team and eventually to public via website with support from John Victorine. $27,000 is needed to install and operate the three accelerometers and looking elsewhere for funds.

Seismic network:

- CGPS is installed at seismometer station #8 (**Figure 10**)
- have the 15 IRIS stations for 3 years
- Sheriff has serial #s and locations of all their equipment to keep an eye out.
- Data storage onsite for now -- max they can run right now is 2 weeks before they run out of room to record data. Currently they are running out every 10 days while getting background.
- Will go to telemetry system, cell phone modem to send data.
- Cement pad on each seismometer station is below frost line to minimize temperature fluctuations on equipment.
- Waiting for recursion relationships to be able to put data out to public. Still don't have enough to see the types of events we expect to see.

Rick is involved in a separate project to increase the aperture of our seismic network with a portable seismic array obtained with state funding to improve monitoring of small earthquakes in southern Kansas. The Wellington array would serve as part of this system.

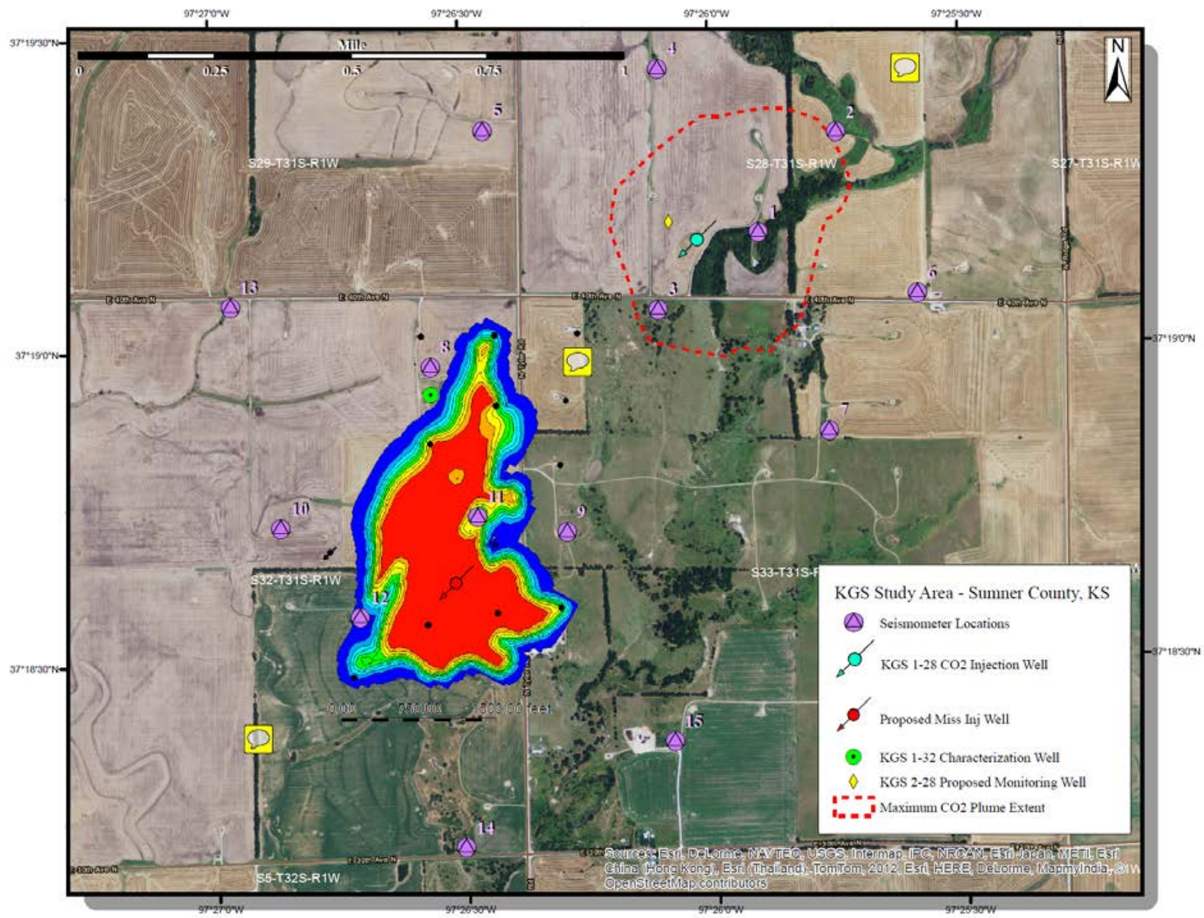


Figure 9. Location of IRIS seismometers, CO_2 injection wells, and CO_2 plumes for the Mississippian and Arbuckle injections.

