An Assessment of Geological Carbon Sequestration Options in the Illinois Basin

A DOE Regional Sequestration Partnership

MGSC Project Team

Presented by
Robert J. Finley
Illinois State Geological Survey

Midwest Geological Sequestration Consortium

Alexandria, VA May 2006

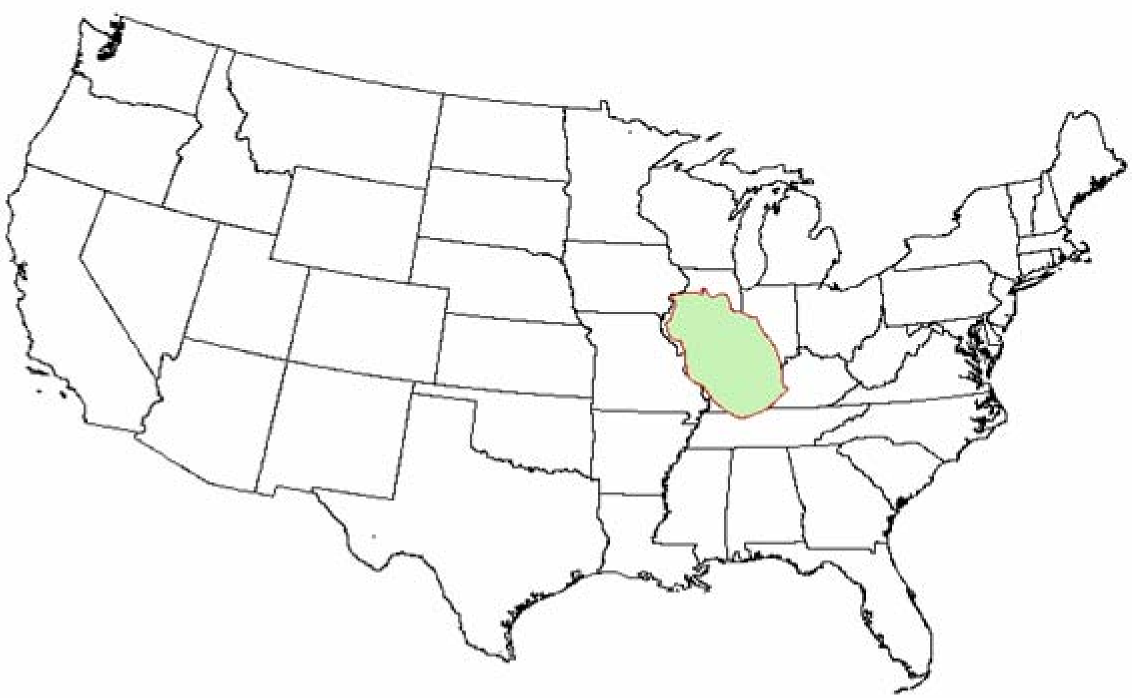
MGSC Project Advisors and Partners

- Utilities: Ameren, Louisville Gas and Electric, and Cinergy
- Industry: Aventine Renewable Energy, American Air Liquide, British Petroleum*, Drummond Coal*, LincolnLand Agri-Energy, Peabody Energy, Power Holdings, and Schlumberger*
- NGO and trade groups: Environmental Defense*, IL, IN, and KY Oil & Gas Associations, IL Corn Growers Association, Electric Power Research Institute, Interstate Oil and Gas Compact Commission
- State government: IL Office of Coal Development, (DCEO), IL Department of Natural Resources

** new in Phase II*

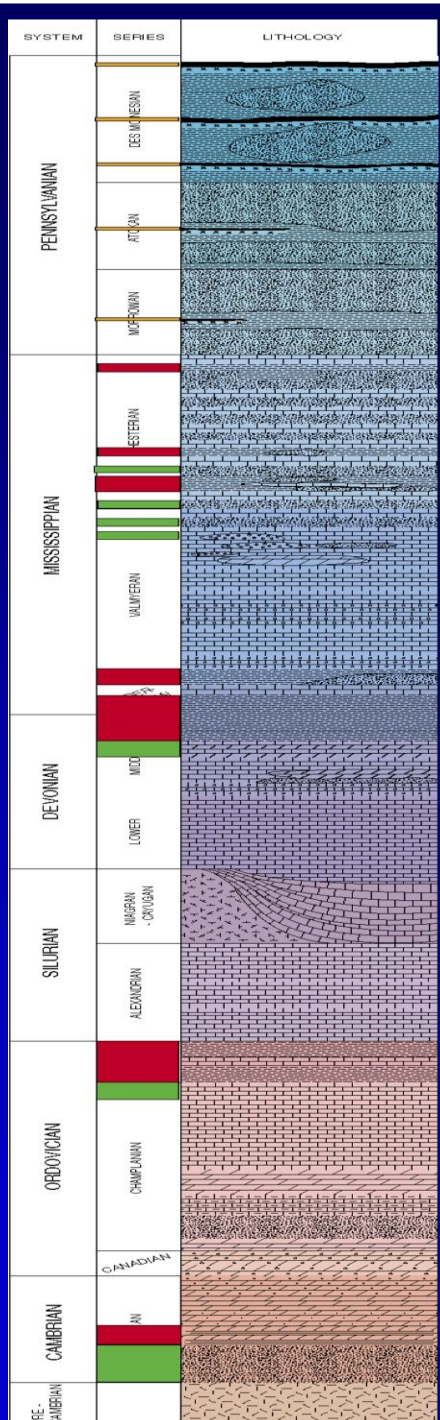
Midwest Geological Sequestration Consortium (MGSC)

A DOE Regional Partnership—Phase II



Illinois Basin Emissions= >283 mmt CO_2/yr

- Led by Illinois State Geological Survey in collaboration with the Indiana and Kentucky Geological Surveys
- 28 other subcontractors and consultants



