Mitchell CarbonSAFE

DOE Project Number DE-FE0032268

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Nathan Webb and Sherilyn Williams-Stroud- CoPIs

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Illinois State Geological Survey

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U.S. Department of Energy

Fossil Energy and Carbon Management and National Energy Technology Laboratory

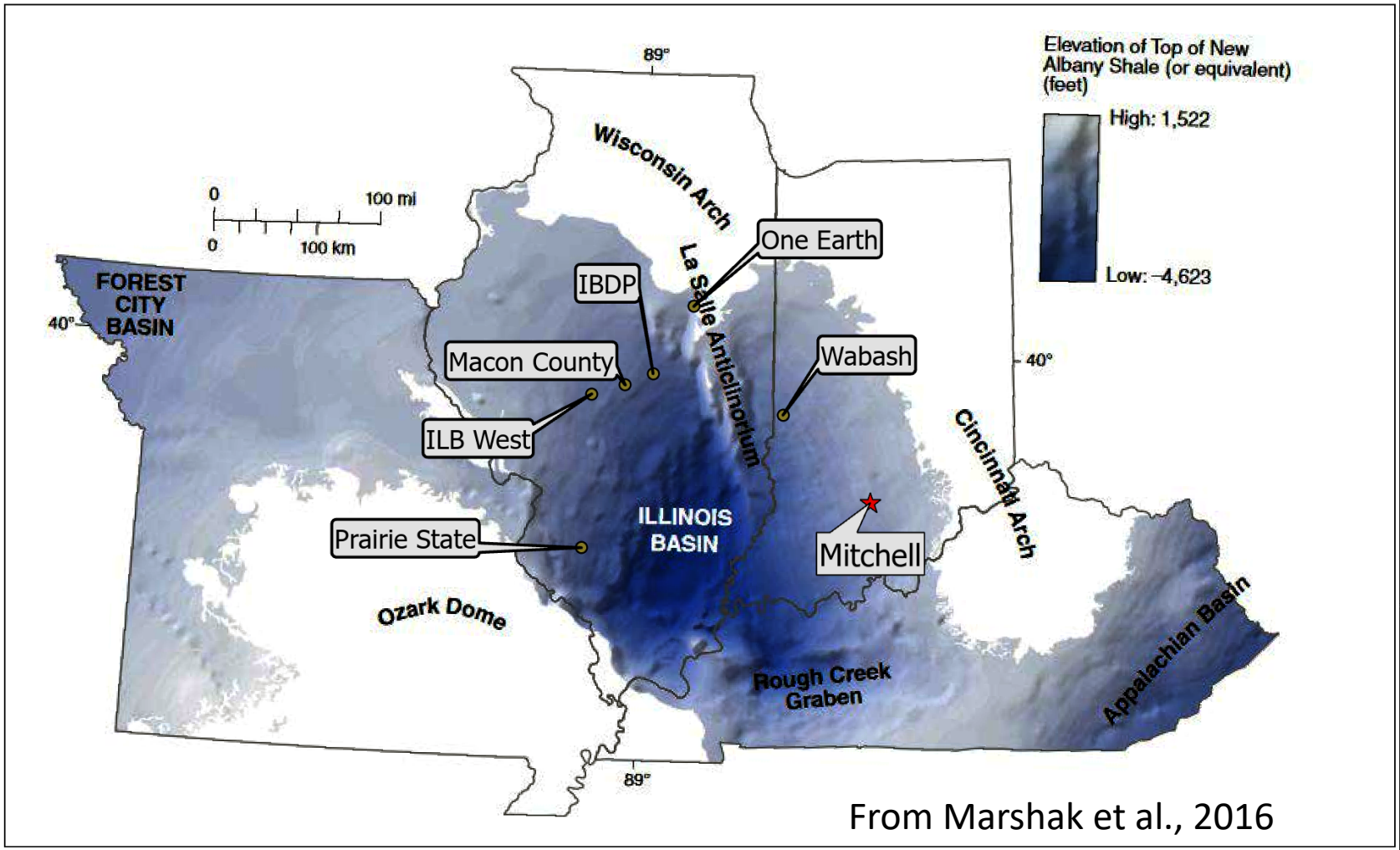
Carbon Management Research Project Review Meeting

Wednesday August 30th; 2023, 2:25PM

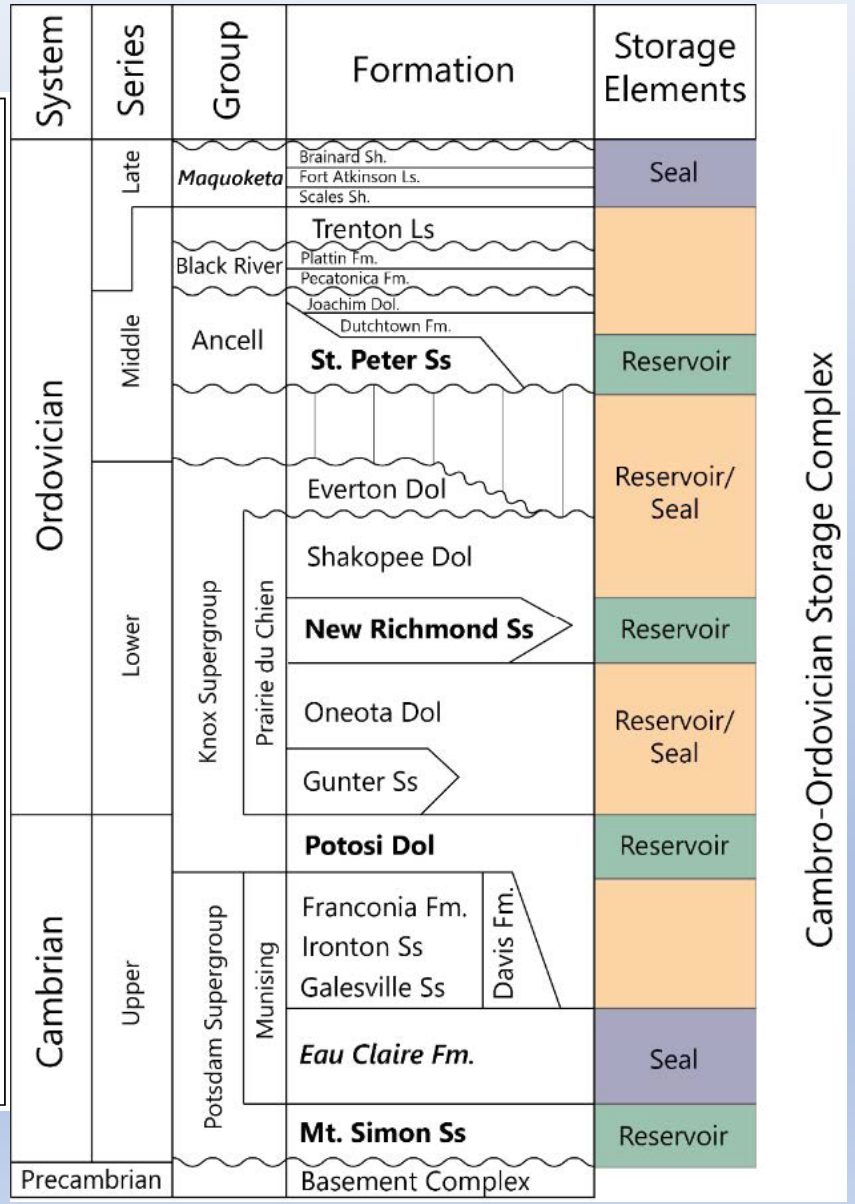
Background: CO_2 Source

- Cement production accounts for ~8% of global CO_2 emissions
- Heidelberg Materials' Beyond 2020 Strategy
  - 2030: Reduce CO_2 to 50% of 1990 emissions
  - 2050: Net zero
  - First full-scale carbon neutral cement plant in Edmonton
- Mitchell Cement Plant
  - Established in 1897
  - $650M upgrade complete on June 15th
  - 2nd largest in North America
- Projects selected for DOE awards
  - FOA 2515 (FE0032222)
    - FECM FEED study: 2-2.6 Mt CO_2/year
  - FOA 2610 (FE0032268)
    - CarbonSAFE Phase II (this study)
  - FOA 2738 (CD0000009)
    - OCED CCS Demonstration project: Capture/transport FEED, Class VI Permit