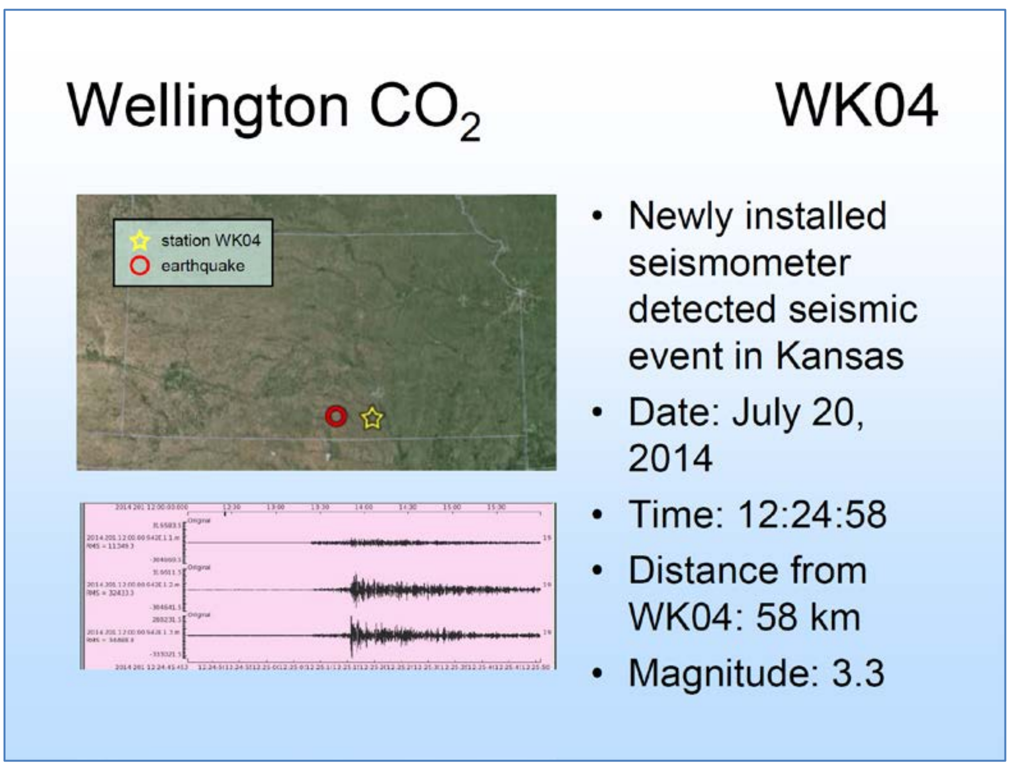


Figure 10. Example of a seismometer vault and a record of nearby earthquake.

Subtask 6.3. Establish Protocols for InSAR data collection

Mike Taylor, Co-I is in charge of acquisition and processing of the CGPS data and using this information to interpret InSAR. The satellite based radar sees through clouds. Each pass of the satellite, ~30 days between passes, can potentially measure displacement of ground surface to mm-scale. With CGPS, Mike can solve for 3 components of the displacement. Right now, these data are manually downloaded.

We do not expect displacement due to earthquakes. Rather the deformation will be a result of pressure changes and very small ground displacement. With a map of subsurface faults, the team will have an idea how they will respond to the injection.

We have a good baseline to observe the repressurization of the Mississippian. If we are raising pressures in an area covering 60-80-100 acres of the field, we should see this in the InSAR data. Berexco is very interested in the use of this technology to monitor waterflooding. The CGPS is anchored 20 feet in cement. It should give us an excellent baseline on millimeter to submillimeter ground motion. We need an accurate baseline measurement of the stresses to understand the pressure changes and for the deformation modeling.

Subtask 6.4. Drill Shallow Freshwater Monitoring Boreholes (Contingent on Go Decision pts 1&3)

Rick Miller's team is installing water wells. Will adjust location of wells based on what we find when drilling. Plans are illustrated in **Figures 11-18.**

ACTION ITEMS: EASTERN and SOUTHERN wells will be drilled this fall. No clusters on the east or the south. Obtain EPA, landowner, and team approval. (All approved via email, in-person meeting & email, and email, respectively). (UPDATE: Approvals obtained to commence activities)

