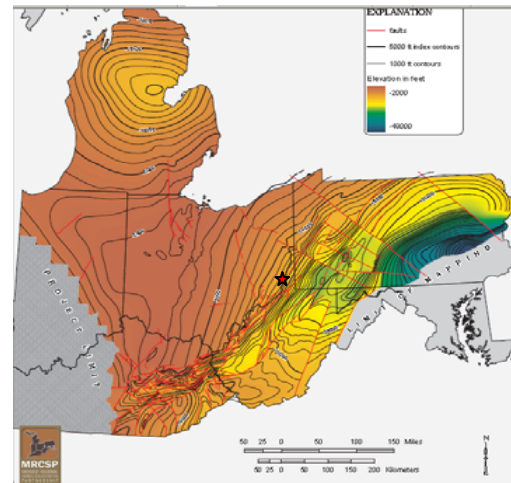


# Appalachian Basin, R.E. Burger Plant Cincinnati Arch, East Bend Plant



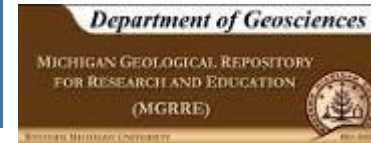
***Presented By: Neeraj Gupta, Battelle***

***Regional Carbon Sequestration Partnerships  
Initiative Review Meeting***

***October 6-8, 2008, Pittsburgh, PA***



# MRCSP Membership



# R.E. Burger Field Test Core Team



*Michele Somerday, Danielle Schneider, and others*



*Larry Wickstrom, Doug Mullet, Ron Riley, Ernie Slucher, Mark Baranoski*



*Dave Ball, Neeraj Gupta, Phil Jagucki, Joel Sminchak, Matt Place, Danielle Meggyesy, Judith Bradbury, Jackie Gerst, Diana Bacon, Ioan Feier*



U.S. Department of Energy/NETL

*Lynn Brickett*



*Lee Avary, Eric Lewis*



*John Harper, Kristin Carter*



*Dwight Peters*



*Al Burgunder*

**CO<sub>2</sub> Supply System evaluation team includes Rob Steele (EPRI)**

**Additional Contributions by Numerous Other MRCSP Team Members**



# East Bend Test Site Core Team



***Dave Ball, Neeraj Gupta, Phil Jagucki, Joel Sminchak, Mark Kelley, Judith Bradbury, Jackie Gerst, Diana Bacon, and others***



***Darlene Radcliffe, Brian Weisker, and others***



***Lynn Brickett***



***John Rupp, Wil Solano***



***Al Burgunder***



***Steve Greb, Jim Drahovzal***



***Dwight Peters***

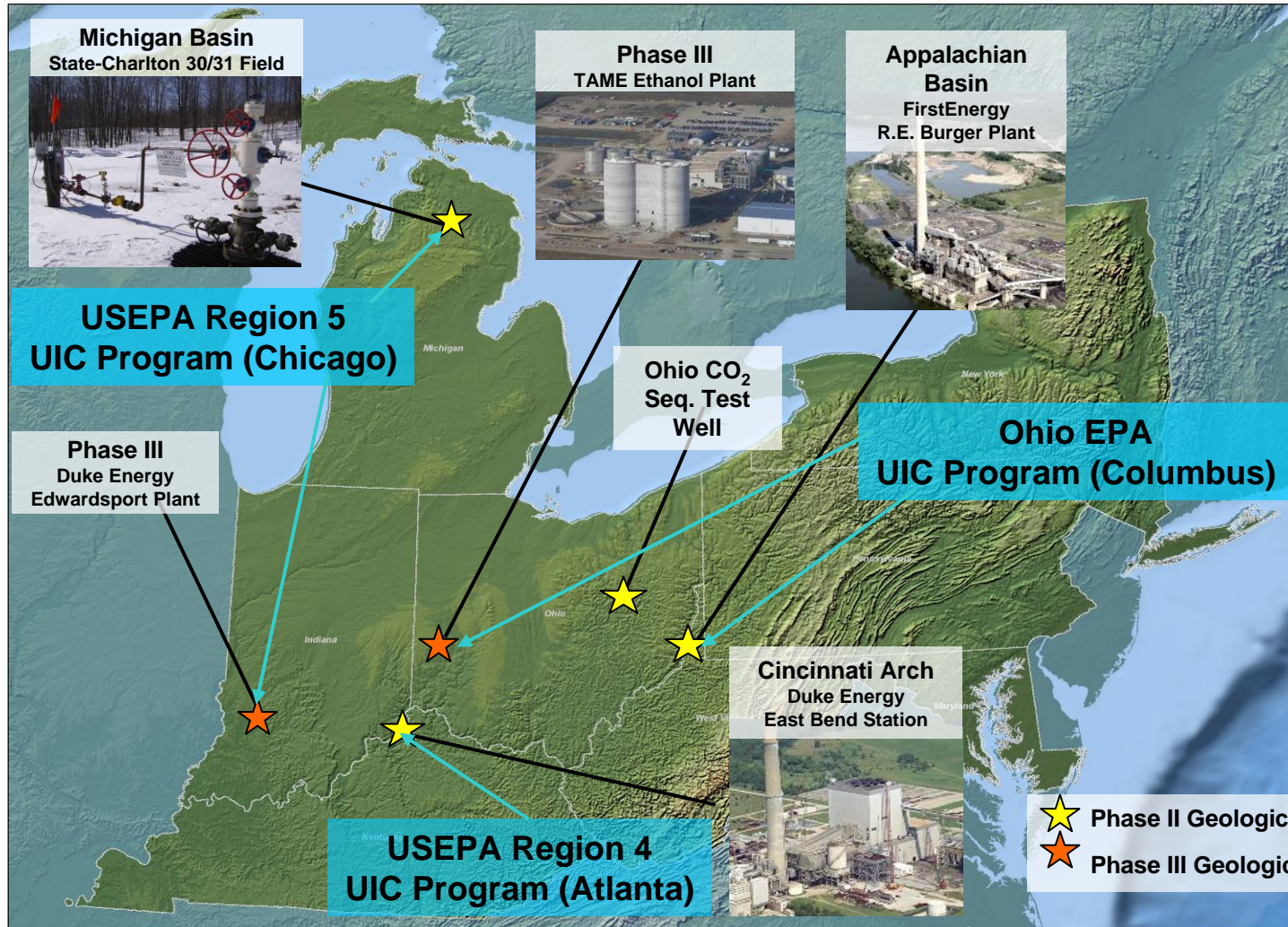


***Larry Wickstrom, Mark Baranoski***

***Additional Contributors to be selected for fieldwork***



# MRCSP Field Test Sites



# R.E. Burger Test Site

- The plant is an industrial setting, with various generating buildings, coal staging areas, and other facilities.
- The site is located at an active plant which is providing property access for the field work and other support that should aid in completing the project.