Background: Regional Geology

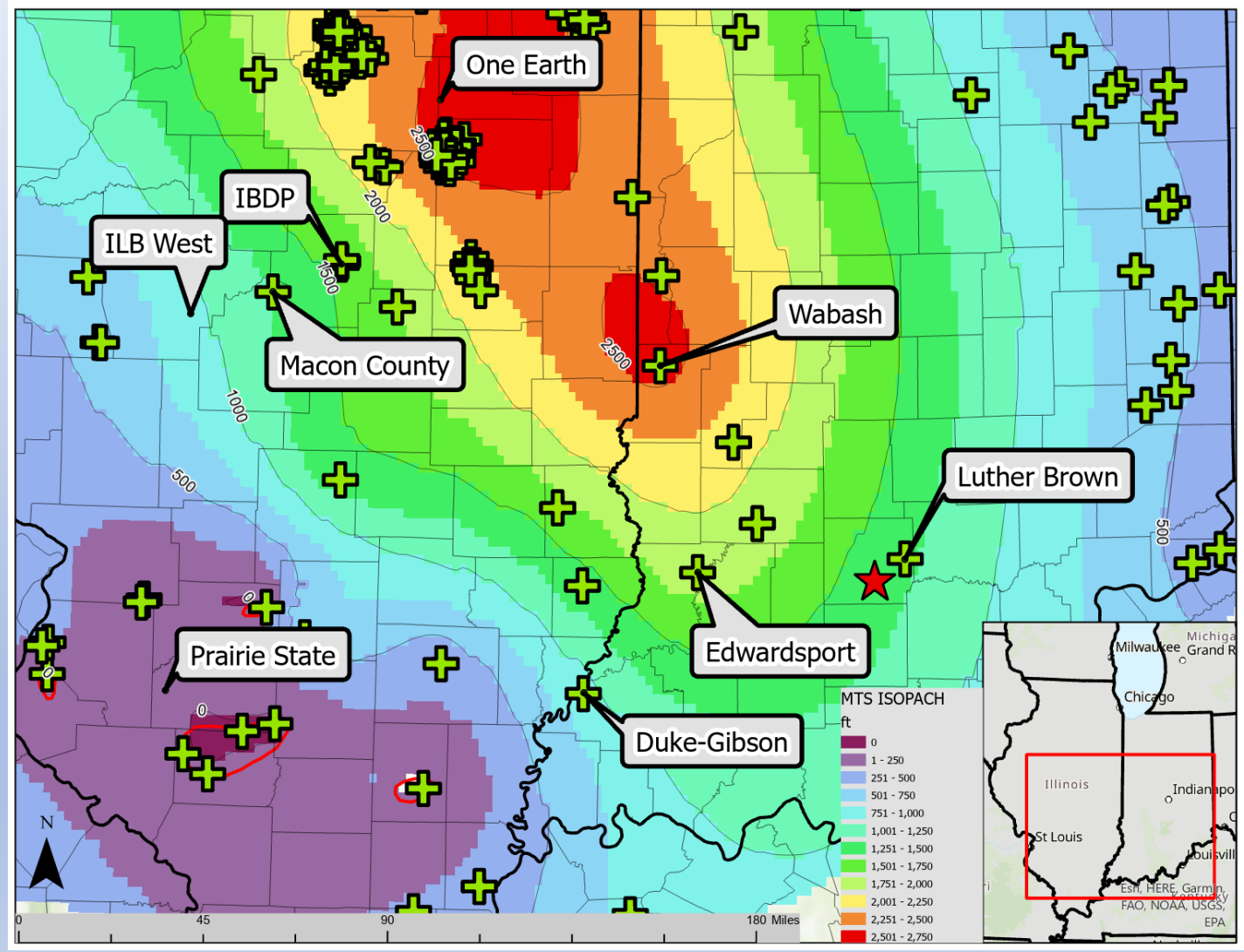


From Marshak et al., 2016



Background: Mt. Simon Sandstone

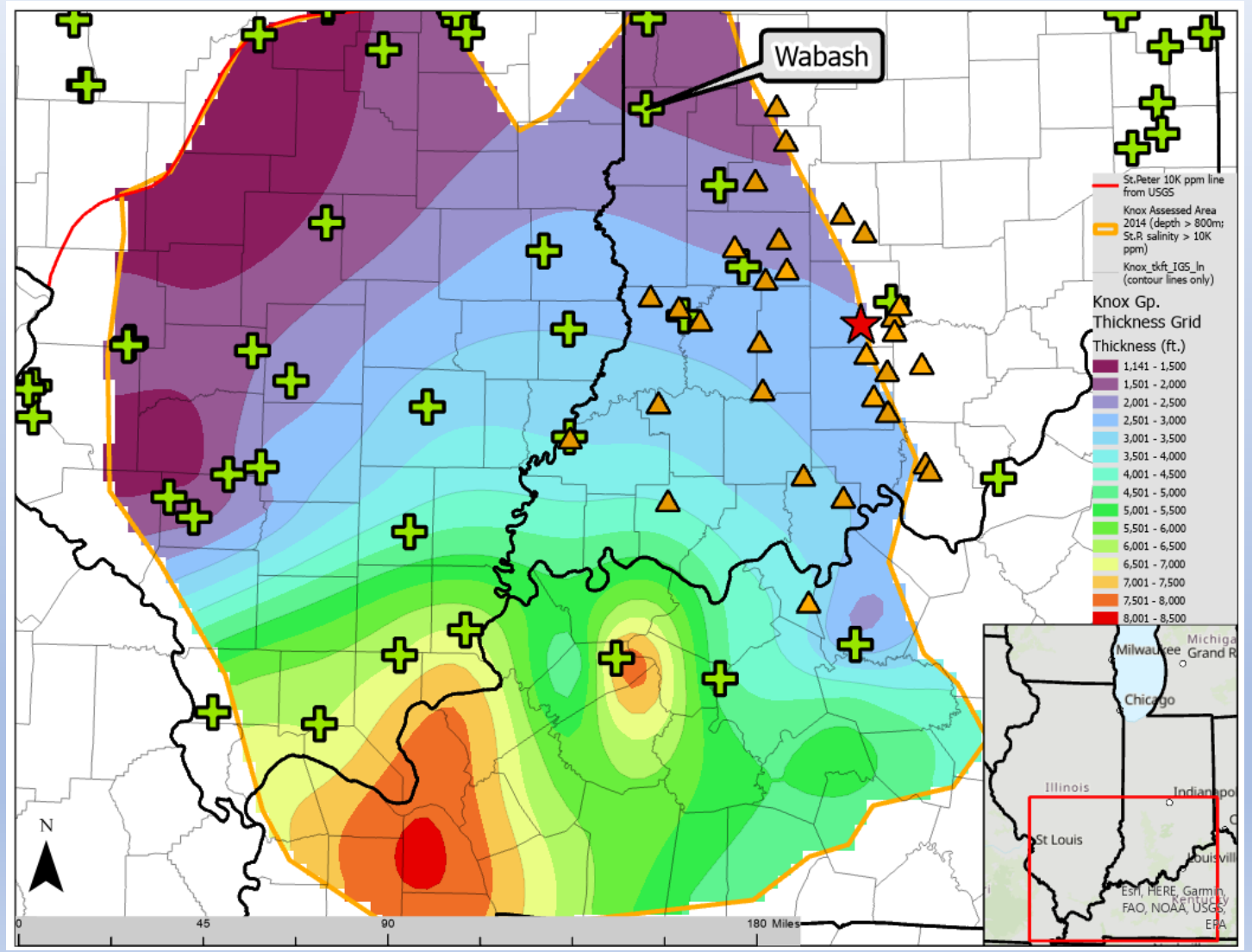
- Regional characterization
  - Approximate depth: 5,800 ft
  - Estimated thickness is 1,200 ft but potentially not porous in the area
- Example: Luther Brown well (9 miles NE)
  - Drilled in 1959; sample descriptions available
  - 450 ft of reddish, medium-coarse grained, poorly consolidated sandstone is present at the base of the Mt. Simon Sandstone
    - Equivalent to “arkosic” intervals observed at IBDP, Macon County, and One Earth sites?
  - Logs suggest some permeability