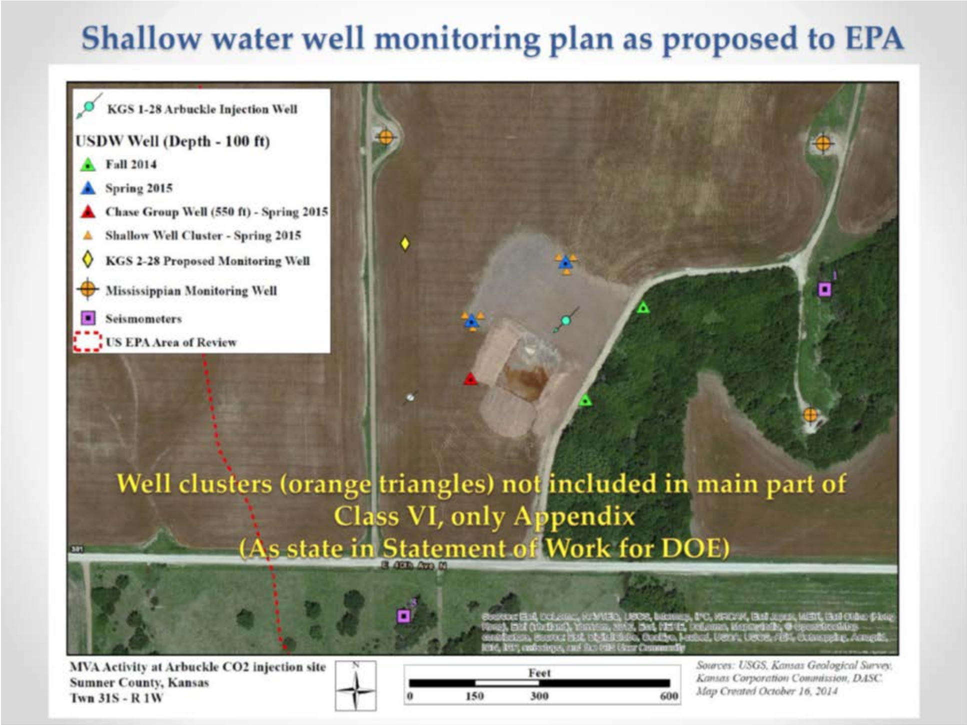


Figure 11. Shallow well monitoring basemap.

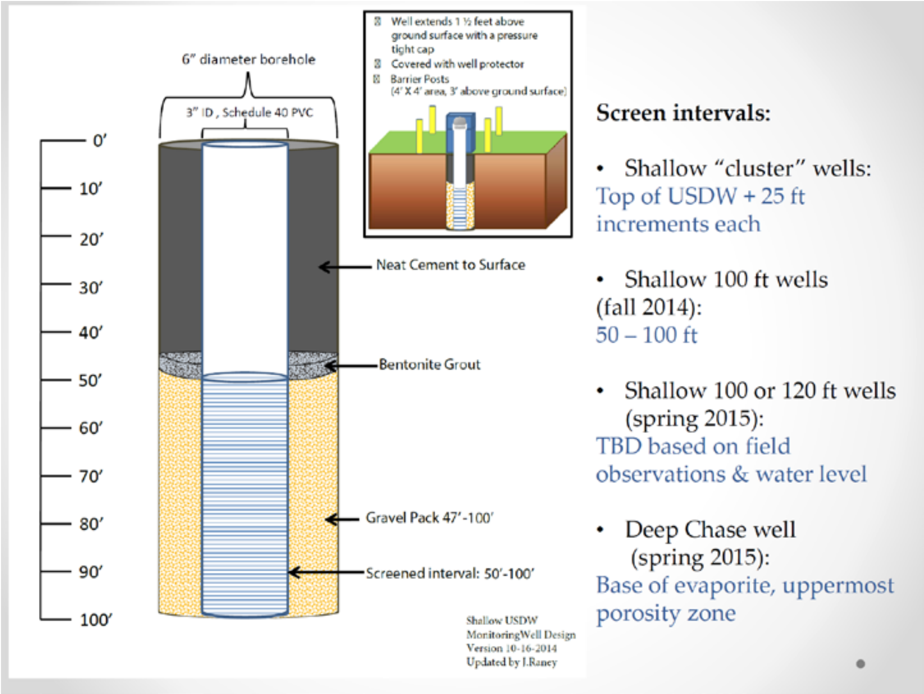


Figure 12. Installation design of 100 ft deep UDSW well, October 2014.