Pennsylvanian coal seams

Mississippian sandstone and carbonate oil reservoirs

New Albany Shale

Maquoketa Shale

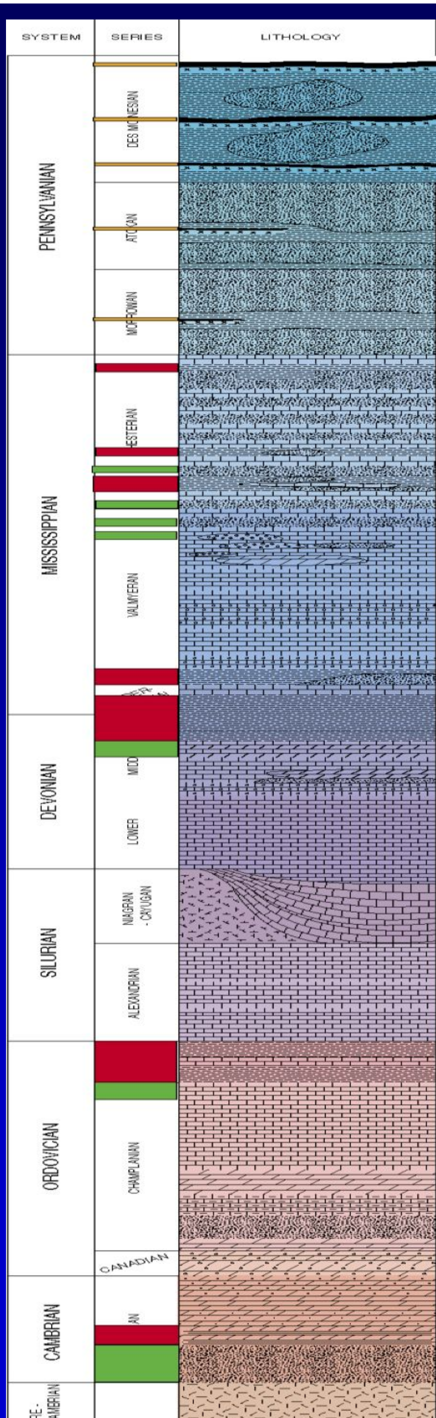
St. Peter Sandstone

Eau Claire Shale

Mt. Simon Sandstone

Illinois Basin Stratigraphic Column

from Leetaru, 2004



Pennsylvanian coal seams

adsorption on coal

Mississippian sandstone and carbonate oil reservoirs

CO_2 EOR in mature fields

New Albany Shale

adsorption on shale

Maquoketa Shale

St. Peter Sandstone

Eau Claire Shale

Mt. Simon Sandstone

major saline reservoirs

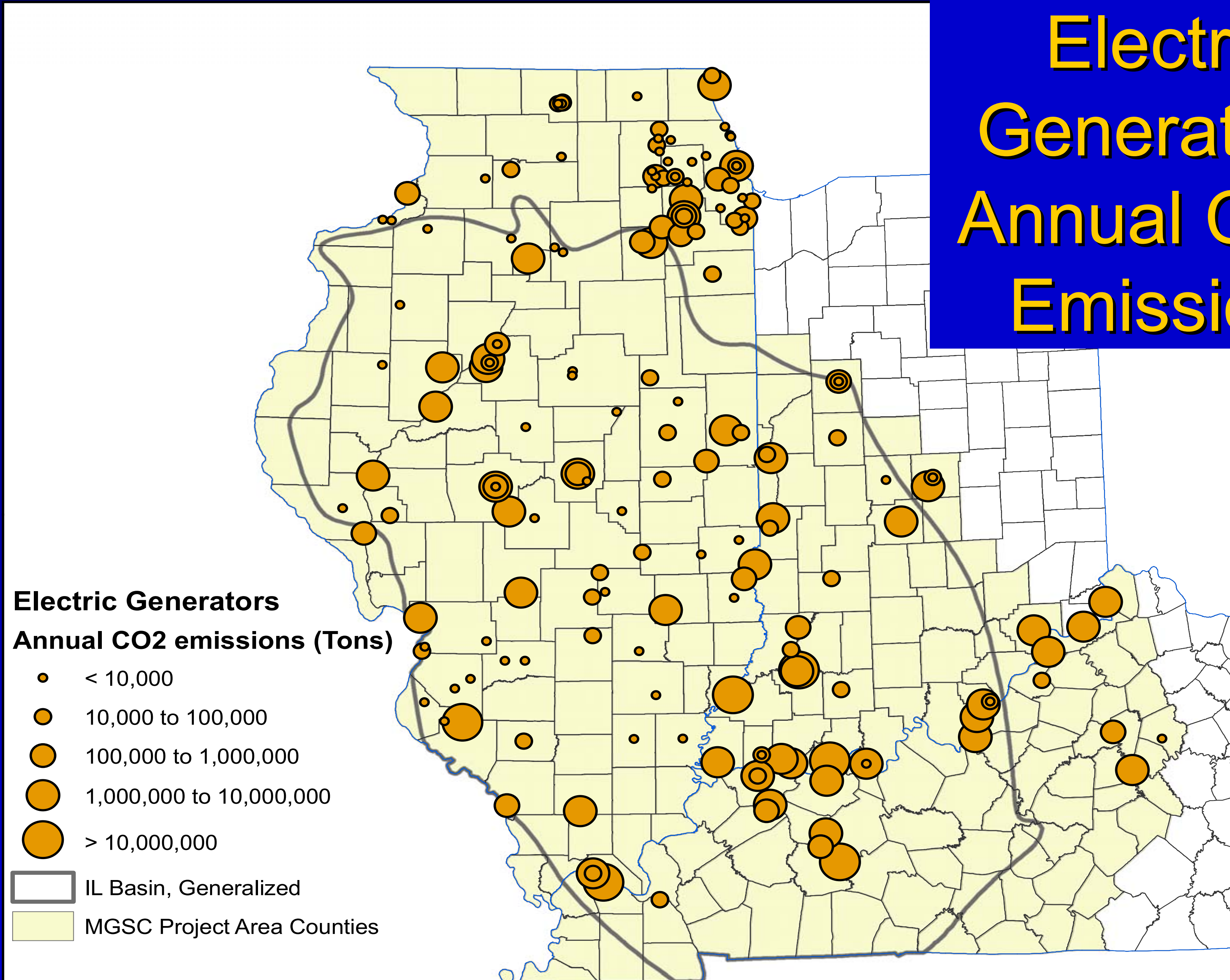
Potential Seal

Potential Sink

Coal Bed Potential Sink and Seal

from Leetaru, 2004

Electrical Generators Annual CO_2 Emissions



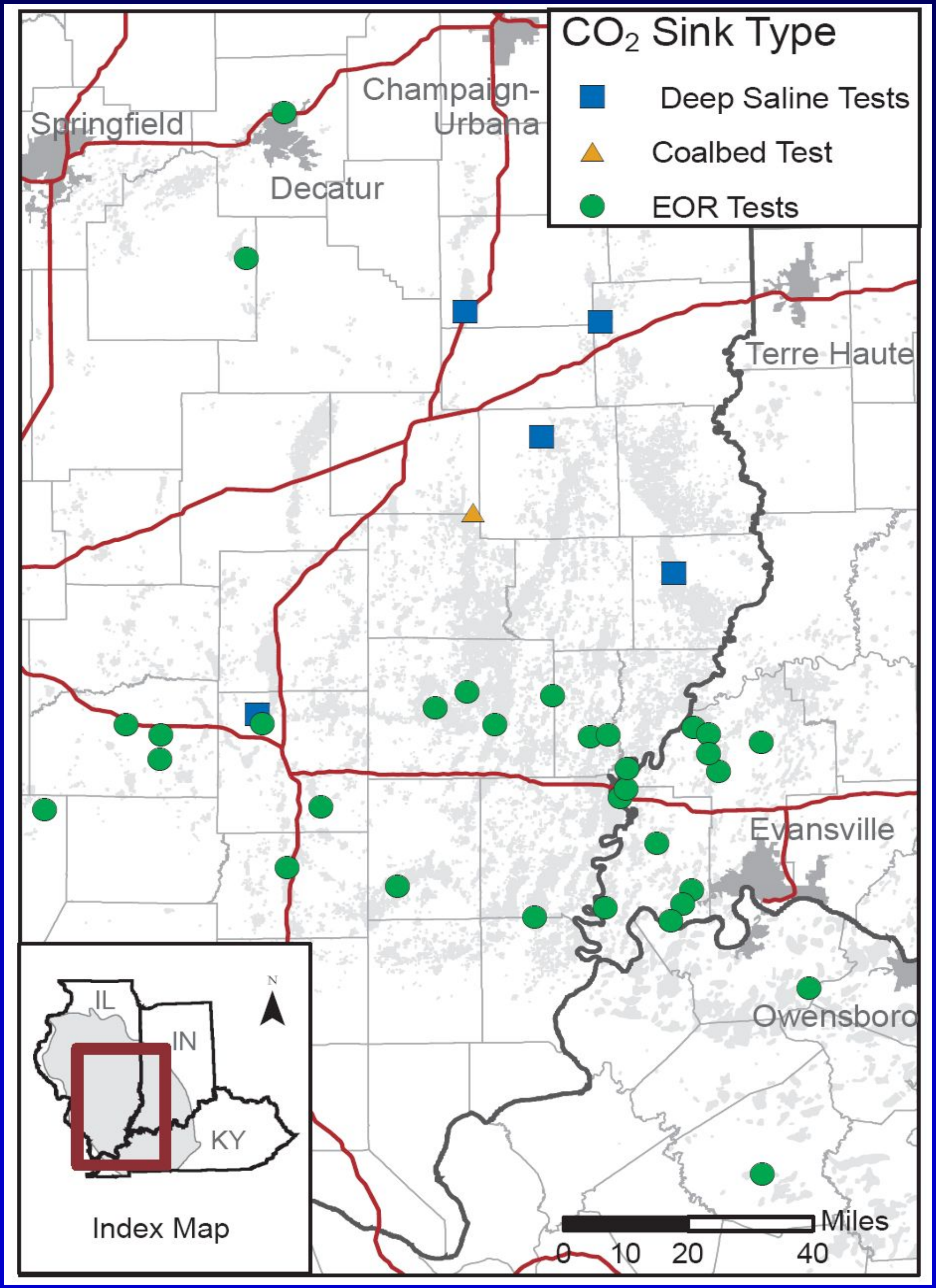
Source: US DOE Energy Information Administration 2002; US EPA Acid Rain 2002, EGRID 2000.