Isopach from DOE, 2012

Background: Knox Supergroup Dolomites

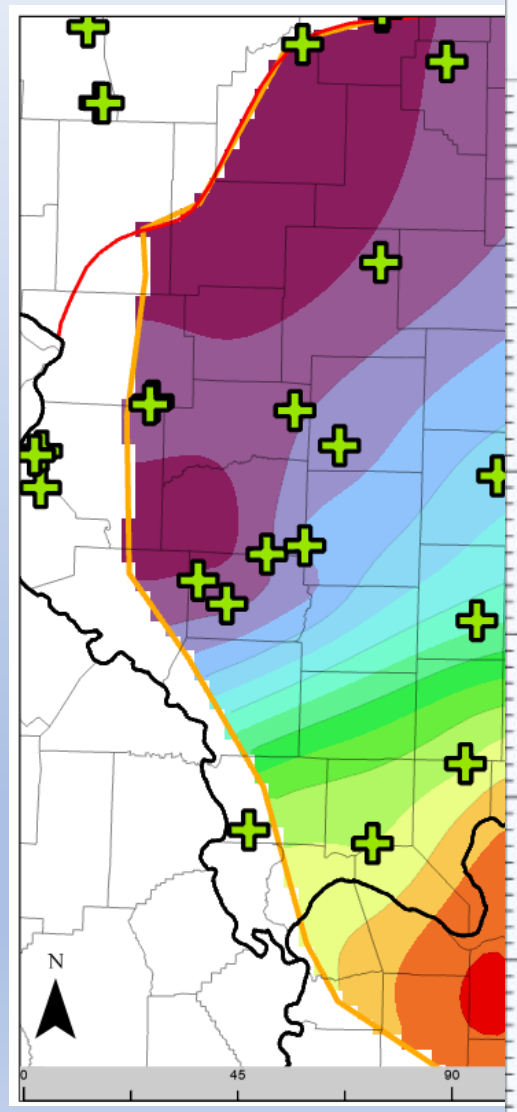
- Regional Characterization
  - Approximate depth:
    - Shakopee Dol – 2,700 ft
    - Oneota Dol – 3,400 ft
    - Potosi Dol – 3,700, ft
  - Estimated 2,500 ft gross thickness at Mitchell
  - Highly porous and permeable vugular intervals embedded within impermeable dolomite
    - Reservoir AND seal characteristics
    - Vugular intervals present throughout the region, but stratigraphic and areal distribution is uncertain

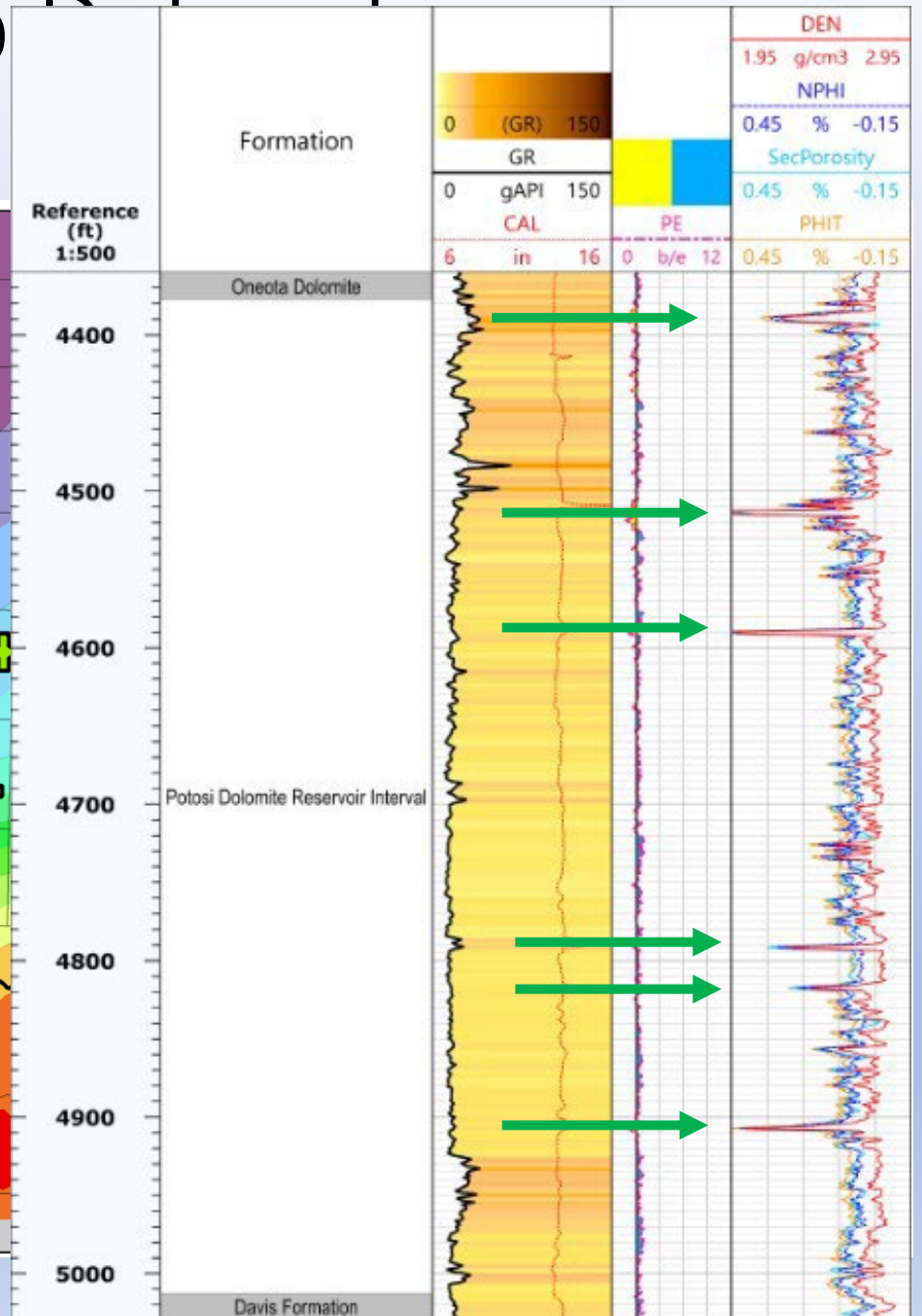


Isopach from Leetaru, 2014

Background: Knox Supergroup

- Example: Wabash well (75 mi NW)
- 6 vuggy intervals within 784 ft of Potosi and Oneota Dolomites being targeted for CO_2 injection