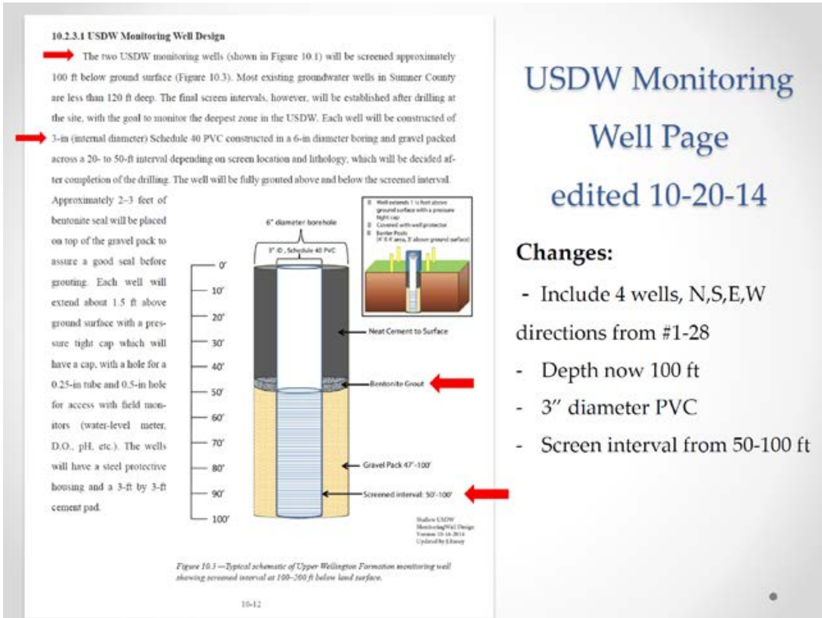


Figure 13. Page from Appendix of Class VI application where additional well detail is described.

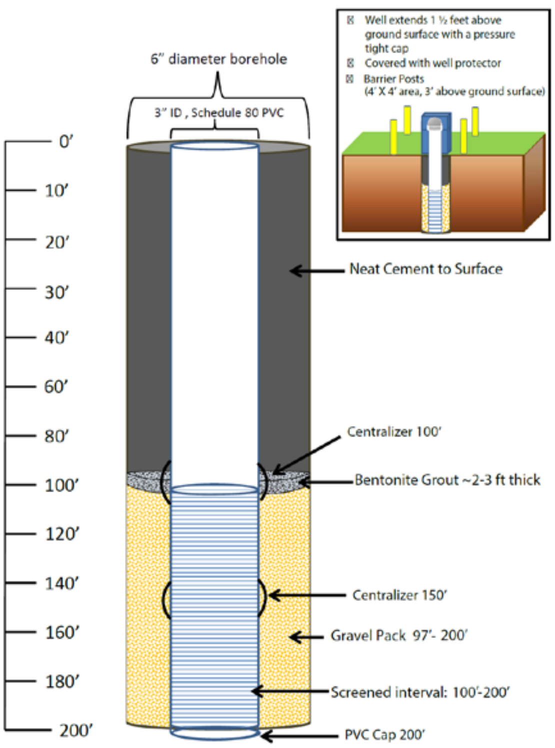


Figure 14. Wellbore diagram of 200 ft UDSW well to be drilled in October 2014.

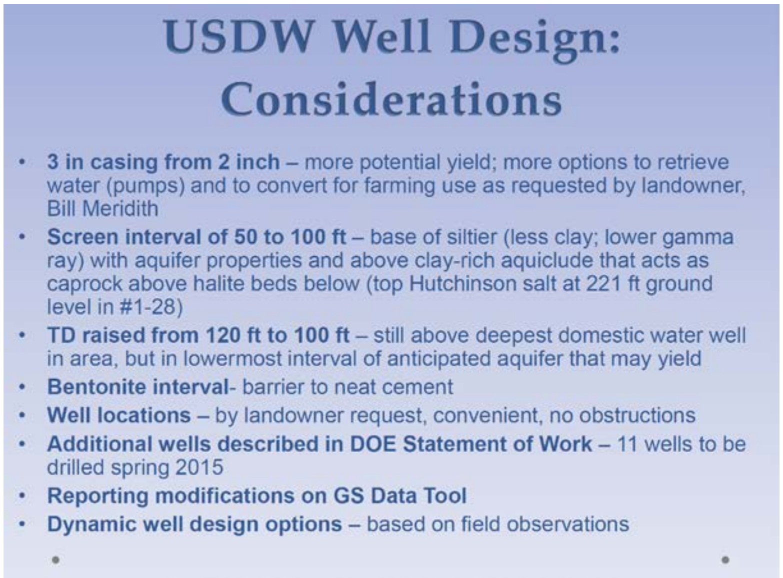


Figure 15. Considerations discussed for UDSW wells.