MGSC: Seeking Optimal Sinks

- High CO_2 storage capacity
- High CO_2 injection rate
- Storage mechanism assessment
- Six field tests proposed from portfolio of 34 potential field test sites among 11 oil operators for Phase II activities
- Coal seam site selected
- First of four EOR pilot test sites in final selection process

Sink Capacities

- Seven major coal seams: 3.6 billion tonnes
  - 6.7 trillion ft^3 incremental methane
- Mature oil reservoirs: 140-440 million tonnes
  - 860-1,300 million barrels incremental oil
- Mt. Simon and St. Peter Sandstones: 7.8 billion tonnes on geological structures
- Mt. Simon and St. Peter Sandstones: 30-35 billion tonnes off structure >4,000 ft



Potential Test Phase II Sites

-1 coal seam site selected

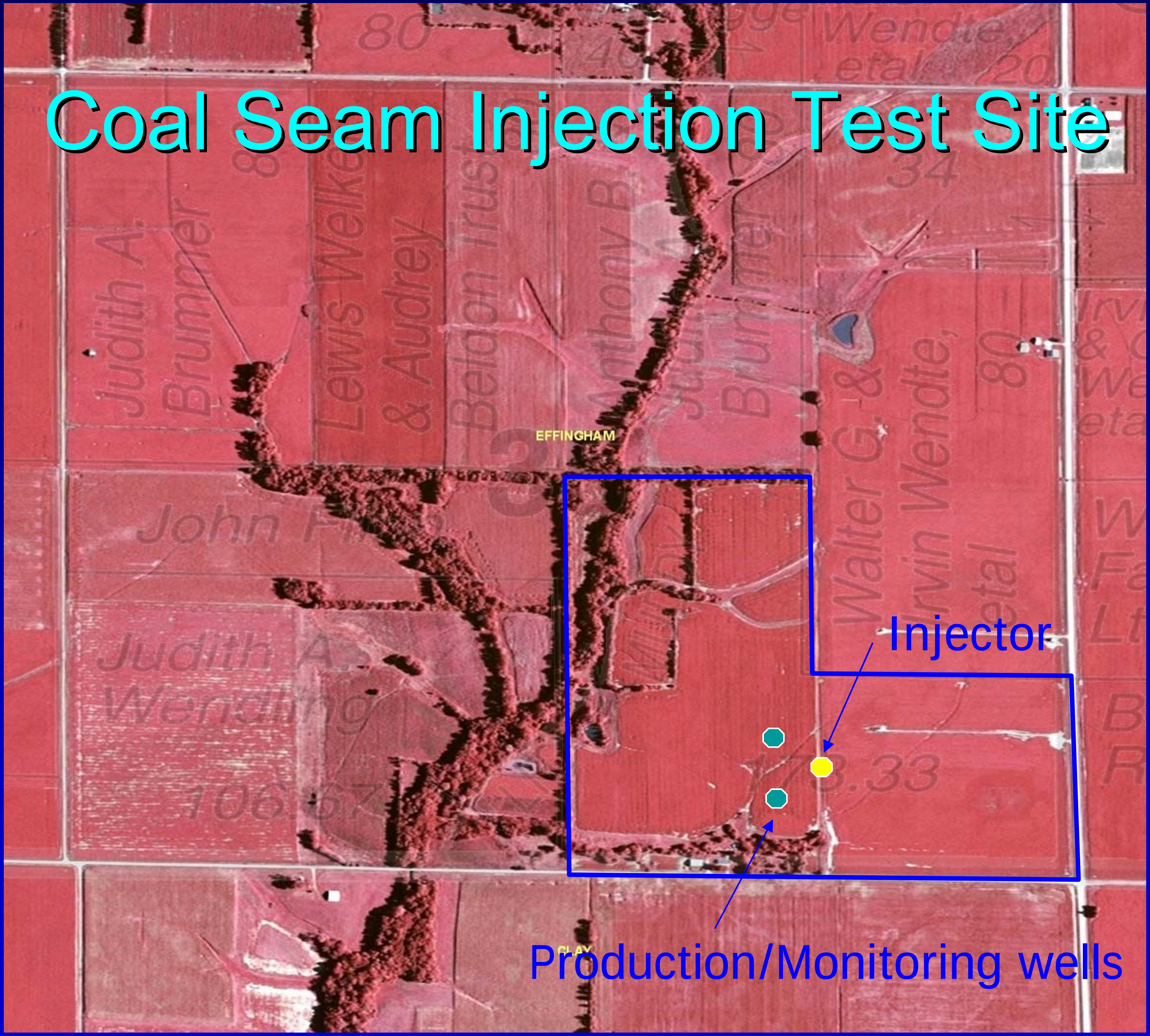
-34 mature oil field sites for EOR; 3 under consideration for first pilot: inject/ soak/ produce test

-5 deep saline reservoir sites in review

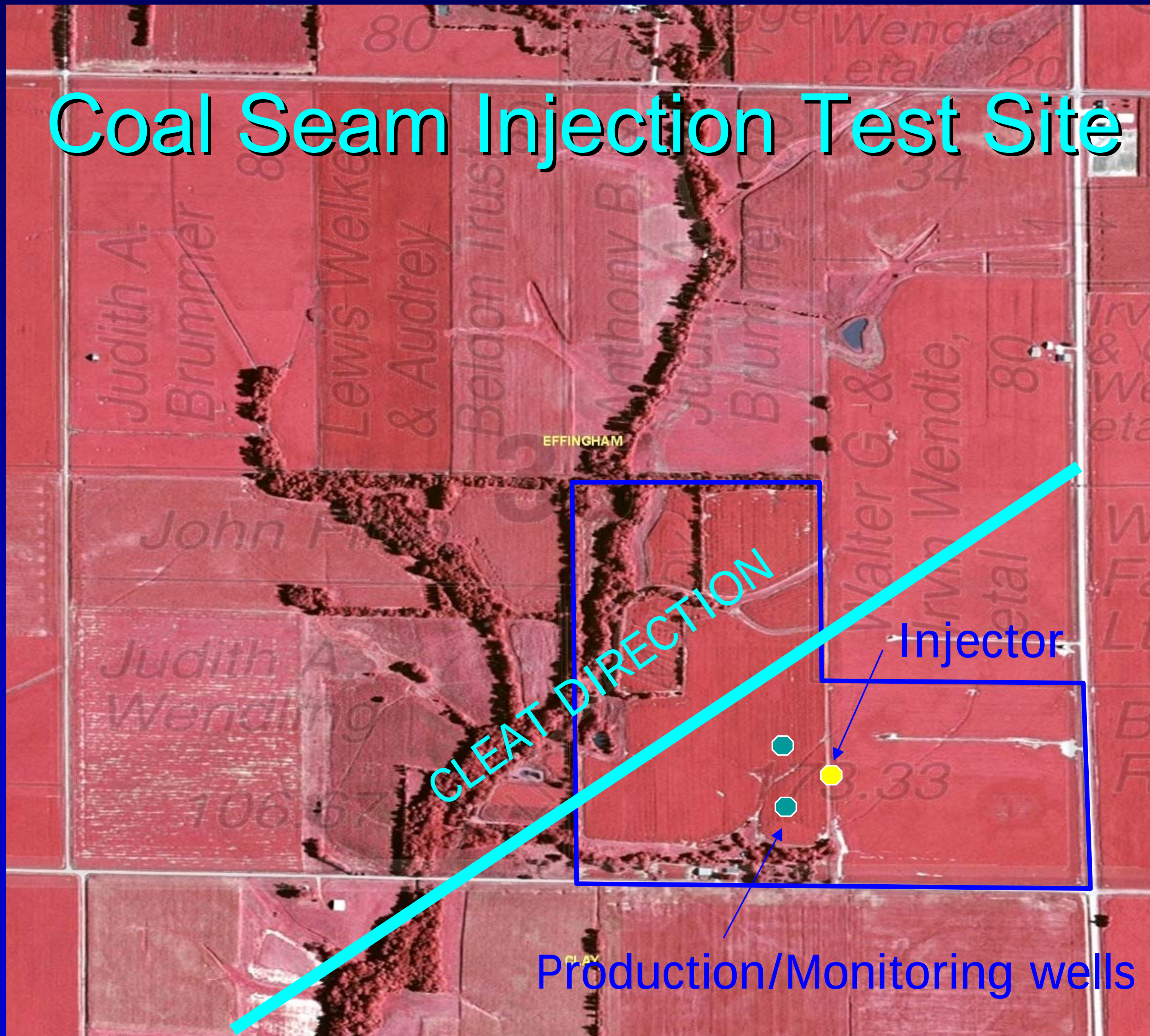
Recent Areas of Focus

- Major focus on reservoir characterization to support pilot test site selection for:
  - coal seams (site selected)
  - oil reservoirs (first site narrowed to three choices)
  - deep saline reservoirs (talking to operators)
- Structural characterization using seismic
- Outreach and teacher materials

