



# South Louisiana Enhanced Oil Recovery / Sequestration R&D Project

## Carbon Storage Program Infrastructure Annual Review Meeting

Sheraton Station Square Hotel, Pittsburgh, PA

November 15-17, 2011

J Roger Hite, Principal Investigator





## CO<sub>2</sub> Sequestration R&D Project

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### ✓ Objectives

- Understand CO<sub>2</sub> behavior and migration
- Demonstrate sequestration projects can be performed safely

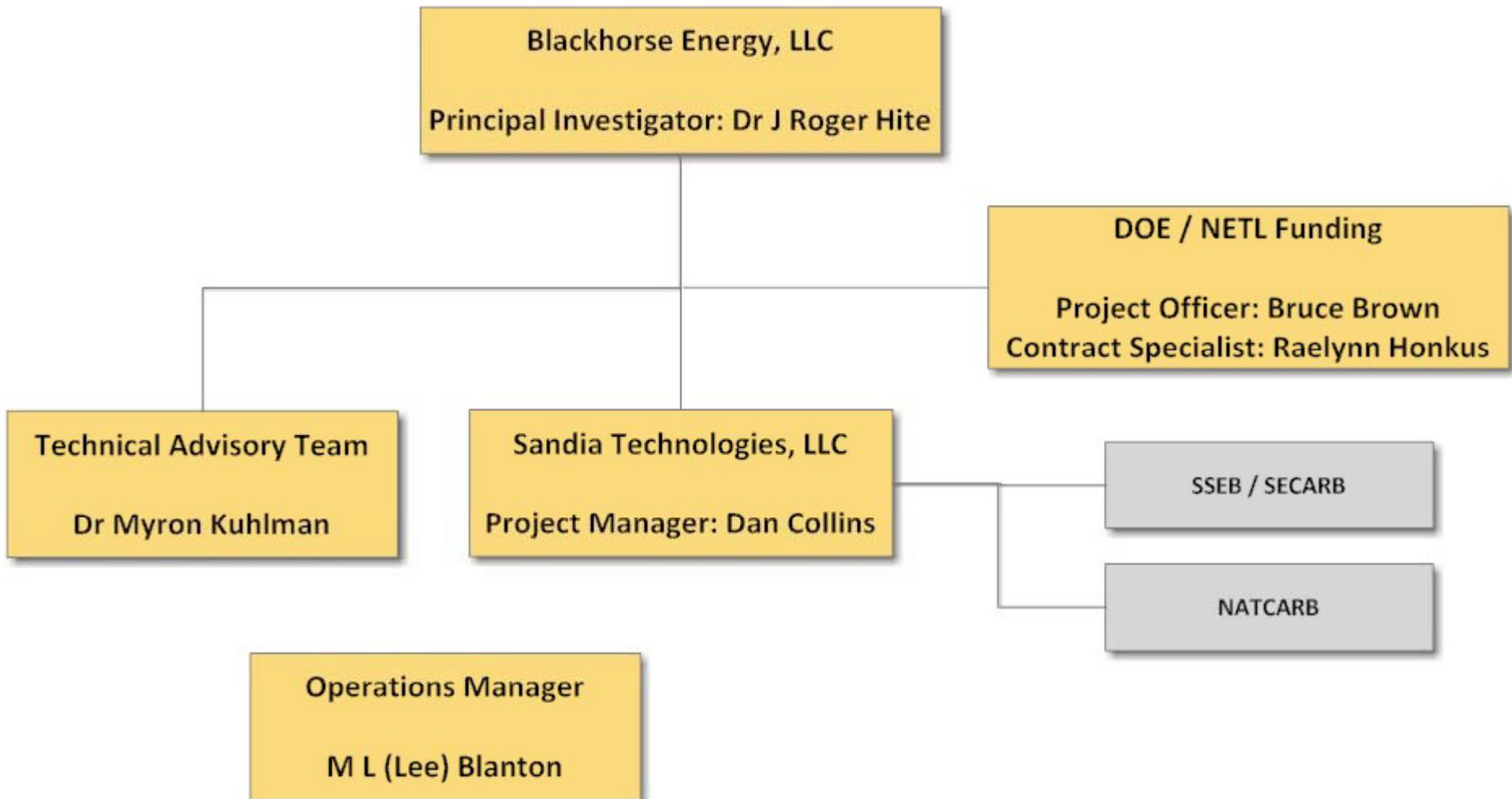
### ✓ Project Management

- Two simultaneous projects
  - Sequestration R&D project – funded by DOE / NETL
  - EOR project – funded by Blackhorse Energy
- Both projects benefit from each other.
- Sequestration Project Management by Sandia Technologies