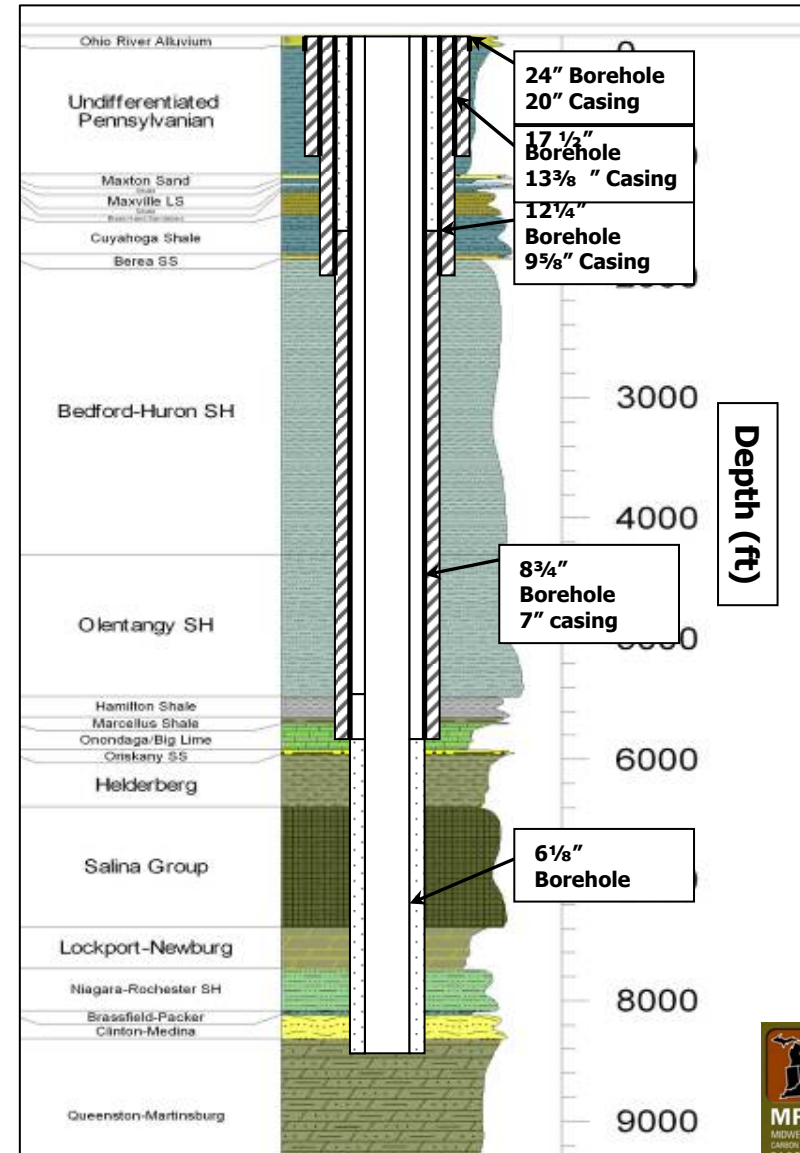


# Site Characterization R.E. Burger Site

Deep Test Well Drilling in Winter 2007  
Total Depth = 8,384' 2/5/07

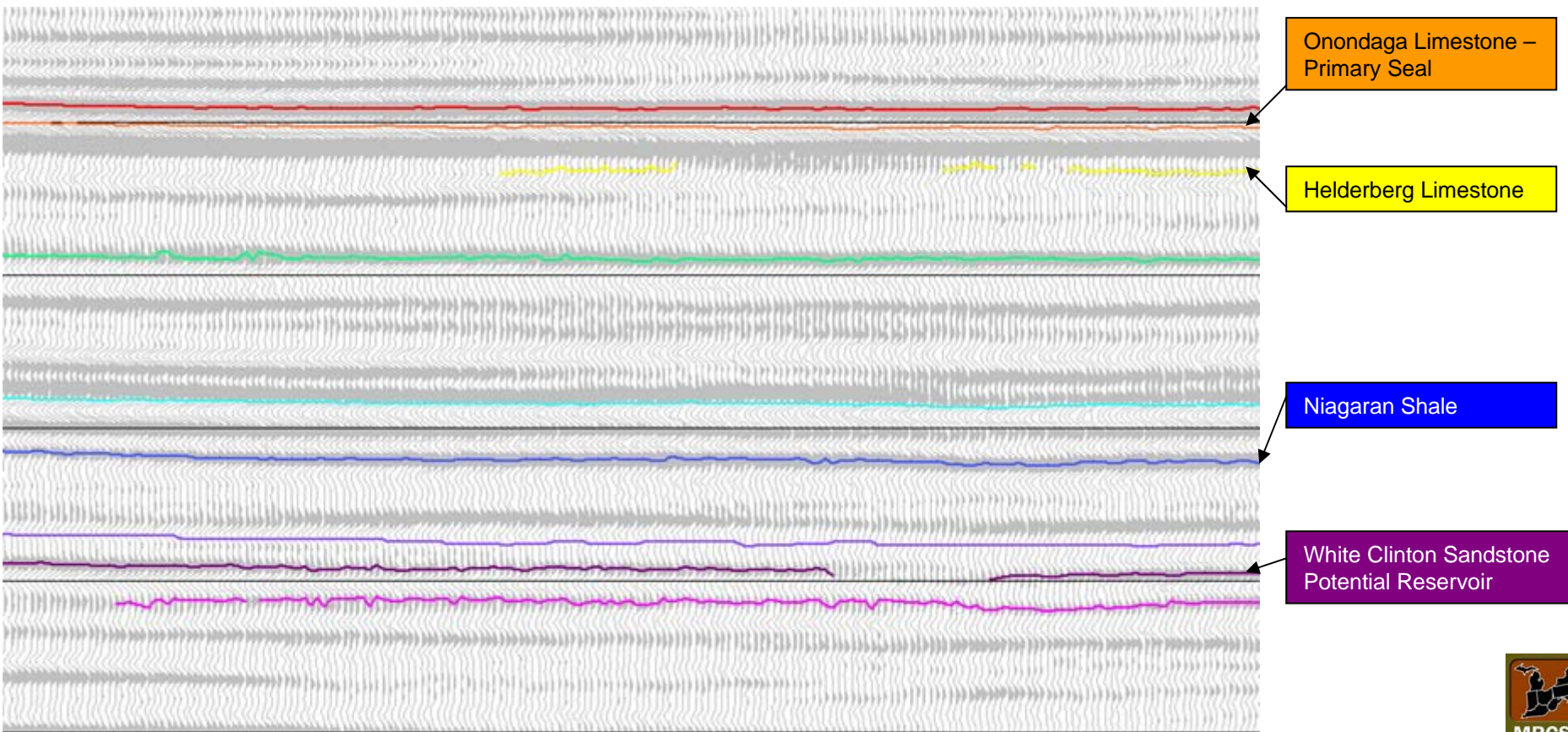


## Well Construction Diagram



# Detailed Seismic Interpretation Example from Appalachian Basin

- The Oriskany Sandstone (between the Onondaga and Helderberg) is right at the resolution limit of this data
- The White Clinton is much easier to see and post injection changes may be detectable

