

# ILLINOIS INDUSTRIAL CARBON CAPTURE AND STORAGE PROJECT

*Project Overview, Lessons, & Future Plans*



## Carbon Sequestration Leadership Forum

June 11-14, 2012

Scott McDonald

Biofuels Development Director

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# Acknowledgements

- **The Industrial Carbon Capture and Storage (ICCS) project is administered by the U.S. Department of Energy's Office of Fossil Energy and managed by the National Energy Technology Laboratory (award number DE-FE-0001547) and by a cost share agreement with the Archer Daniels Midland Company, University of Illinois through the Illinois State Geological Survey, Schlumberger Carbon Services, and Richland Community College. This ICCS project received DOE funding from the American Recovery and Reinvestment Act of 2009 (\$141.4 million).**
- **The Midwest Geological Sequestration Consortium is funded by the U.S. Department of Energy through the National Energy Technology Laboratory via the Regional Carbon Sequestration Partnership Program (contract number DE-FC26-05NT42588) and by a cost share agreement with the Illinois Department of Commerce and Economic Opportunity, Office of Coal Development through the Illinois Clean Coal Institute.**
- **The Midwest Geological Sequestration Consortium (MGSC) is a collaboration led by the geological surveys of Illinois, Indiana, and Kentucky**



# ADM is:

**A Global Leader in Renewable Fuels and Products using our Premier Position in Agricultural Processing to Serve Vital Human Needs for Food and Energy by Connecting the Harvest to the Home.**



# ADM Company Profile

## Core Purpose

Connecting the harvest to the home and transforming crops into products that serve vital needs for food and energy.

## Financials

- FY 2011 Net Sales: **\$80 billion**
- FY 2011 Net Earnings: **\$2.0 billion**

## Processing

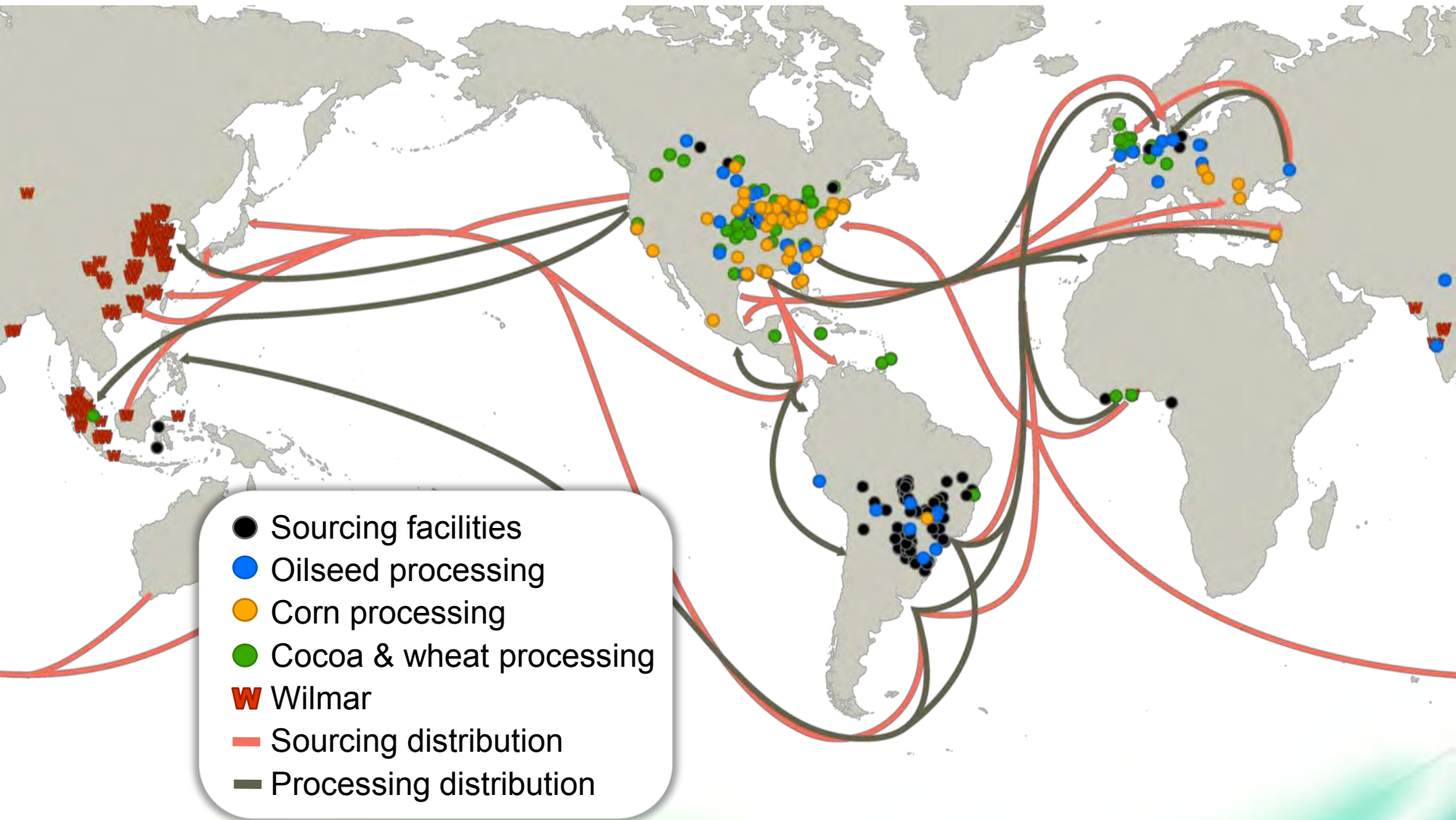
- 66,000 MT of corn each day
- 100,000 MT of oilseeds each day
- 28,000 MT of wheat each day
- 3,000 MT of cocoa beans

## Logistics

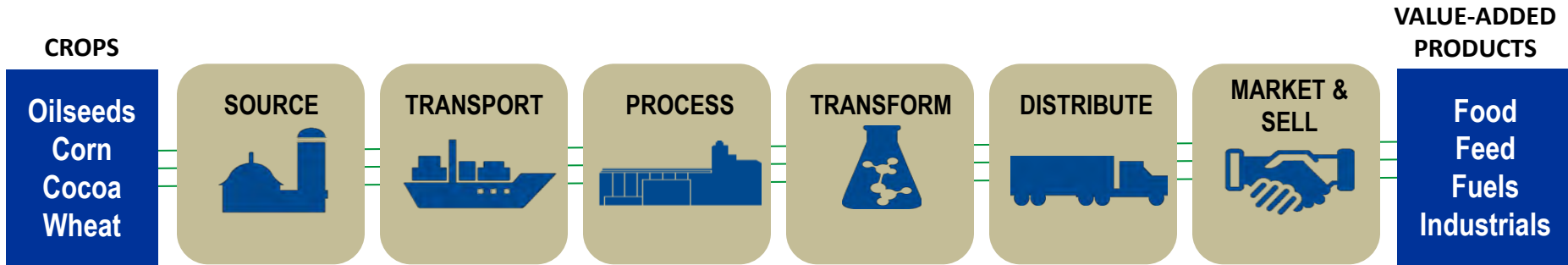
- 26,100 Rail cars
- 1,700 Barges
- 700 Trucks – 1,500 Trailers
- 8 Oceangoing Ships



# ADM's Global Assets



# The ADM Value Chain



**Business Acumen and Financial Strength**

**Technology Is Key Across the Value Chain**



**Feedstocks Sourcing and Transportation**

- New Traits
- New Feedstocks

**Process & Transform**

- Efficiency
- New Products
- Sustainability

**Distribute, Market & Sell**

- Product Safety
- Applications Research
- Quality

**Microbiology, Chemistry, Engineering, Food and Animal Science**





## Feed

- Soy protein meal
- Corn gluten meal
- Lysine
- Threonine
- Other feed ingredients



## Food

- Vegetable oil
- Sweeteners
- Flour
- Cocoa
- Soy protein
- Lecithin
- Other specialty food ingredients



## Fuel

- Ethanol
- Biodiesel



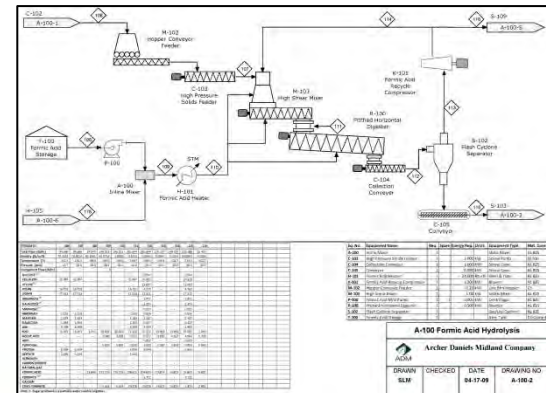
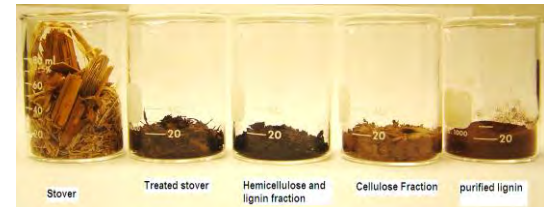
## Industrials

- Linseed oil
- Soybean oil
- Lactic acid
- Starch
- Polyols
- Others



# ADM Research Initiatives

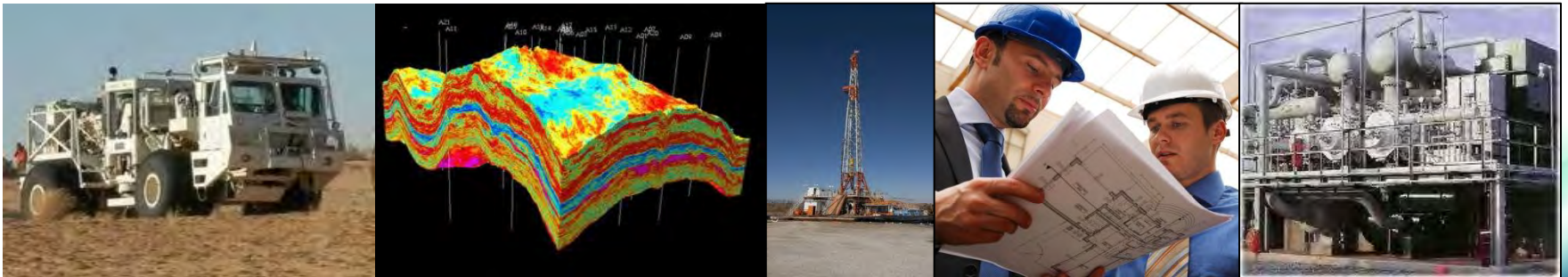
- Biomass Conversion to Fuel Additives
- Integrated Biorefinery: Ethanol & Ethyl Acrylate
- Carbon Capture and Storage
- Membrane Solvent-Extraction: Ethanol
- HTL, Catalytic Pyrolysis, & Hydrogen Research
- Chemical Platform Development: PG/EG
- And Many More.....





# Focus of Today's Presentation

- **Provide an Overview and Comparison of the CCS projects underway in Decatur, Illinois**
  - Illinois Industrial Carbon Capture and Storage Project (IL-ICCS)
  - Illinois Basin Decatur Project (IBDP)
- **Features, Activities, & Impacts of IL-ICCS**
- **Review Lessons Learned**
- **Future Plans for the Facility & Site**



# Illinois Basin Decatur Project (IBDP)

## Project Overview

DOE - Regional Carbon Storage Partnerships (Phase 3)

### Program Objective

Large scale geologic test to inject 1.0 million tons of CO<sub>2</sub> over a three year period (1,000 MT/day).

### Project Team Members



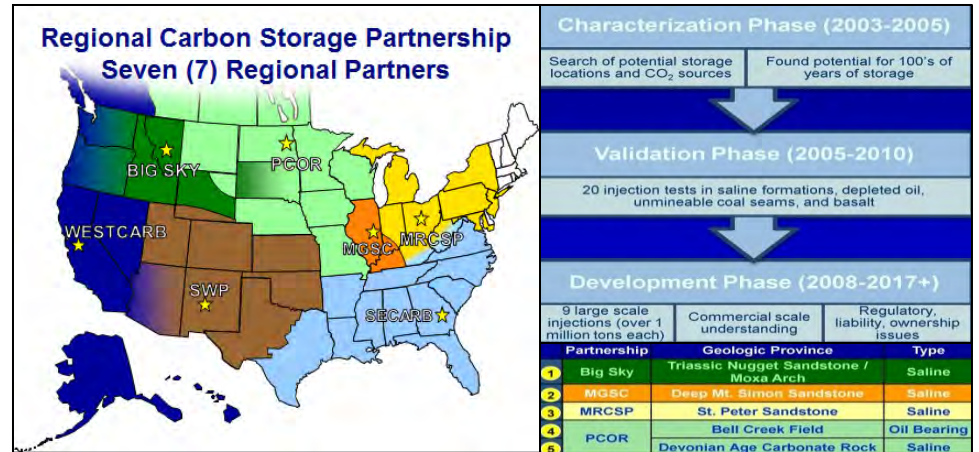
### Schedule of Activities

- Engineering Q1 2008 – Q1 2012
- Permitting Q1 2008 – Q1 2013
- Construction Q2 2009 – Q3 2011
- Operation Q4 2011 – Q4 2014
- Monitoring Q1 2015 – Q4 2016

### Knowledge Base

- Site Geological Characterization
- Risk Assessment & Reservoir Modeling
- Engineering Design & MVA

*Breaking ground for anthropogenic CO<sub>2</sub> storage in a saline reservoir using cutting-edge sequestration technology*



# Illinois Industrial CCS Project (IL-ICCS)

## Project Overview

DOE - Large-Scale CCS from Industrial Sources (Area 1)

### Program Objectives

- Target & Demonstrate Advanced CCS Technologies at Industrial Scale Facilities
- Inject and Store One Million Tons of CO<sub>2</sub> Annually (3,000 tons/day)

### Project Team Members



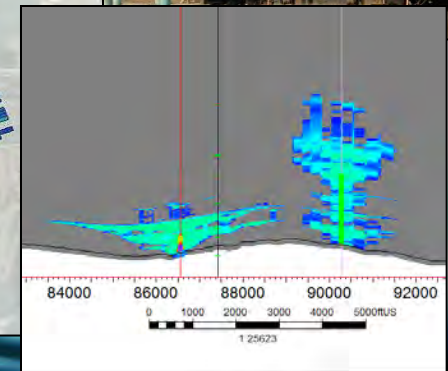
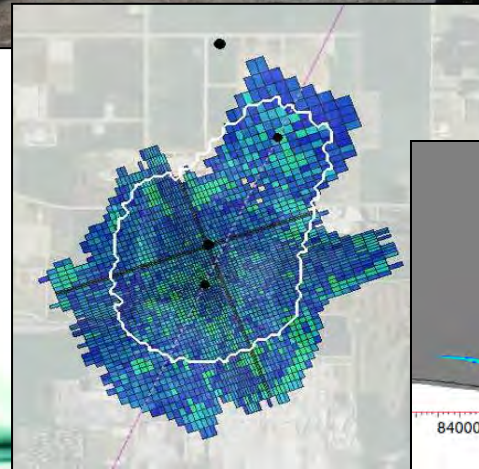
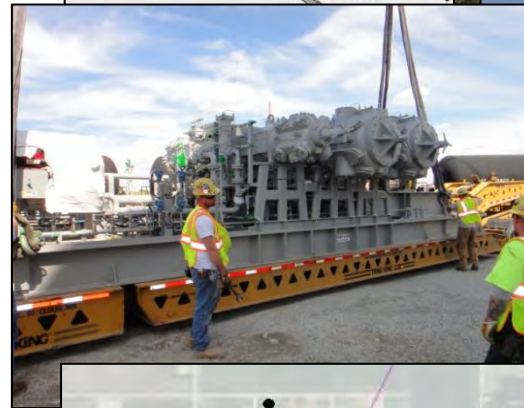
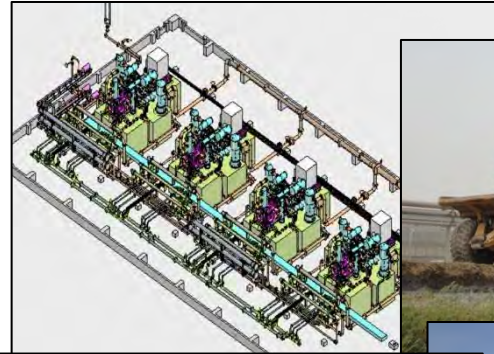
### Schedule of Activities

- Engineering Q3 2010 – Q1 2012
- Permitting Q3 2011 – Q1 2013
- Construction Q2 2011 – Q2 2013
- Operation Q3 2013 – Q3 2015

### Knowledge Base

- Site Geological Characterization
- Risk Assessment & Reservoir Modeling
- Engineering Design & MVA
- Education and Public Outreach

*Study the interaction between the CO<sub>2</sub> plumes from two injection wells within the same formation.*

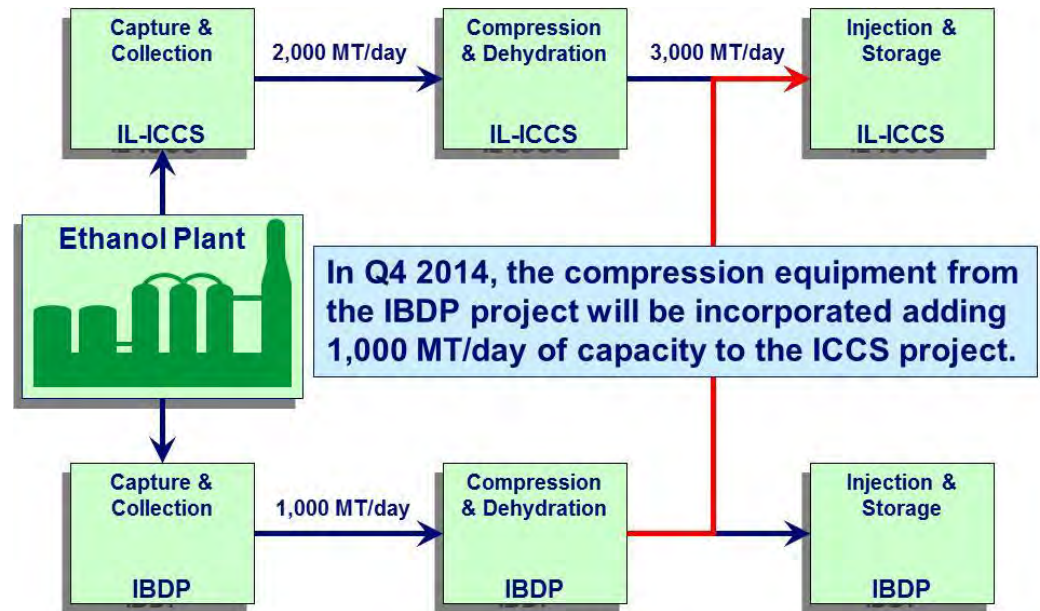


# Illinois Industrial CCS Project (IL-ICCS)

## Project Objectives

### Project Objectives

- Design, construct, and operate a new CO<sub>2</sub> collection, compression, and dehydration facility capable of delivering up to 2,000 metric tons of CO<sub>2</sub> per day to the injection site.
- Integrate the new facility with an existing 1,000 metric tons of CO<sub>2</sub> per day compression and dehydration facility to achieve a total CO<sub>2</sub> injection capacity of 3,000 metric tons per day or one million tons annually.
- Implement deep subsurface and near-surface MVA of the stored CO<sub>2</sub>.
- Develop and conduct an integrated community outreach, training, and education initiative.