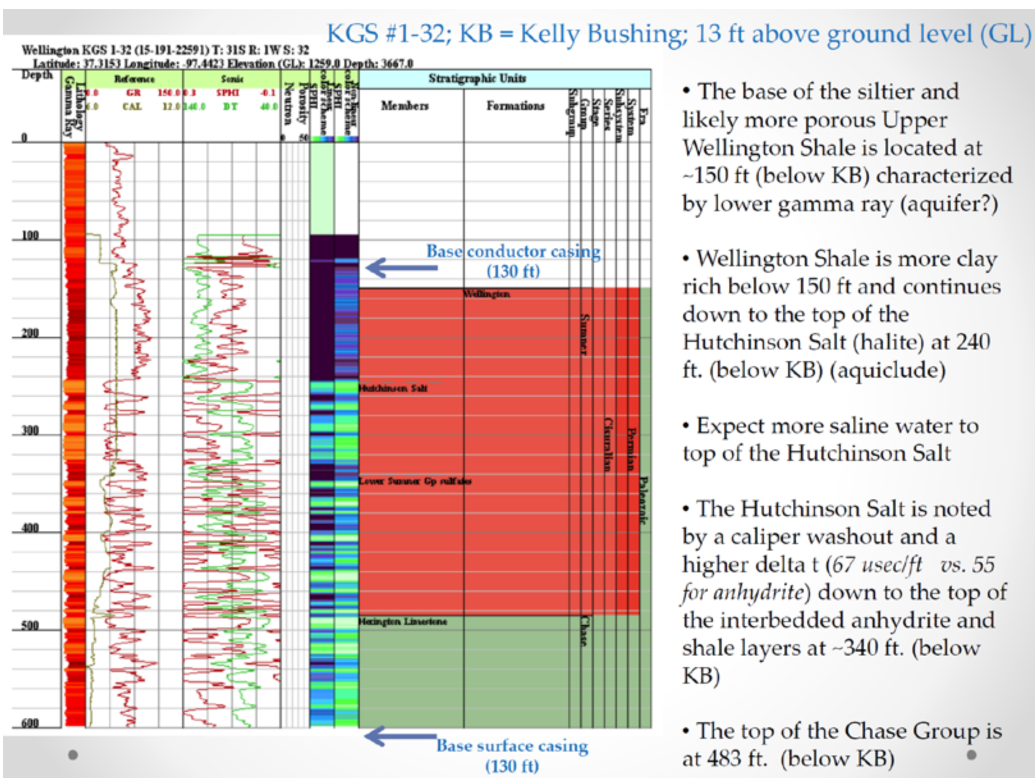


Figure 16. Basis for selection of the depths of the USDW wells.

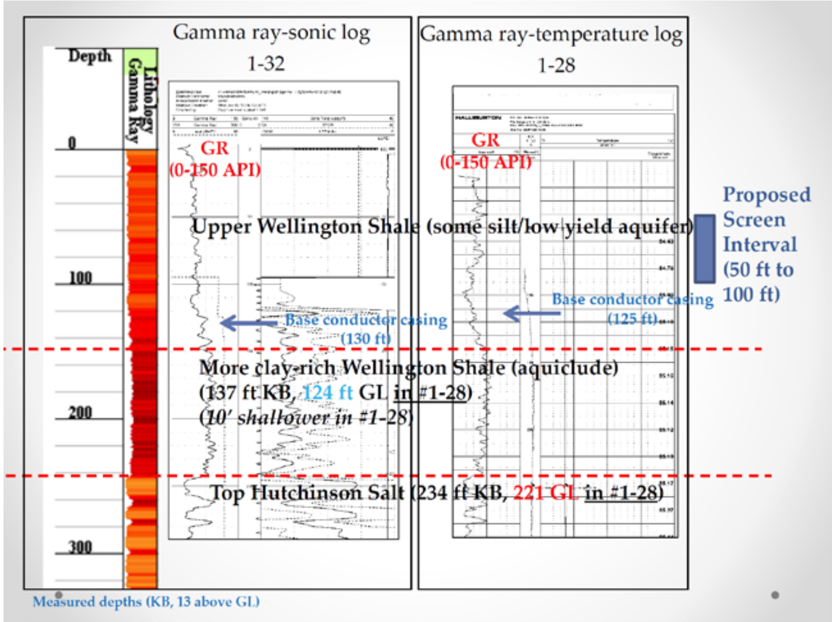


Figure 17. As Figure 16.