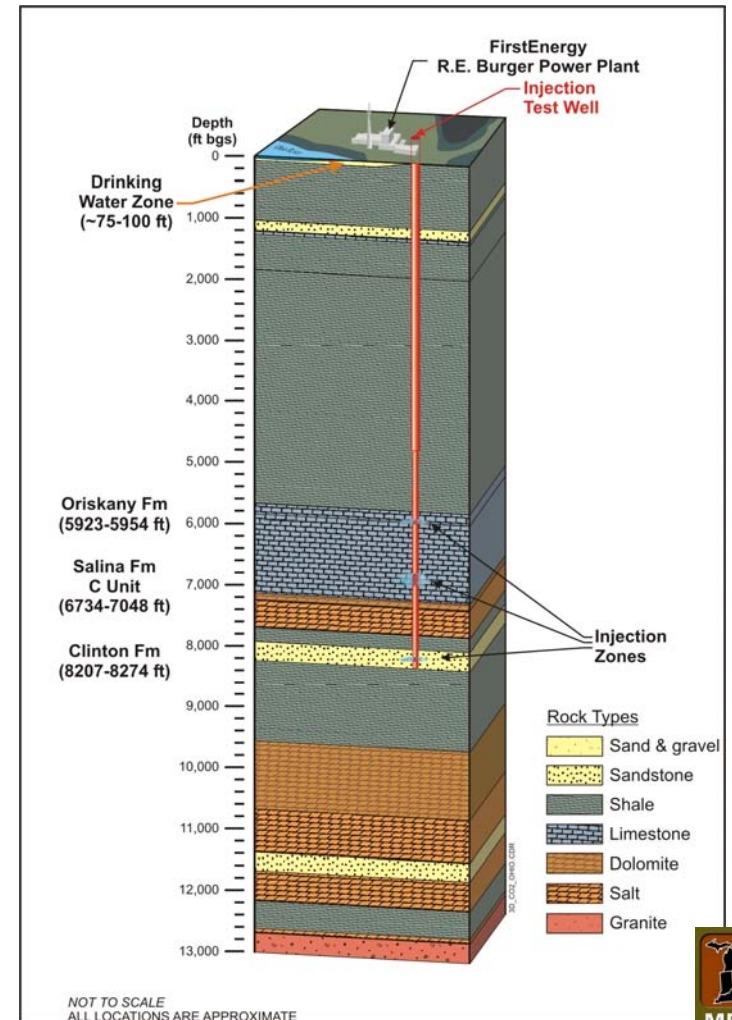


\*Initial Results



# Permitting - Appalachian Basin R.E. Burger Site

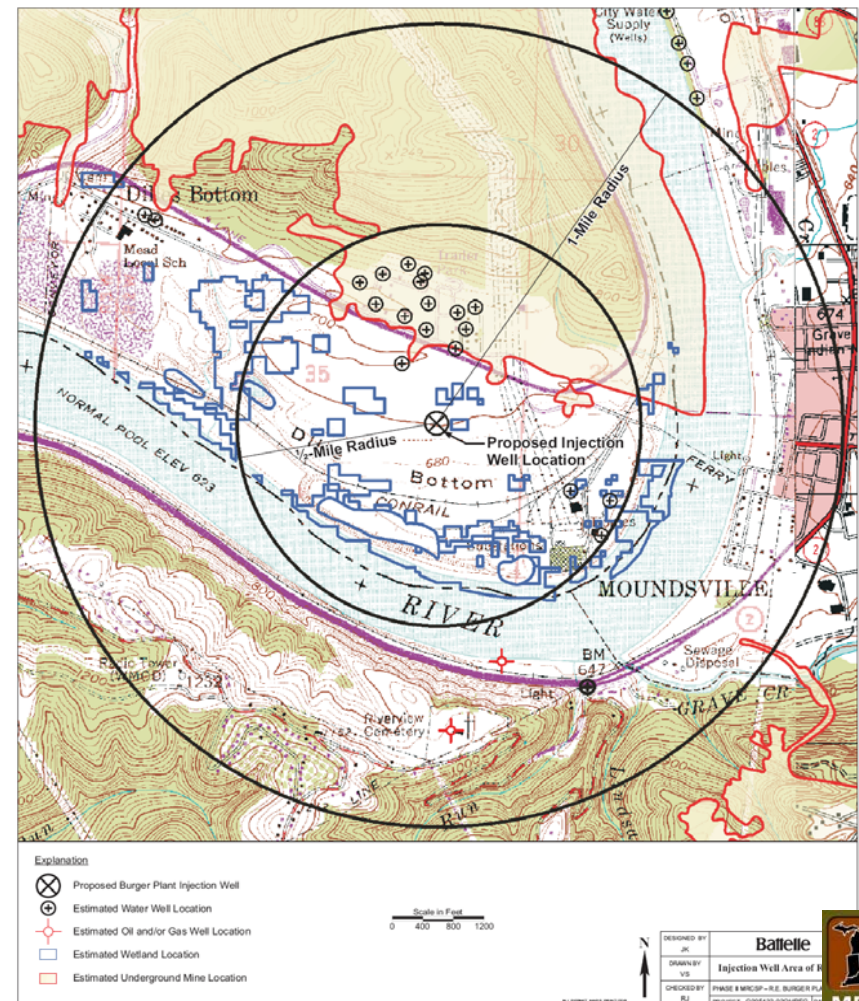
- Drilling permit prepared and approved by ODNR MRM Fall 2007.
- Test well drilled Jan-Feb 2007.
- UIC Class 5 permit application submitted to Ohio EPA UIC program January 17, 2008.
- Draft permit issued May 29, 2008.
- Public meeting June 24, 2008.
- Public notice June 21-July 21, 2008.
- Permit issued September 3, 2008.
- MIT underway Sept 2008
- Daily interaction with Ohio EPA continues on field effort



# Permitting - Appalachian Basin R.E. Burger Site

- AOR defaults to minimum due to injection scale.
- Regulators flexible to multiple completion, which allowed more options for injection.
- Well construction requirements for a test well have been resolved (i.e. cement bond logging, mechanical integrity tests).

Area of Review- R.E. Burger Site



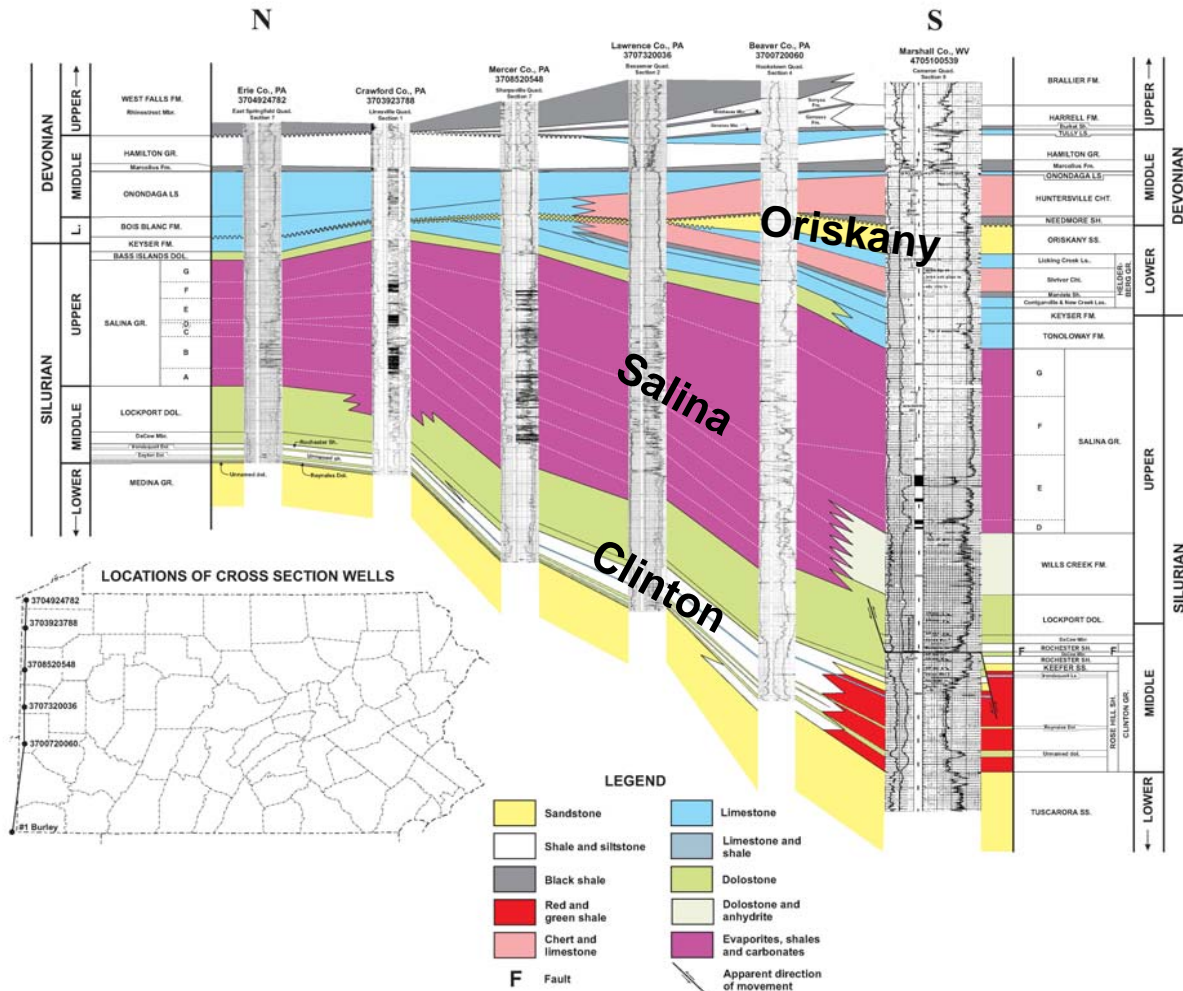
# Injection Plan - Targets

Injection is targeting 3 significant formations for the region.