# Illinois Industrial CCS Project (IL-ICCS)

## *Project Team Members*

### Archer Daniels Midland Company

- Project Leader
- Overall Project Execution
- Facility Owner and Operator
- Design & Construction of Surface Facilities
- UIC Class VI Permit Holder



### Schlumberger Carbon Services

- Seismic Acquisition & Data Processing
- Reservoir Modeling
- Design & Construction of Storage Facility
- Subsurface Operations
- Deep MVA CO<sub>2</sub> Monitoring



### Illinois State Geological Survey

- Site Characterization
- MVA Development
- USDW Monitoring
- Near-Surface CO<sub>2</sub> Monitoring
- Outreach and Communication



### Richland Community College

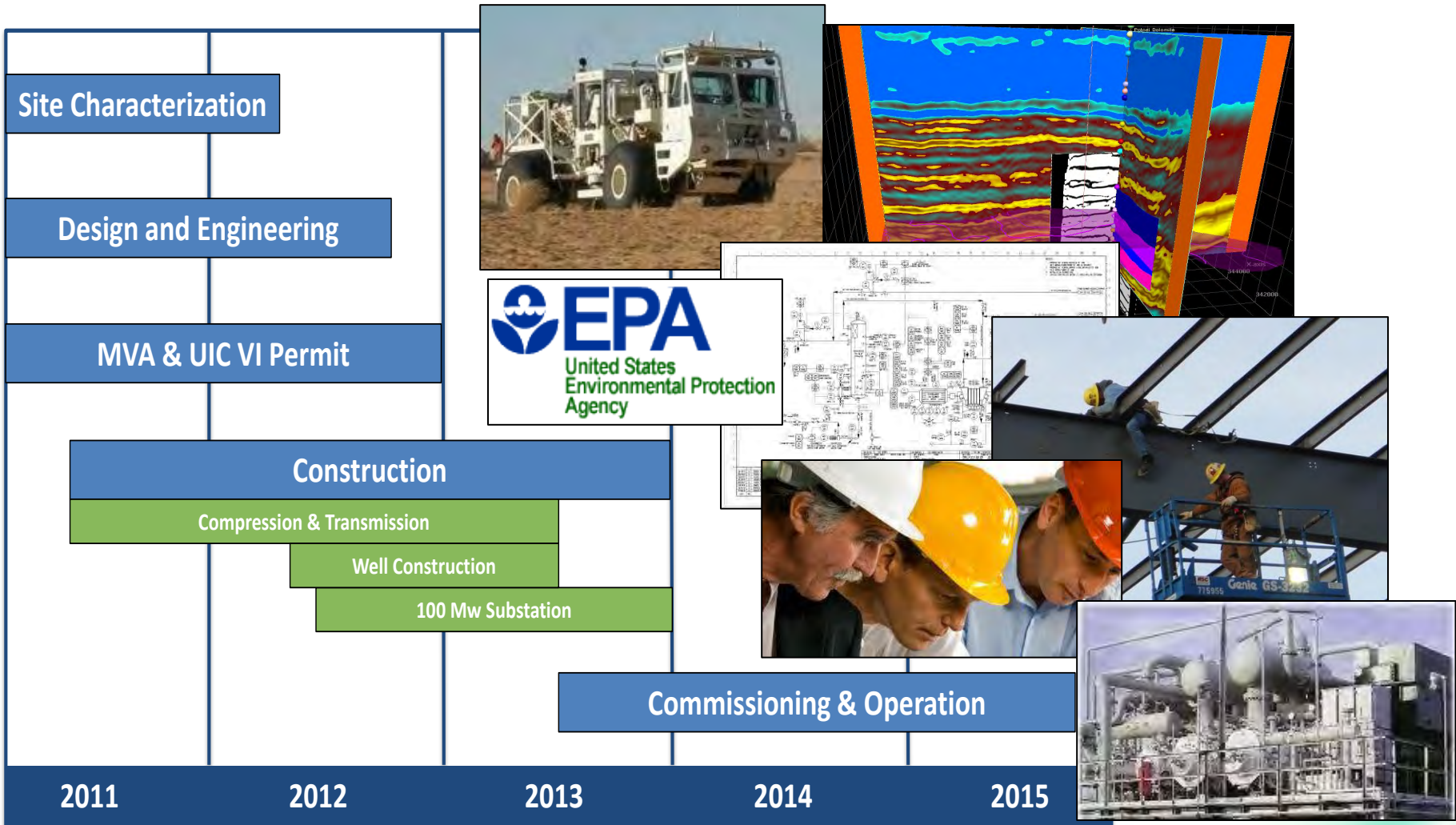
- National Sequestration Education Center
- Community Outreach & CCUS Training
- New Associate Degree Programs in CCUS



*Leveraging Knowledge and Experience*

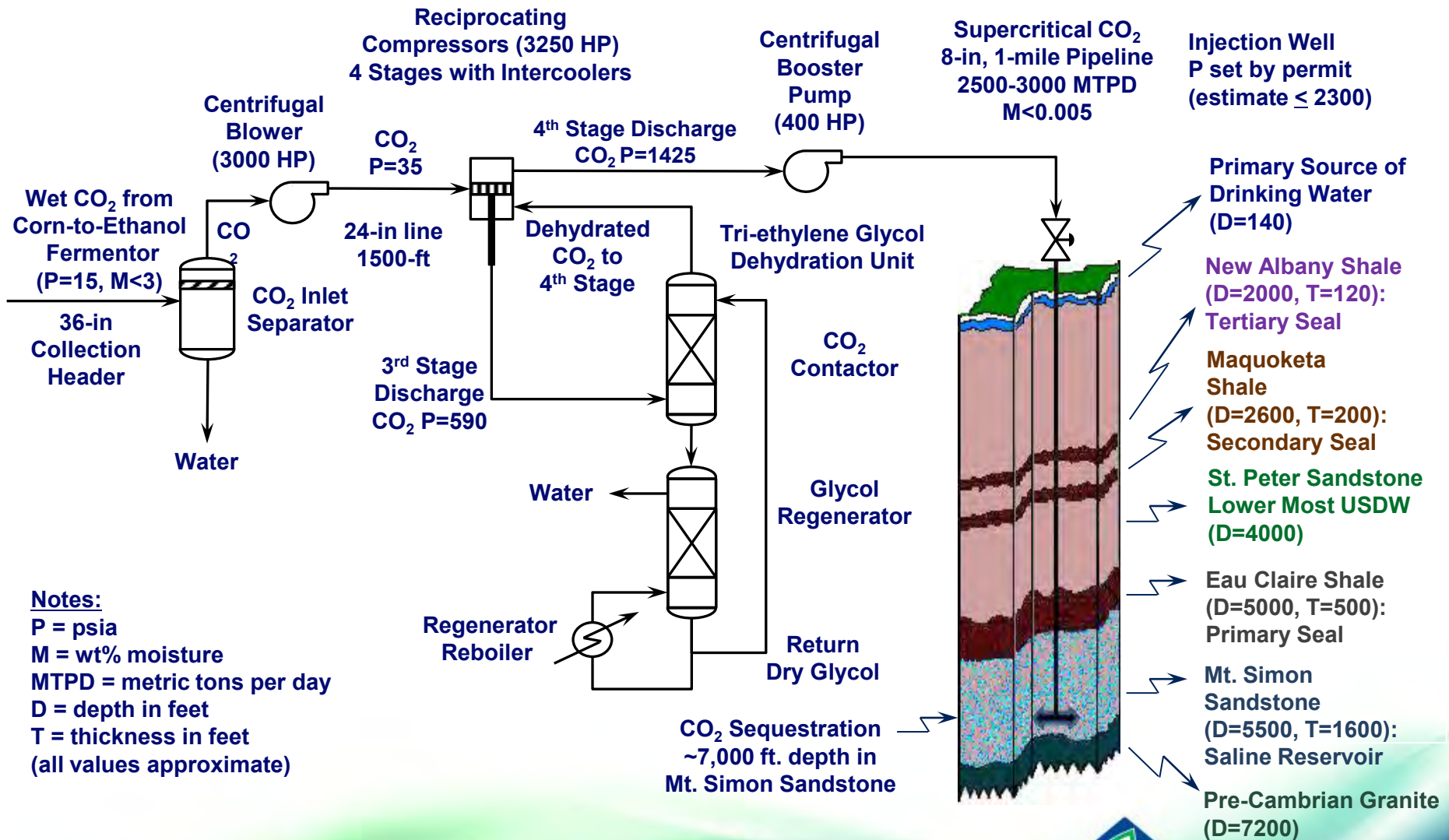


# Illinois Industrial CCS Project (IL-ICCS) Project Schedule



# Illinois Industrial CCS Project (IL-ICCS)

## Project Process Flow Diagram



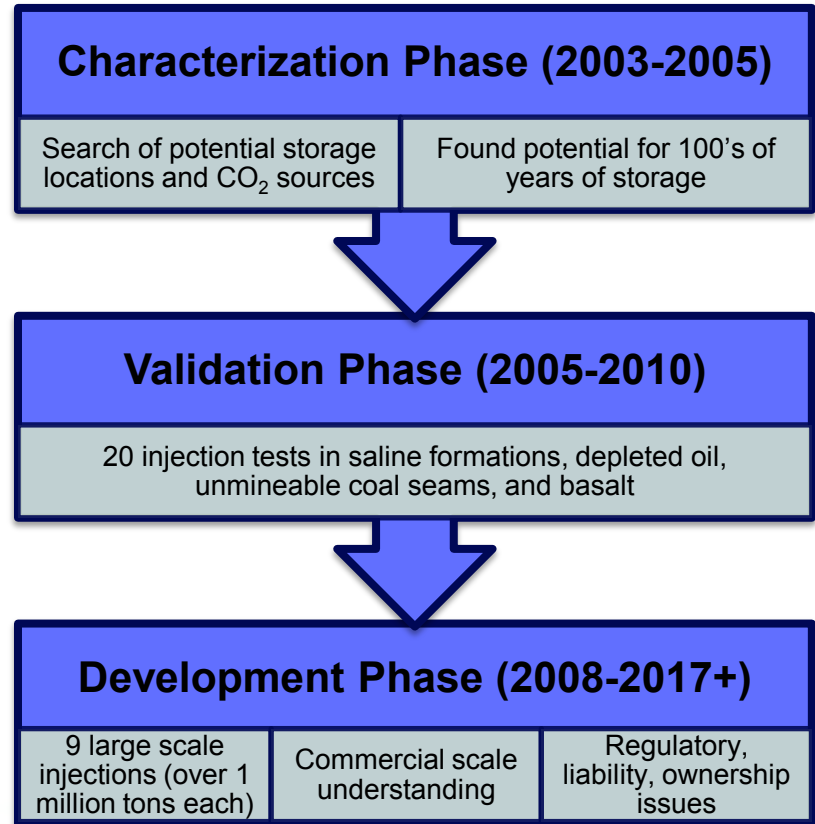
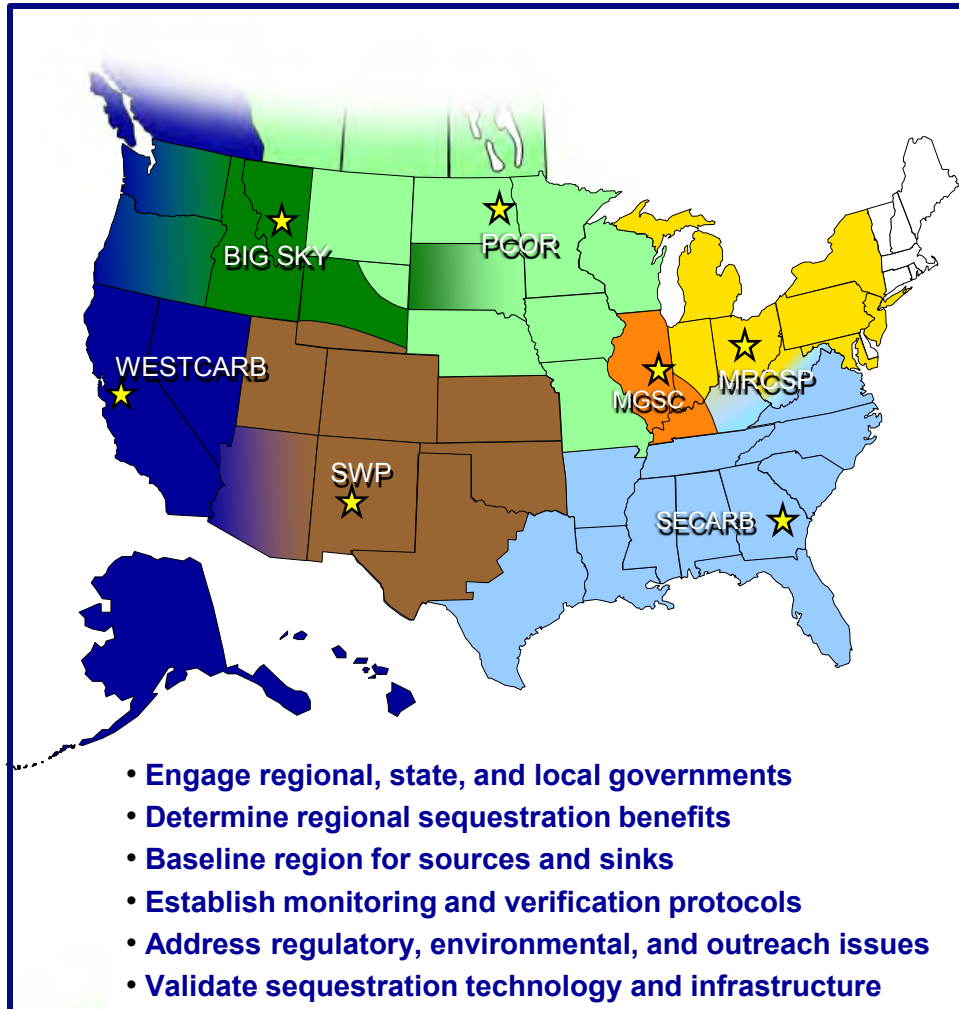
**Notes:**  
 P = psia  
 M = wt% moisture  
 MTPD = metric tons per day  
 D = depth in feet  
 T = thickness in feet  
 (all values approximate)



# Site Selection

## Regional Carbon Sequestration Partnerships

ICCS project site selection benefitted from the information developed through the Regional Carbon Sequestration Partnership Program.

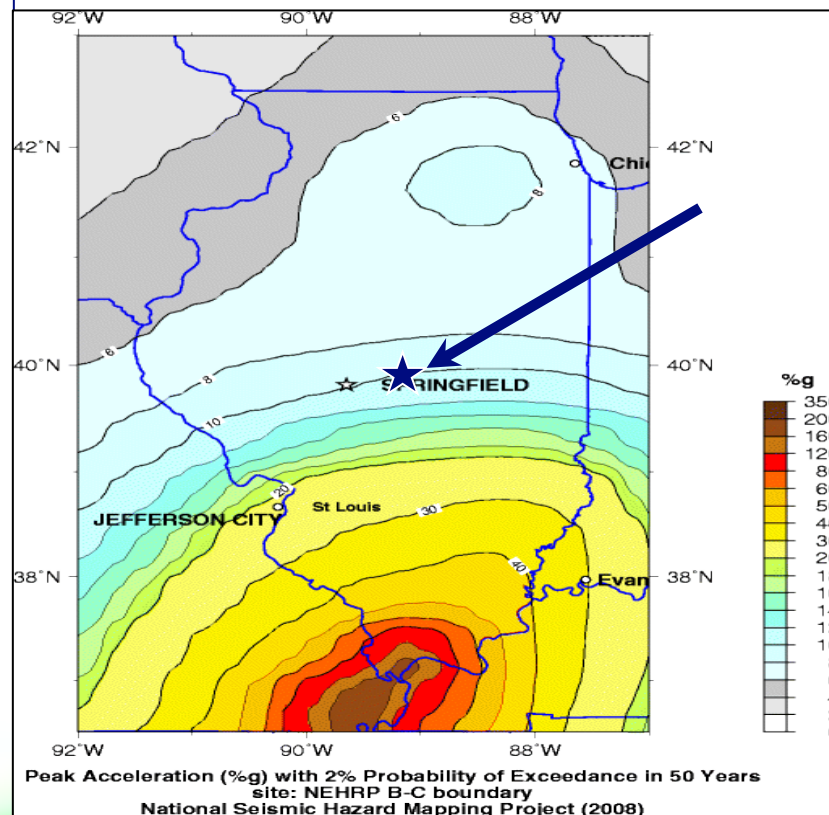




# Site Selection

## Regional Geologic Characterization

- Cratonic basin
- 60,000 square mile area
- Structurally complex to the south with faulting and seismicity



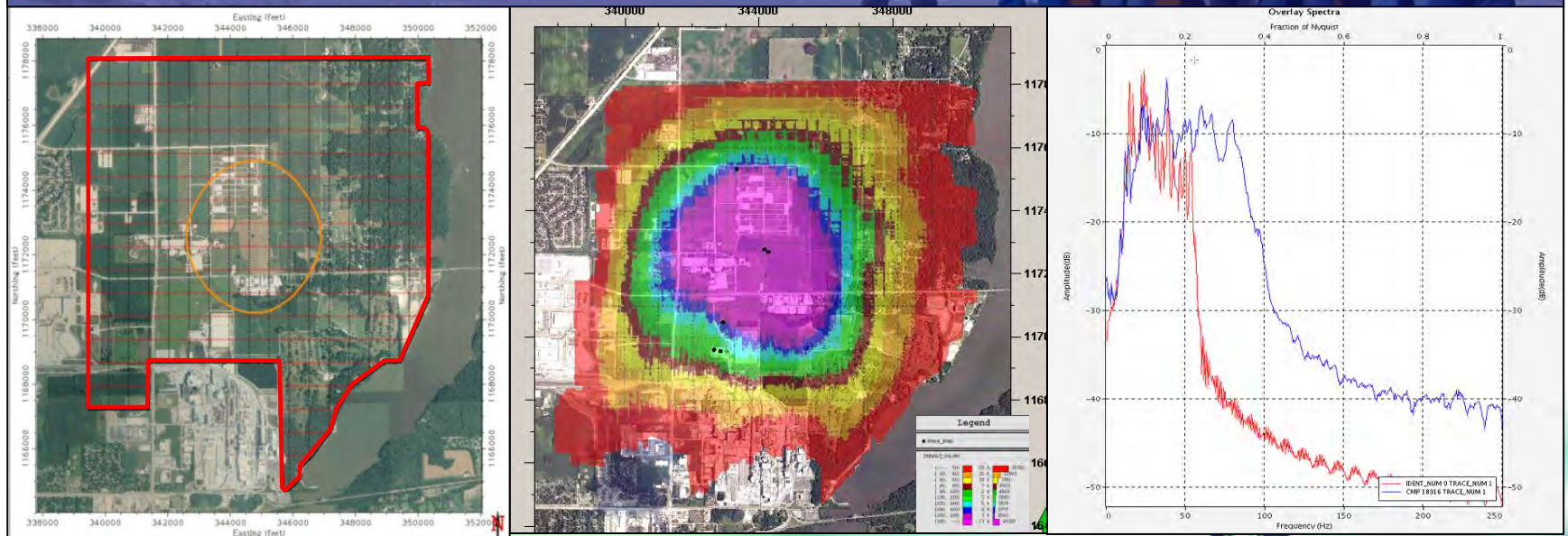
- ADM Decatur facility is located near the center of this geologic formation
- Estimated CO<sub>2</sub> storage capacity between 27 to 109 billion metric tons



# Site Characterization

## Seismic Acquisition

- Receiver lines spaced 640 ft. (N-S lines)
- 18,090 point receivers
- Source lines spaced 720 ft. (E-W lines)
- 2,018 shot points
- Fold coverage is maximized over injection well location
- 40'-by-40' bin size (horizontal resolution)
- Q-Land Technology with improved signal-to-noise ratio
- More desirable for acquiring seismic data within industrial settings



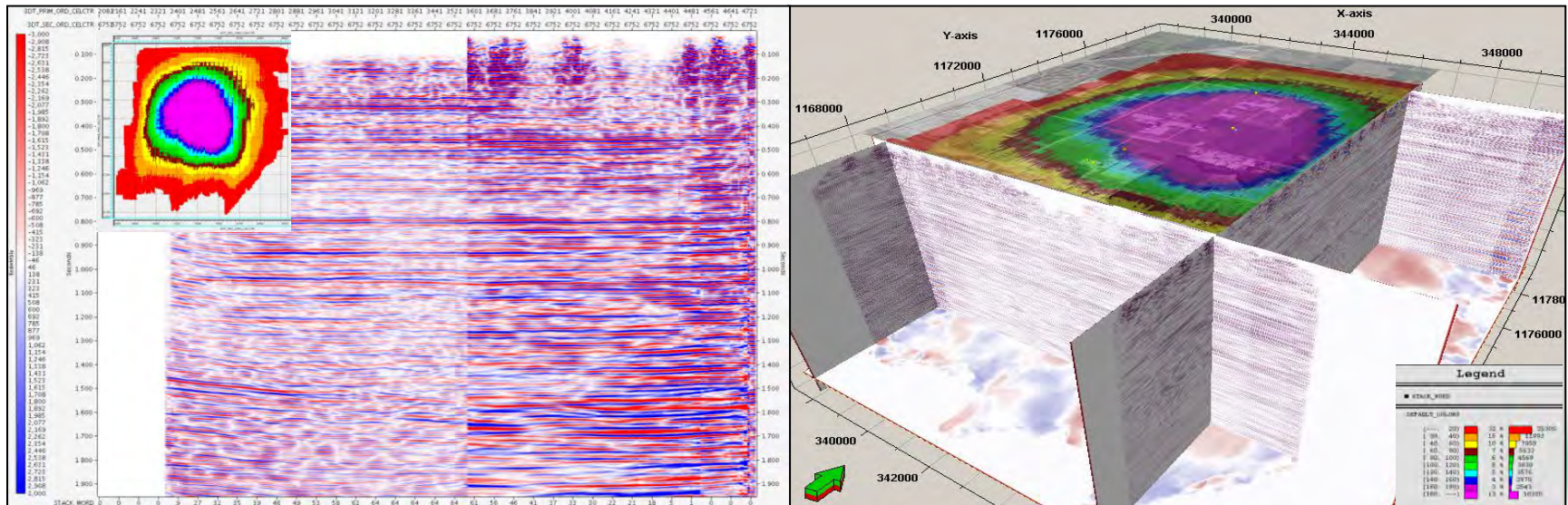
# Site Characterization

## Seismic Processing & Geocellular Model Development

- Both projects seismic data sets were merged prior to processing
- Improved resolution and clarity
- Petrophysical properties extrapolated from CCS #1 logs
- Extended coverage over both sites
- Large model dimensions (30-by-30 miles) used to minimize boundary effects
- Yielding more usable data within AoR.

