

Review of HB-1 Research

Kentucky Geological Survey Sequestration Research under HB-1 (2007)

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KyHB-1 Funding Research for Economic Development

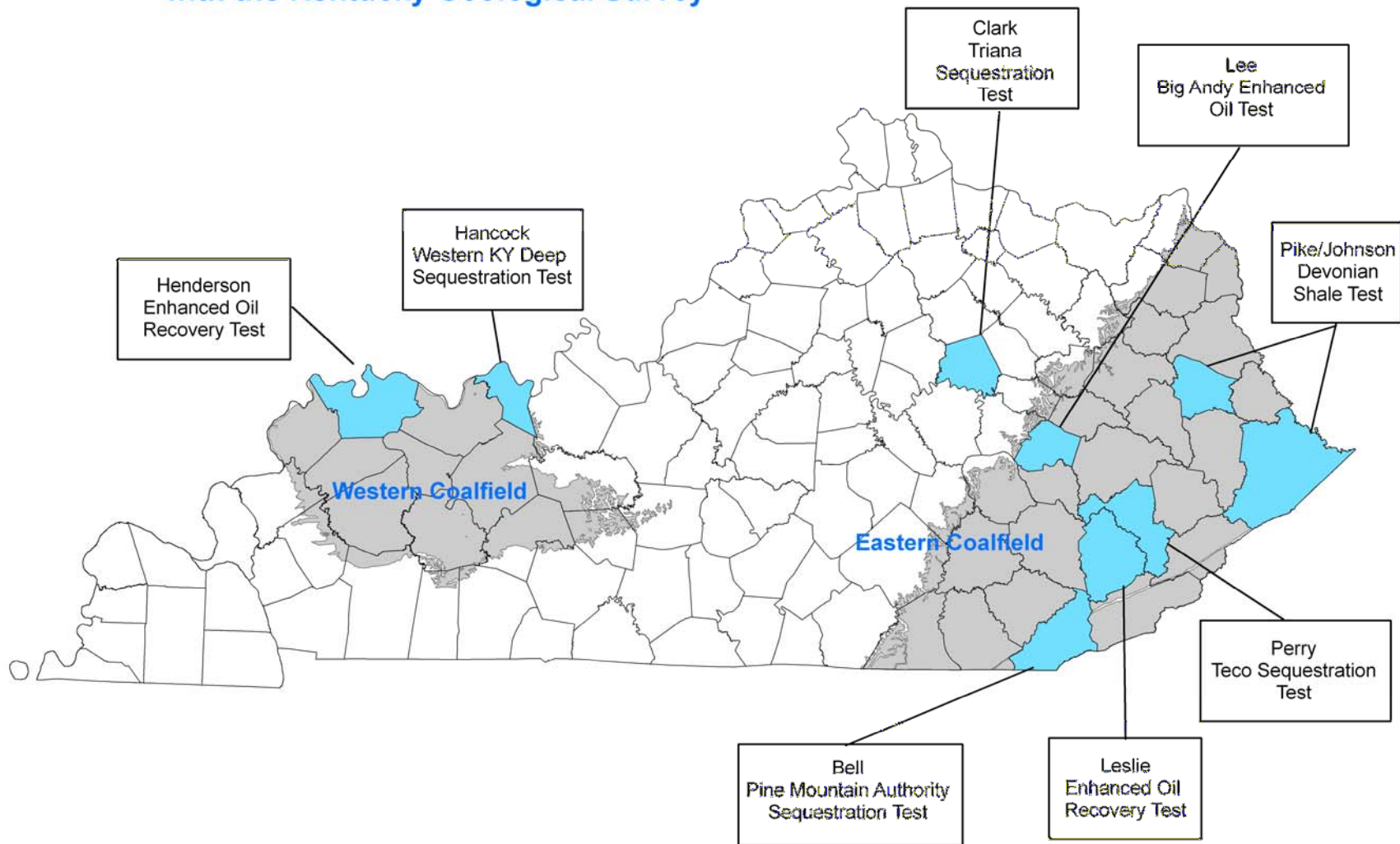
- In passing HB-1 (2007), an energy bill with sequestration research, Kentucky legislators signaled to the nation that the need for domestic energy and controls on CO₂ had penetrated into the state political scene, a bellwether event!
- Leveraged nearly \$1.0 million in annual salaries from KGS.
- Leveraged nearly \$6.0 million in private industry funding and technical input.
- Allows time to get the research done over a four year time frame
- Motivated the creation of the Western Kentucky Carbon Storage Foundation, an industry 501 (c) (3) foundation to match HB-1 funding.