Oriskany SS

Mid-Salina

Clinton-Medina

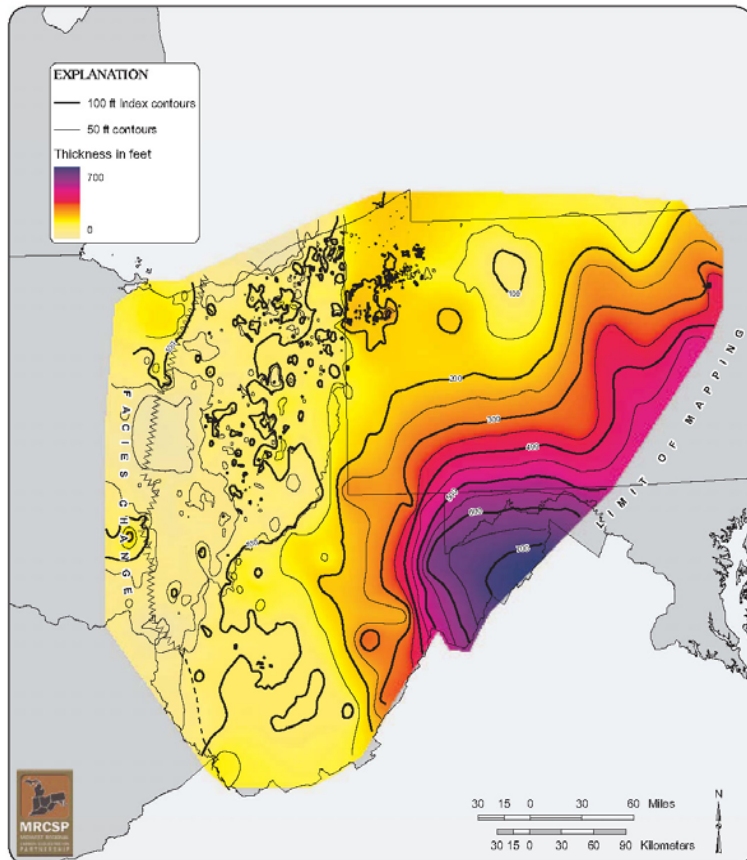


CROSS SECTION ALONG THE PENNSYLVANIA - OHIO BOUNDARY

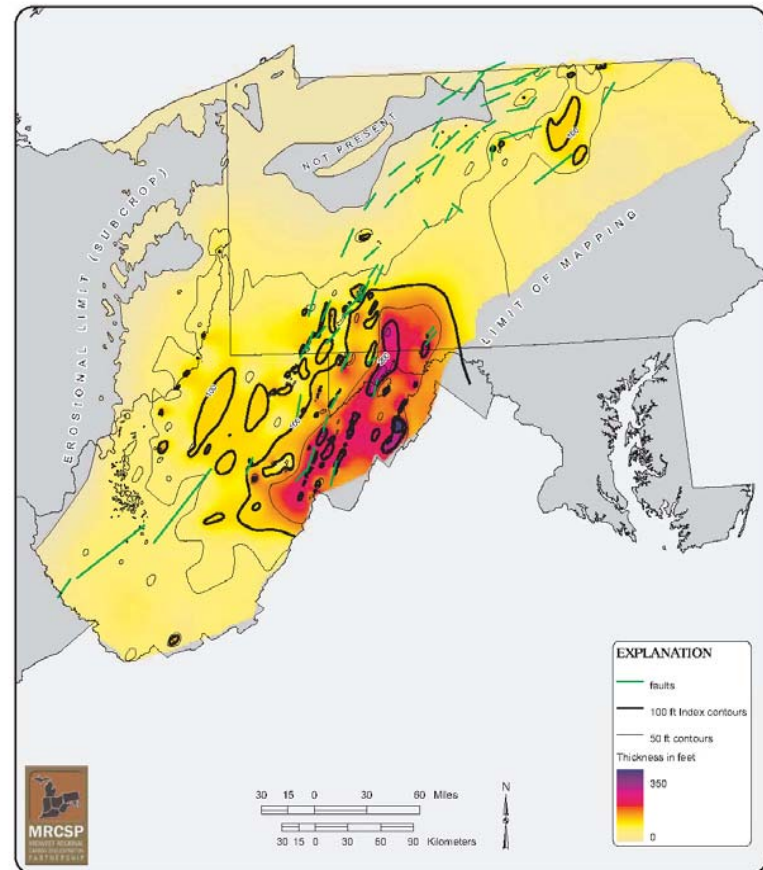
# Injection Plan - Targets

- Formations thicken to form more substantial storage targets to east.

**"Clinton"- Medina**



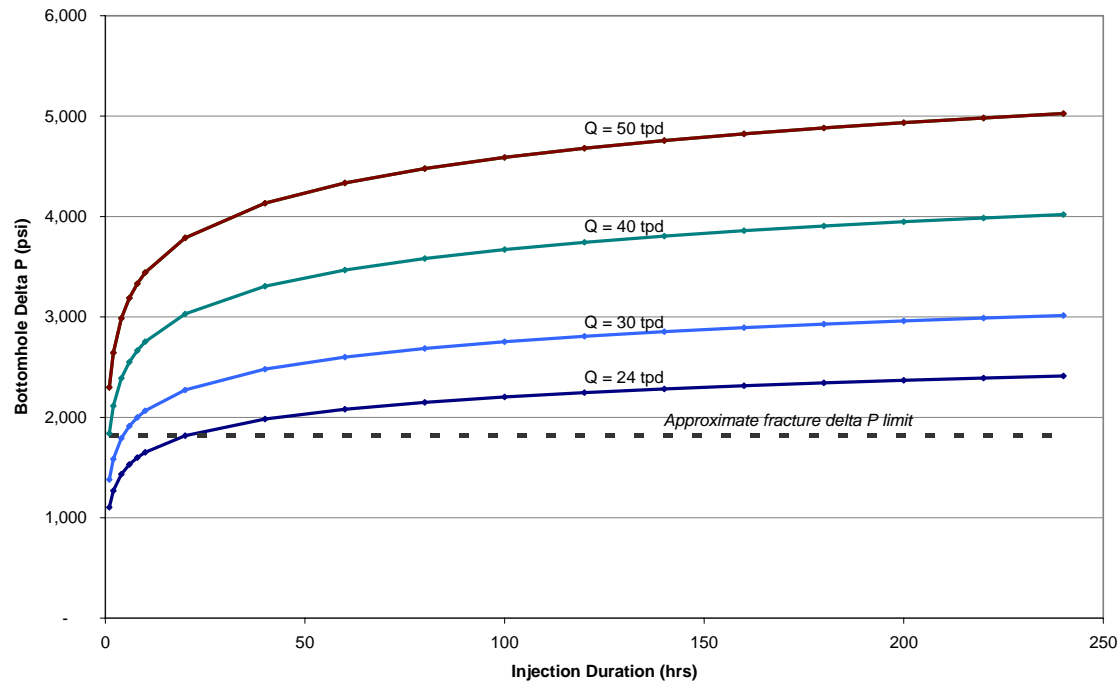
**Oriskany Sandstone**



# Injection Plan

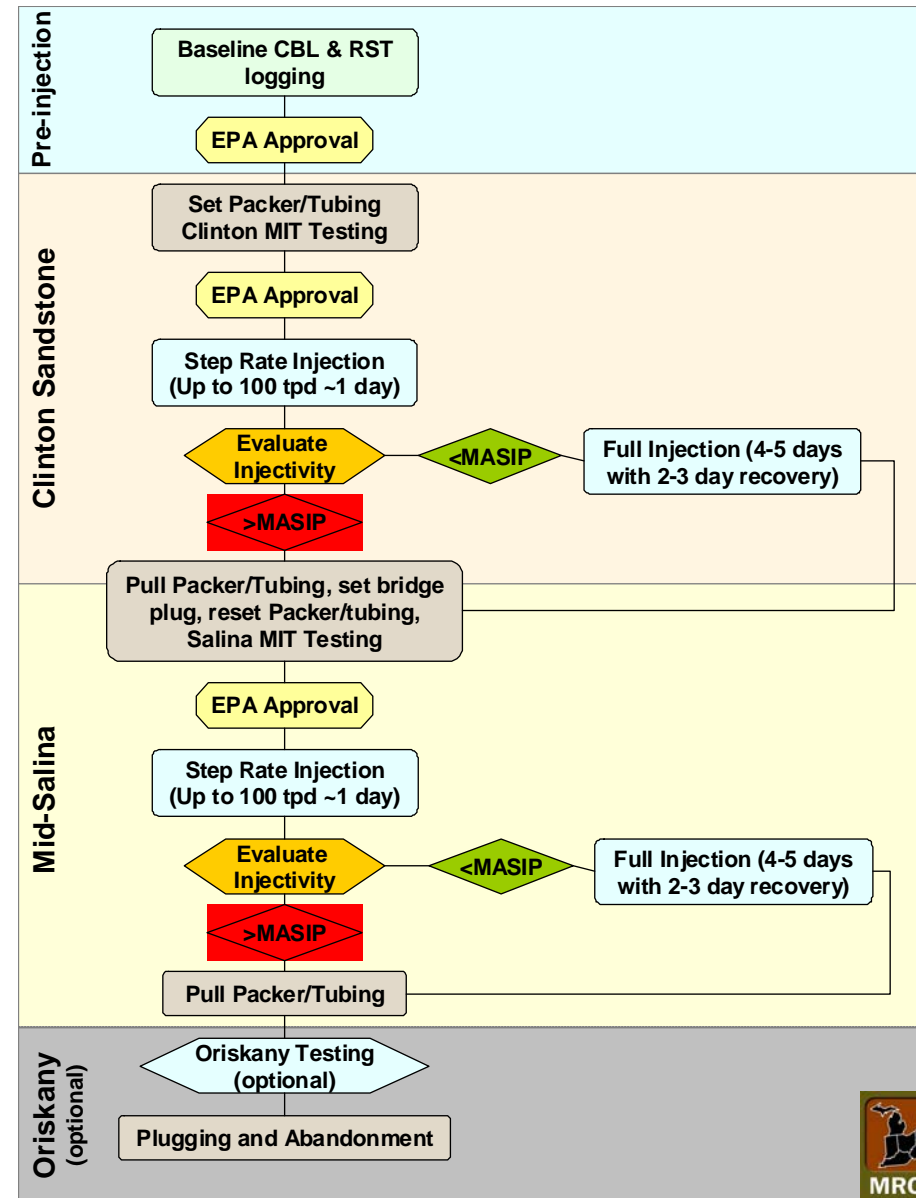
- Overall plan is to test 3 discrete units Clinton-Medina, Salina, and Oriskany at depths of 5923-8274 ft.
- Hydraulic analysis of injection potential for these units suggest that they may have limited injection potential. Therefore, a flexible injection plan was designed.