Legacy Data

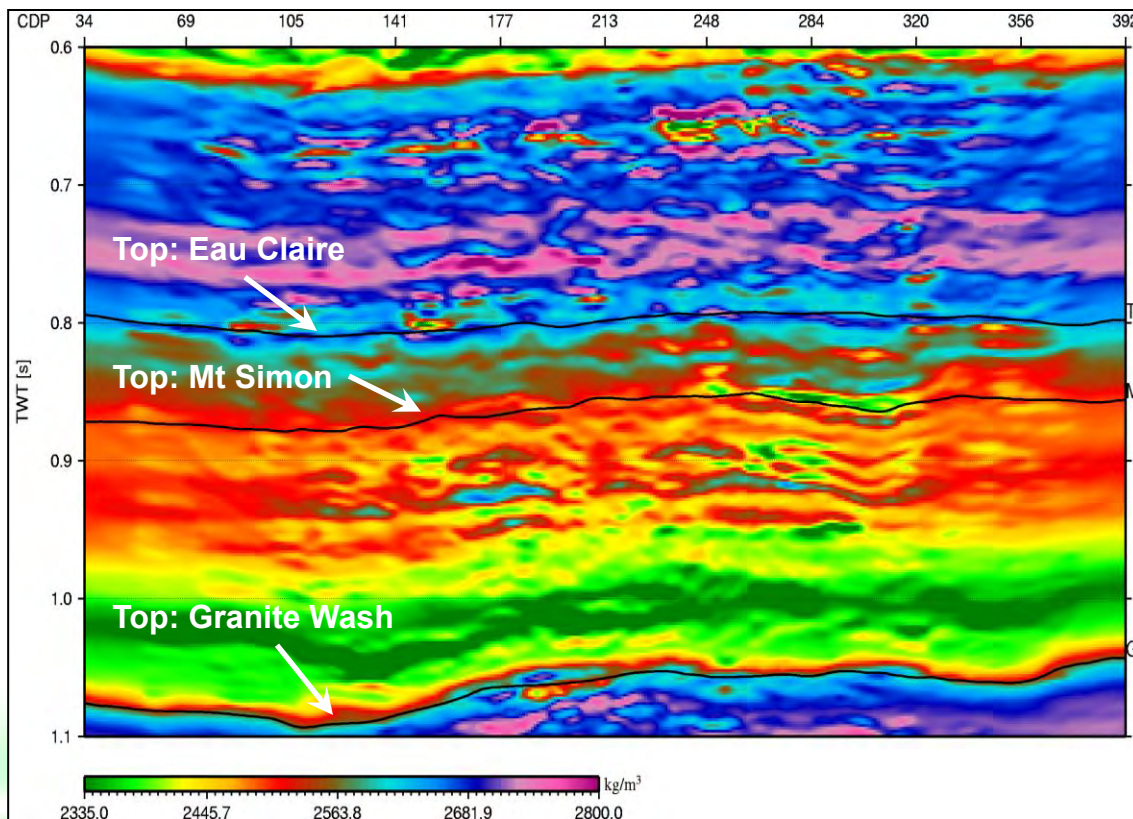
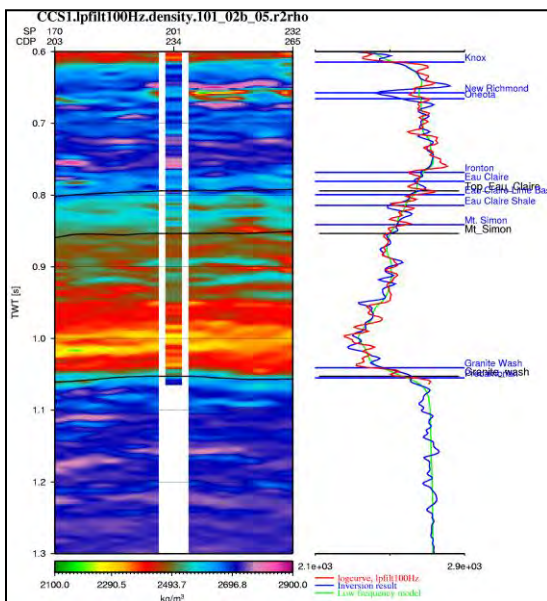
Merged Data



# Site Characterization

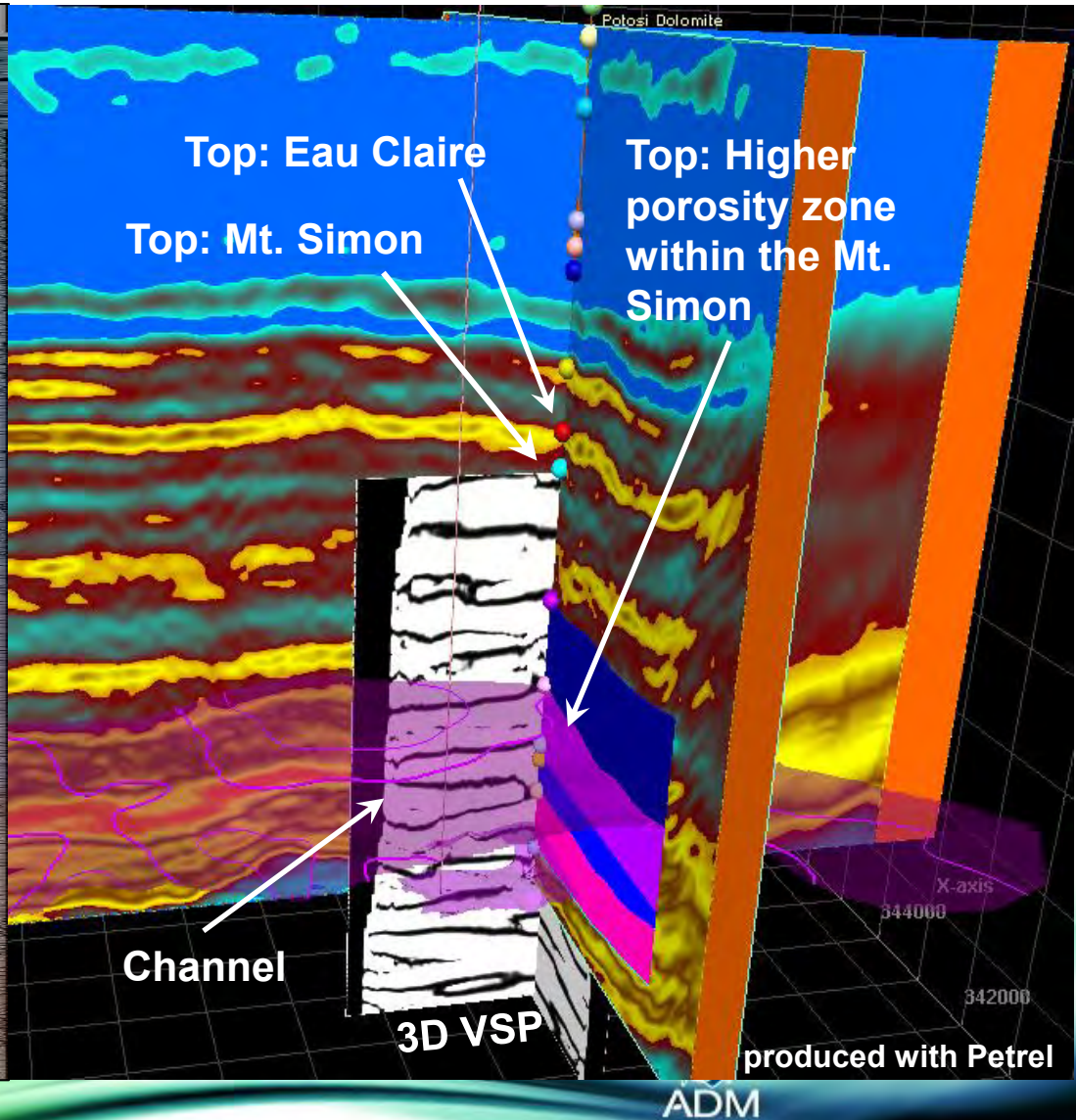
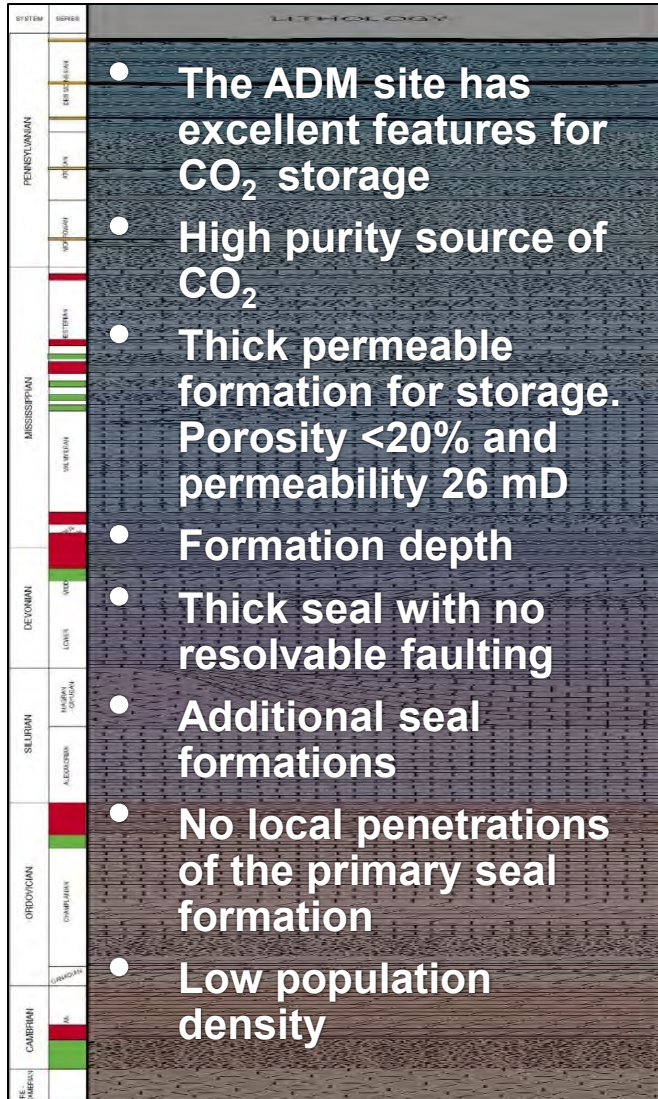
## Seismic Inversion: Formation Density

- Synthetic wavelet constructed from correlation to wellbore log data
- Seismic data inverted to generate petrophysical properties
- 2D Line 101 inverted to generate image of formation density
- Enhances detailed features and allows interpretation of depositional bodies



# Site Characterization

## Evaluation of the Decatur Site



# Site Characterization

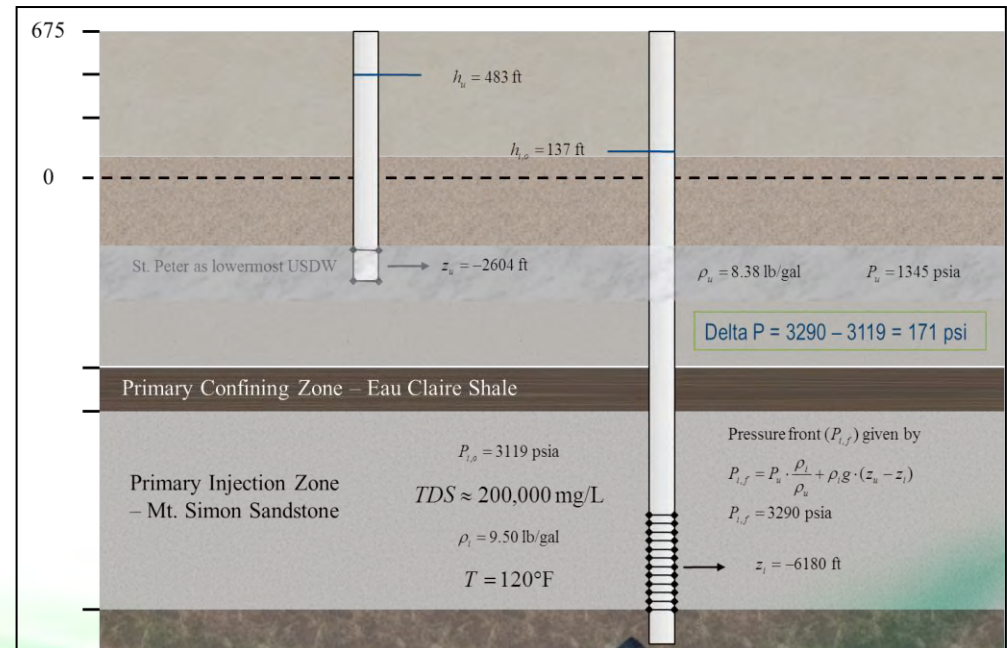
## AoR - Maximum Extent of the Plume or Pressure Front

- The delineation of the AoR is based on the Maximum Extent of the Separate-phase Plume or Pressure-front (MESPOP) methodology, as detailed in the relevant US EPA guidance document (USEPA, 2011).
- The pressure front is defined by the differential pressure needed to allow fluid from the injection zone to flow through a hypothetical open conduit into the overlying lowermost USDW (St. Peter Sandstone)
- Site specific data used to determine the MESPOP and was calculated to be 171 psi.

### USEPA Pressure Front Delineation Equation

$$P_{i,f} = P_u \cdot \frac{\rho_i}{\rho_u} + \rho_i g \cdot (z_u - z_i)$$

Illustration of pressure front delineation calculation based using the St. Peter Sandstone is as the lowermost USDW.

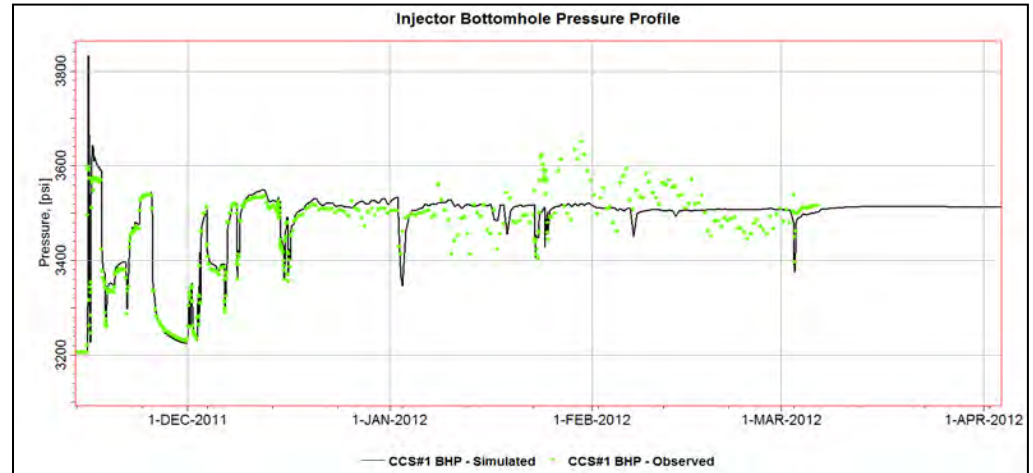


# Site Characterization

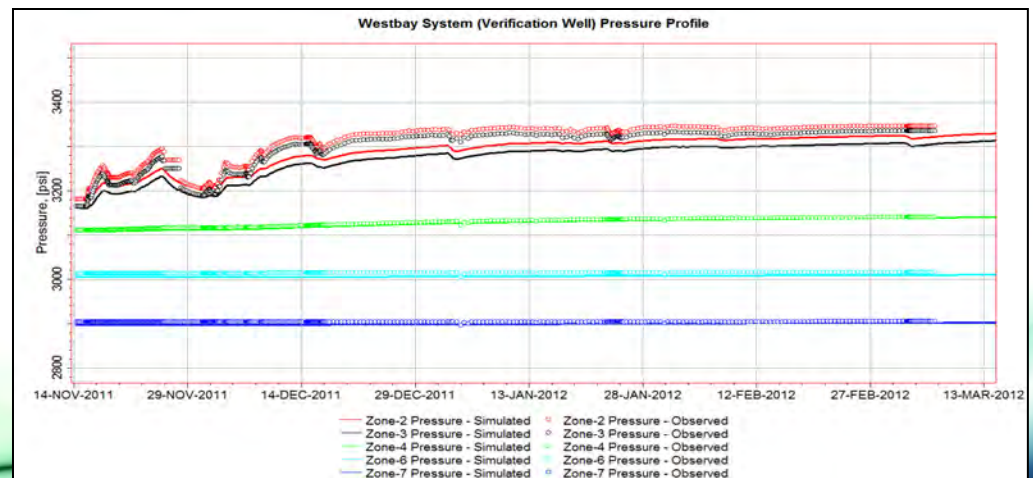
## Updating the Site Model – Matching Operational History

- The site model was calibrated using data obtained during the first four (4) months of the IBDP injection period.
- The IBDP injection rate was input into the simulation to calculate the bottom hole pressures and pressures at five different zones at the verification well.
- Reservoir permeability and skin were the main parameters impacting the injection pressure calibration and were used as fitting parameters.
- Once the injection bottom hole pressure was calibrated, simulated pressures at five different zones at the verification well were fine-tuned calibrating the kv/kh ratio of the tight sections and compressibility of the reservoir rock

History Matched Injection Bottom Hole Pressure (BHP) for CCS#1.