Coal Seam Injection Test Site



Coal Seam Injection Test Site



COMET Modeling Study to Determine Well Spacing for ECBM Pilot

Pilot well spacing criteria:

- quantifiable response at observation/production wells:
  - within 30 days
  - Min. pressure Δ: 1.0 psi; min. gas saturation: 10%
- observation wells oriented orthogonal to CO_2 injector
- face cleat orientation uncertain: northeast
  - observation wells equidistant from injector
  - relatively close spacing to ensure response

Pilot:

- 1 injector, 2 observation/production wells

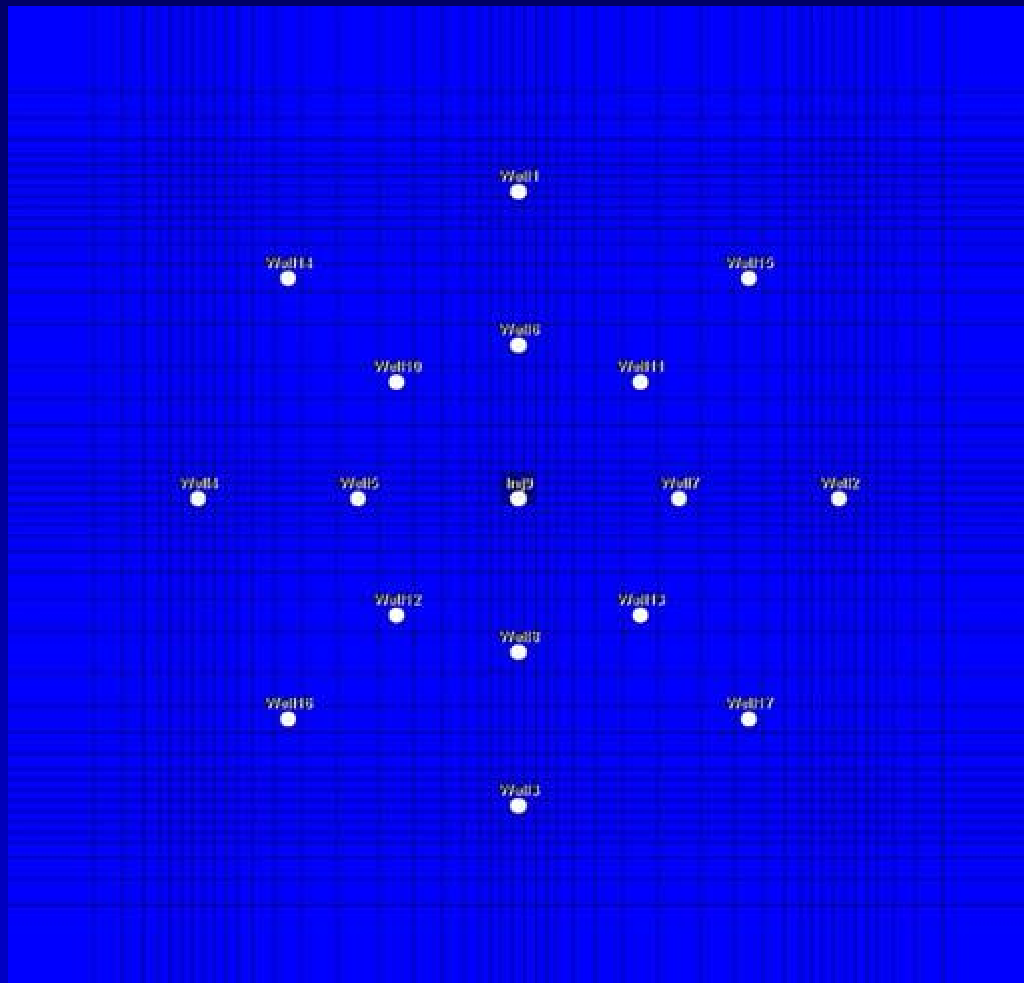
COMET Modeling Study to Determine Well Spacing for ECBM Pilot

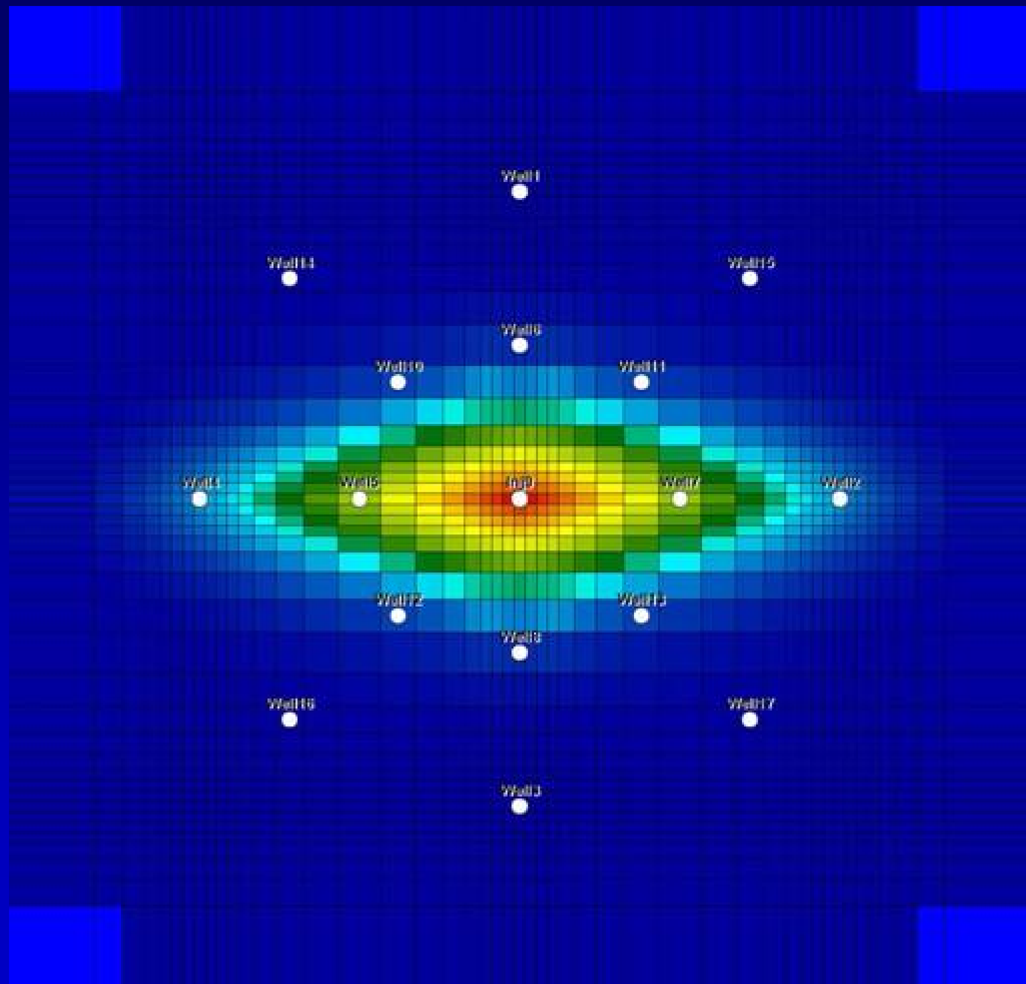
Reservoir model:

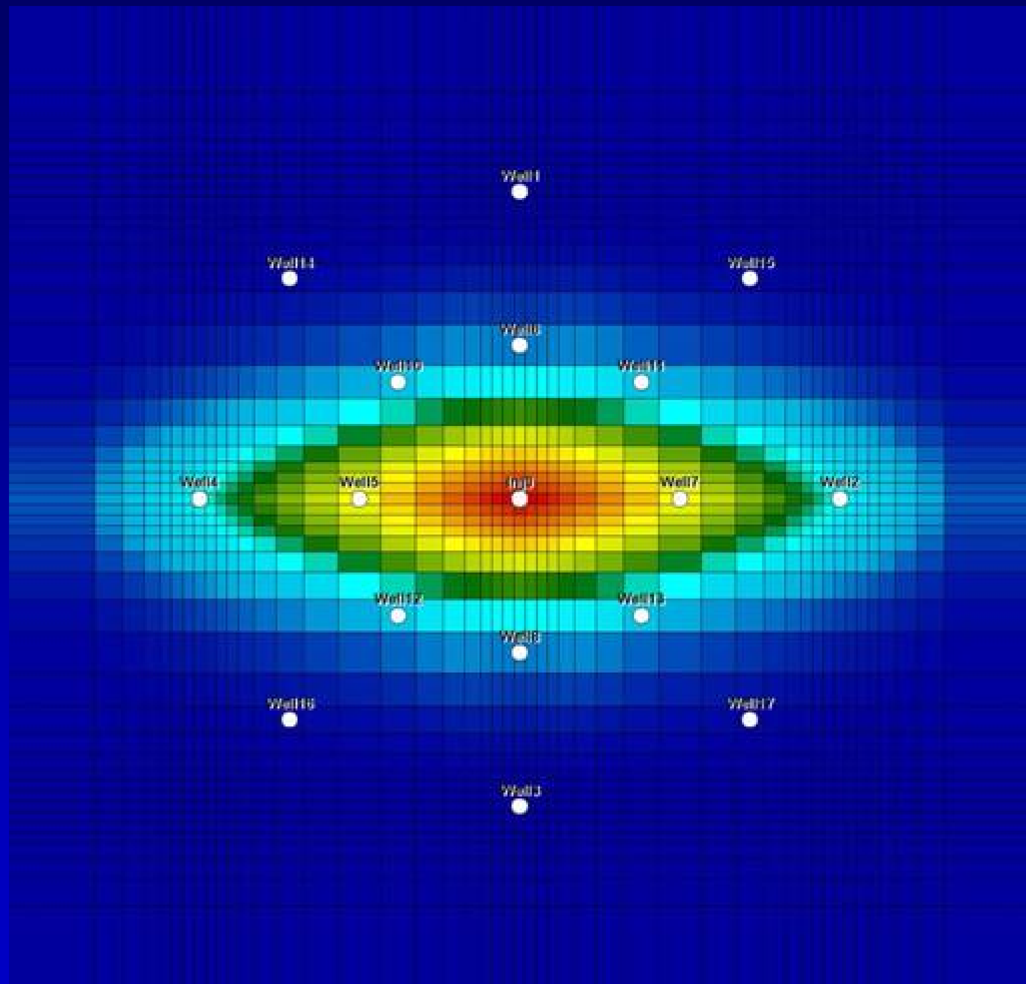
- Area: 21.53 acres
- Grid: single layer (Herrin coal, 4.0’), 5-spot hybrid grid
- Wells:
  - 16 observation/production with 150’ and 300’ spacing
  - observation/production wells oriented along x and y axis and 45° diagonal

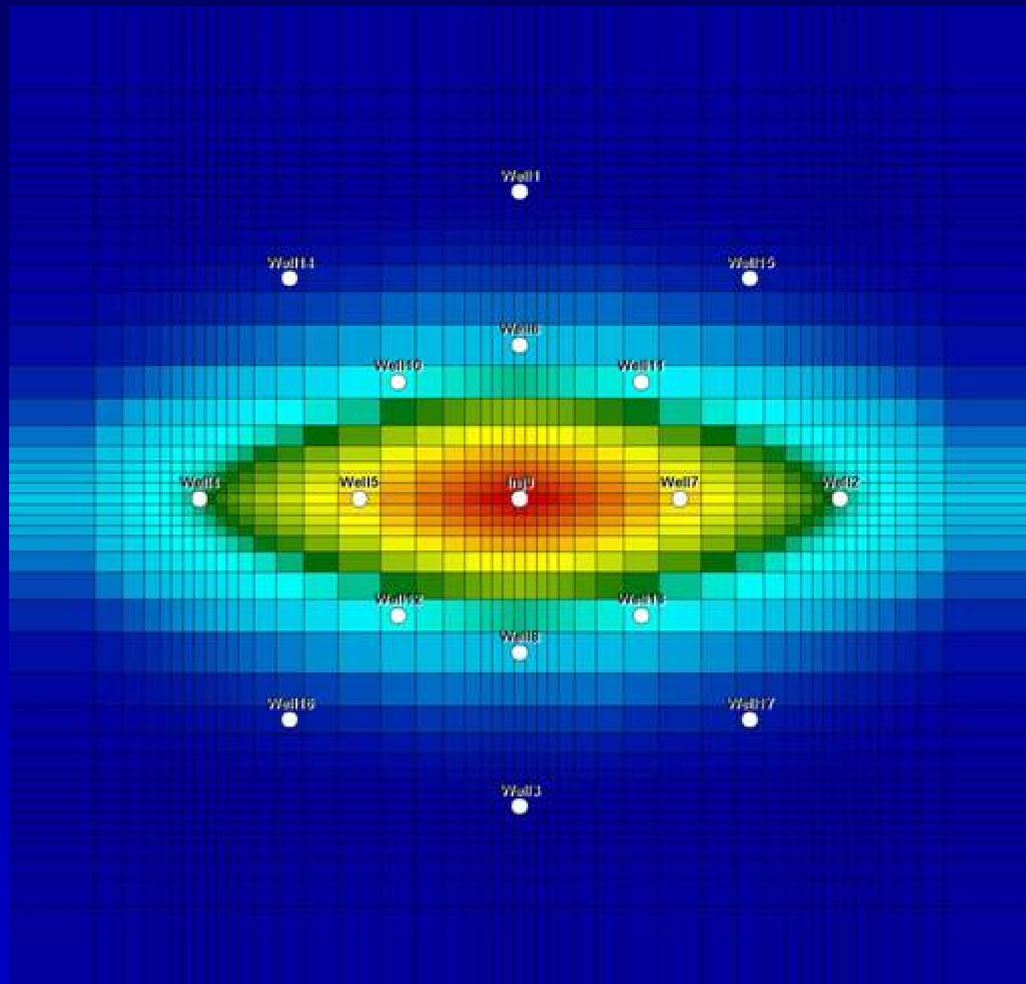
Reservoir Parameters:

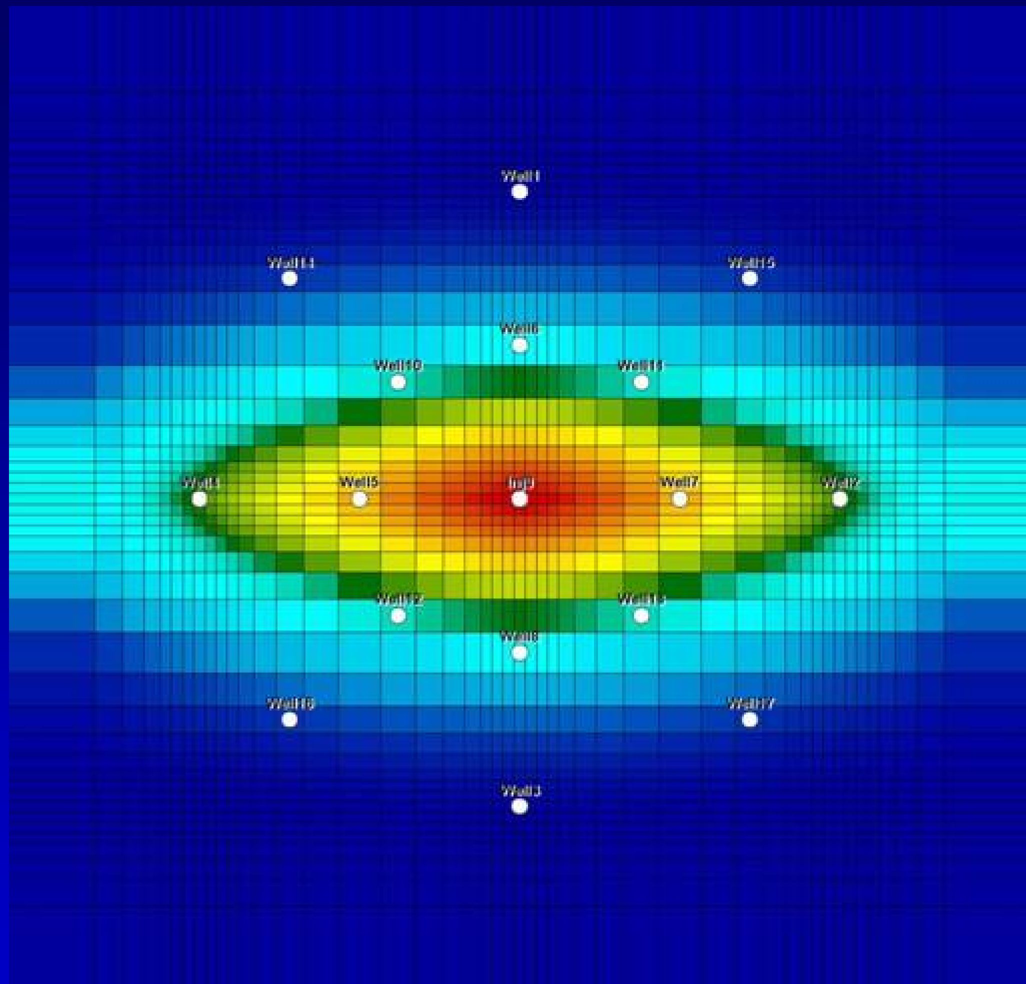
- obtained from DST, core data, recently tested area wells, and regional data