Estimated Bottomhole Delta P - Clinton Interval



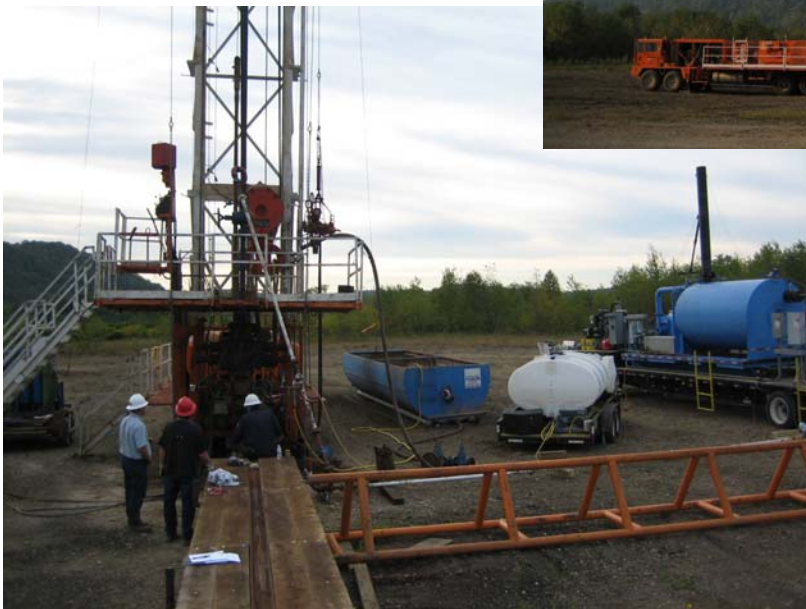
# Injection Plan

- Injection plan designed to test multiple units and fulfill UIC mechanical integrity requirements.
- In general, the injection system focuses on assessing injectivity in these units given their deep isolated nature.



# Injection Operations and Monitoring

- Well completion and preparation activities (perforation, mechanical integrity annular pressure tests, tubing & packer) – October 2008.



# Injection Operations and Monitoring

- Injection system set up to run injection tests (Sep-Oct 2008)



CO<sub>2</sub> delivery and annular pressure system



CO<sub>2</sub> wellhead metering system



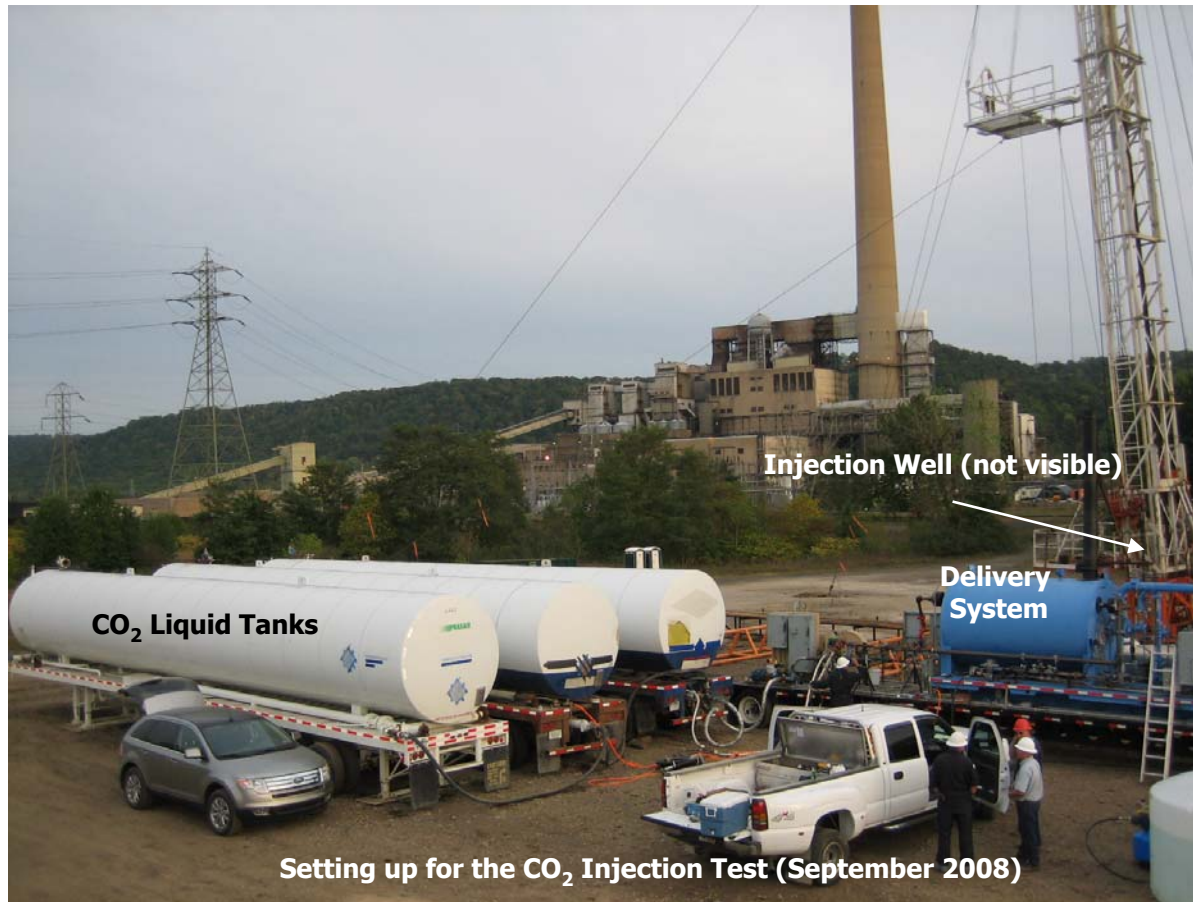
# Injection Operations and Monitoring

- Commercial CO<sub>2</sub> source delivered to site to run injection tests.

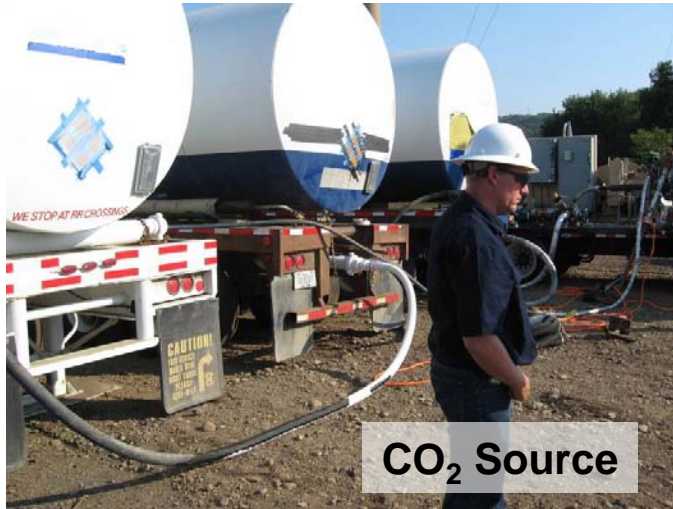


# Injection Operations and Monitoring

- Injectivity testing phase started late September 2008
- Testing is in progress, expected to last into October.