History Matched Pressures at Verification Well for CCS#1

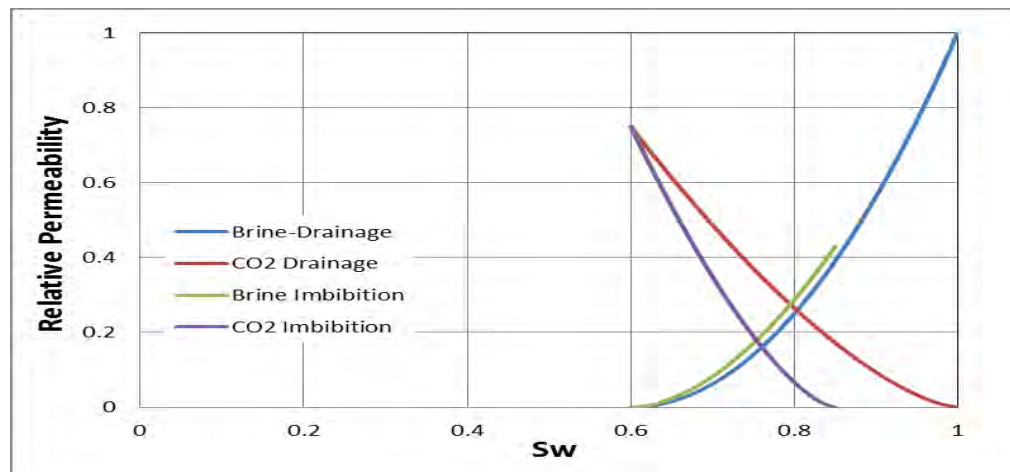


# Site Characterization

## Updating the Site Model – Matching Operational History

- RST Well Logs helped us estimate the location, saturation, and thickness of the CO<sub>2</sub> column around the injection and verification wells.
- This information helped us fine tune the end points of relative permeability curves which dominate the CO<sub>2</sub> and brine flow in the reservoir.
- Using the calibrated model, a predictive simulation was run to evaluate plume development and pressure perturbation during the course of the injection.
- The project's planned injection schedule was used for the 52 year simulation.

Calibrated Reservoir Unit Relative Permeability Curves



Injection Schedule for IBDP (CCS#1) and IL-ICCS (CCS#2) Projects

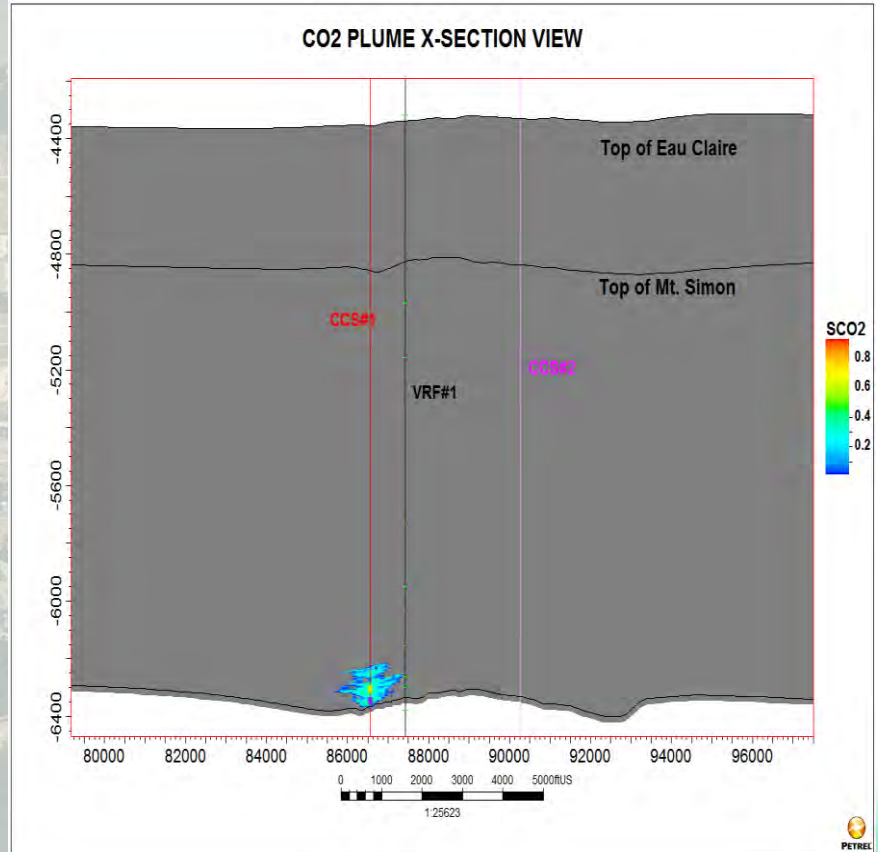
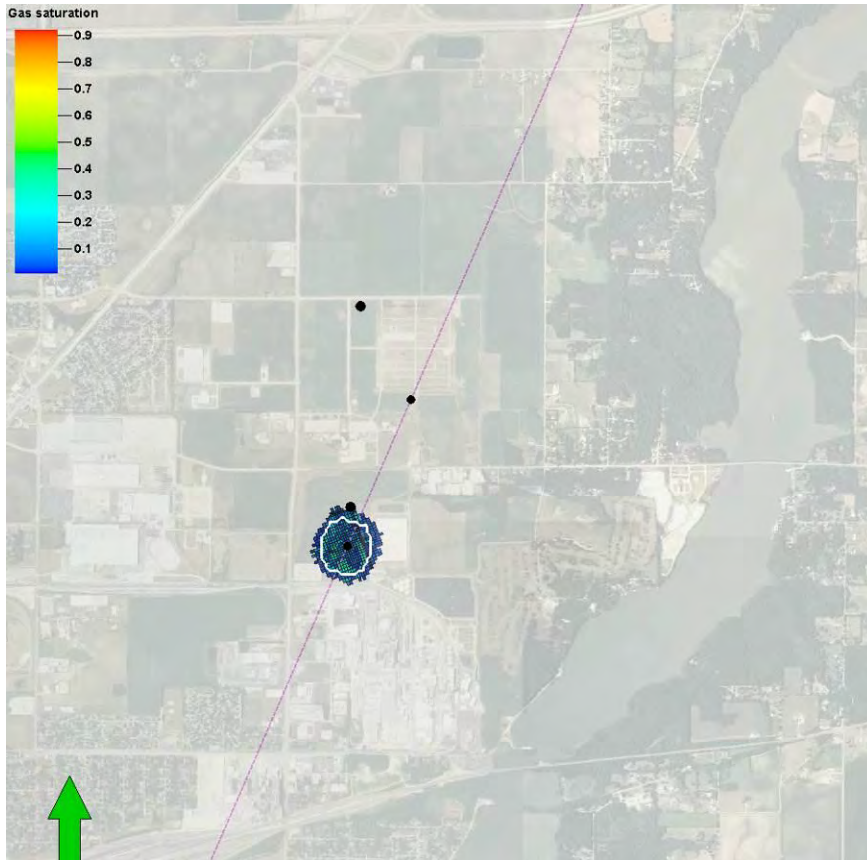
YEAR	IBDP (MT/D)	IBDP (MT/YR)	ICCS (MT/D)	ICCS (MT/YR)
1	1,000	333,333		
2	1,000	333,333		
3	1,000	333,333	2,000	730,000
4			3,000	1,000,000
5			3,000	1,000,000
6			3,000	1,000,000
7			3,000	1,000,000
<b>Total</b>		<b>1,000,000</b>		<b>4,750,000</b>



# Site Characterization

## *Modeling Plume Extent and Pressure Front*

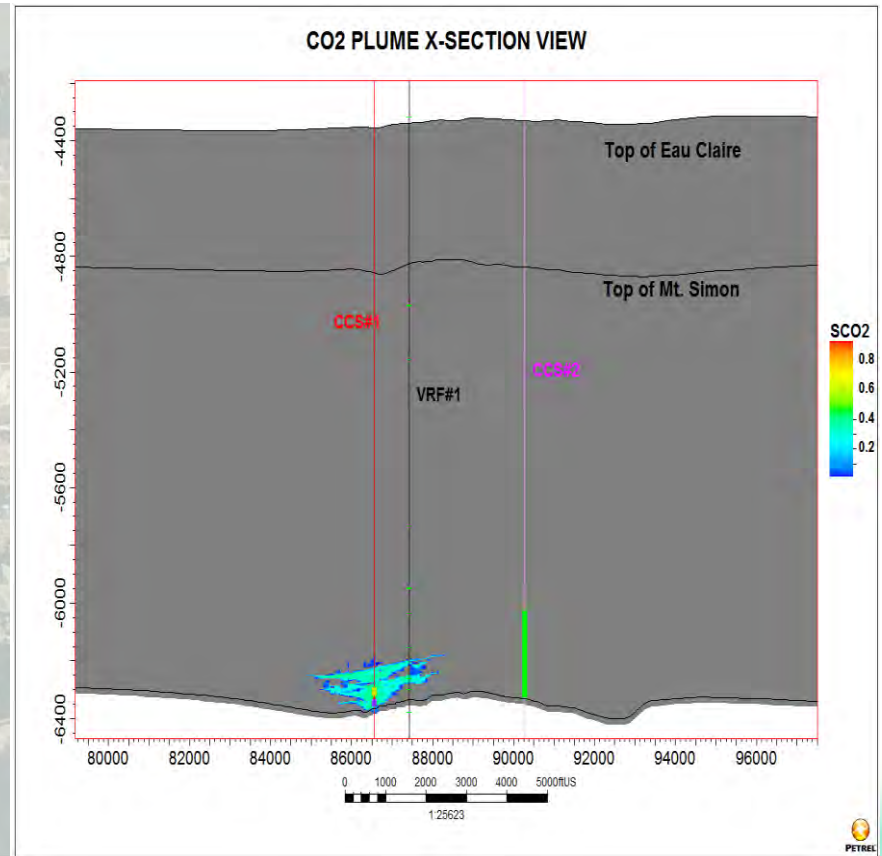
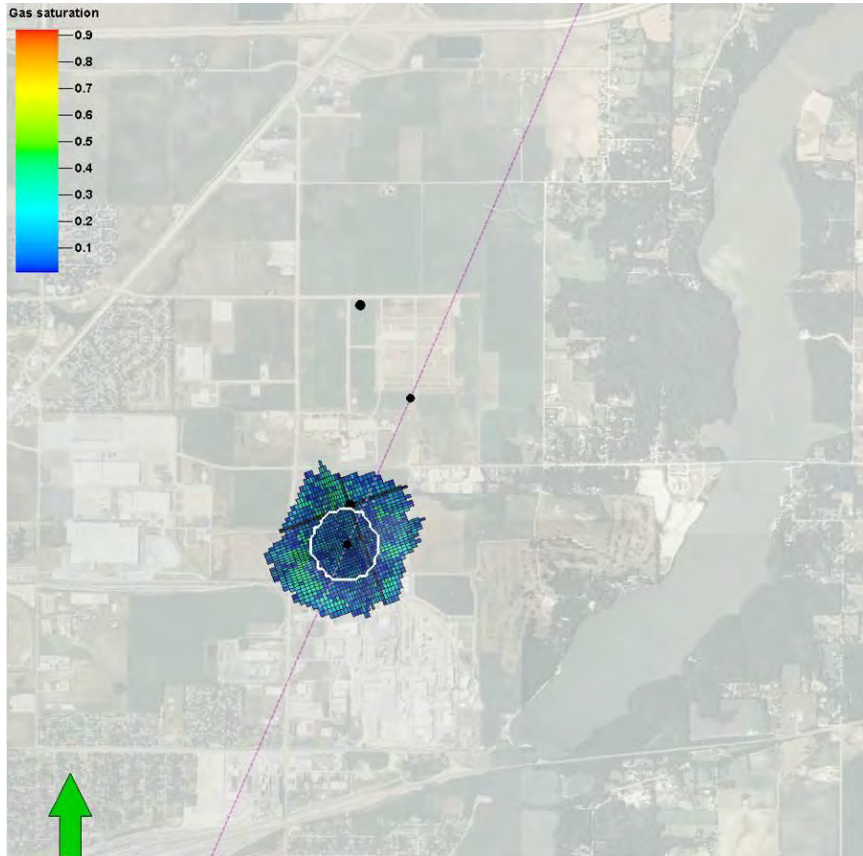
### *March 2012 (Year 0.3)*



# Site Characterization

## Modeling Plume Extent and Pressure Front

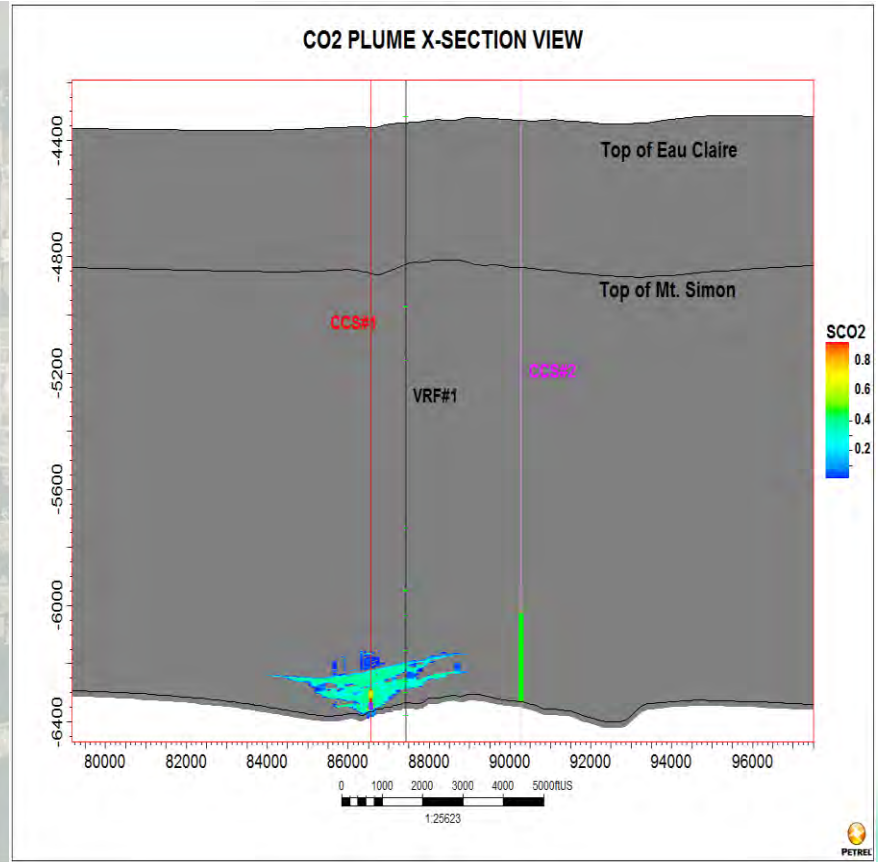
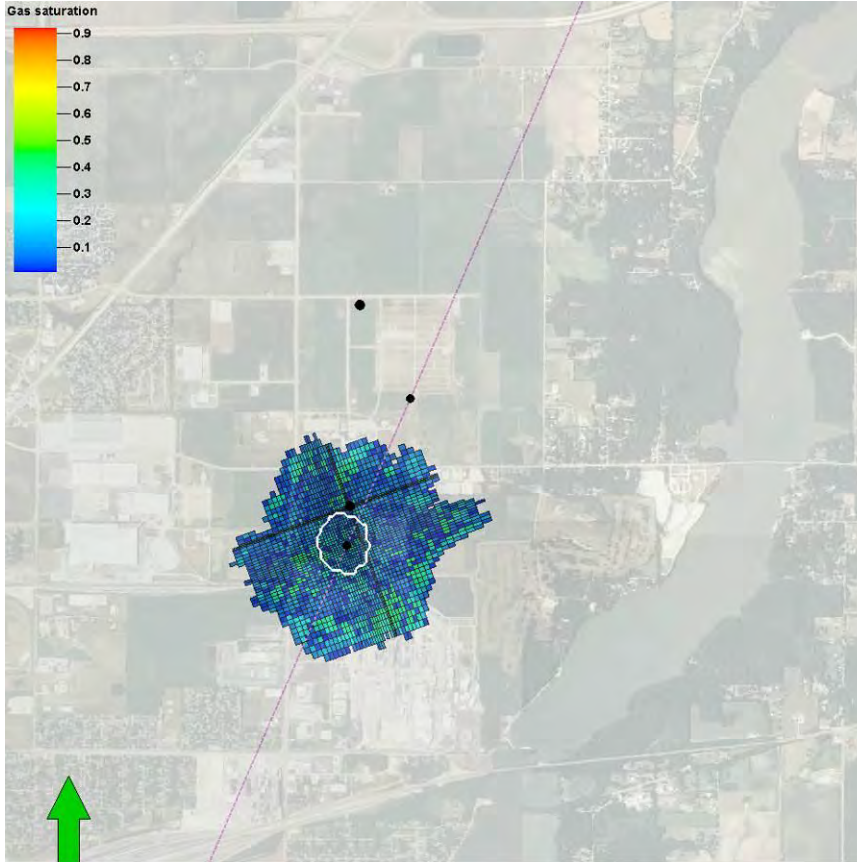
### January 2013 (Year 1.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