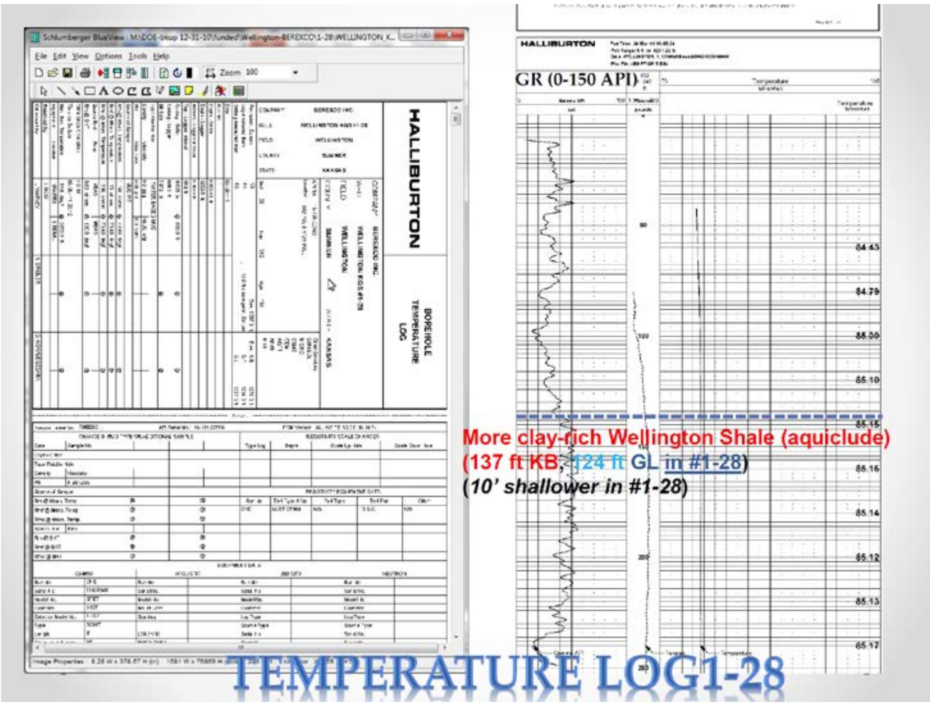


Figure 18. As Figure 16.

Subtask 6.6. Soil Gas Chemical and CO_2 Flux Monitoring/Sampling Grid around Injector

Discussions with LBNL on soil gas sampling led to the recommendation that we use lysimeters to sample the soil gas with 2 installed at each of the wells (4 total). LBNL related that the P-Site at Cranfield has an example of lysimeter design. (~5 meter depth. $200 each). KSU will be asked to use field-GC to sample lysimeters after further discussion.

Subtask 6.7. Outfit Surrounding Mississippian Boreholes for MVA (Contingent on Go pts 1&3)

Details are being discussed with Berexco, KSU, and KGS.

Subtask 7.5 High Res 2D Seismic Lines Targeting Mississippian Reservoir

Rick Miller will acquire a baseline 2D high-resolution seismic designed to go through both CO_2 flood areas. Because of permitting/access issues, will need to arrange for costs for the farmers. Will be harder to acquire data during the winter months, but will be easier to get access. **Action** -- Discuss permitting issues for Rick's high resolution seismic with Berexco.

<u>Action items</u>: 1) Estimate timing for 2D seismic baseline survey for Rick's team since needs to be a baseline before repressurization. 2) Eugene to provide Berexco with pressurization instructions.

TASK 8. RECONDITION MISSISSIPPIAN BOREHOLES AROUND MISSISSIPPIAN INJECTOR RE-PRESSURING MISSISSIPPIAN AND SAMPLING PRODUCING WELLS (NOV 2015)

Need to do this a few months ahead of CO_2 injection, most likely in a Jan-Feb. 2015 timeframe. KCC Class II permit needed for injection. It is good for 1 year. Nothing stopping us for the Class II well and Berexco will soon submit the application. It is possible that we may need to do a Step Rate Test to get the pressure data that KCC needs.

For repressurization – the injection site can be quickly repressurized, but the duration of this process is currently considered to be month.

Key Findings

1. The field activities have just begun and data is being received from the cGPS and seismometers.
2. The UDSW well plan has been completed with agreement by USEPA.
3. The geomodel and simulations of the Mississippian reservoir have been refreshed and will be used to drive the discussion of the repressurization design and location of the Mississippian monitoring wells. The small fault architecture in the Mississippian will also be useful for validation with the planned high-resolution 2D seismic baseline to be acquired this fall-winter running between the Mississippian and the Arbuckle injection sites.
4. Soil gas sampling modification is proposed to use lysimeters near the CO2 injection wells.
5. U-Tube and CASSM design work is proceeding so the costs can be refreshed and installation can be thoroughly discussed.
6. CO2 supply and surface equipment continues to be discussed.

Plans for Fourth Quarter 2014 (BP2 start date -- September 22, 2014)

a. Update Gantt chart.
b. Repressurization schedule will be finalized, more likely after Feb 2015 after drill the Mississippian injection well is drilled in order to directly monitor pressure and evaluate how repressurization should go.
c. Check into continuous bottom hole monitoring for temperature and pressure in injection well.
d. Continue discussion of the geomodel before Mississippian injection
e. Jason and Eugene discuss seismic interpretation with KU Geology
f. Establish a structural and geomechanical framework as a baseline for the microseismic and InSAR before the Mississippian injection begins.
g. Discuss permitting issues for Rick’s high resolution seismic with Dana
h. Update the fluid substitution model to anticipate resolution of the CO2 using seismic.
i. Update DOE on the interaction with EPA on UDSW water well installation and upcoming discussions regarding the Class VI application.
j. Obtain contractual arrangements w/ CO2 suppliers.
k. Class II Permit Mississippian Injection well to drill the well around February 2015. Permit will be shared with DOE.