Budget for HB-1 Sequestration Research

Western KY Seq.	<u>State*</u>	<u>Industry</u>	<u>Other</u>	<u>TOTAL</u>
	\$1.35 M	\$6.0 M	\$0.5 M	\$ 7.85M
Eastern KY Seq.	\$1.35 M	\$1.35 M	\$0.5 M	\$3.2 M
EOR	\$0.85 M	\$0.85 M	\$0.5 M	\$2.20 M
EGR	\$0.85 M	\$0.85 M	\$0.5 M	<u>\$2.20 M</u>
	<u>\$4.90 M</u>			<u>15.45 M</u>

*UK is cost sharing their F & A indirect costs

Kentucky Counties with Active and Proposed HB-1 Projects with the Kentucky Geological Survey



Kentucky House Bill 1- 2007

HB-1 directs KGS to conduct research, either itself or in collaboration or under contract with other entities, to quantify the potential for enhanced oil and gas recovery and enhanced coalbed methane recovery using carbon dioxide. The research shall include the drilling of deep wells in both coal fields (Illinois and Appalachian) in Kentucky, and performing the analysis necessary to estimate the potential for enhanced oil and gas recovery, enhanced coalbed methane recovery, or permanent storage of sequestration of carbon dioxide.

Kentucky House Bill 1- 2007

At least one of the wells will test the Devonian shale for enhanced gas recovery and sequestration potential. The Kentucky Geological Survey is encouraged to use these funds to match available federal and private funds to the extent possible. The Governor's Office of Energy Policy shall report to the Legislative Research Commission by December 1, 2007, regarding the status of the research project with this appropriation.

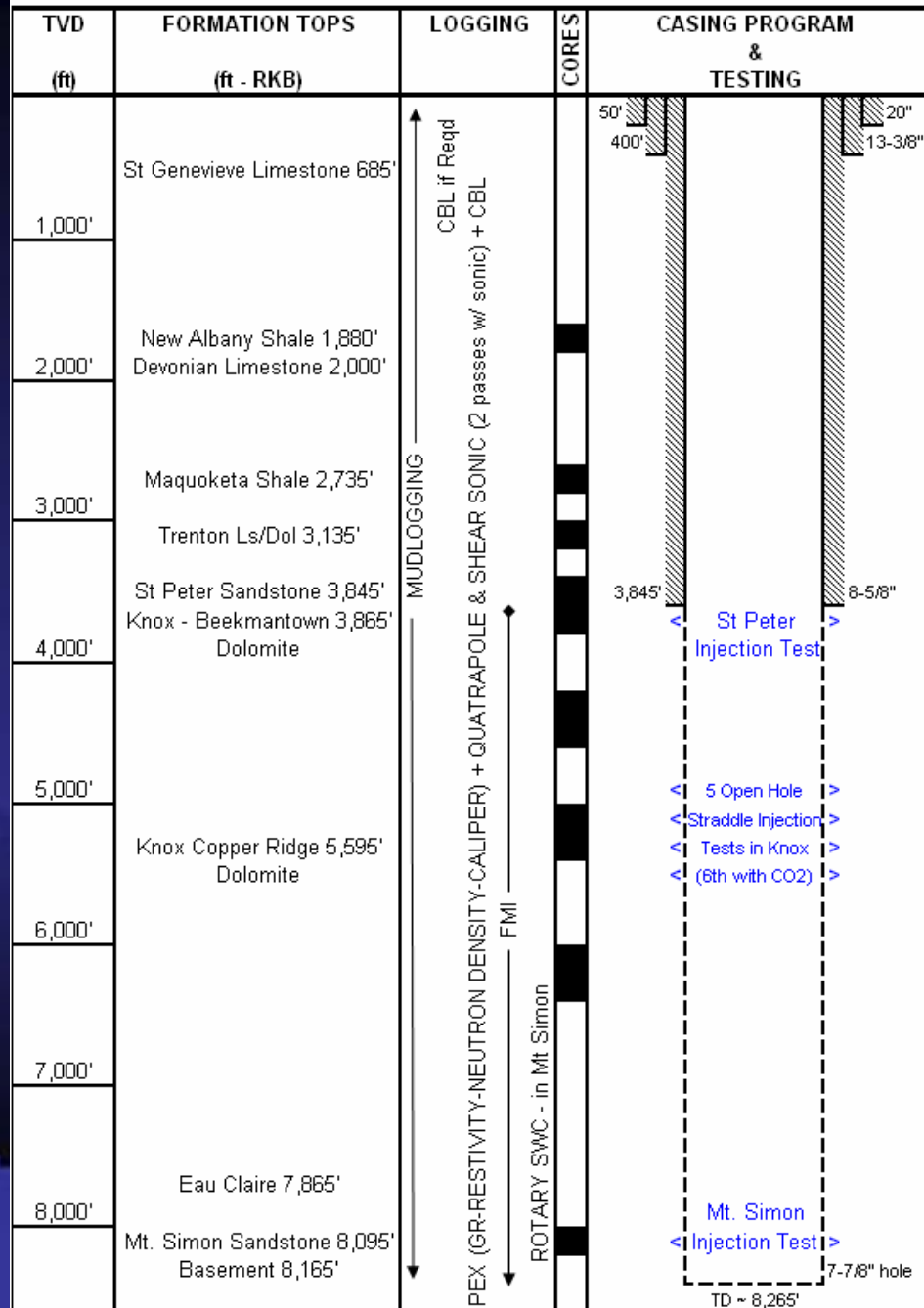


Hancock County site for the western Kentucky sequestration test

Project Goals

- **Demonstrate CO₂ storage in deep saline reservoirs under the Western Kentucky Coal Field through the drilling and testing of an 8250 ft well in east-central Hancock County**
- **Demonstrate the integrity of reservoir sealing strata for long-term CO₂ storage in western Kentucky**
- **Demonstrate appropriate technologies for the evaluation of CO₂ storage in Kentucky deep saline reservoirs**
- **Publish the project results for use by government, industry, and the public in evaluating CO₂ storage in Kentucky**
- **Accomplish this project with consideration of the interests and concerns of the landowner, residents of Hancock County and western Kentucky, and the citizens of the Commonwealth**