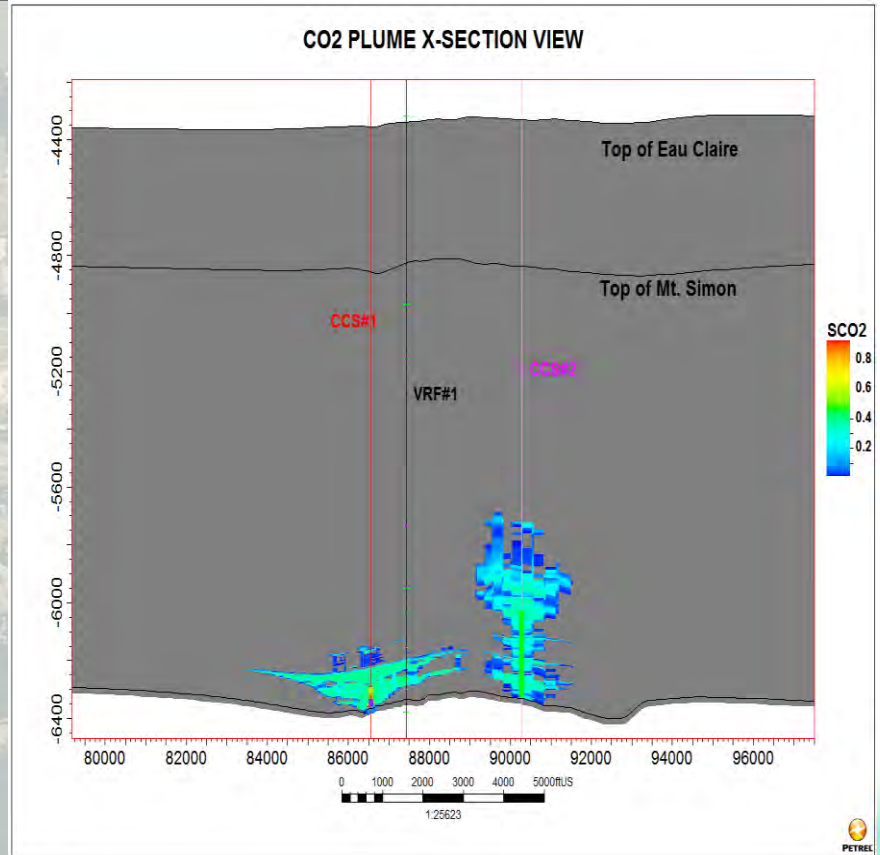
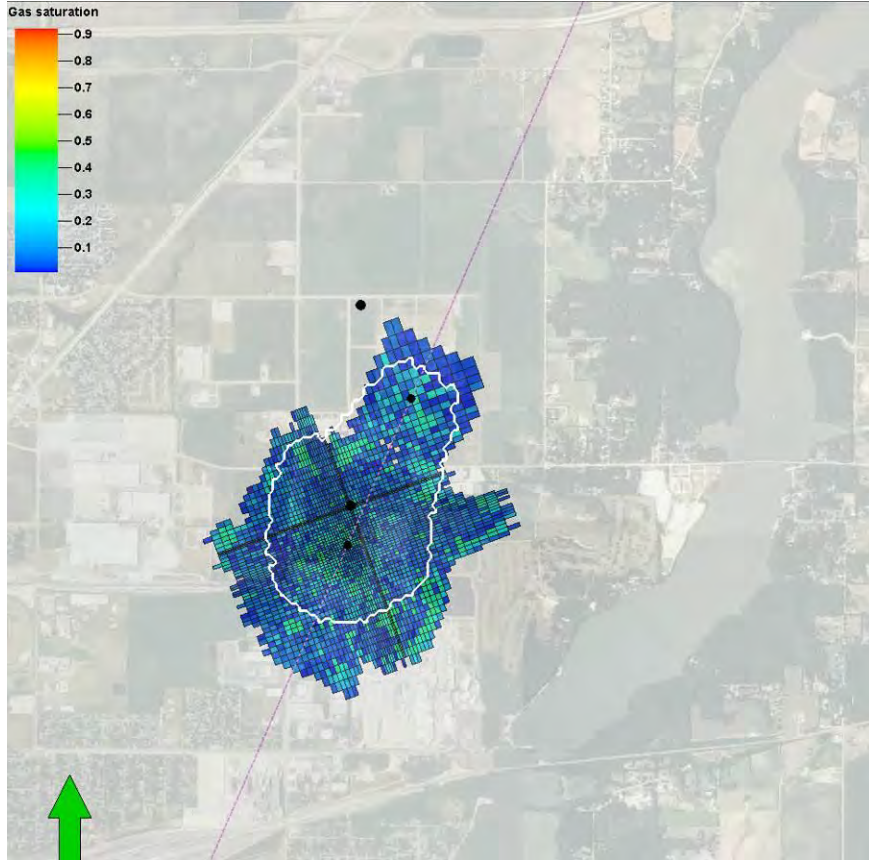
### January 2014 (Year 2.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

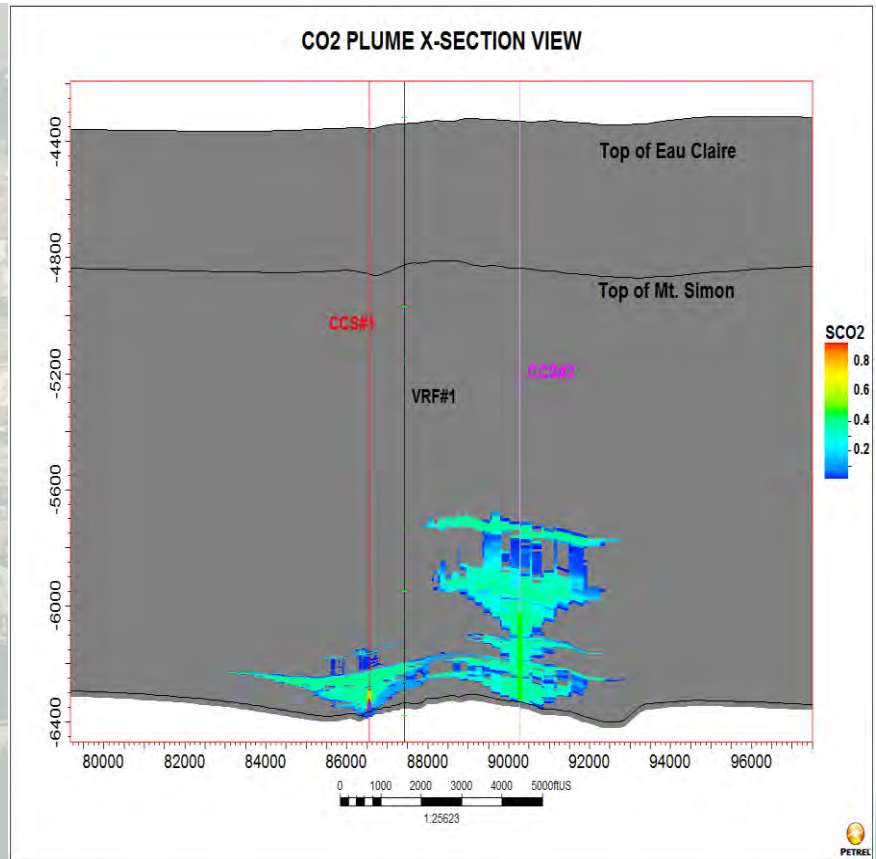
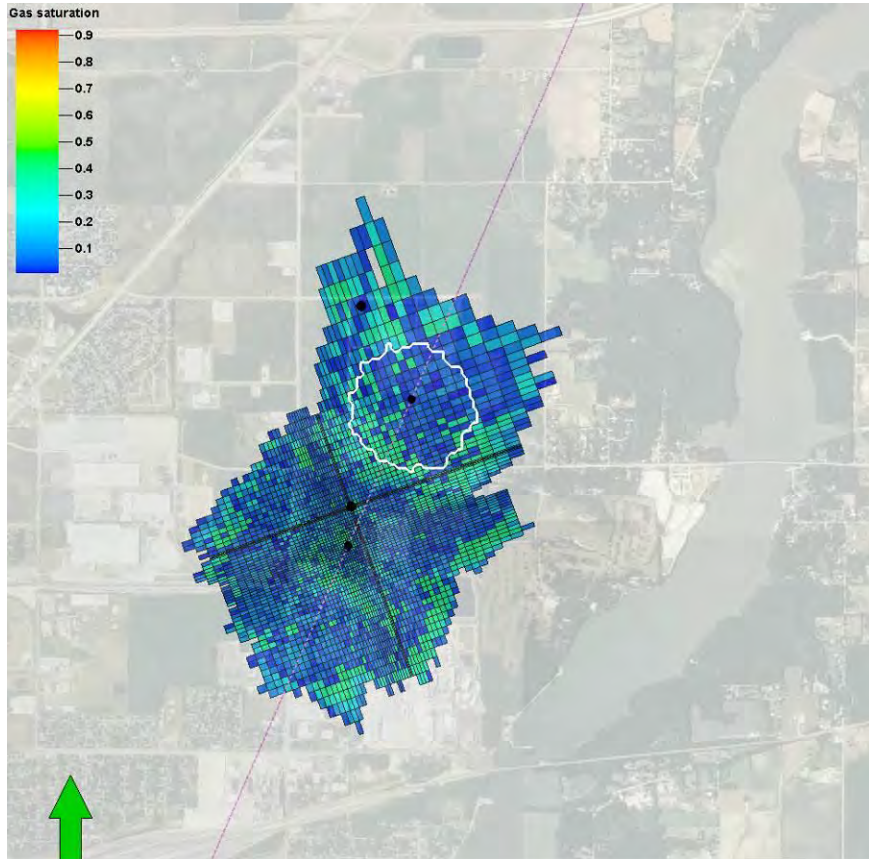
### January 2015 (Year 3.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

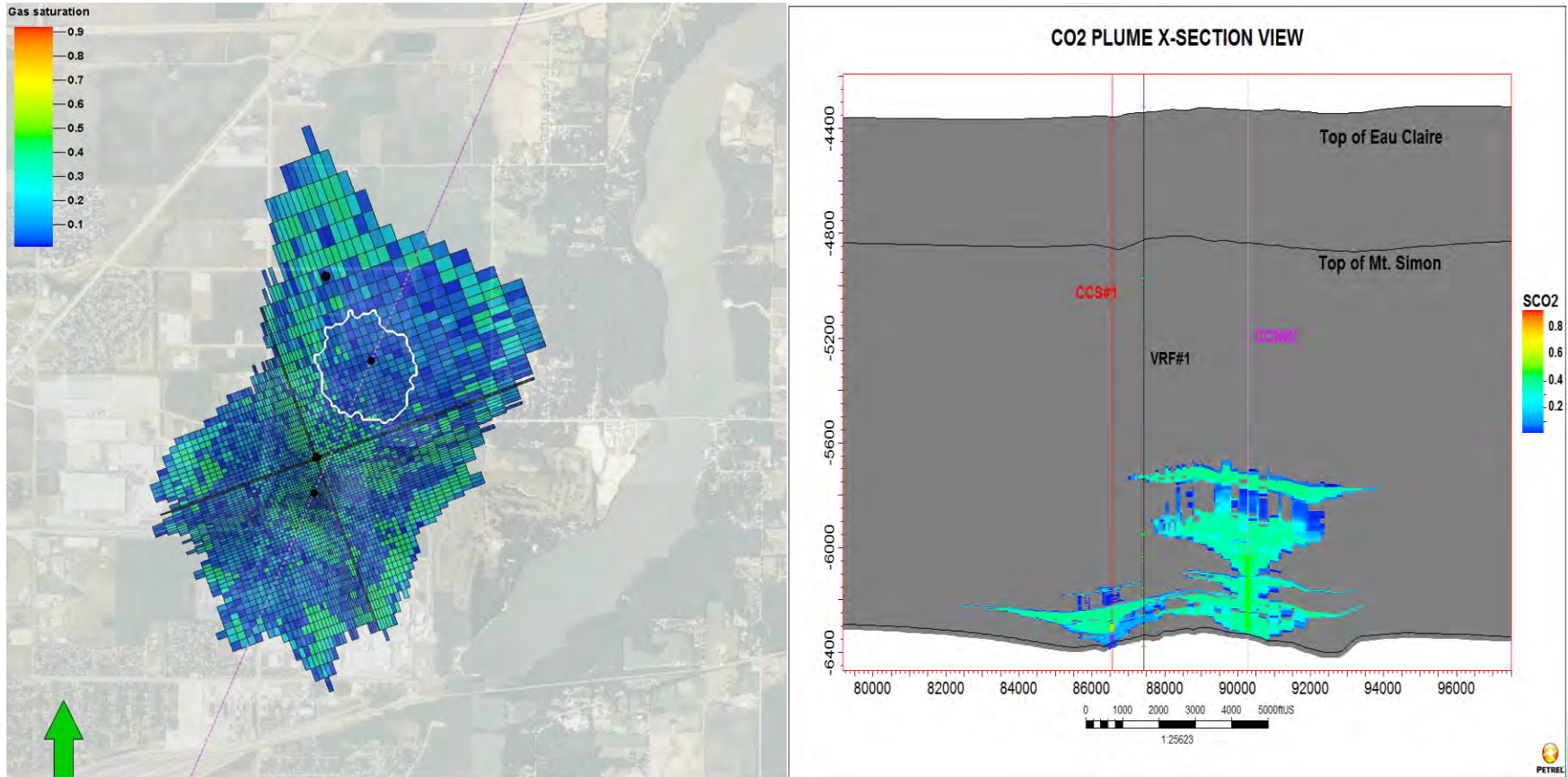
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# Site Characterization

## Modeling Plume Extent and Pressure Front

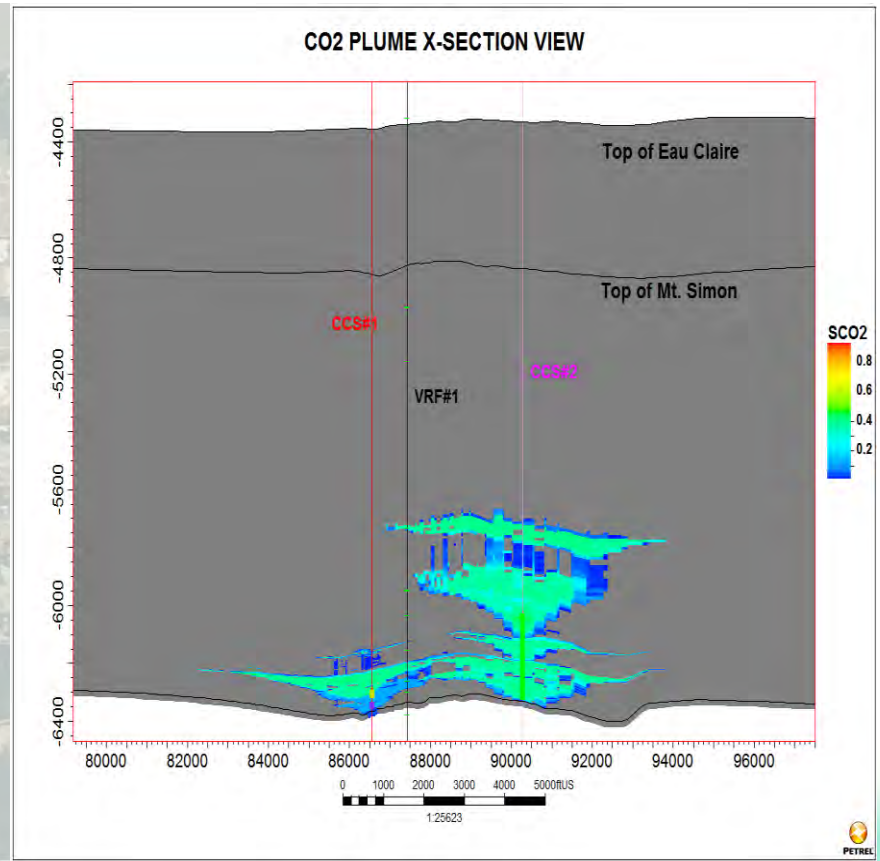
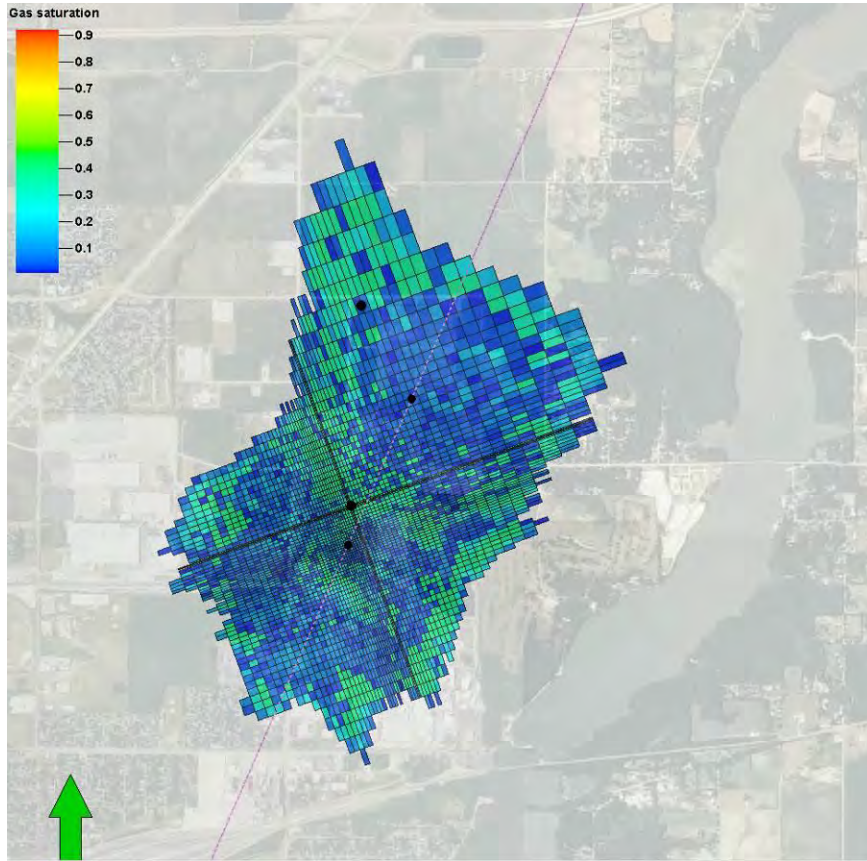
### January 2019 (Year 7.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

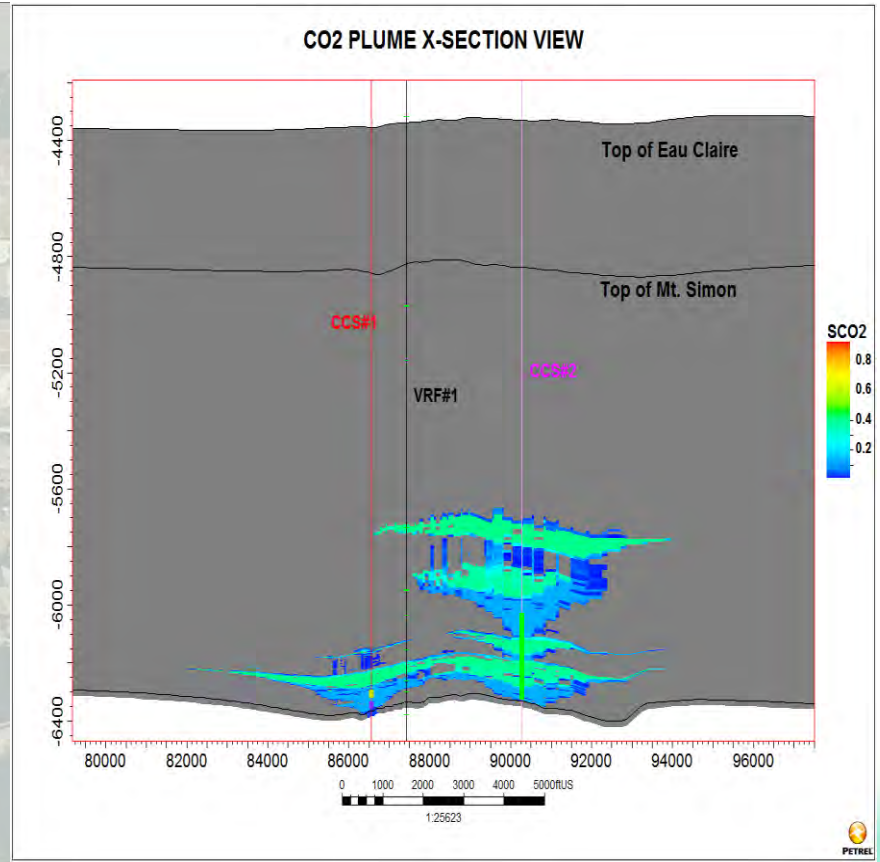
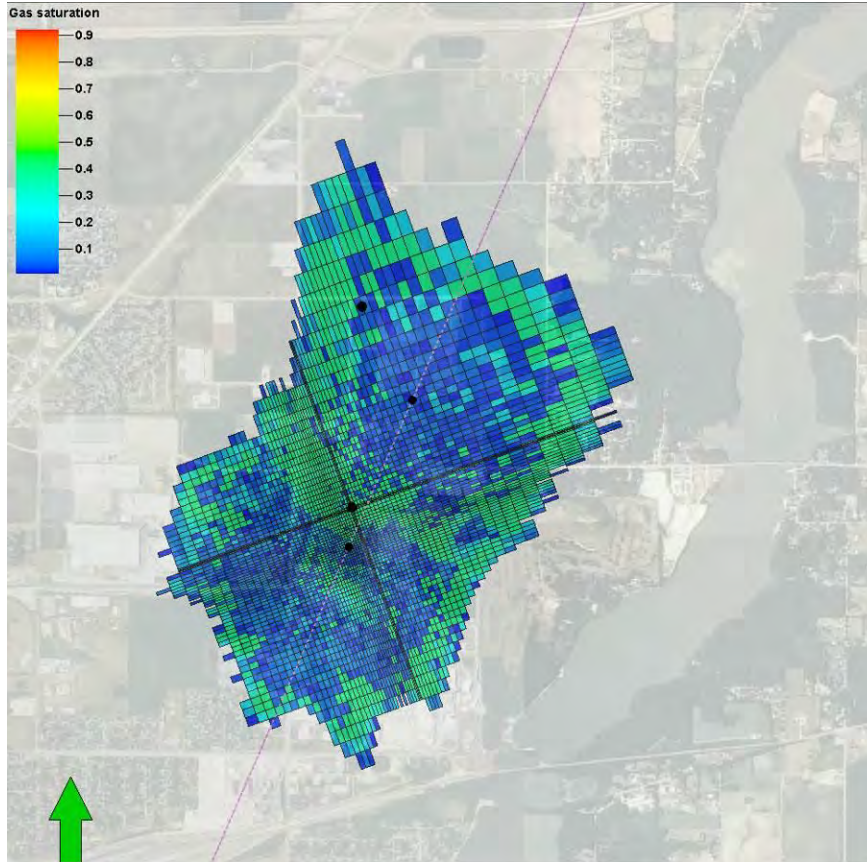
### January 2020 (Year 8.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