PRODUCTS

Publications, conference papers, and presentations

Yevhen Holubnyak*, Willard Watney, Jason Rush, and Fatemeh Fazelalavi, 2014, Reservoir Engineering Aspects of Pilot Scale CO2 EOR Project in Upper Mississippian Formation at Wellington Field in Southern Kansas, Energy Procedia 00 (2013) 000–000, 9 p.

Watney, W.L., 2014, “Carbon Storage and Utilization in Kansas – Are We Ready?” at Annual Oil and Gas Seminar, Kansas NextStep, Hays, Kansas.

Watney, W.L., Rush, J., and Raney, J., 2014, SMALL SCALE FIELD TEST DEMONSTRATING CO2 SEQUESTRATION IN ARBUCKLE SALINE AQUIFER AND BY CO2-EOR AT WELLINGTON FIELD SUMNER COUNTY, KANSAS DE-FE0006821Present update of project at DOE review meeting in Pittsburgh, Carbon Storage R&D Project Review Meeting Developing the Technologies and Infrastructure for CCS

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

A project organization chart follows (**Figure 19**). The work authorized in this budget period includes tasks discussed above.

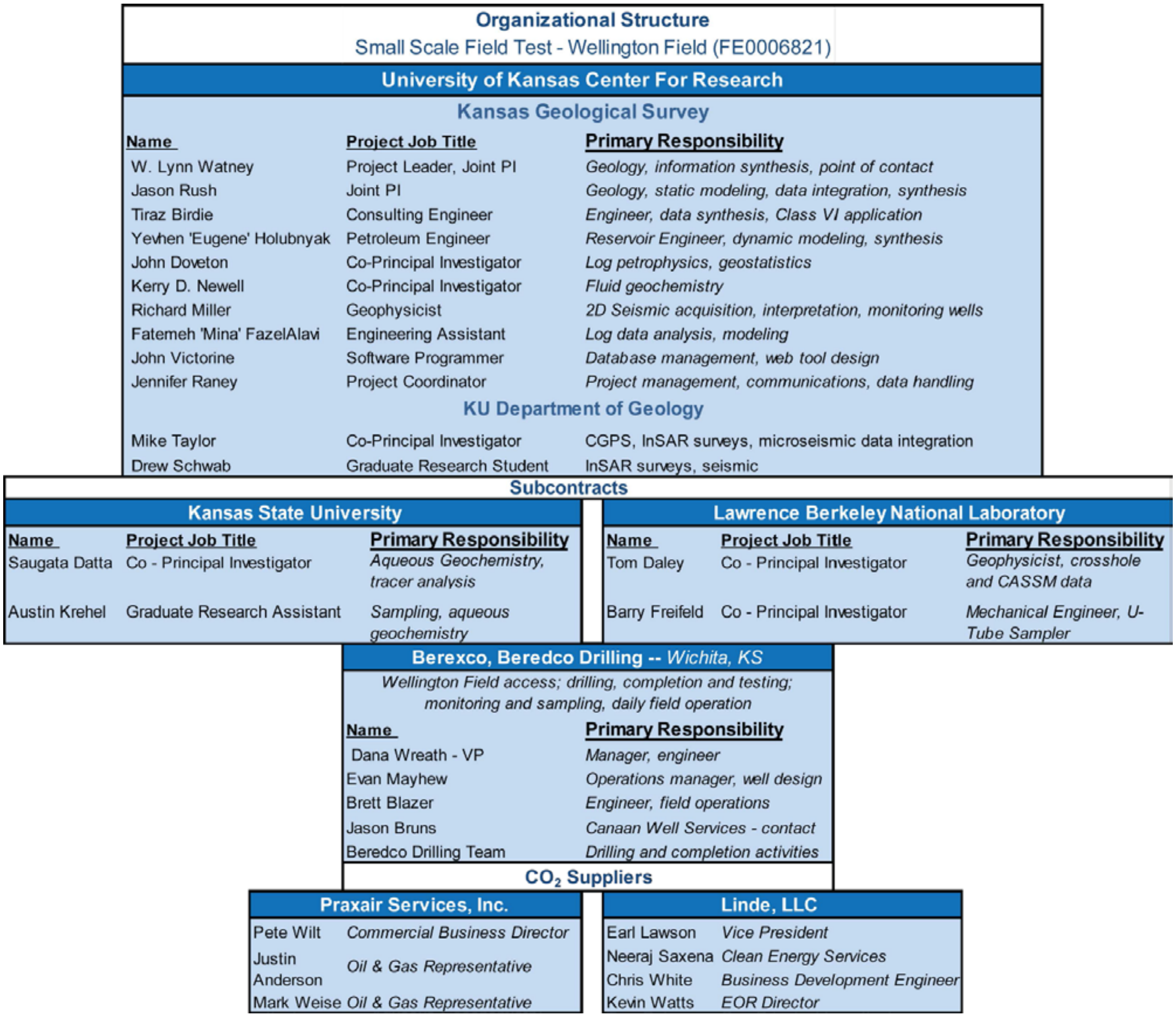


Figure 19. Organizational Chart.