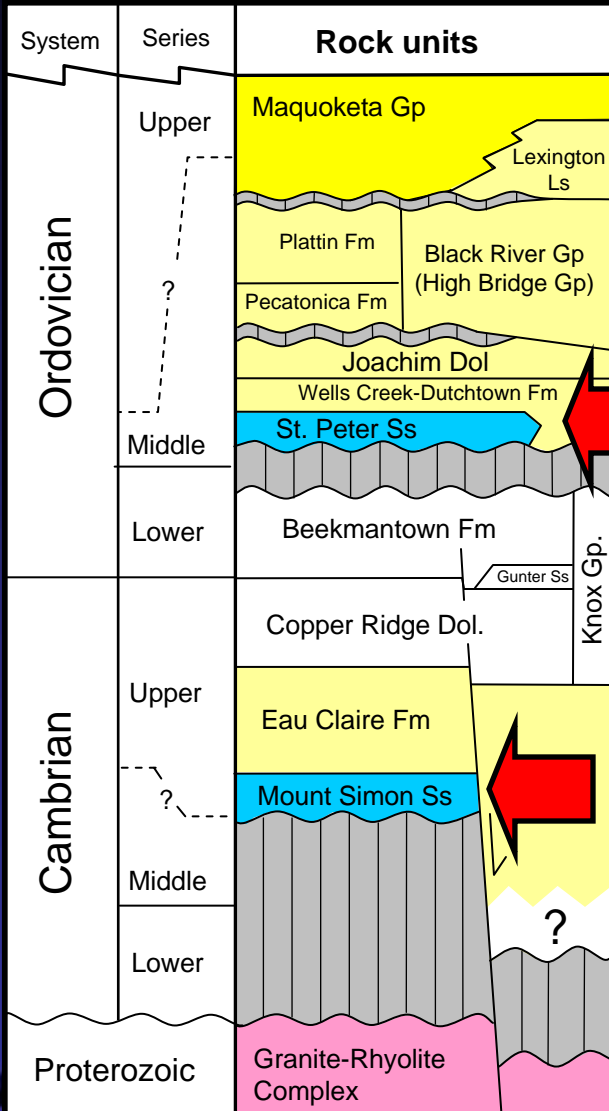
HANCOCK COUNTY, KENTUCKY - CARBON STORAGE TEST



Potential Reservoirs for CO₂

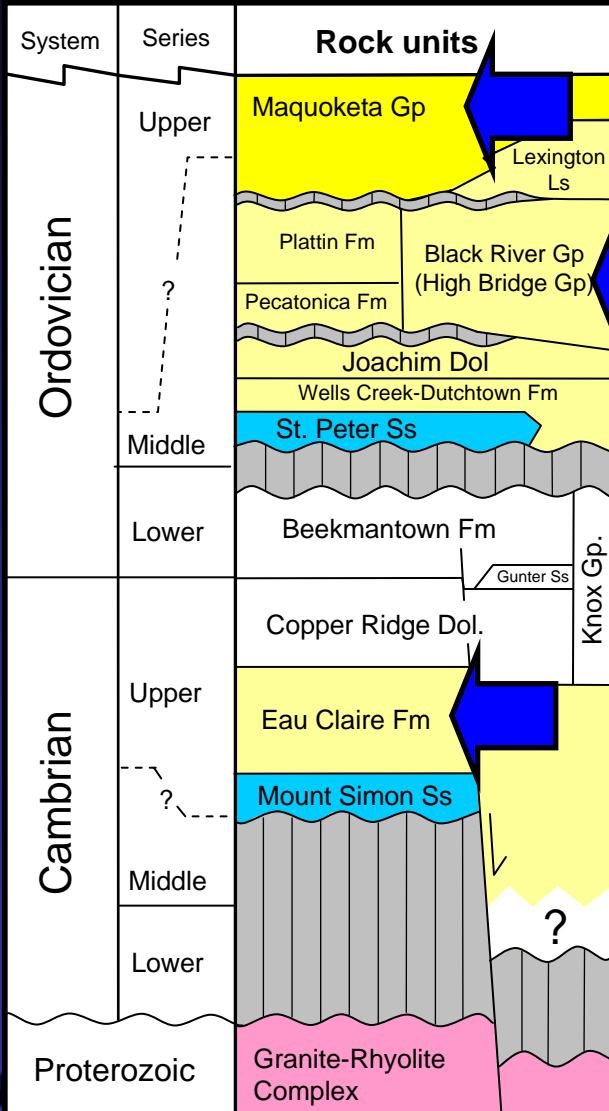
Regional saline reservoirs:

- Mt. Simon Sandstone
- Knox Group dolomites
- St. Peter Sandstone



- Potential CO₂ sinks/ reservoirs
- Sealing interval
- Missing section
- Sink or seal (depends on location)
- Metamorphic and igneous rocks (mostly seal)

Potential Seals for CO₂ Storage



Just as important in an injection project are the sealing units:

- Eau Claire Formation
- Maquoketa Shale
- Ordovician carbonates
- Devonian Shales

■ Potential CO₂ sinks/ reservoirs

■ Sealing interval

■ Missing section

■ Sink or seal
(depends on location)

■ Metamorphic and igneous rocks (mostly seal)

Porosity Development in Knox Group Dolomites, DuPont WAD #1

Intragranular
Porosity



1718 ft

Intragranular
Porosity

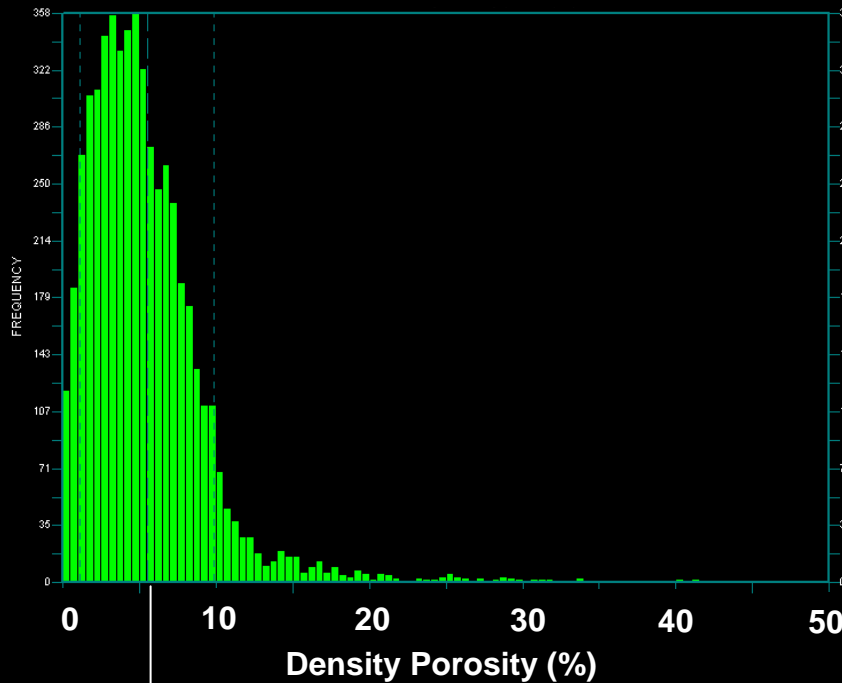


2521 ft

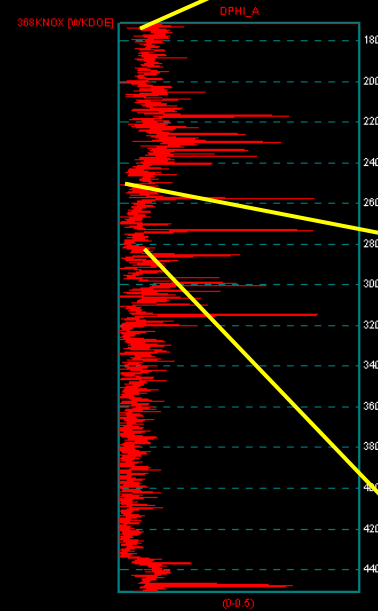
Vuggy
Porosity



2815 ft



Mean porosity 5.5%

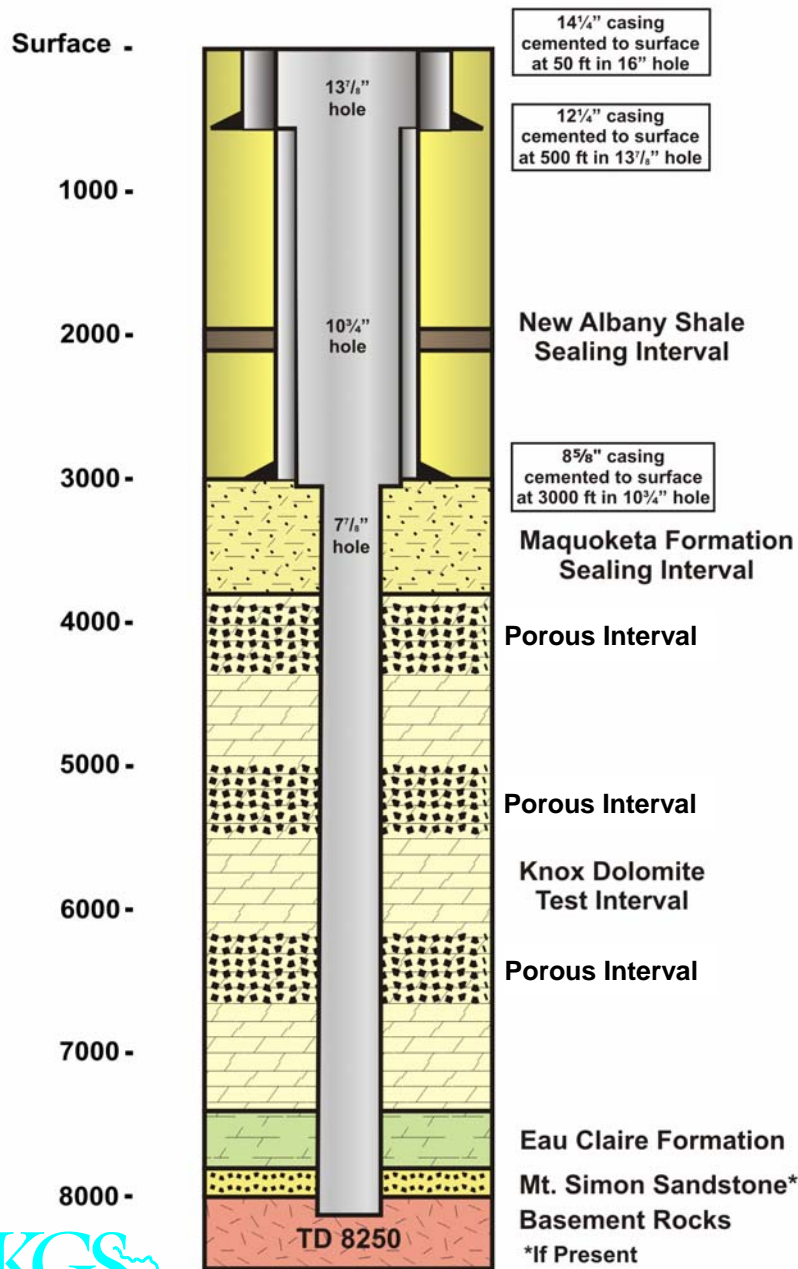




Rig for deep drill holes

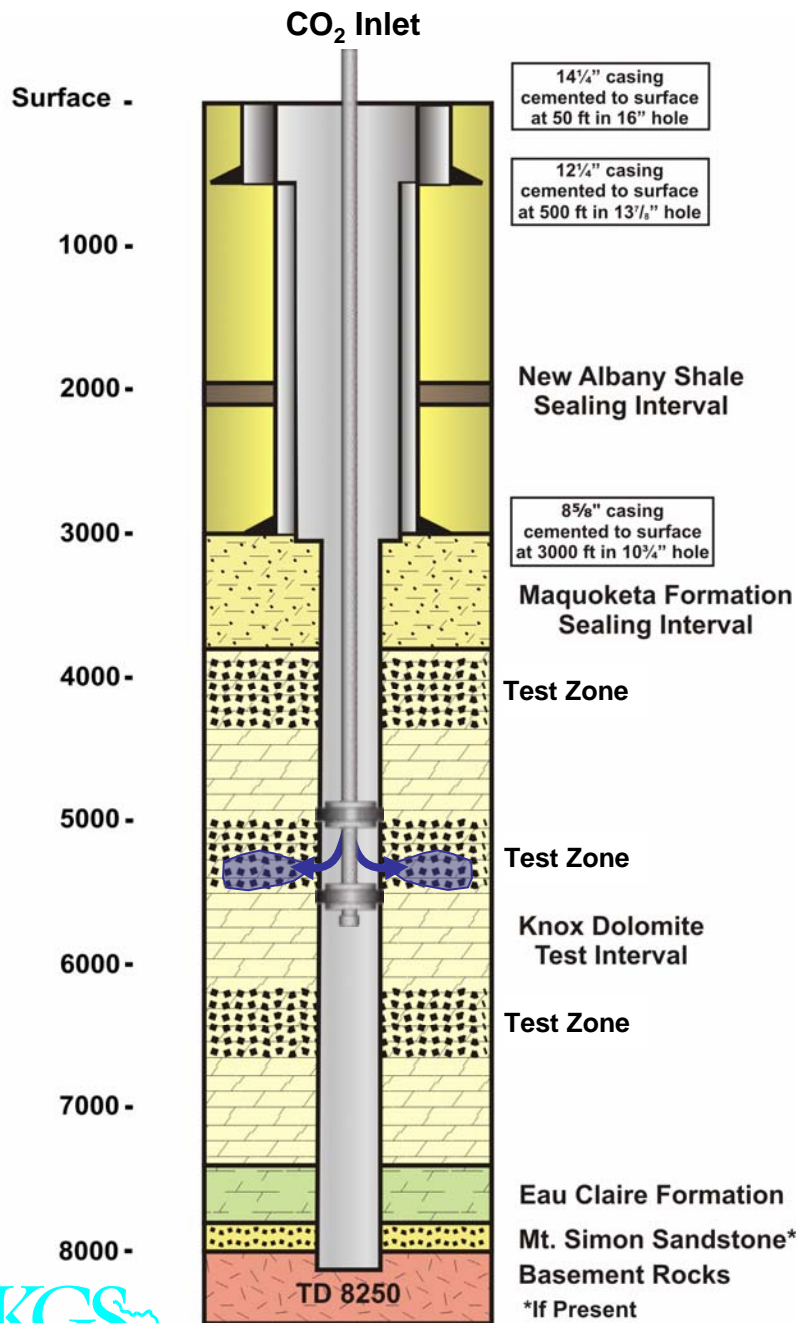


Seismic survey



Drilling Program

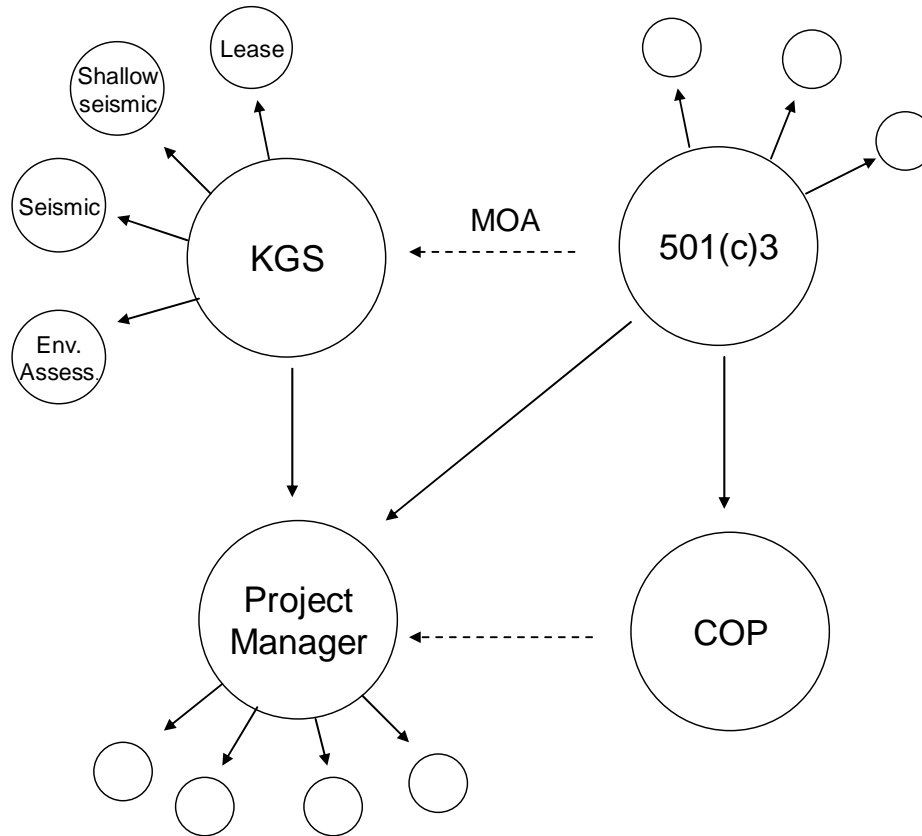
- Drill to 400 ft and cement casing to protect ground water
- Drill to 3000 ft and cement casing to ensure against any possible leakage to the surface during testing
- Drill to 8250 ft to gather geological, geophysical, and geochemical data to identify and aid the design and evaluation of the intervals to be tested



Testing Program

- Testing will proceed from the deepest interval to the shallowest below casing
- Test intervals will be isolated from deeper and shallower intervals
- All intervals will be first tested by injection of an artificial brine
- The most favorable interval will be tested by injection of a small volume of CO₂
- At the completion of testing the well will be plugged and abandoned to Kentucky and EPA standards