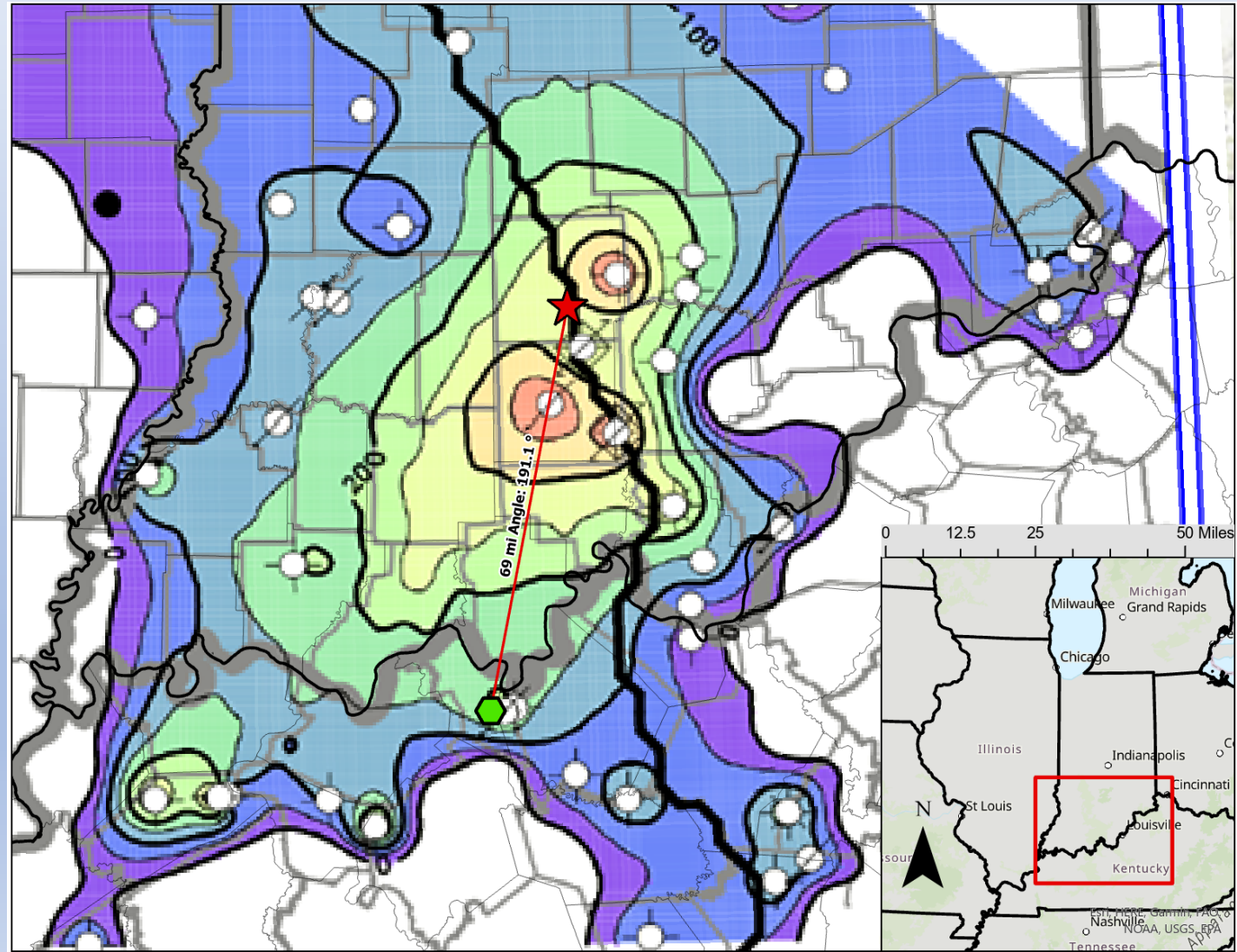




Background: New Richmond Sandstone

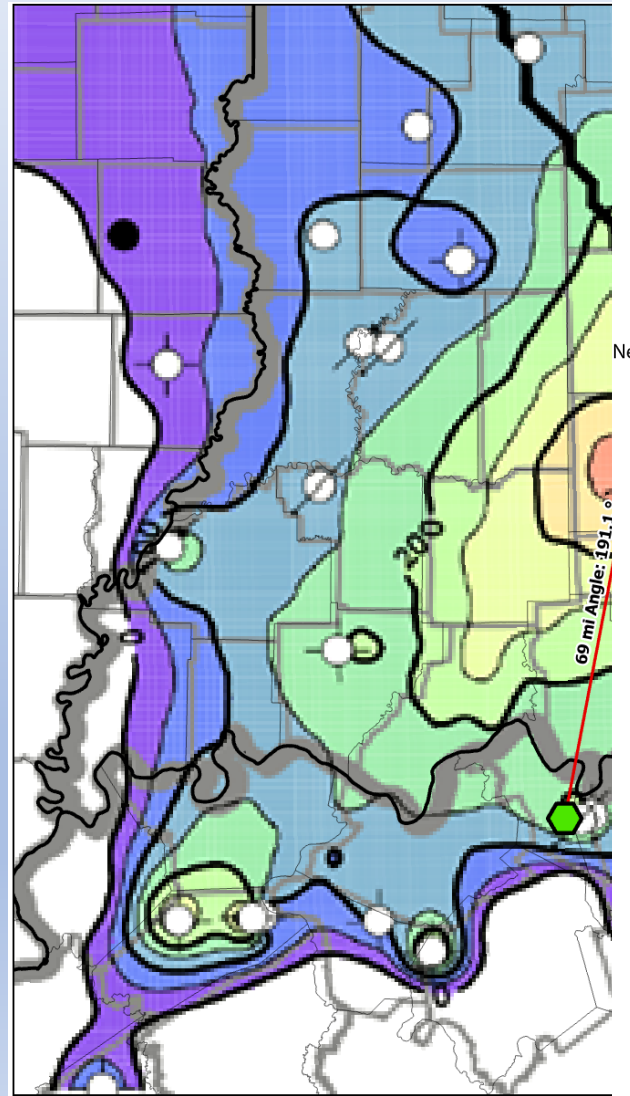
Isopach from Harris et al., 2014

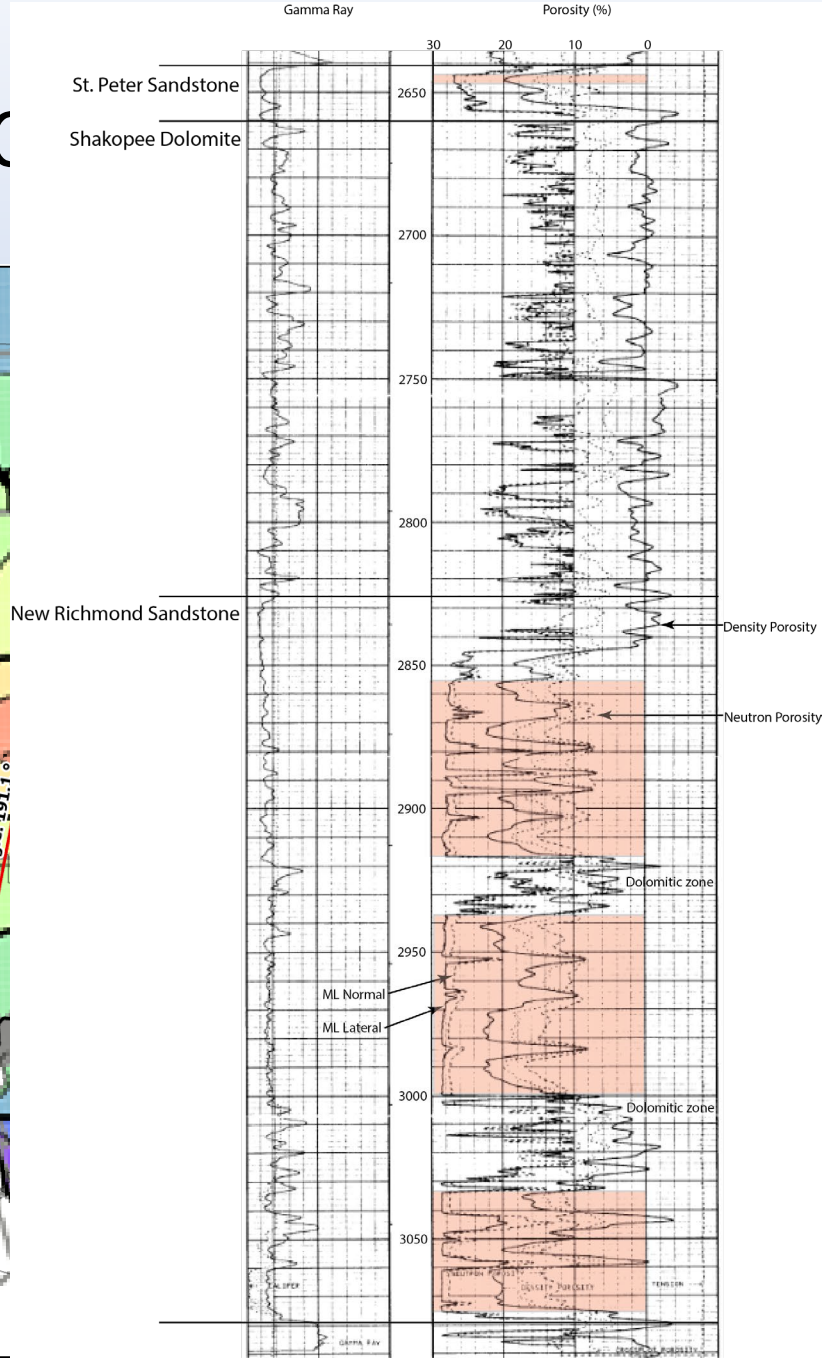
- Regional characterization
  - Approximate depth: 2,900 ft
  - 200-400 ft thick at site *(Harris et al., 2014)*
  - Porous and permeable fine to medium grained sandstone interbedded with dolomite
- Previous CO_2 injection test in Marvin Blan #1 well (70 mi S)
  - Approx. 600 tons in 2009-2010 *(Bowersox and Hickman, 2012; Bowersox and Williams, 2014)*