Well1
Well14
Well15
Well6
Well10
Well11
Well4
Well5
Inj9
Well7
Well2
Well12
Well13
Well8
Well16
Well17
Well3

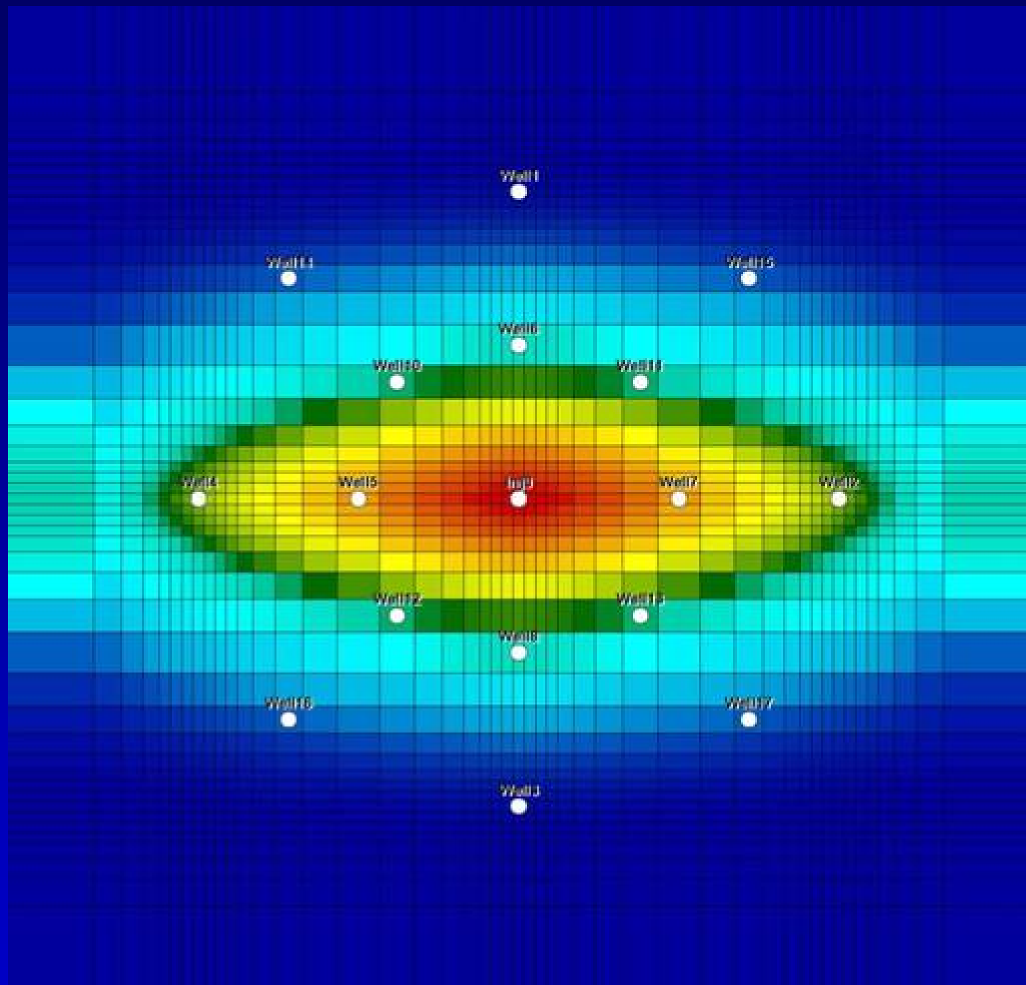

Well1
Well14
Well15
Well6
Well10
Well11
Well4
Well5
Well7
Well2
Well12
Well13
Well8
Well16
Well17
Well3

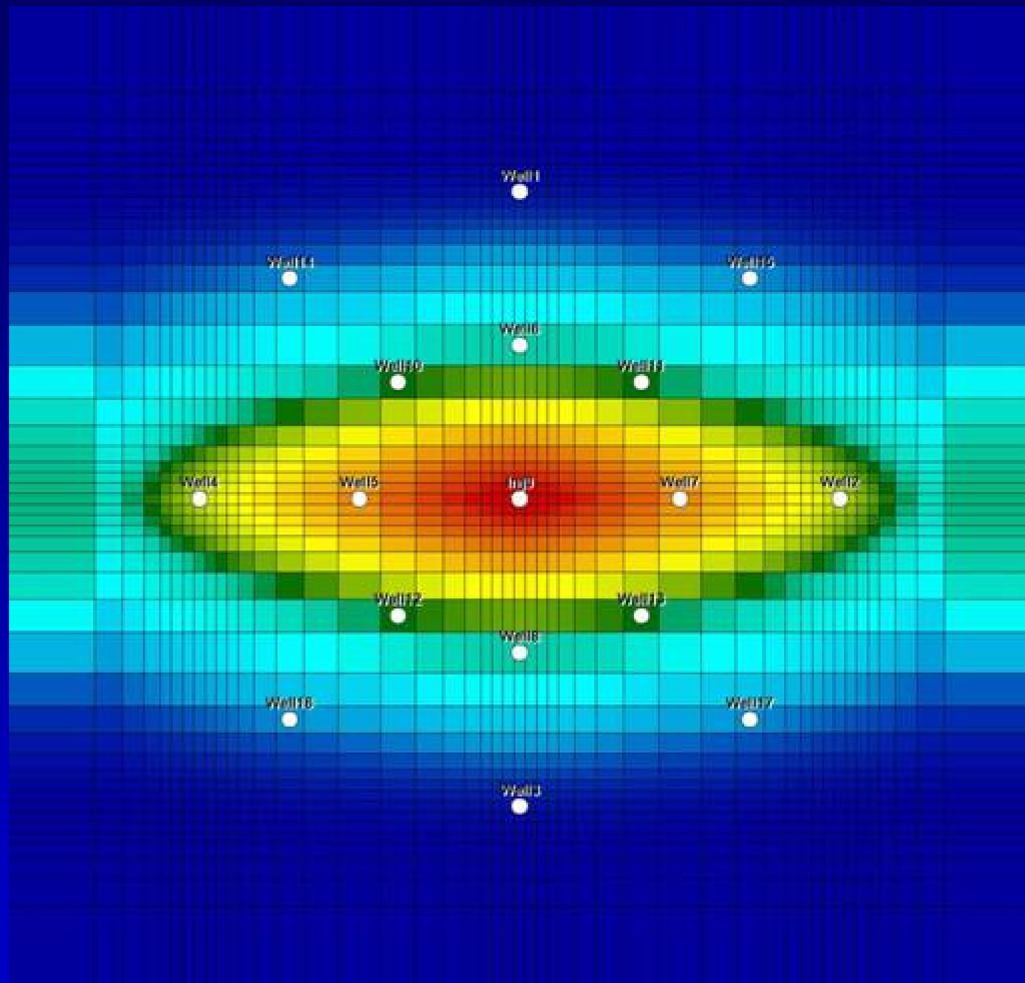

Well1
Well14
Well15
Well10
Well11
Well4
Well5
Well7
Well2
Well12
Well13
Well16
Well17
Well3


Well1
Well14
Well15
Well6
Well10
Well11
Well4
Well5
Well7
Well2
Well12
Well13
Well8
Well16
Well17
Well3