IMPACT

See earlier discussion.

CHANGES/PROBLEMS

Please refer to earlier discussion.

BUDGETARY INFORMATION

Cost Status Report

See table below and on the following page for the cost status for quarters 1-12.

COST PLAN/STATUS	BP1 Starts: 10/1/11					
	10/1/11-12/31/11	**1/1/12-3/31/12**	**4/1/12-6/30/12**	**7/1/12-9/30/12**	**10/1 /12- 12/31/12**	**1/1/13 - 3/31/13**
Baseline Reporting Quarter	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**
Baseline Cost Plan (from SF-424A)	(from 424A, Sec. D)					
Federal Share	$326.84	$17,208.52	$17,282.92	$31,693.50	$23,000.00	$23,000.00
Non-Federal Share	$365,421.00	$365,421.00	$365,421.00	$365,421.00	$0.00	$0.00
Total Planned (Federal and Non-Federal)	$365,747.84	$382,629.52	$382,703.92	$397,114.50	$23,000.00	$23,000.00
Cumulative Baseline Cost	$365,747.84	$748,377.36	$1,131,081.28	$1,528,195.78	$1,551,195.78	$1,574,195.78
Actual Incurred Costs						
Federal Share	$326.84	$17,208.52	$17,282.92	$31,693.50	$31,572.56	$25,465.07
Non-Federal Share	$0.00	$6,475.85	$43,028.94	$9,058.04	$15,226.34	$0.00
Total Incurred Costs-Quarterly (Federal and Non-Federal)	$326.84	$17,208.52	$60,311.86	$40,751.54	$46,798.90	$25,465.07
Cumulative Incurred Costs	$326.84	$17,535.36	$77,847.22	$118,598.76	$165,397.66	$190,862.73
Variance						
Federal Share	$0.00	$0.00	$0.00	$0.00	-$8,572.56	-$2,465.07
Non-Federal Share	$365,421.00	$358,945.15	$322,392.06	$356,362.96	-$15,226.34	$0.00
Total Variance-Quarterly Federal and Non-Federal)	$365,421.00	$358,945.15	$322,392.06	$356,362.96	-$23,798.90	-$2,465.07
Cumulative Variance	**$365,421.00**	**$724,366.15**	**$1,046,758.21**	**$1,403,121.17**	**$1,379,322.27**	**$1,376,857.20**

				BP1 Ends 8/31/14		BP2 Starts 9/1/14
Baseline Reporting Quarter	**4/1/13 - 6/30/13 Q7**	**7/1/13-9/30/13 Q8**	**10/1/13 - 12/31/13 Q9**	**1/1/14 - 3/31/14 Q10**	**4/1/14 - 6/30/14 Q11**	**7/1/14 - 9/30/14 Q12**
Baseline Cost Plan (from SF-424A)						
Federal Share	$23,000.00	$23,000.00	$1,997,070.75	$1,997,070.75	$1,997,070.75	$1,997,070.75
Non-Federal Share	$0.00	$0.00	$258,982.75	$258,982.75	$258,982.75	$258,982.75
Total Planned (Federal and Non-Federal)	$23,000.00	$23,000.00	$2,256,053.50	$2,256,053.50	$2,256,053.50	$2,256,053.50
Cumulative Baseline Cost	$1,597,195.78	$1,620,195.78	$3,876,249.28	$6,132,302.78	$8,388,356.28	$10,644,409.78
Actual Incurred Costs						
Federal Share	$13,078.68	$52,993.14	$23,181.46	$12,053.49	$9,400.96	$0.00
Non-Federal Share	$0.00	$0.00	$0.00	$0.00	$90,624.59	$0.00
Total Incurred Costs-Quarterly (Federal and Non-Federal)	$13,078.68	$52,993.14	$23,181.46	$12,053.49	$100,025.55	$0.00
Cumulative Incurred Costs	$203,941.41	$256,934.55	$280,116.01	$292,169.50	$392,195.05	$392,195.05
Variance						
Federal Share	$9,921.32	-$29,993.14	$1,973,889.29	$1,985,017.26	$1,987,669.79	$1,997,070.75
Non-Federal Share	$0.00	$0.00	$258,982.75	$258,982.75	$168,358.16	$258,982.75
Total Variance-Quarterly Federal and Non-Federal)	$9,921.32	-$29,993.14	$2,232,872.04	$2,244,000.01	$2,156,027.95	$2,256,053.50
Cumulative Variance	**$1,386,778.52**	**$1,356,785.38**	**$3,589,657.42**	**$5,833,657.43**	**$7,989,685.38**	**$10,245,738.88**