Background: New Richmond Sand

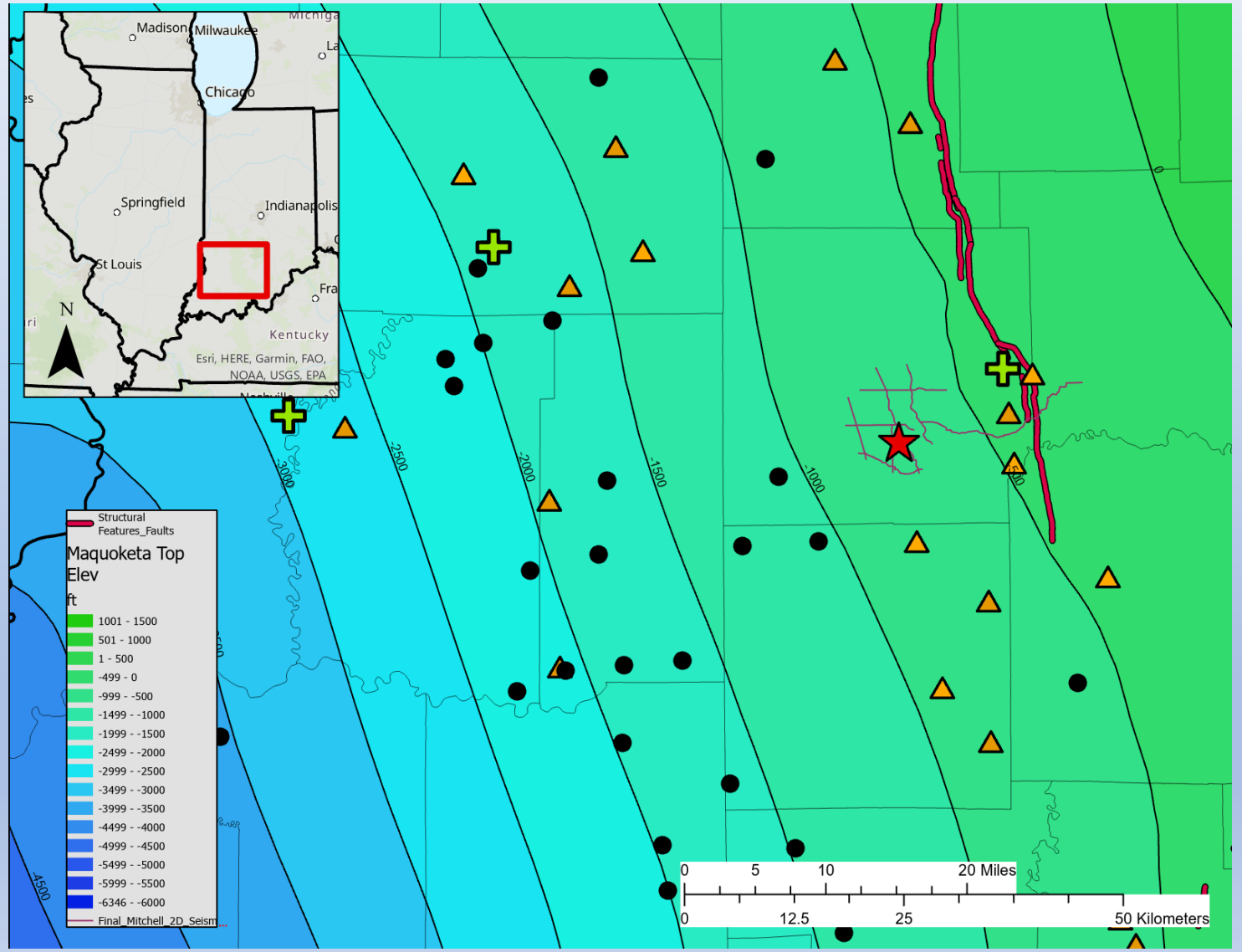
- Example: Bailey well (7 mi S)
  - >160 ft of 10+% porosity and microlog separation (indicating permeability) within three sandstone intervals
  - Uppermost sandstone used for saltwater injection





Background: Seals and known faults

- Eau Claire Formation
  - Seal for Mt. Simon
  - ~700 ft thick
- Maquoketa Group
  - Seal for Knox Supergroup, including New Richmond Sandstone
  - ~350 ft thick
  - Dip downward to SW at ~35 ft/mile
- Mt. Carmel Fault
  - Surface trace 12 miles east



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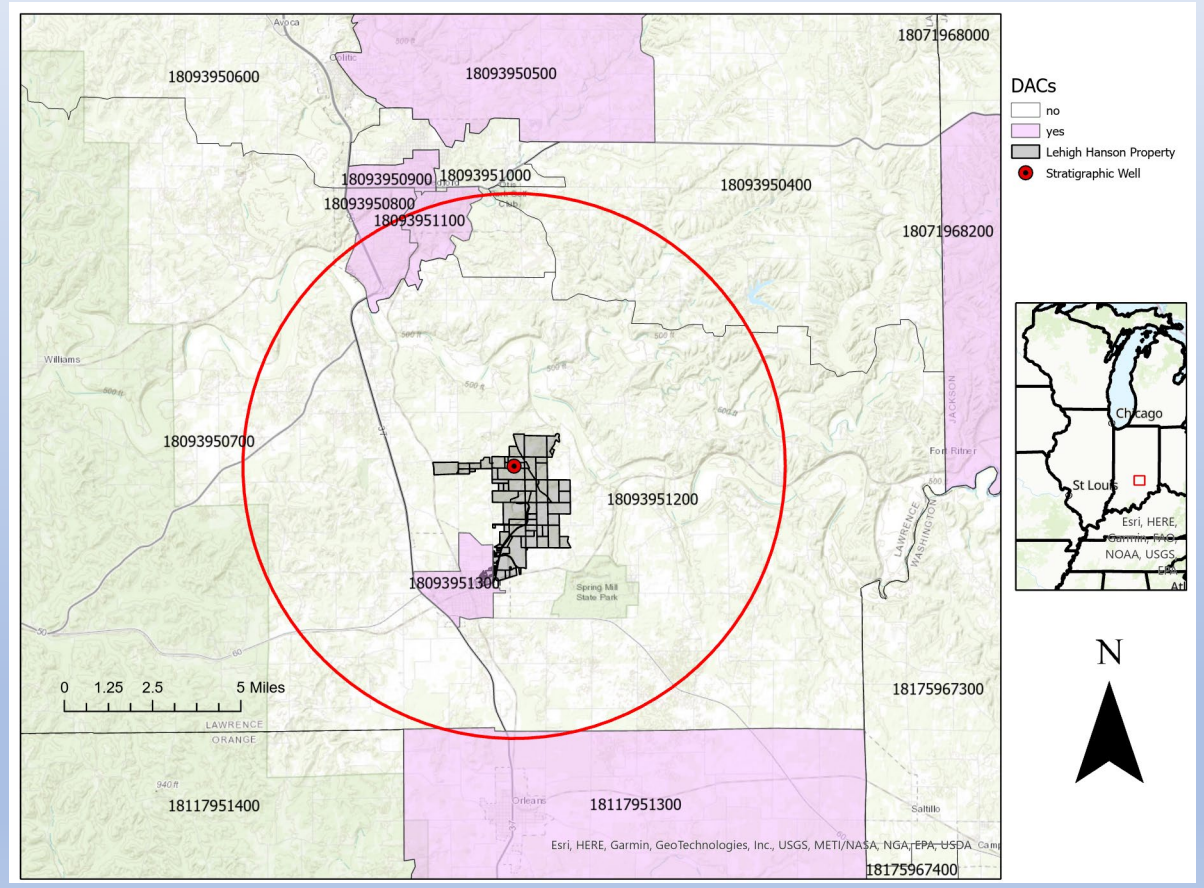
Background: Community Benefits Plan

- Preliminary assessment of communities within 6 miles:
  - DACs in Mitchell, Bedford, Orleans
  - Rural, low income, poorly educated, at risk of population loss
- Heidelberg Materials has robust community outreach program
  - Mitchell website: news, videos, picture gallery



Project Overview

Objectives

- Prepare Mitchell for Class VI permit
  - Geologic characterization
    - Establish geologic suitability of the site for CCS
  - Conduct risk assessment
  - Develop Community Benefit Plan
  - Evaluate technical and economic feasibility of site

- Performance Dates
  - 08/2023 to 07/2025
- Funding summary
  - $8,898,036 federal funds
  - $2,224,760 cost share
  - **$11,122,796 total**

	Project Funding Profile Per Project Team Member					
	Budget Period 1					
	Year 1		Year 2		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Applicant (ISGS/UIUC)	$1,820,986	$286,548	$1,744,316	$286,552	$3,565,302	$573,100
Heidelberg		$1,576,988				$1,576,988
Projeo Corporation	$5,011,752				$5,011,752	
Indiana Geological and Water Survey	$100,000	$25,336	$100,000	$25,336	$200,000	$50,672
Trimeric Corporation			$24,974		$24,974	
Gnarly Tree Sustainability Institute	$47,535	$11,884	$48,473	$12,116	$96,008	$24,000
Total ($)	$6,980,273	$1,900,756	$1,917,763	$324,005	$8,898,036	$2,224,760
Total Cost Share (%)						20%