### January 2025 (Year 13.0)

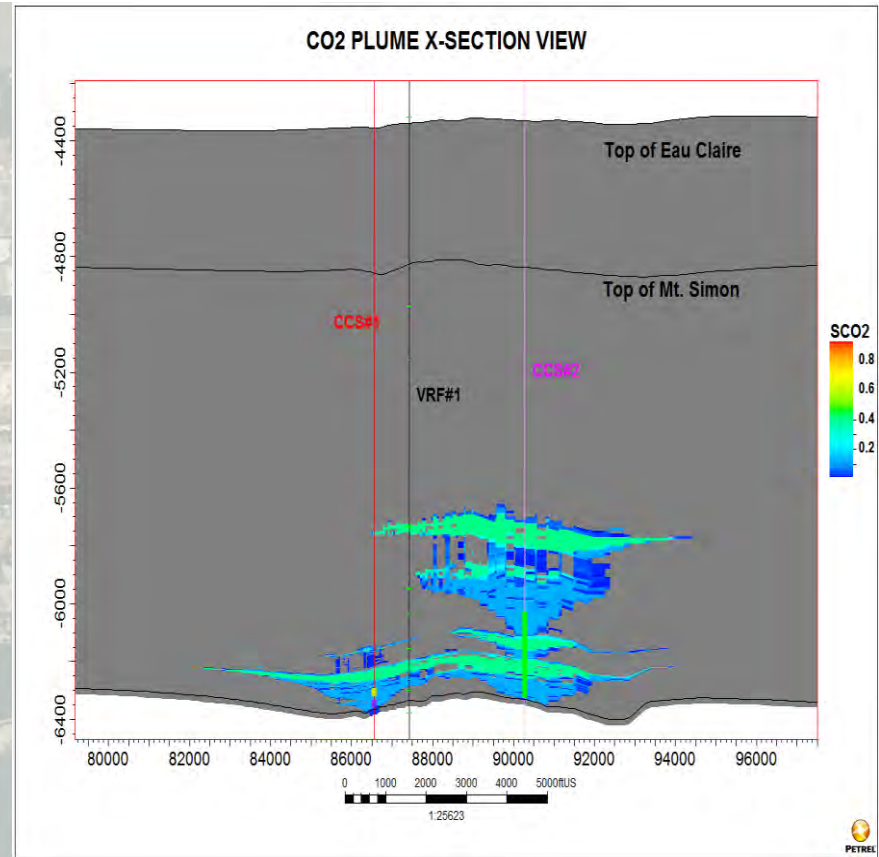
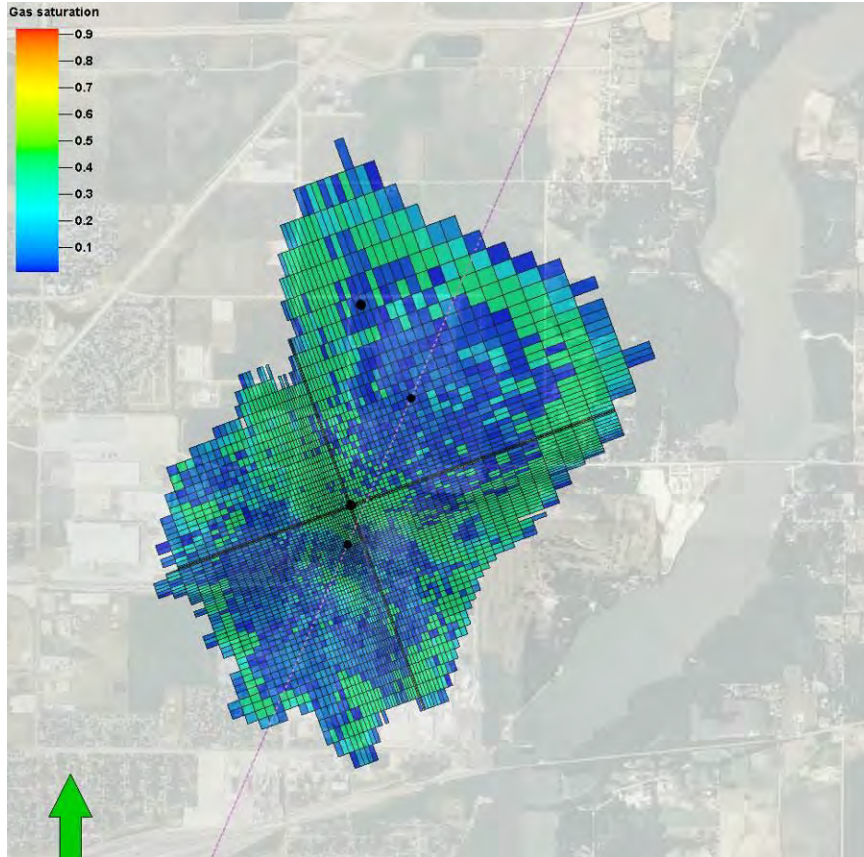




# Site Characterization

## Modeling Plume Extent and Pressure Front

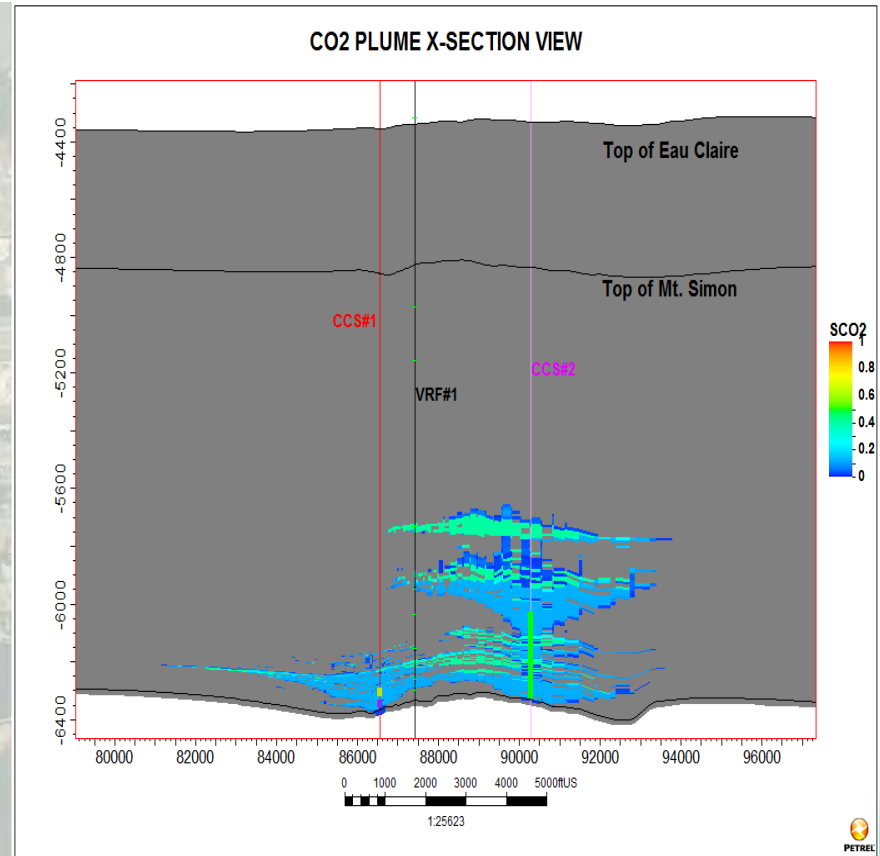
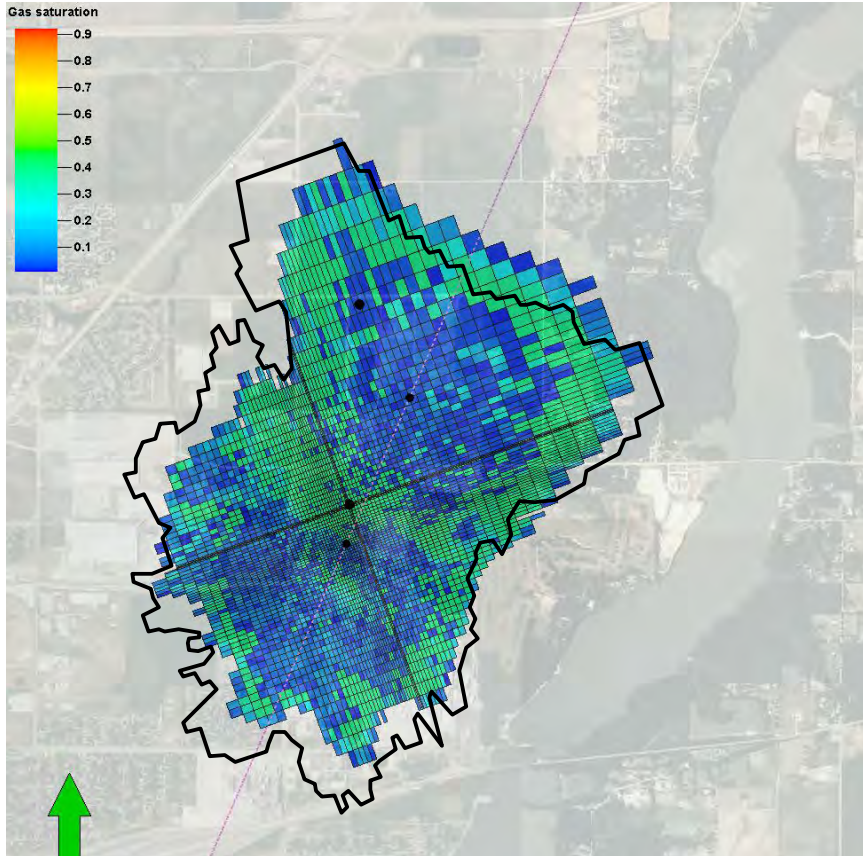
### January 2030 (Year 18.0)



# Site Characterization

## Modeling Plume Extent and Pressure Front

### January 2062 (Year 50.0)



# Site Permitting

## USEPA: UIC Class VI Permit

## 1<sup>st</sup> UIC Class VI Permit Application Reviewed by the US EPA

- UIC Class VI permit application submitted on July 25, 2011.
- US EPA Region V issued a notice of completeness on August 26, 2011.
- EPA issued an information request on December 21, 2012.
- The project team sent a response on January 25, 2012.
- The EPA issued a determination that stated the St. Peter Sandstone formation was the lower most USDW.
- The project team submitted revised permit application using new USDW on May 31, 2012.
- OG-7 application for construction of monitoring well submitted June 4, 2012.

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
REGION 5  
77 WEST JACKSON BOULEVARD  
CHICAGO, IL 60604-3590

**AUG 26 2011**

**CERTIFIED MAIL 7009 1408 0000 7670 8029**  
**RETURN RECEIPT REQUESTED**

Mark Brian  
Declarer Curt Plant Manager  
Archer Daniels-Midland Company  
4666 Fates Parkway  
Decatur, Illinois 62526

**Re: Completeness Review of Underground Injection Control (UIC) Permit for a Geologic Sequestration Well, United States Environmental Protection Agency UIC Permit No. IL-115-6A-0001**

Dear Mr. Brian:

On July 27, 2011 we received your permit application for the carbon sequestration located in Decatur, Illinois. Title 40 of the Code of Federal Regulations Section 141.101 requires a completeness review within 30 days of our receipt of the application. We reviewed the application and determined that you did not provide the financial information needed to make sure that there will be funds available for the cost of this facility. We understand that the exact amount of necessary funds can be determined at this time. Please be aware that the financial assurance documentation provided and reviewed prior to the issuance of a draft permit. We are proceeding with the evaluation of the information for technical soundness and compliance with applicable Underground Injection Control regulations. If additional information is necessary to modify or supplement the information you provided, we will notify you. When that information is provided to sufficient for a permitting decision, a draft permit and a statement of basis will be prepared and supplied to you as well as the comment.

If you have any questions, please feel free to contact Dana Rozek of my staff at [drozek.dana@epa.gov](mailto:drozek.dana@epa.gov).

Sincerely yours,  
*[Signature]*

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
REGION 5  
77 WEST JACKSON BOULEVARD  
CHICAGO, IL 60604-3590

**DEC 14 2011**

**CERTIFIED MAIL 7009 1408 0000 7670 8043**  
**RETURN RECEIPT REQUESTED**

Mr. Scott McDonald  
Project Manager  
Archer Daniels-Midland Company  
4666 Fates Parkway  
Decatur, Illinois 62526

**Subject: Additional Information Request for Archer Daniels Midland (ADM) Well CCS #2, United States Environmental Protection Agency Underground Injection Control (UIC) Permit Application #IL-115-6A-0001**

Dear Mr. McDonald:

The Underground Injection Control (UIC) Branch has completed its partial technical review of the permit application referenced above. Our comments and request for additional information for Sections 2 and 5 are enclosed. Please submit your answers within 30 days of your receipt of this letter.

Inquiries concerning the contents of the enclosures may be directed to Dana Rozek of my staff by telephone at (312) 353-6492 or by email to [drozek.dana@epa.gov](mailto:drozek.dana@epa.gov).

Sincerely yours,  
*[Signature]*  
Rebecca Harvey, Chief  
Underground Injection Control Branch

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
REGION 5  
77 WEST JACKSON BOULEVARD  
CHICAGO, IL 60604-3590

**MAR 21 2012**

**CERTIFIED MAIL 7009 1408 0000 7670 8098**  
**RETURN RECEIPT REQUESTED**

Mr. Scott McDonald  
Project Manager  
Archer Daniels-Midland Company  
4666 Fates Parkway  
Decatur, Illinois 62526

**Subject: Lowermost Underground Source of Drinking Water in the Area of Prop Archer Daniels-Midland Class VI Well**

Dear Mr. McDonald:

It has come to our attention that the identification of the lowermost underground source drinking water (USDW) in the application for the Class VI permit for Archer Daniels Midland (ADM) is not accurate. Under federal regulations, any aquifer that contains more than 10,000 mg/l total dissolved solids (TDS) and is not an exempted aquifer is a USDW under the Code of Federal Regulations Section 141.1. An undocumented in Appendix B4 additional information EPA received on January 31, 2012, to support the ADM Class VI application, the TDS content of the formation water in the St. Peter Sandstone is less than 10 mg/l and therefore, the St. Peter Sandstone is a USDW. Other formations below the St. Peter may need to be evaluated to determine the lowermost USDW at the site. Any aquifer determined to qualify as a USDW based upon its characteristics is afforded regulatory protection as a USDW under the Safe Drinking Water Act, regardless of if it is currently being used as a source of drinking water or proposed to be.

We request that ADM establish how the forthcoming determination of the lowermost USDW will impact its permit application, particularly the delineation of the extent of the Area Review (AR). Since the ADM is determined in part by the presence differential sand cause the movement of injected fluid or formation fluids into a USDW, using the true characteristics of the lowermost USDW are crucial. This will allow you to revise the AR pressure used in the delineation of the AR and therefore, possibly change its extent.

We note that because the intermediate casing extends below the base of the St. Peter and is cemented to surface, no change in the casing and cementing program is required.

**ILLINOIS DEPARTMENT OF NATURAL RESOURCES**  
Office of Mines and Minerals  
200 North LaSalle Street  
Springfield, Illinois 62762-3211

**FORM 100 - PERMIT APPLICATION TO DRILL, BORE, OR CONSTRUCT A WELL**

Well to be used for:  OIL PRODUCTION  WATER SUPPLY  IRRIGATION  RECREATION  OTHER (SEE NOTE)

WELL TO BE DRILLED IN:  SURFACE  UNDERGROUND  BOTH SURFACE AND UNDERGROUND

ELEVATION OF GROUND SURFACE AT WELL LOCATION: \_\_\_\_\_ FT. ELEVATION OF WELL: \_\_\_\_\_ FT. DEPTH OF WELL: \_\_\_\_\_ FT.

SECTION: 32 TOWNSHIP: 12 RANGE: 12E COUNTY: DECATUR

LATITUDE: 39° 02' 30" N LONGITUDE: 90° 02' 30" W

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
Section 32									
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

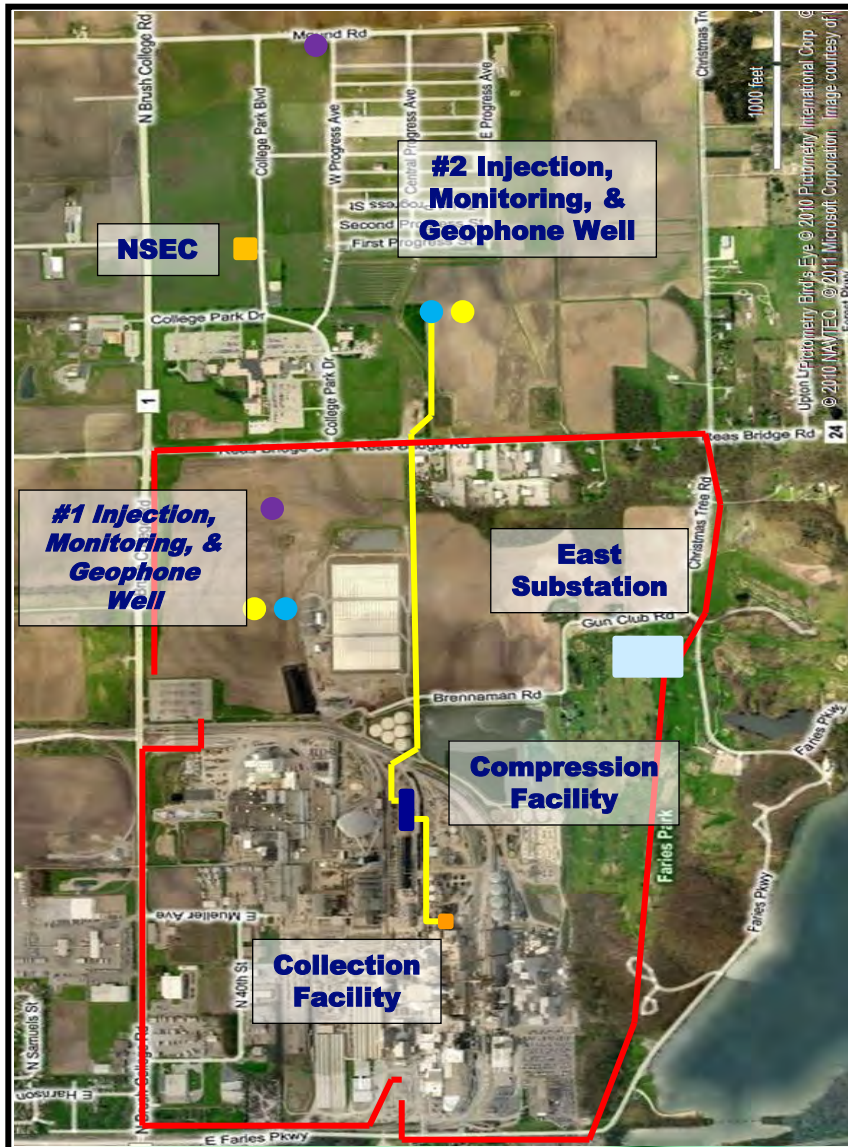
DRILLING LOGS & WELL LOGS MUST BE FILED WITH THE STATE OF ILLINOIS

I HEREBY CERTIFY THAT TO THE BEST OF MY KNOWLEDGE THE LOCATION AND EXTENSION OF THE ABOVE DESCRIBED WELL, POND OR OTHER STRUCTURE OR CONSTRUCTION WORK IS AS SHOWN ON THE ATTACHED MAP AND THAT THE SAME WILL BE MAINTAINED AND KEPT IN A STATE AT THE EXACT LOCATION INDICATED THEREON.

DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

# Engineering Design & Construction

## Major Capital Elements



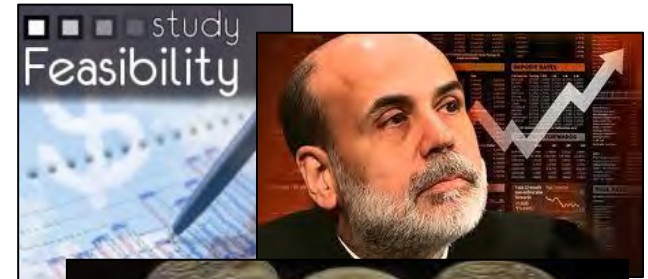
- Collection, Compression, and Dehydration Facility
- CO<sub>2</sub> Transmission System
- 100 MW Electrical Substation
- Electrical Distribution System
- Sequestration Site and Monitoring Facility
- National Sequestration Education Center (NSEC)

# Engineering Design & Construction Capital Project Approach Plan

ADM has a stage-gate project plan that is divided into six stages:

- **Concept and Feasibility Stage**
- **Assessment Stage**
- **Development and Design Stage**
- **Construction Stage**
- **Start up and Commissioning Stage**
- **Final Audit and Closing Stage**

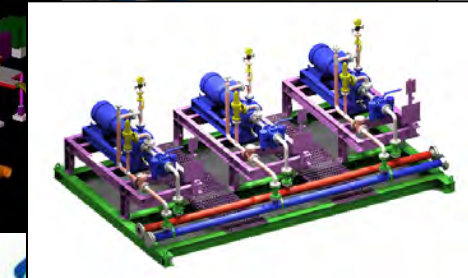
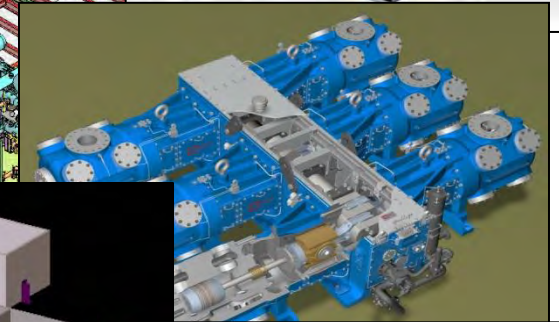
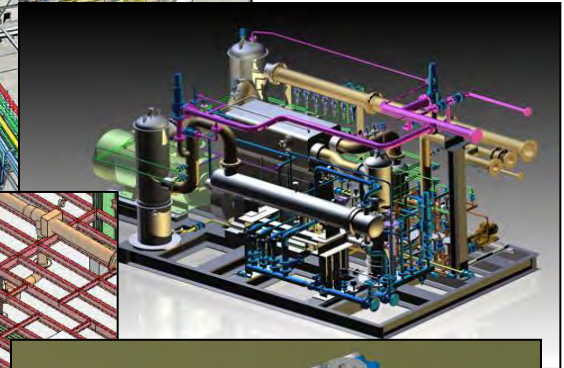
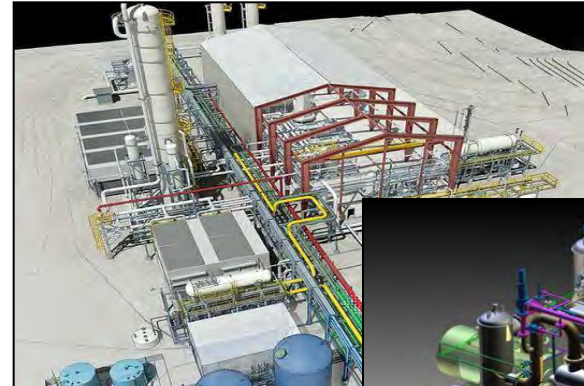
**Reduce Capital  
and Technical Risk**



# Engineering Design & Construction

## *Modular Design & 3D Computer Aided Design*

- Major equipment designed as modular components on self contained skids using 3D CAD
- Combined modules into single model which allowed integration of the mechanical, structure, civil, & electrical design elements
- 3D model allowed rapid evaluation of changes to the mechanical and structural design elements
- All construction drawings were created from the 3D model allowing for precise shop fabrication of 80% of the mechanical, structural & electrical components.



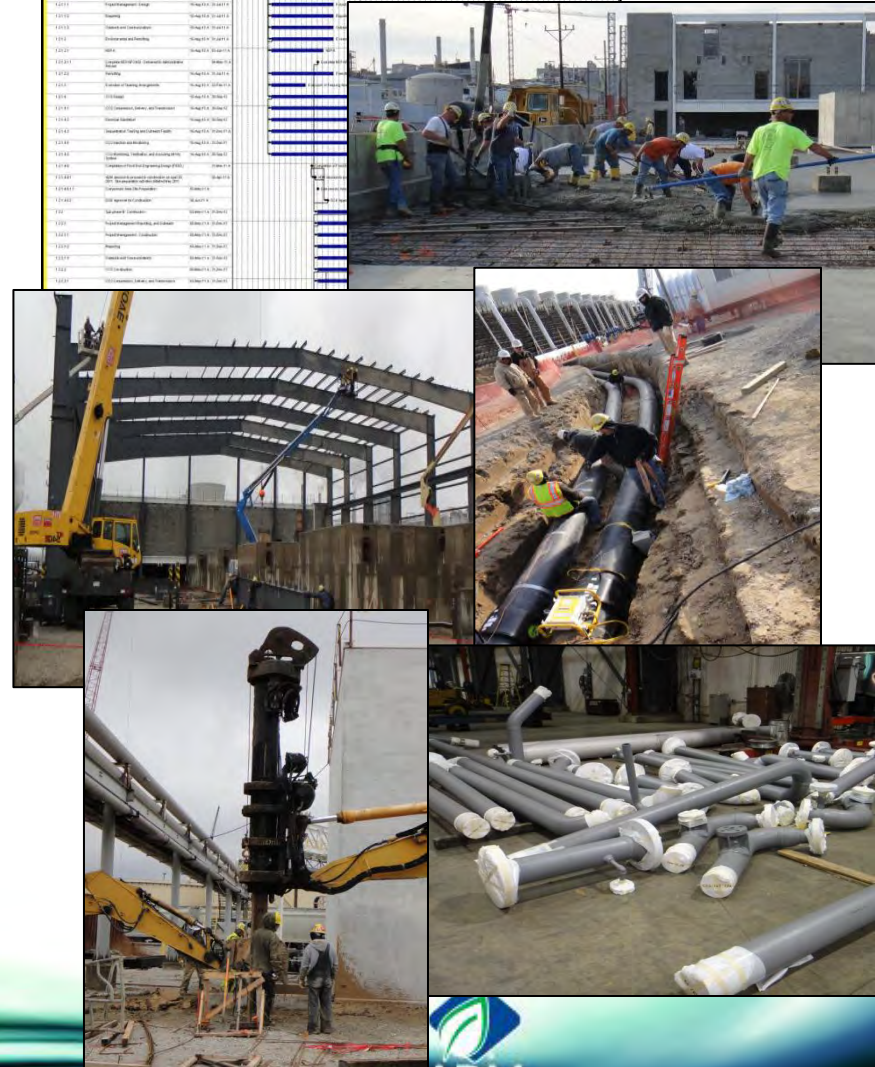
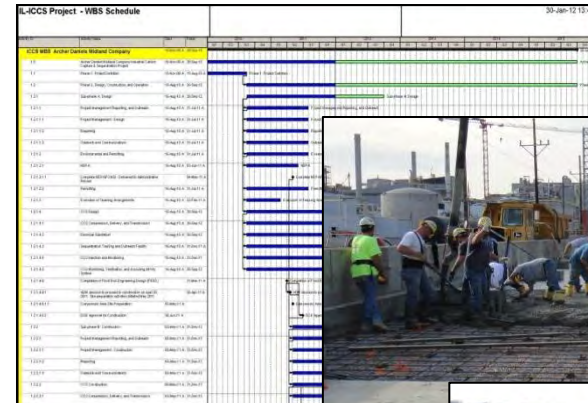
**Reducing Installation Cost**

# Engineering Design & Construction Planning

## Construction Scheduling and Equipment Installation

- Designed enclosures with a coordinated/staged construction schedule
- Minimized craft interference and accelerated building erection
- Staggered craft work schedule minimized interference
- The enclosure also facilitate construction during winter or periods of inclement weather
- Refurbished existing equipment and a structures to minimize project footprint and costs
- 24 month construction schedule

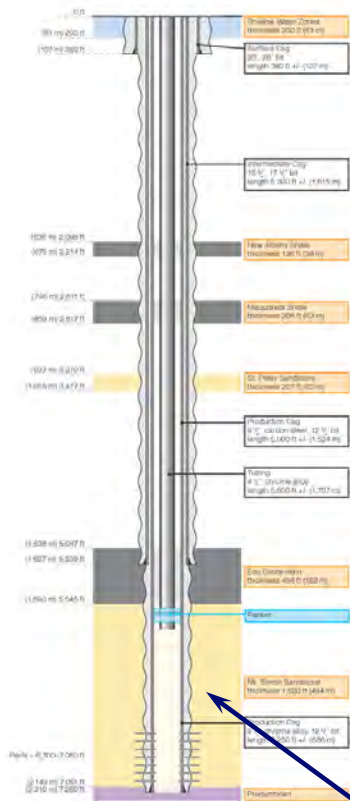
**Reducing Installation  
Time & Cost**



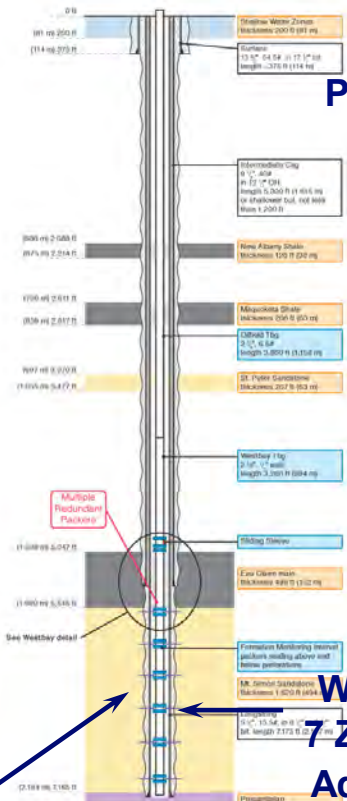
# Engineering Design & Planning Storage Site: Major Well Schematics

## Illinois Basin - Industrial Sources Major Well Schematics

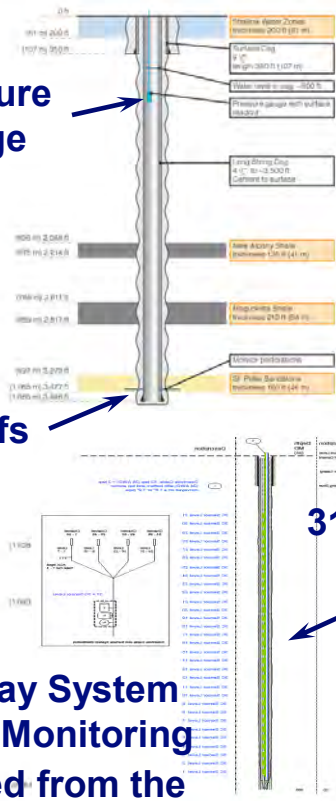
**Injection Well Schematic**



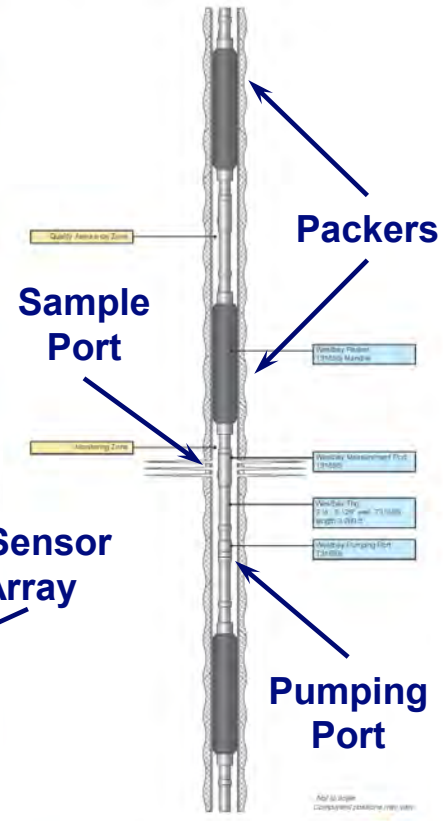
**In-Zone Monitor Well Schematic**



**Geophysical Monitoring Well Schematic**



**Detail of the Westbay System**



13 CR Casing

Westbay System  
7 Zone Monitoring  
Adapted from the  
water industry

**Built to Meet Class VI Standards**

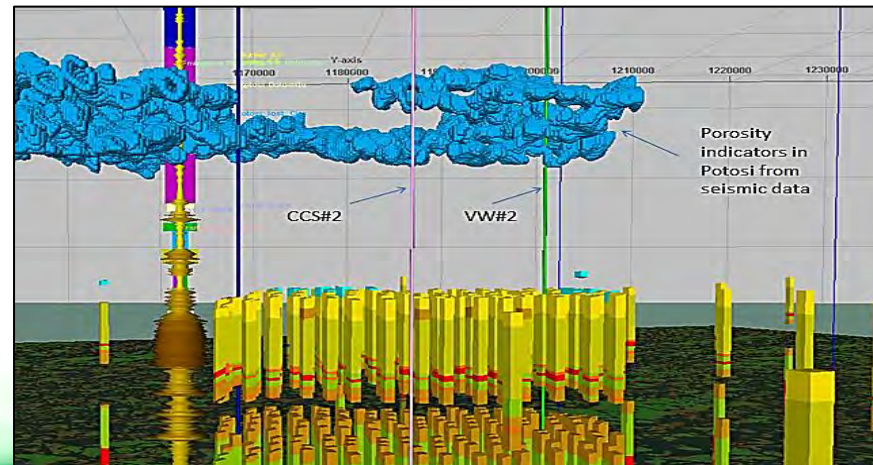
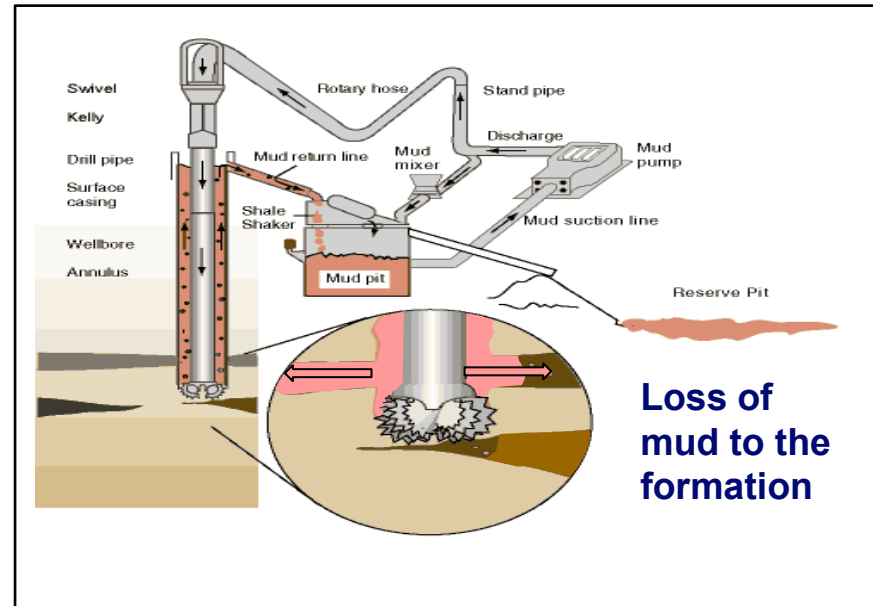




# Well Construction Management

## Storage Site - Lost Circulation Event

- CCS #1 LCM event in the Knox zone conventional LCM were not effective for this zone – Set cement plugs
- MW #1 – bypassed LCM and set cement plugs. 70% cost reduction vs. CCS #1
- Using of 3D seismic and modeling techniques to predict location and severity of lost returns.
- Developed drilling protocol to maximize drill time during LC event (drill thru the formation) and set cement plug.