# Injection Operations and Monitoring



**CO<sub>2</sub> Source**



**Delivery System**



**Controls**

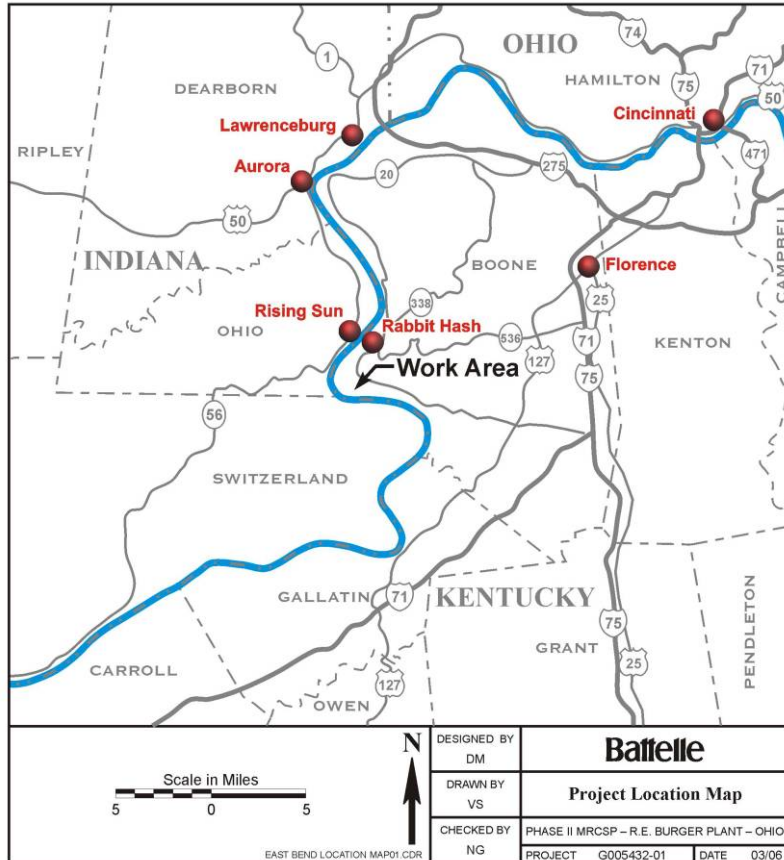


**Injection Well**

# Injection Operations and Monitoring

Monitoring Technique	Application
Radioactive Tracer Test	<ul style="list-style-type: none"> <li>○ Tracing movement of CO<sub>2</sub> in the storage formation</li> <li>○ Tracing leakage</li> </ul>
Brine Chemistry/ Water Composition	<ul style="list-style-type: none"> <li>○ Evaluating solubility and mineral reactions</li> <li>○ Quantifying CO<sub>2</sub>-water-rock interactions</li> <li>○ Detecting leakage into shallow groundwater aquifers</li> </ul>
Subsurface Pressure and Temperature	<ul style="list-style-type: none"> <li>○ Maintaining formation pressure below fracture gradient</li> <li>○ Wellbore and injection tubing condition</li> <li>○ Leakage out of the storage formation</li> </ul>
Well logs	<ul style="list-style-type: none"> <li>○ Tracking CO<sub>2</sub> movement in and above storage formation</li> <li>○ Tracking migration of brine into shallow aquifers</li> <li>○ Calibrating seismic velocities</li> </ul>

# East Bend Test Site

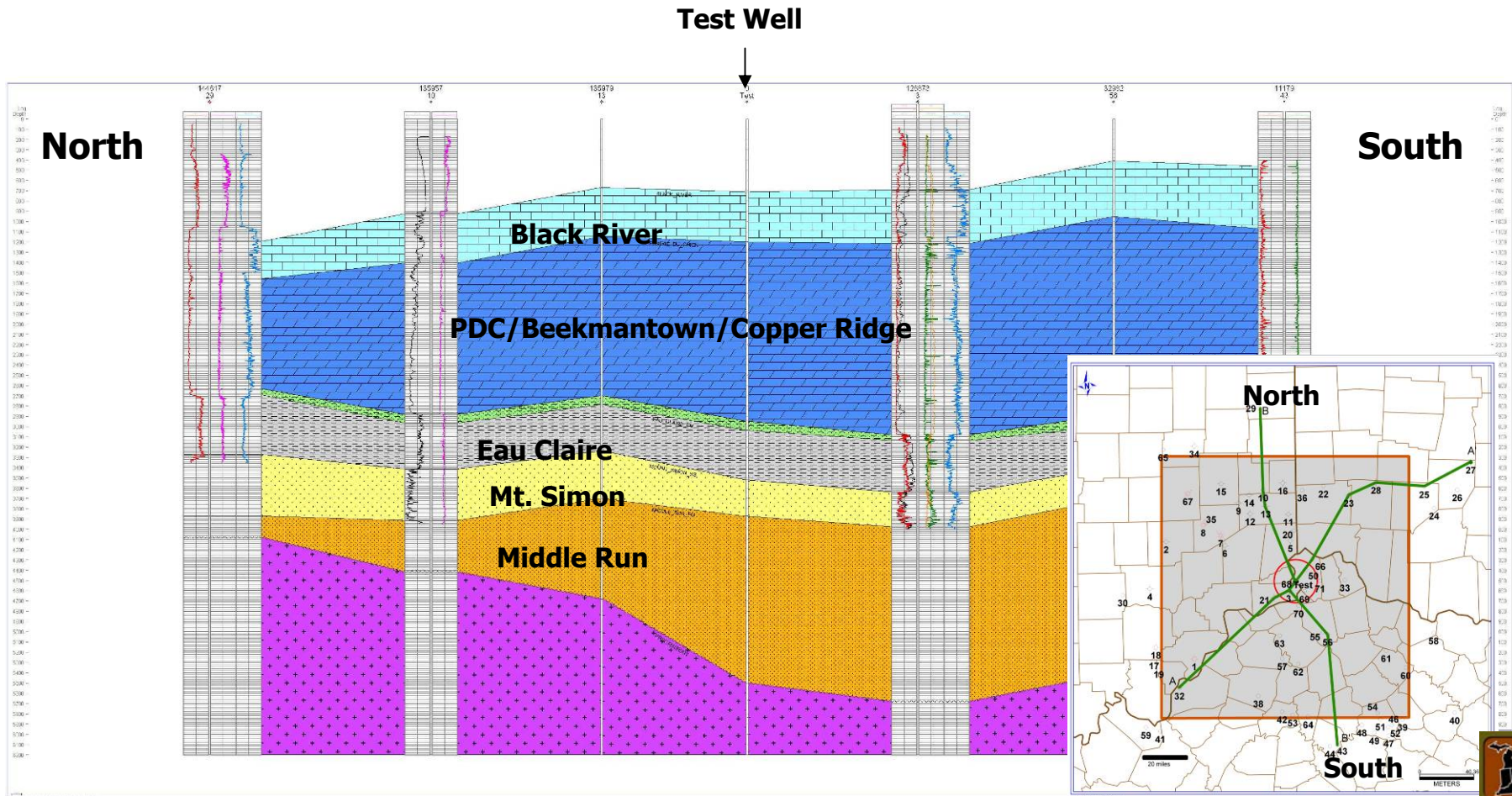


- Duke Energy East Bend Station
- 650 MW coal-burning power plant
- SOx and NOx control systems