Western Kentucky Sequestration Project Management Structure



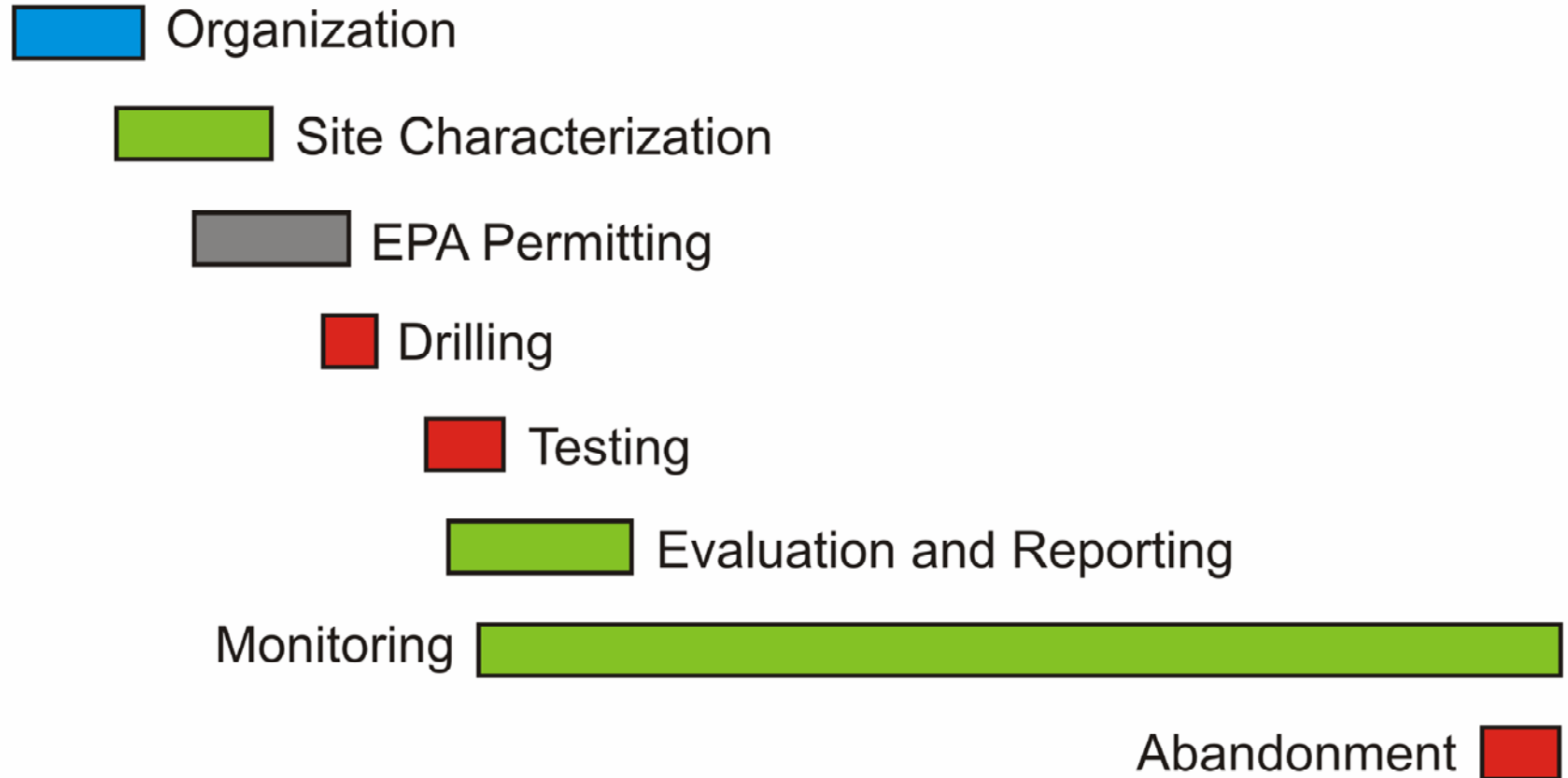
RELATIONSHIPS OF PARTNERS AND DIVISION OF RESPONSIBILITIES

(Dashed lines indicate oversight; solid lines indicate payment for services)

Western Kentucky Project Timeline

- **Characterize the background surface conditions for follow-on environmental monitoring**
 - Shallow seismic program at the wellsite to define karsting
 - Soil gas surveys of the area surrounding the wellsite
- **Acquire ~25 mi of new seismic lines in east-central Hancock County to characterize the subsurface structure**
- **Permit the well for CO₂ injection with EPA Region 4**
- **Drill an 8250 ft well to Precambrian basement rocks**
 - Collect subsurface reservoir characterization data for Knox Group dolomites and other reservoirs
 - Complete an extensive reservoir evaluation program of geologic and geochemical testing and petrophysical, geomechanical, and reservoir engineering modeling
- **Conduct an extensive program of fluid injection and pressure testing including both brine and CO₂**
- **Conduct long-term surface environmental monitoring**