Mitchell CarbonSAFE Team

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Heidelberg Materials

Projeo

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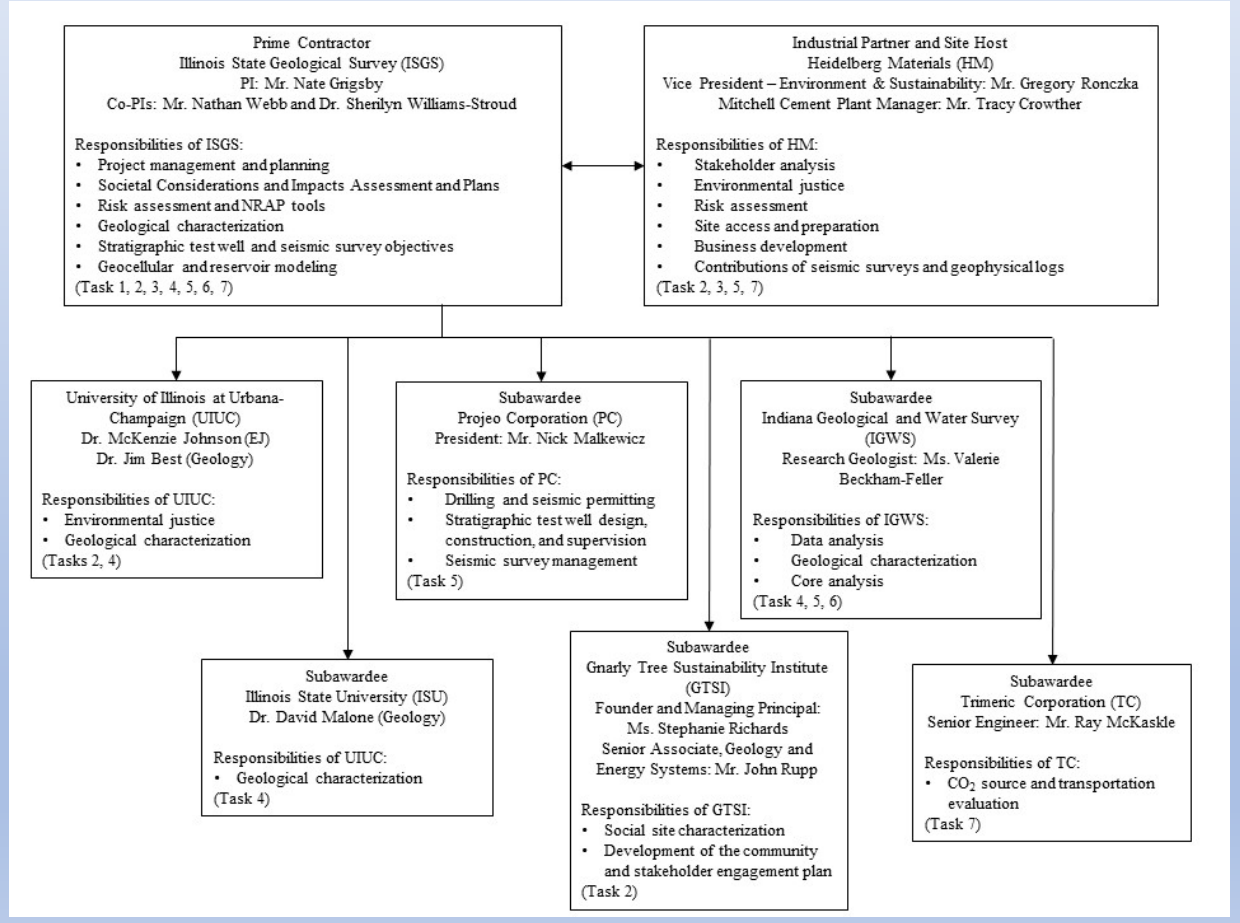
Gladly we learn and teach
18 57

GNARLY TREE SUSTAINABILITY INSTITUTE

TRIMERIC CORPORATION



Technical Approach/Project Scope

Project Execution Plan (Tasks)

- 1: Project Management and Planning
- 2: Community Benefit Plan
  - Community outreach programming
- 3: Risk Assessment and Monitoring
  - Identification of project risks
  - Development of mitigation and monitoring strategies
- 7: Storage Complex Development Planning
  - Conceptual level design study

Expected Outcomes (products)

- 1: Effective project management
- 2: Updated CBP
  - DEIA Implementation
  - Community engagement strategy
  - EEJ assessment and J40 Initiatives
- 3: Site specific risks and monitoring and mitigation strategies
- 7: Technical and economic feasibility of site

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Technical Approach/Project Scope

Project Execution Plan (Tasks)

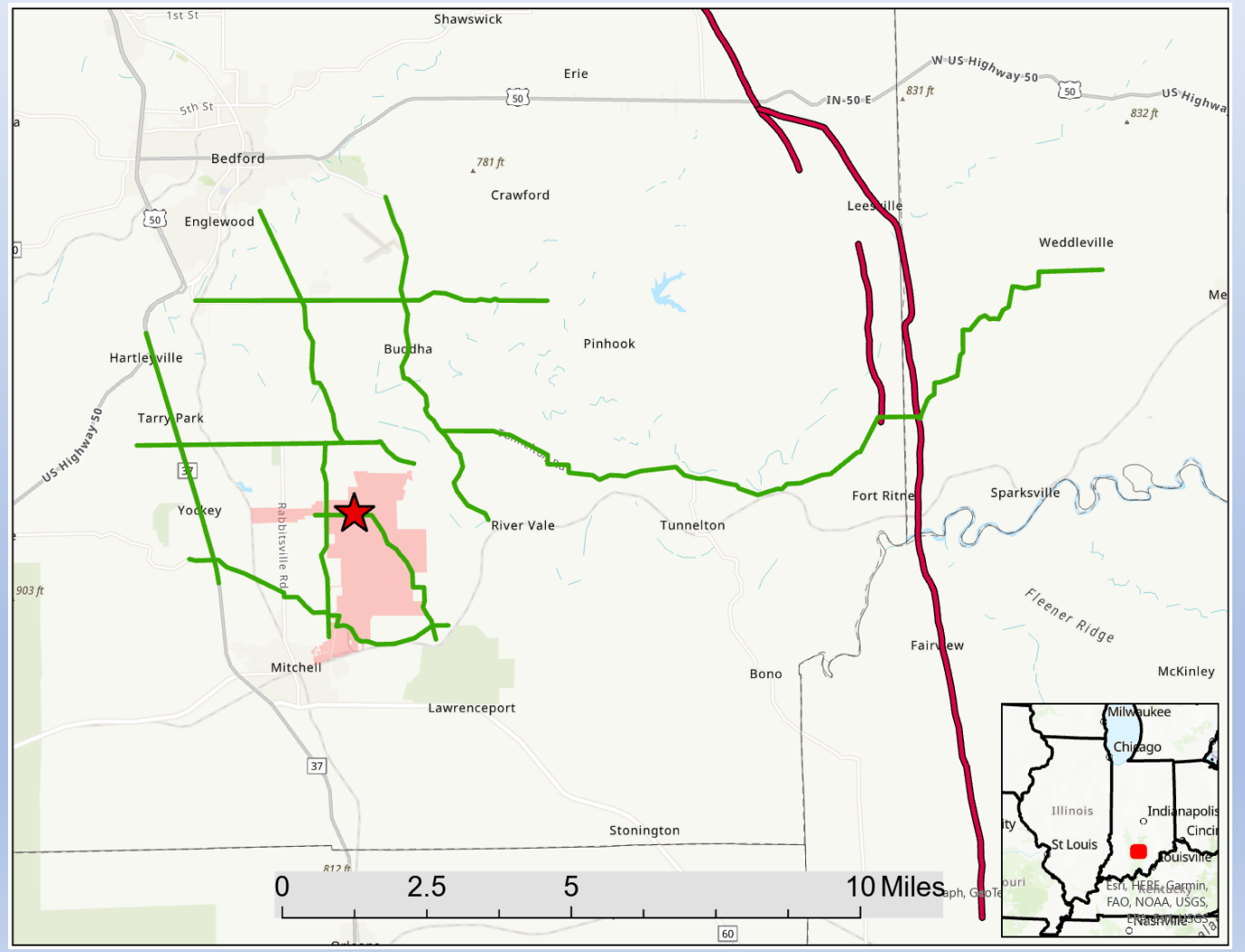
- 4: Subsurface Characterization
  - Develop and update conceptual geologic models of reservoirs and seals
  - Data evaluation
- 5: Drilling and Field Data Acquisition
  - Stratigraphic test well
    - ~7,200 ft (through Mt Simon)
    - Sophisticated logs, ~600ft core, ~100 sidewall, 3 DSTs
  - 2D Seismic Survey
    - 54 miles to evaluate structure and formation continuity
- 6: Storage Complex Modeling
  - Geocellular Modeling
  - Reservoir Simulations

Expected Outcomes (products)

- 4: Refined characterizations
  - Geologic conceptual models for targets and seals
  - Local fluid properties (USDW)
- 5: Site specific data to inform Tasks 4 and 6
- 6: Constrain reservoir injectivity, containment, capacity
  - AoR

Accomplishments: Task 5: Drilling and Data Acquisition

- 2D Seismic Survey: Subtask 5.4
  - 54 linear miles acquired in June 2023
  - Data currently being processed
- Test well
  - Stratigraphic test well permit application submitted to Indiana DNR in March 2023
  - Responded to questions from DNR in July and August
  - Permit expected in coming weeks
    - Subtask 4.1