Well1
Well14
Well15
Well6
Well10
Well11
Well5
Well7
Well2
Well12
Well13
Well8
Well16
Well17
Well3


Well1
Well4
Well5
Well7
Well2



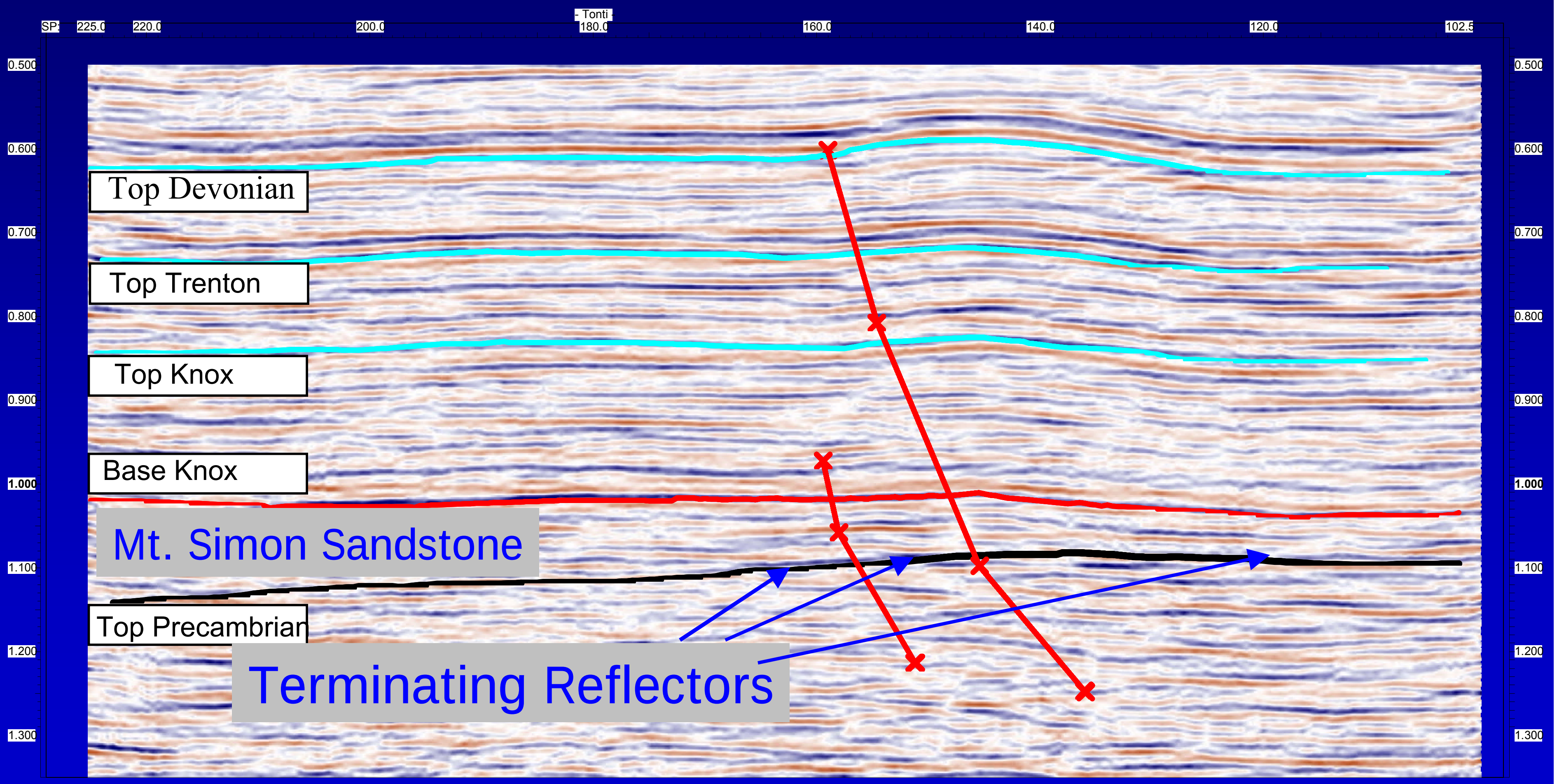
Well1
Well14
Well15
Well6
Well10
Well11
Well4
Well5
Well7
Well2
Well12
Well13
Well8
Well16
Well17
Well3

Saline Reservoir Test

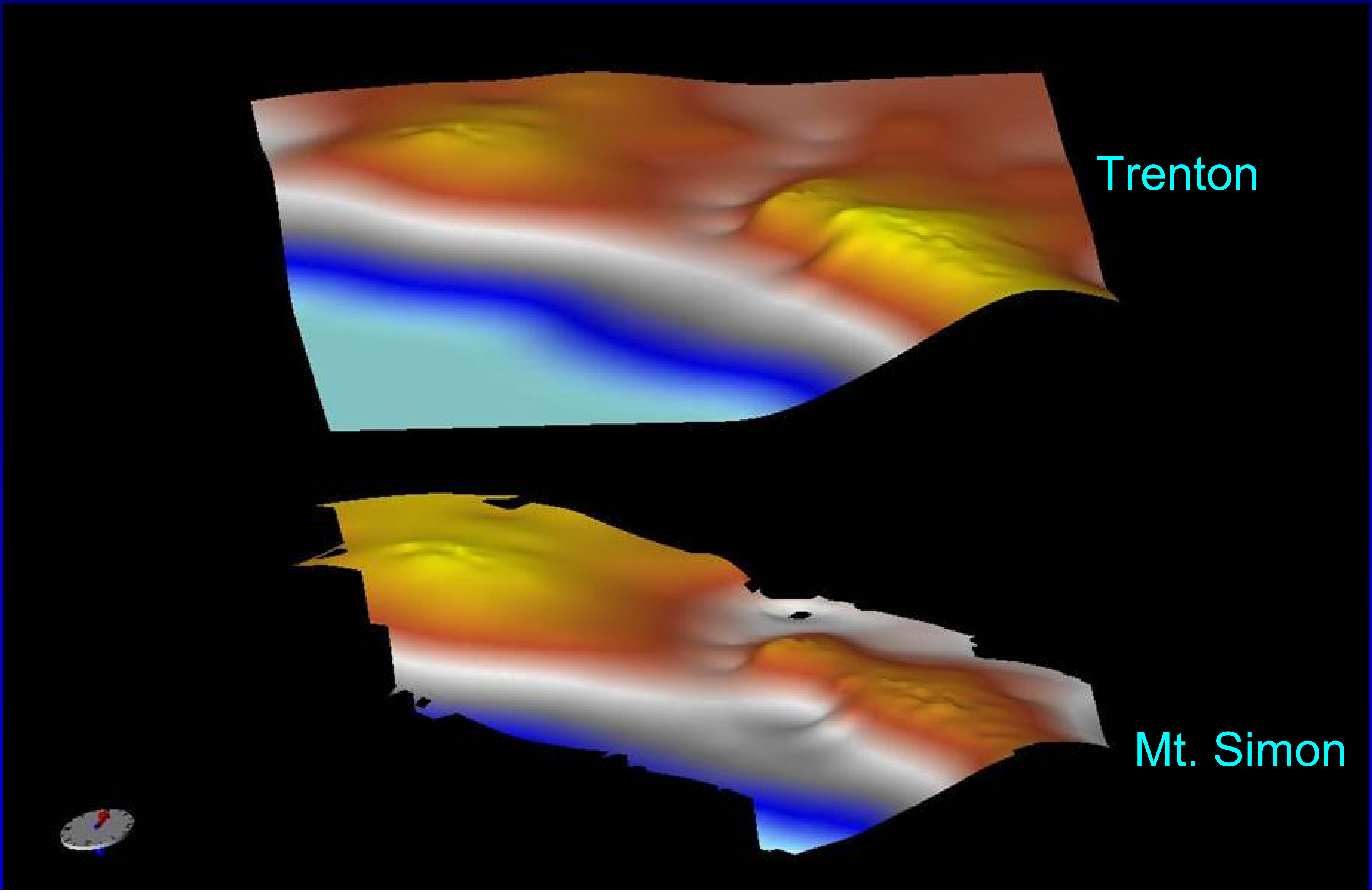
- Primary target is the Mt. Simon Sandstone; secondary target is the St. Peter
- Original proposed depth was 9,400 ft
  - trying to assess shallower sites due to cost considerations
- However, favorable geology (thickness and confidence in occurrence) and collaborative operator remain primary concerns