Western Kentucky Project Timeline



Project Status: Review

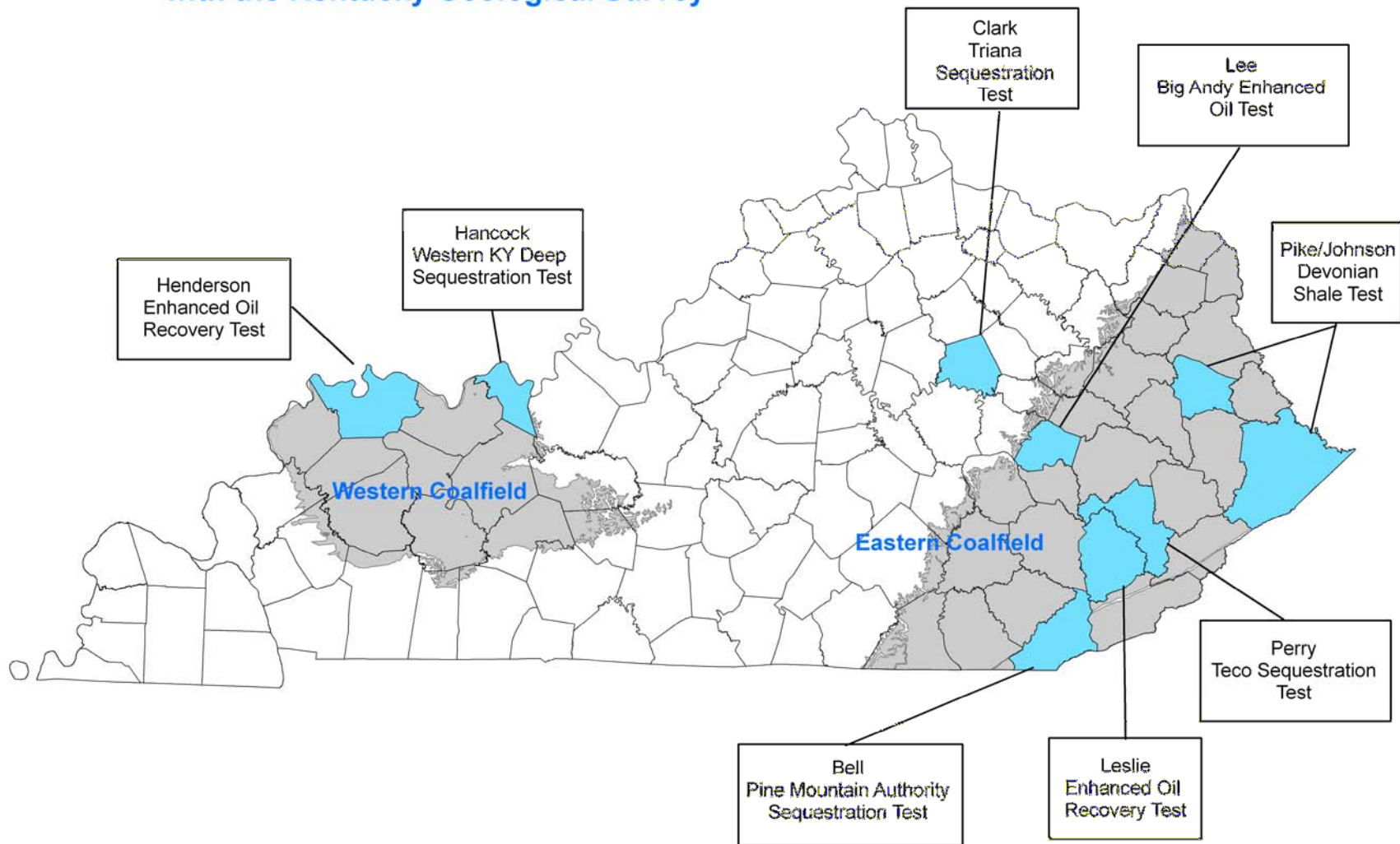
- **The western Kentucky CO₂ storage demonstration project has progressed quickly**
 - A consortium of KGS and energy industry partners has been organized
 - The project funding vehicle has been established
 - A drillsite has been identified and lease terms negotiated with the landowner and oil and gas leaseholder
 - Initial contractor service bids are under review
 - Drillsite construction is being evaluated
- **Estimated commencement of operations is during the 4th Quarter of 2008 with well testing, reservoir evaluation, and final reports completed by yearend 2009**
- **Surface monitoring will continue through year-end 2012 until the abandonment of the well and dissolution of the consortium**

Acknowledgements

This research is supported by a consortium of more than 30 industry and county government partners, principally:

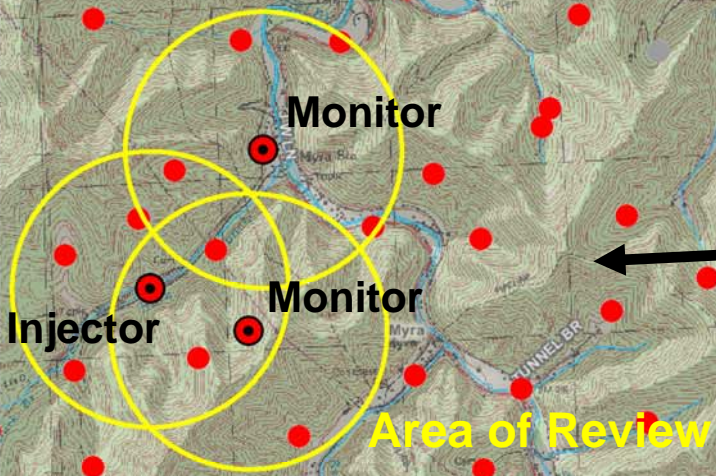
- **ConocoPhillips**
- **E.ON US**
- **Schlumberger**
- **Peabody Energy**
- **GEO Consultants, LLC**
- **Smith Management Group**
- **Wyatt, Tarrant, and Combs**
- **Commonwealth of Kentucky**
- **University of Kentucky**
- **Kentucky Geological Survey**

Kentucky Counties with Active and Proposed HB-1 Projects with the Kentucky Geological Survey



Burk Branch

- GAS
- ◆ Combined oil and gas
- OIL
- ⊗ Dry
- Location



5.6 mi

Blue Flame:
Sidewall Cores
Logs



Nominated by Pike County Fiscal Court



Other HB-1 Projects

- Collaborating with three DOE Sequestration partnerships- Illinois Basin, Appalachian Basin, & Southern States- Duke Energy, Boone County test
- Pike County Energy Development Board, Devonian shale Pike-Johnson Co.
- Triana Wells- Clark County test wells with DOE
- Equitable Resources- well sites and possible cooperation
- Pine Mountain Regional Industrial Authority- tests

Thank you

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