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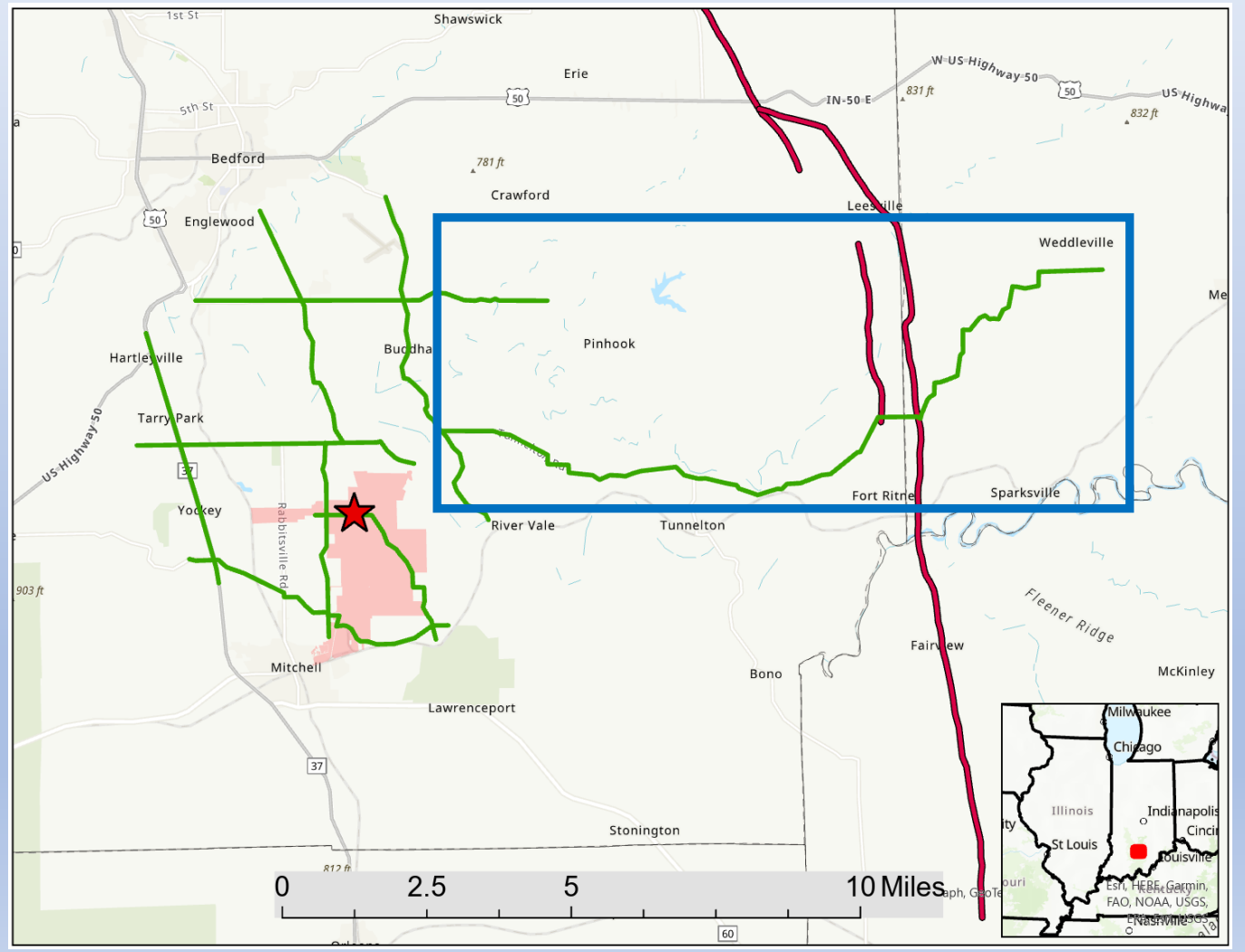
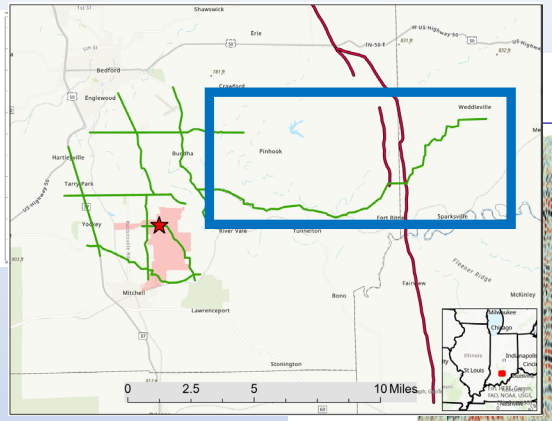


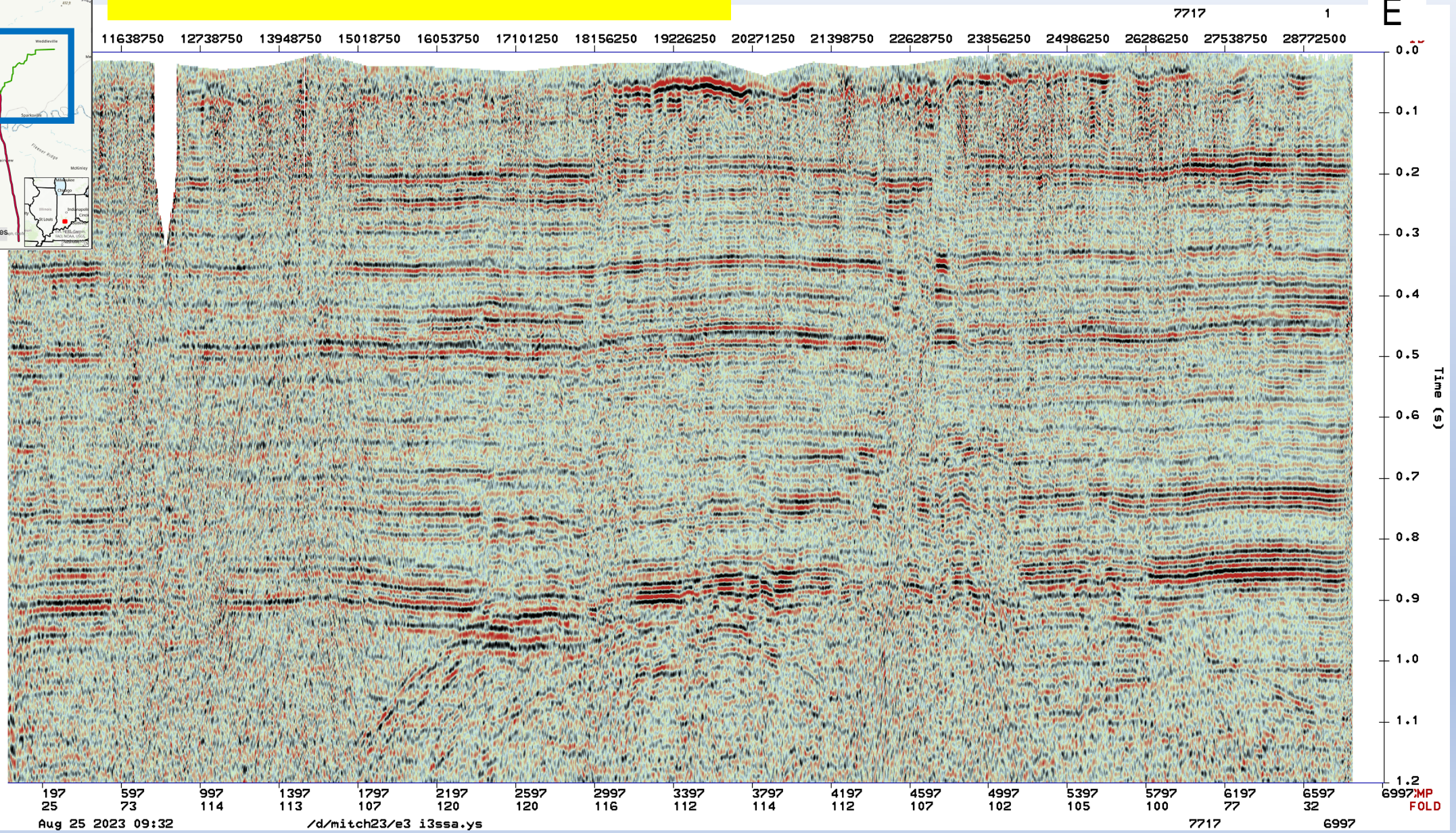
Stack – Residual Statics and Velocity Updates + Pre-Stack Noise Attenuation

E3 – Shallow

1st Pass. NOT FINAL!!!!



Note there is roughly 13 miles of data displayed on screen



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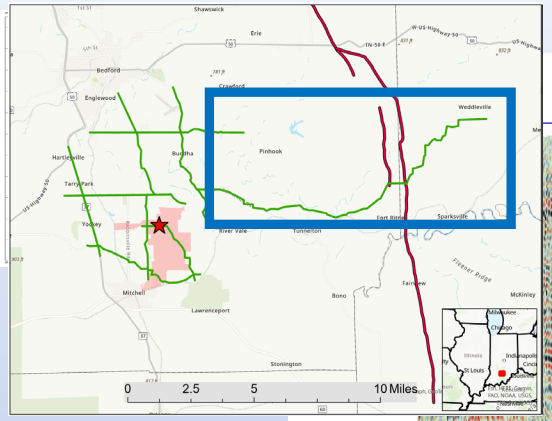

Luther Brown

Mt Carmel Fault

E

To test well

Sub Basin?