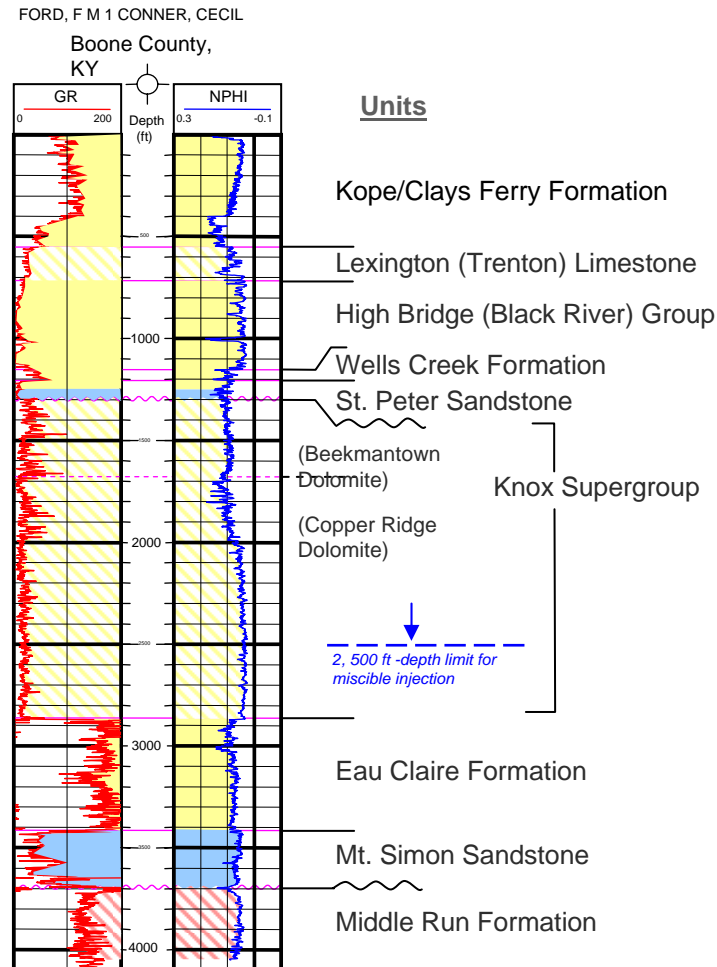
• 1,800 acres on the floodplain along a bend in the Ohio River

# Geologic Cross-Section Through Study Area

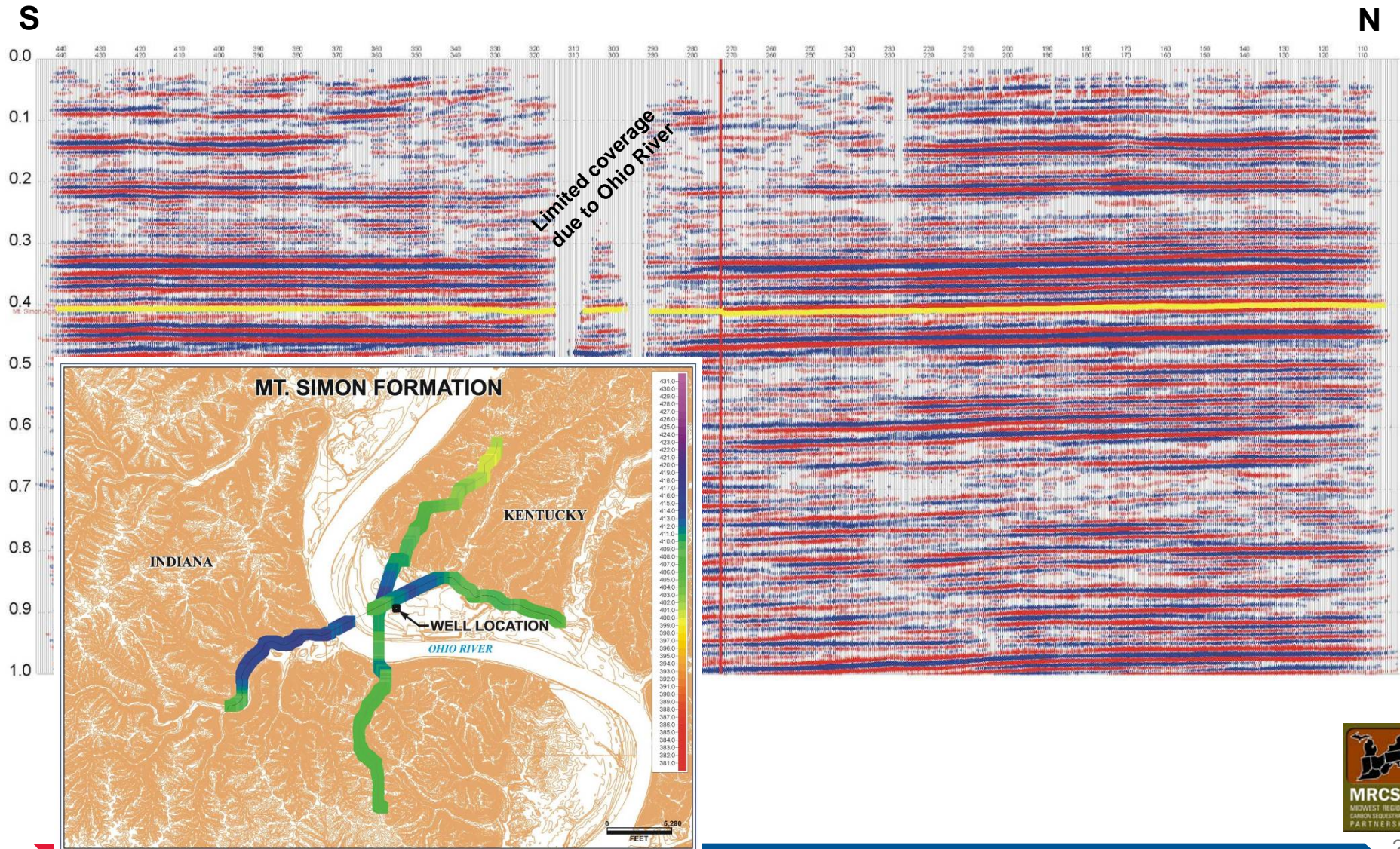


# Preliminary Geology

- Few deep wells in area.
- Essentially no oil and gas fields nearby.
- Logs show distinct rock units.