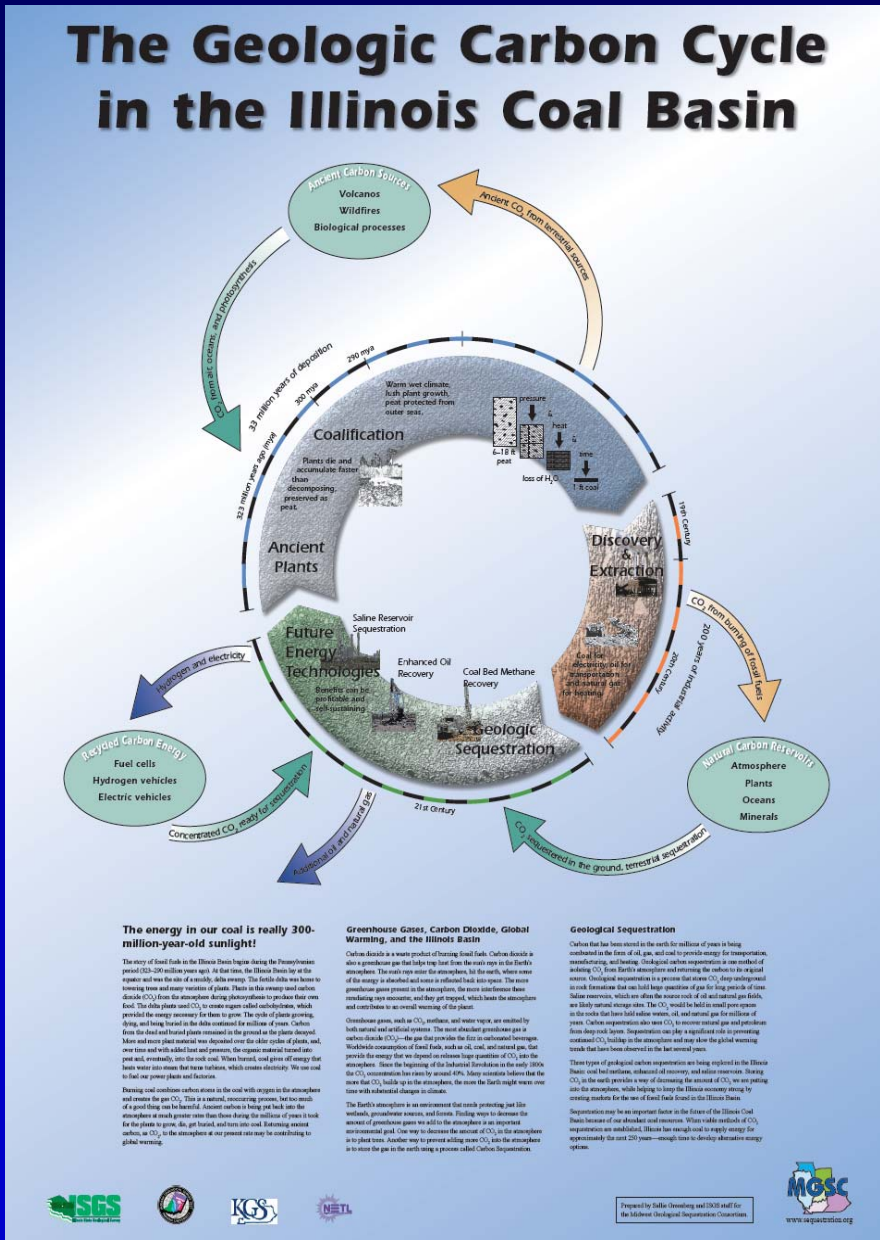
Tonti Reflection Seismic

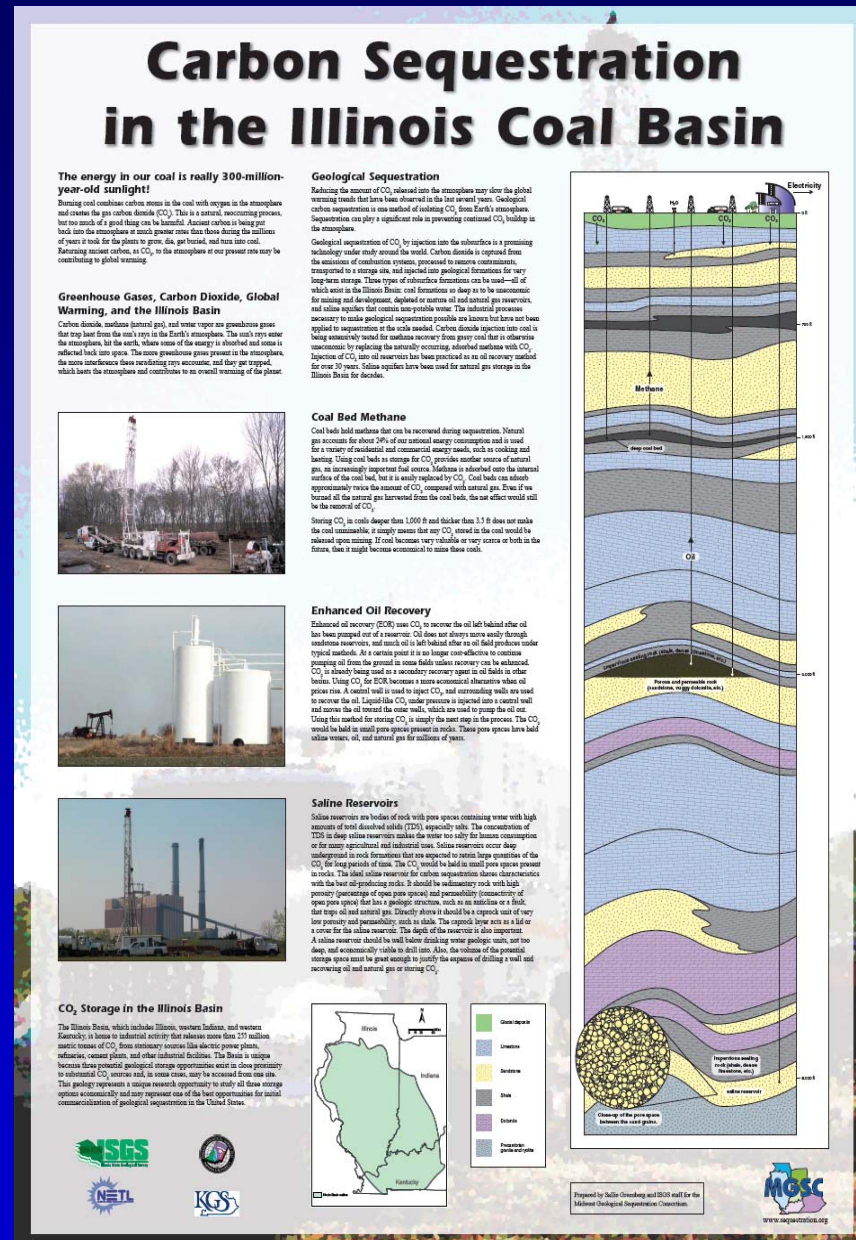
(acquired June 2005)



Hersher Gas Storage Field
Structural Migration




The Geologic Carbon Cycle in the Illinois Coal Basin
Ancient Carbon Sources
Volcanos
Wildfires
Biological processes
Coalification
Ancient Plants
Discovery & Extraction
Future Energy Technologies
Geologic Sequestration
Recycled Carbon Energy
Fuel cells
Hydrogen vehicles
Electric vehicles
Natural Carbon Reservoirs
Atmosphere
Plants
Oceans
Minerals
The energy in our coal is really 300-million-year-old sunlight!
Greenhouse Gases, Carbon Dioxide, Global Warming, and the Illinois Basin
Geological Sequestration


Carbon Sequestration in the Illinois Coal Basin
The energy in our coal is really 300-million-year-old sunlight!
Greenhouse Gases, Carbon Dioxide, Global Warming, and the Illinois Basin
Geological Sequestration
Coal Bed Methane
Enhanced Oil Recovery
Saline Reservoirs
CO2 Storage in the Illinois Basin

Midwest Geological Sequestration Consortium

www.sequestration.org

A DOE Regional Carbon Sequestration Partnership