# Environmental Monitoring (MVA) *Conceptual Framework*

**Near Surface**

**Deep  
Subsurface**

**Soil and Vadose Zone**

**Ground  
Water**

**Above  
Seal**

**Injection  
Zone**

Aerial Imagery

Soil CO<sub>2</sub> Flux

Geochemical  
Sampling  
P/T  
Monitoring

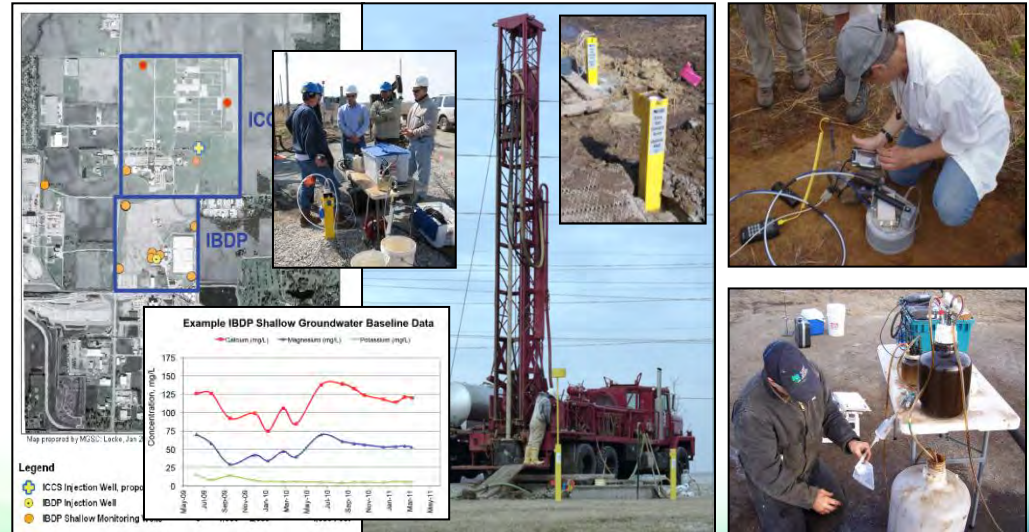
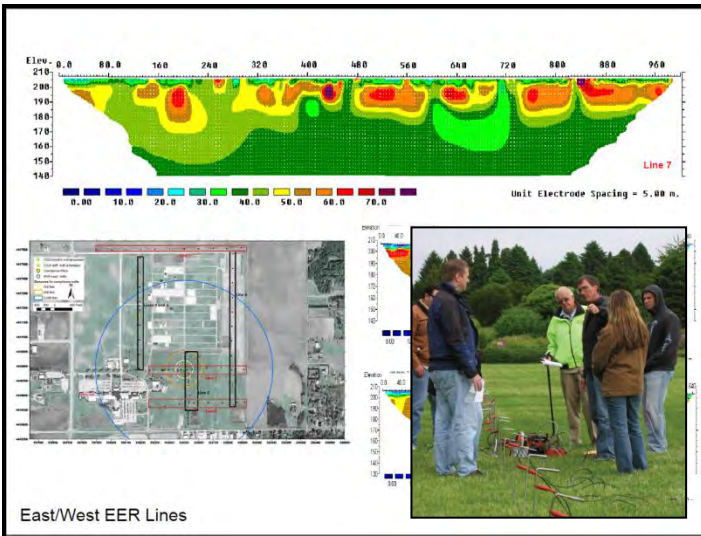
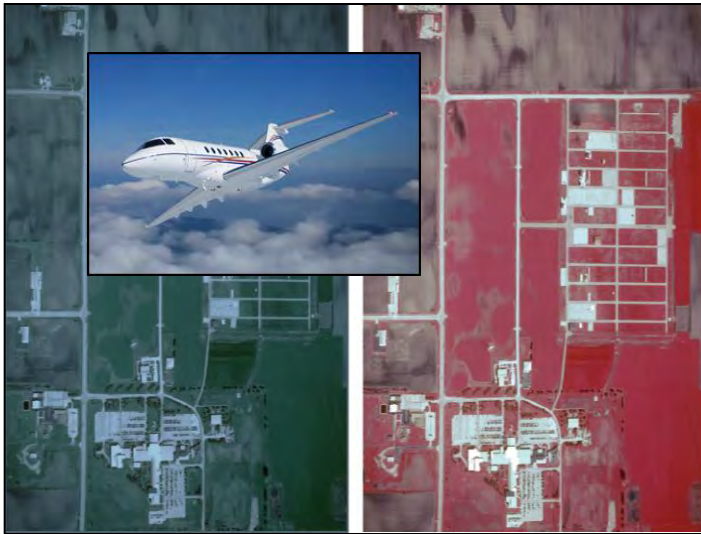
Geophysical  
Surveys  
Seismic  
Monitoring  
P Monitoring

Geophysical  
Surveys  
Geochemical  
sampling  
P/T Monitoring

# Environmental Monitoring

## Near Surface Monitoring

- Near infrared aerial imagery will be used to evaluate plant stress
- Soil resistivity characterized shallow depths for identification of optimum GWM locations
- GWM for baseline conditions and operational surveillance
- Surface soil CO<sub>2</sub> flux monitoring



# Environmental Monitoring

## Deep Subsurface Monitoring



- CCS#2 T/P monitoring
- Distributed Temp Sensor
- VM#2 Westbay system
- Multi-level sampling ports reservoir fluid collection and T/P monitoring
- GM#2 has 31 sensor array
- Pressure sensor to monitor above the seal
- Allow offset or walkaway Vertical Seismic Profile (VSP)
- Well logging (RST)

# ICCS Outreach and Education

## *Building on Current Regional CCS Activities*

- **Trusted Information Source**
- **Local, Regional, National, and International Events**
  - Decatur Public Events
  - AAPG Short Courses
  - IEA GHG Summer School 2011
- **Providing Information**
  - Invited presentations
  - Technical presentations
  - Model presentations
  - Teacher workshops
  - Coordination with STEM.
- **Education Development**
  - STELA Learning Environment
  - Undergraduate CCUS course

*Working with local programs to leverage program dollars.*



# National Sequestration Education Center

- Innovative Educational Spaces
- Academic Curricula
- Community & Industry Workshops
- Workforce Training Activities
- Visitor Center
- K-12, Community & Regional Outreach
- Sequestration Training & Learning Array (STELA)



Project Groundbreaking Ceremony: August 24, 2011

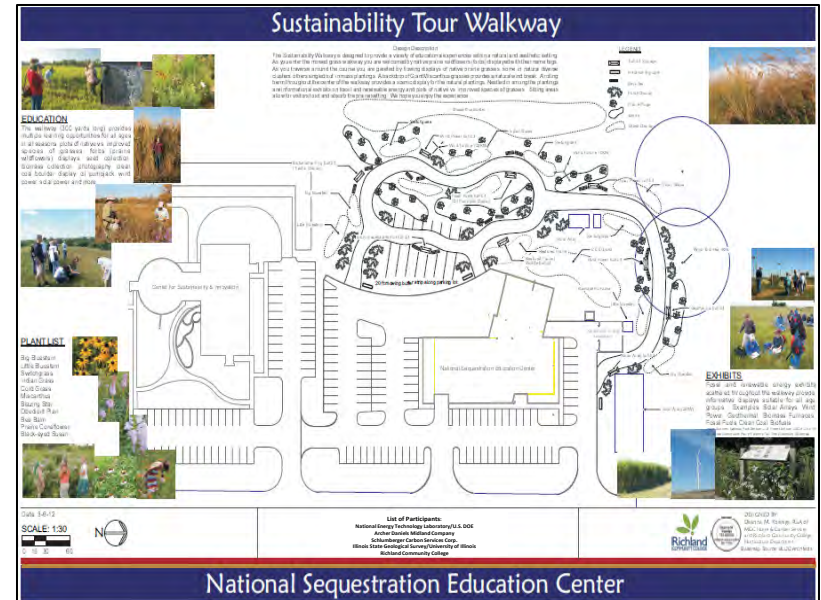
# Richland Community College

Richland is developing two new degree programs with an emphasis on CCUS:

- Associate of Applied Science Engineering Technology-Sequestration Specialty (Starts in fall 2012)
- Associate of Science - Sequestration Concentration

Several universities in Illinois have already reviewed and accepted Richland CCUS courses as electives in their degree program(s).

This recognition allows the students obtaining their 2-year degree from Richland to receive credits for the CCUS courses when they transfer to a 4-year degree program at these universities.



# Environmental and Cost Benefits

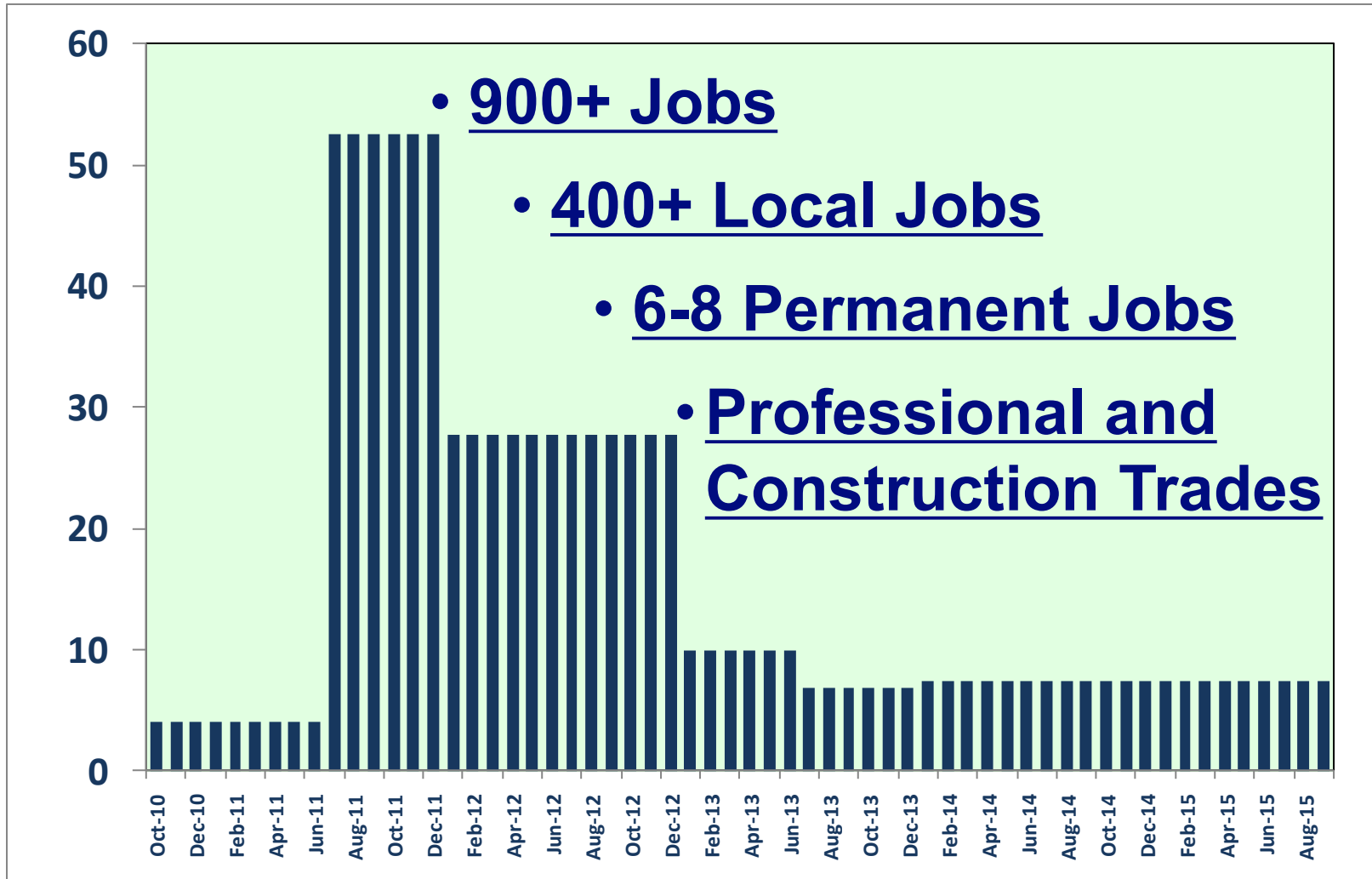
## *GHG Reduction & Fuel LCA*



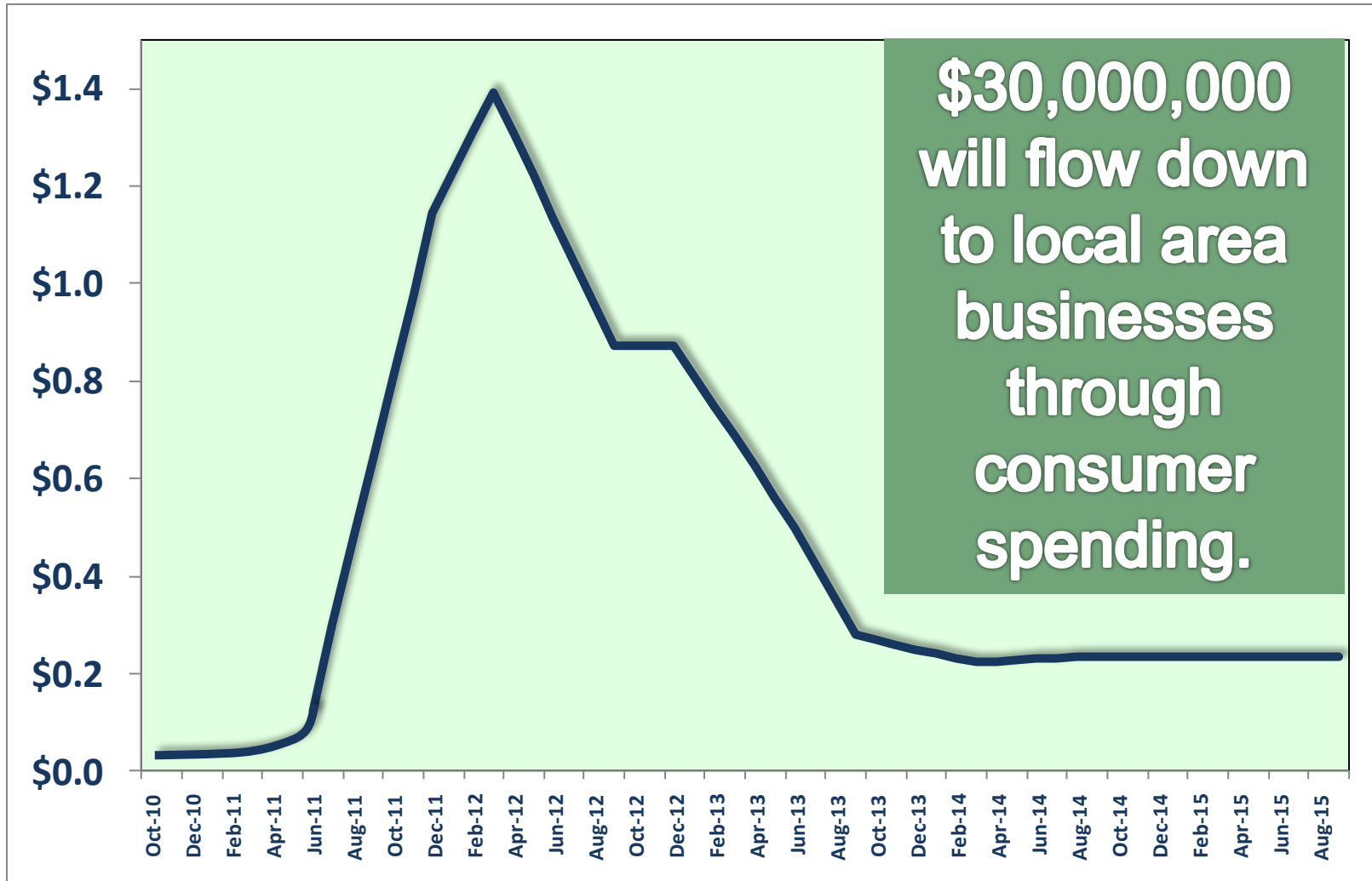
- Significant CO<sub>2</sub> site emission reductions.
- Injected CO<sub>2</sub> has a reduction of 94% GHG emissions based on using Midwest electricity (coal).
- CCS will significantly reduce the carbon footprint of fuel ethanol.
- The operational expense is significantly lower than post combustion capture.
- 15 billion gallons annually, represents about 40 million metric tons of CO<sub>2</sub>.



# Estimated Jobs Creation & Retention



# Local Area Businesses



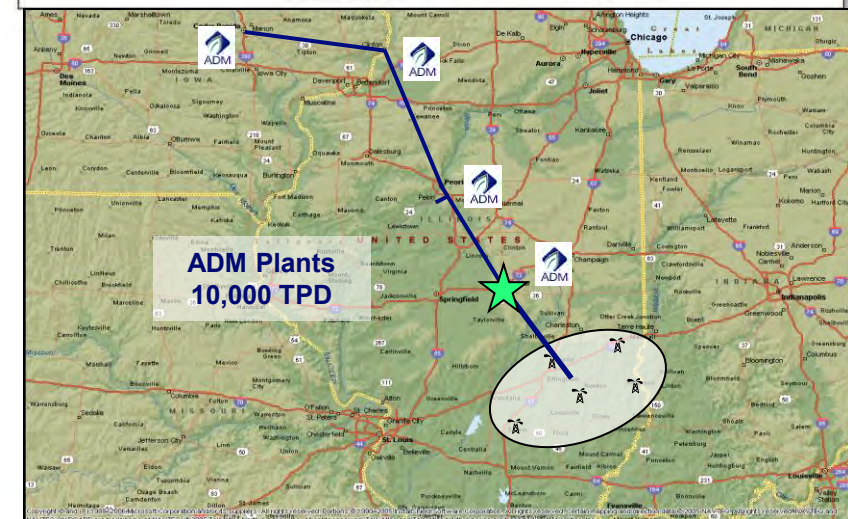
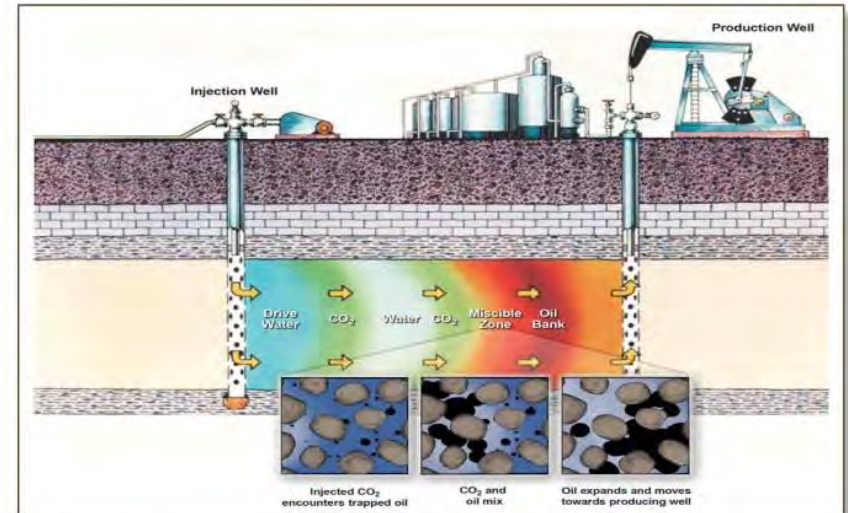
Estimated from Consumer Spending: US Labor Dept, Bureau of Statistics, April 2009.



# Future Commercial Potential

- Enhanced Oil Recovery
- Product Development
  - CO<sub>2</sub> Liquids
  - Carbonates
  - Fertilizer
- Process Development
  - SC Extraction
  - Solvent Applications
- Carbon Management
  - Storage
  - Trading & Risk Management

(1) BASIN ORIENTED STRATEGIES FOR CO<sub>2</sub> ENHANCED OIL RECOVERY: ILLINOIS AND MICHIGAN BASIN OF ILLINOIS, INDIANA, KENTUCKY AND MICHIGAN; Advanced Resources International, February 2006



•Illinois Basin - Oil Producing Region  
•Est. Recoverable Oil = 700 million bbls<sup>(1)</sup>  
•Est. CO<sub>2</sub> Requirements = 150 million tons

# Project Construction *Progress Photographs*



# Project Construction *Progress Photographs*



# Project Construction

## *Progress Photographs*



# IL-ICCS: Project Benefits Review

## Public Benefits

- Recovery Act funding creating jobs for economic recovery
- Mitigating risks for the industry to demonstrate the largest integrated, saline storage project in the U.S.
- Community Outreach - CCUS technologies
- Collected CO<sub>2</sub> is produced from biologic fermentation, a significant feature of the Illinois ICCS project is its “negative carbon footprint.”
- Validate the Mt. Simon Sandstone saline reservoir site for commercial-scale, long-term geologic storage of CO<sub>2</sub>. Collect crucial scientific and engineering data in advance of carbon capture requirements

## Project Outcomes

- Demonstrates cost advantages/economic viability of CCS at ethanol plants
- Facilitates exploration of long-term CO<sub>2</sub> utilization options- EOR Illinois Basin Develops a market for utilization of U.S. geologic saline storage capacity that ranges from 1,700 to 20,000 billion metric tons (2010 Carbon Sequestration Atlas, NETL)



# Thank You!

## Industrial Carbon Capture and Storage Project:

- U.S. Department of Energy Award No. DE-FE-0001547
- Administered by the DOE's Office of Fossil Energy
- Managed by the National Energy Technology Laboratory
- DOE cost share from American Recovery and Reinvestment Act of 2009

## Cost Share Agreements:

- Archer Daniels Midland Company
- University of Illinois through the Illinois State Geological Survey
- Schlumberger Carbon Services
- Richland Community College

## Project Team Members Contacts:

- Dr. Sai Gollakota (NETL-DoE) [Sai.Gollakota@NETL.DOE.GOV](mailto:Sai.Gollakota@NETL.DOE.GOV)
- Dr. Robert Finley, (ISGS) [finley@isgs.illinois.edu](mailto:finley@isgs.illinois.edu)
- Eric Berlin, (Schlumberger Carbon Services) [berlin1@slb.com](mailto:berlin1@slb.com)
- Dr. Douglas Brauer (RCC) [dbrauer@richland.edu](mailto:dbrauer@richland.edu)

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