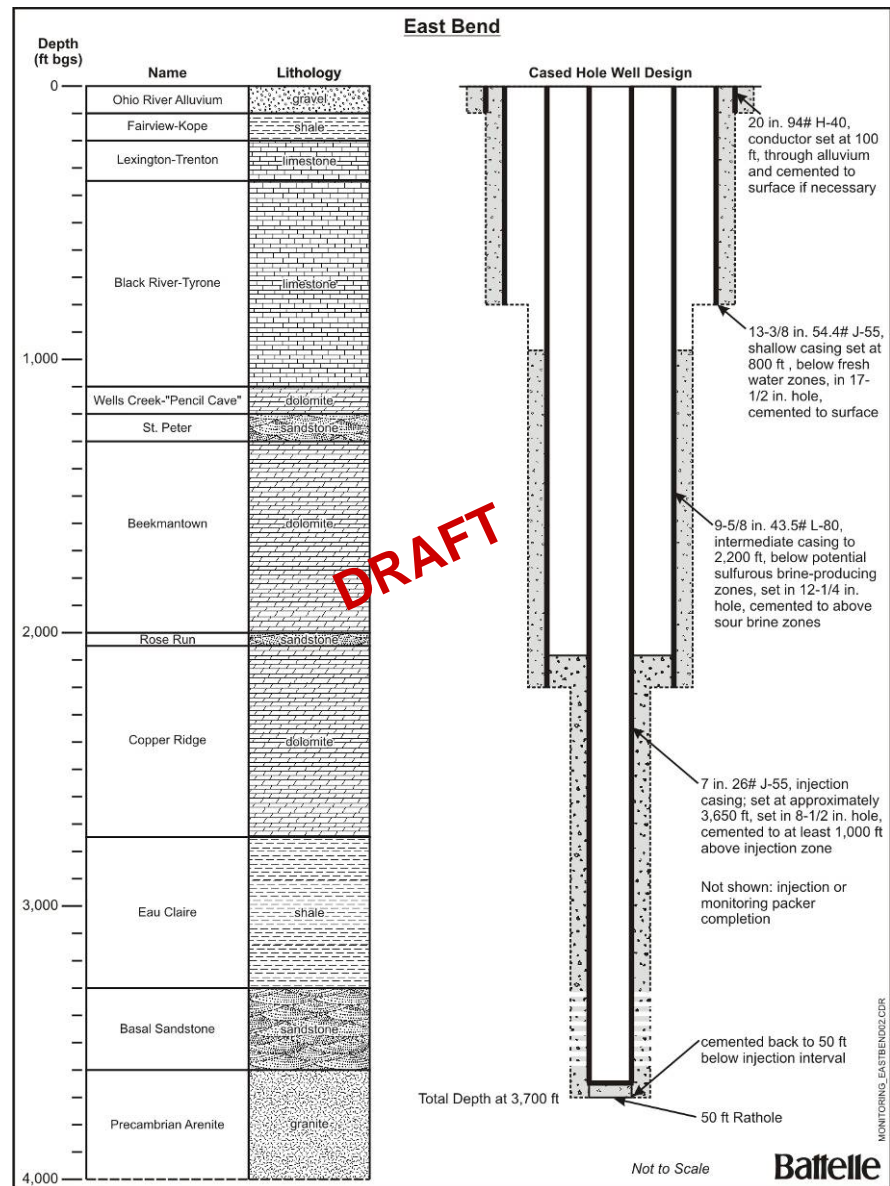
# Seismic Survey- Mt. Simon





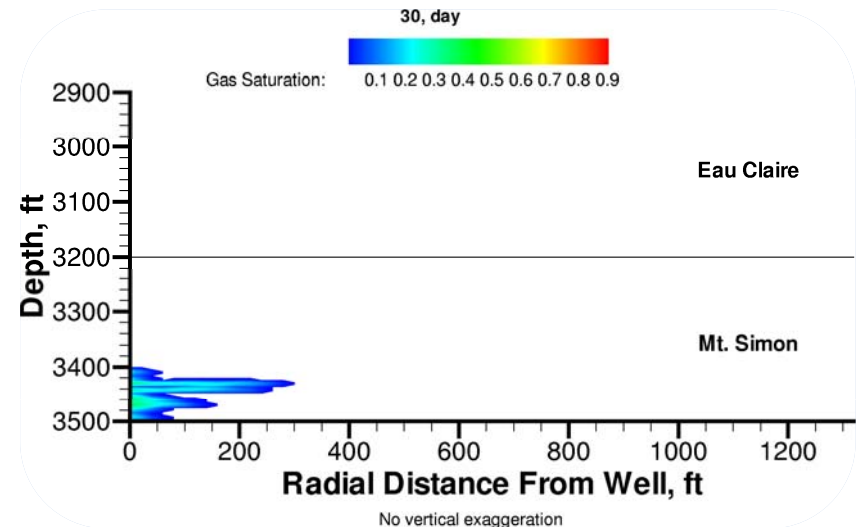
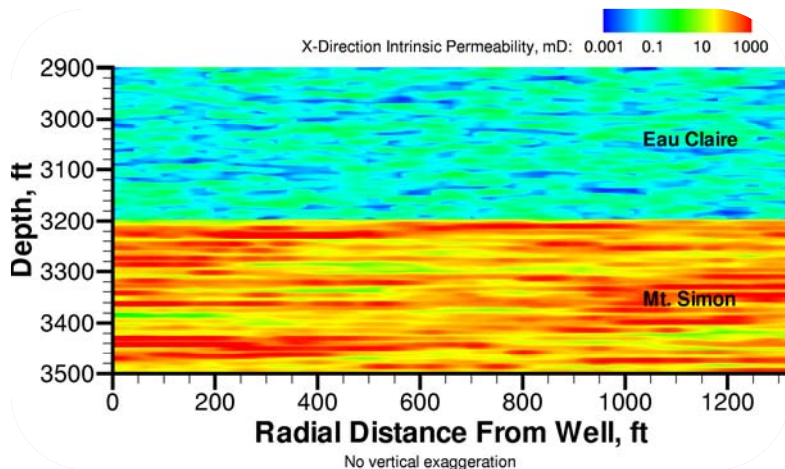
# Test Well Design

- Mt. Simon = primary target, ~300 ft thick
- Eau Claire Shale = primary containment unit
- Well construction specifications under development

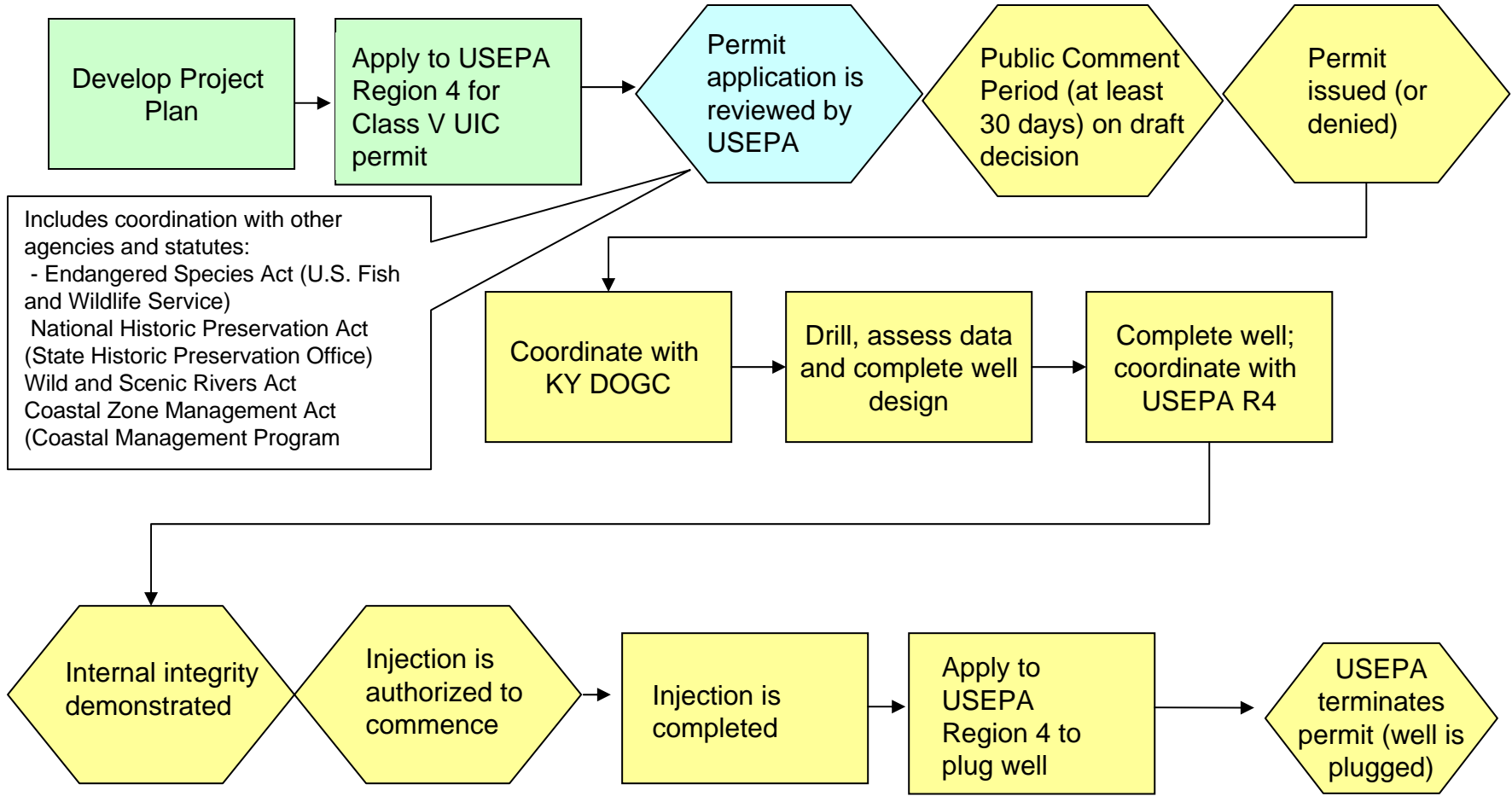


# Cincinnati Arch- East Bend Site

- Preliminary STOMPCO<sub>2</sub> modeling has been run to aid in developing system and monitoring plans.
- Model input parameters were based on other deep well data over 30 miles away. Consequently, results based on test data may be significantly different.



# Key Regulatory Steps In Kentucky



Key: MRCSP USEPA R4 KY DOGC Completed In progress Future



# Permitting – Cincinnati Arch East Bend Site

- Pursuing UIC Class 5 permit under Region 4 EPA (Atlanta) UIC program
- May 1, 2008- UIC Permit Application submitted.
- June 30, 2008- Technical comments received.
- August 4, 2008- Response to technical comments sent.
- September 2008 – Verbal response to additional questions
- Currently awaiting draft permit, should be available within a few weeks.
- Future- 30 day public notice, final permit, test well, permission to inject.