Note there is roughly 13 miles of data displayed on screen

Time (s)

Accomplishments: Task 5: Drilling and Data Acquisition

- 2D Seismic Survey: Subtask 5.4
  - 54 linear miles acquired in June 2023
  - Data currently being processed
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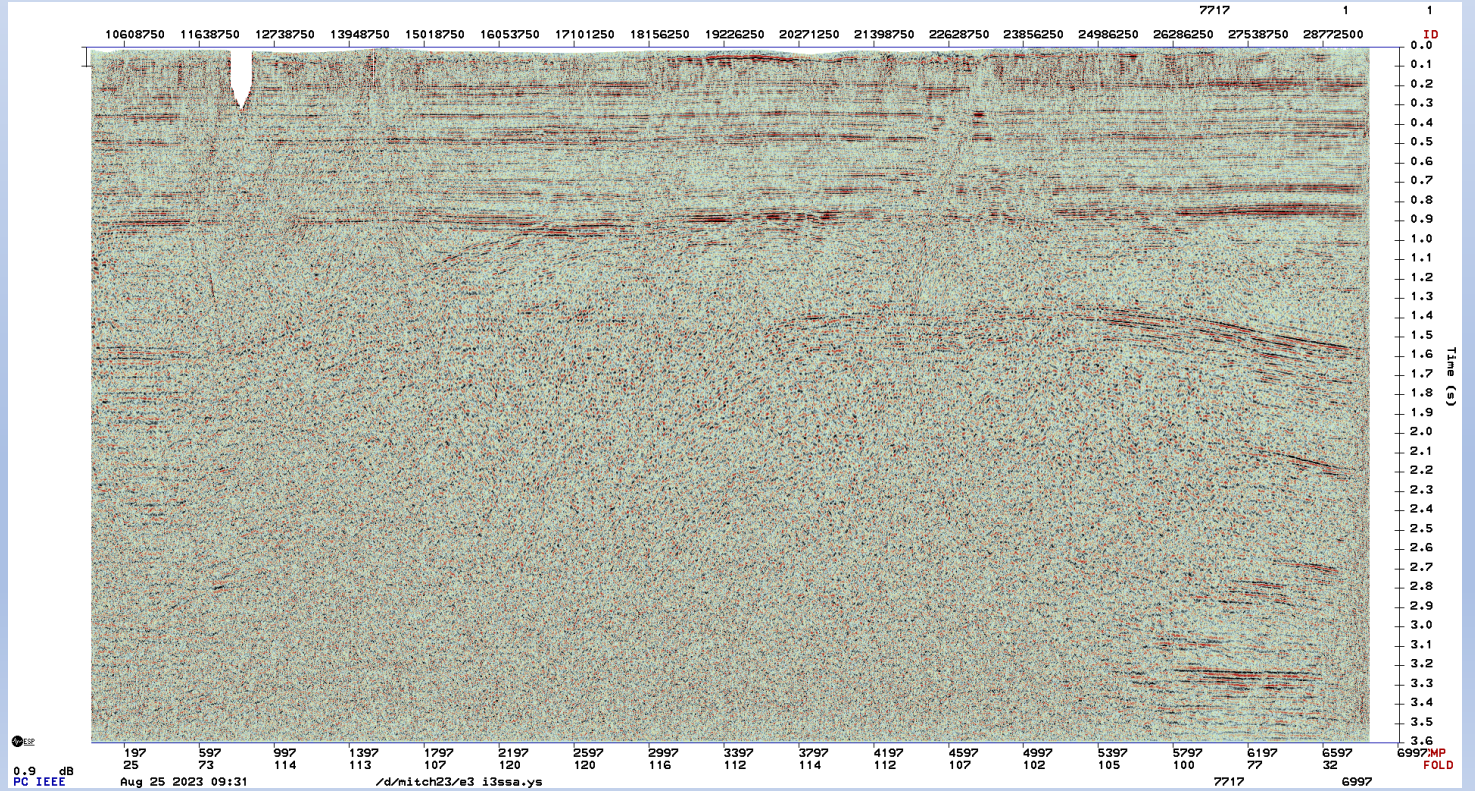

Next Steps

- Task 2 CBP
  - Project kickoff with ISGS/GTSI
  - Social site characterization
- Task 3: Risk Assessment
  - Preliminary high-level risk register
- Task 4: Geologic Characterization
  - Identify and compile available data
  - Develop preliminary conceptual geologic models
- Task 5: Drilling and Data Acquisition
  - Acquire well permit
  - Prepare site
- Task 6: Modeling
  - Develop preliminary geocellular models and input parameters
- Task 7: Technical and Economic Feasibility
  - Project kickoff with ISGS/Trimeric
  - Identify data needs
    - FECM FEED overlap

Thank you

- Questions?

Works cited

- Bowersox, R., and Hickman, J.B. (2012). An Evaluation of the Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins. Topical report to Department of Energy (DE-FE0002068).
- Bowersox, R., and Williams, D. A. (2014). Geology of the Kentucky Geological Survey Marvin Blan No.1 Well, East-Central Hancock County, Kentucky. Kentucky Geological Survey, ser. 12, Report of Investigations 25.
- Harris, D. C., Ellett, K., and Rupp, J. A. (2014). GEOLOGIC CHARACTERIZATION AND CARBON STORAGE RESOURCE ESTIMATES FOR THE KNOX GROUP, ILLINOIS BASIN, ILLINOIS, INDIANA, AND KENTUCKY Part 1. Regional Stratigraphic Correlations Part 2. Knox Lithofacies and Core Descriptions, Western Kentucky Part 3. Knox Carbon Storage Resource Estimates for the Illinois Basin Topical Report An Evaluation of the Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins. Topical Report to Department of Energy under cooperative Agreement Number: DE-FE0002068.
- Marshak, S., Larson, T. H., and Abert, C.C. (2016). Geological and Geophyscal Maps of the Illinois Basin-Ozark Dome Region. Illinois Map 23.
- Leetaru, H. (2014). An Evaluation of the Carbon Sequestration Potential of the Cambro-Ordovician Strata of the Illinois and Michigan Basins; US DOE Final Report under cooperative Agreement Number: DE-FE0002068. 82 p.
- U.S. Department of Energy Office of Fossil Energy, National Energy Technology Laboratory, November 2012, The United States 2012 Carbon Utilization and Storage Atlas, Fourth Edition, 128 p.

Project Schedule and Key Milestones

ID	Milestone Title & Description
A	**Project Kickoff Meeting**
B	**Updated Project Management Plan**
C	**Updated DEIA Plan and J40, Community Engagement Development Plans**
D	**Mid Project Update Meeting**
E	**DEIA SMART (per DEIA Plan)**
F	**Justice40 Initiative Plan**
G	**Stakeholder Engagement and Outreach Plan**
H	**Risk Mitigation Plan**
I	**Obtain Stratigraphic Well Drilling and Seismic Permits**
J	**Complete Stratigraphic Test Well**
K	**Complete 2D Seismic Survey**
L	**Storage complex characterization and assessment report**
M	**Detailed Site Characterization Plan**
N	**Preliminary CO_2 management & monitoring plan, including coverage for transport of CO_2**
O	**Technical and economic feasibility evaluation of a proposed CO_2 storage project**

	Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.0	Project Management and Planning																								
1.1	Manage all project activities, objectives, & milestones	A																							
1.2	Project management plan		B																						
1.3	Data management																								
1.4	Access to geologic materials / samples																								
2.0	Community Benefits Plan																								
2.1	Community and Labor Engagement			C								E	D											E	
2.2	Investing in Job Quality and a Skilled Workforce Continuity																								
2.3	Diversity, Equity, Inclusion, and Accessibility												D							F					
2.4	Justice 40 Initiative												D							G					
3.0	Risk Assessment and Monitoring																								
3.1	Conduct risk assessment																								
3.2	Develop risk mitigation & monitoring strategies																							H	
4.0	Subsurface Characterization																								
4.1	Conduct pre-drilling site assessment & obtain drilling & seismic acquisition permits						I																		
4.2	Develop conceptual geological model																								
4.3	Analyze well data																								
5.0	Drilling and Data Acquisition																								
5.1	Design seismic acquisition & well drilling program																								
5.2	Drill & construct stratigraphic test well										J														
5.3	Collect well data																								
5.4	Conduct regional 2D seismic survey														K										
6.0	Storage Complex Modeling																								
6.1	Develop geocellular models																								
6.2	Develop reservoir models																				L				
6.3	Identify future data requirements																							M	
7.0	Storage Complex Development Planning																								
7.1	Develop conceptual level design study																								N
7.2	Assess technical & economic feasibility of storage complex																								O