# Project Organization

## Steering Team





## Project Organization

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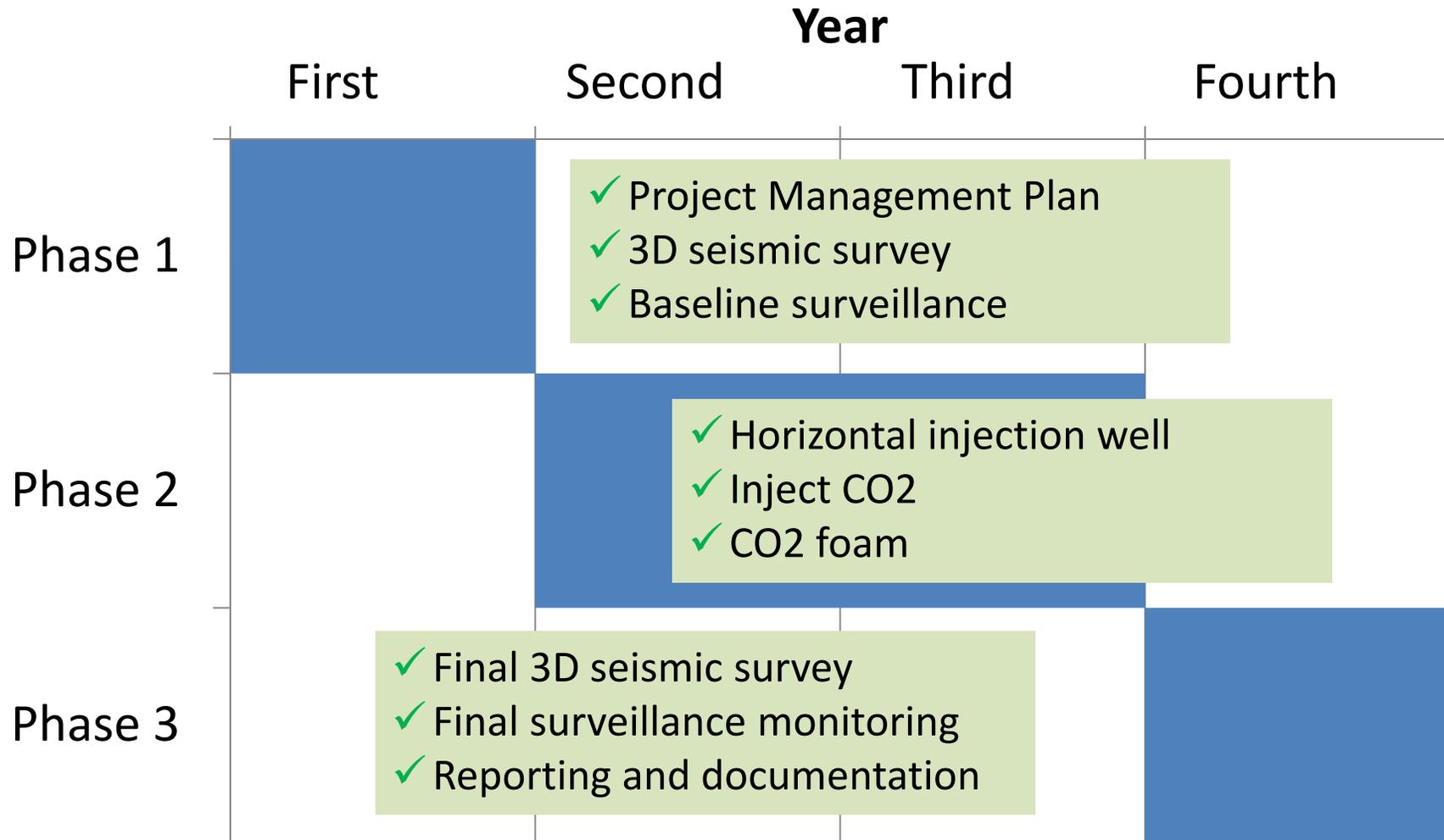
### ✓ Other Participants

- Universities
  - Rice University
  - Louisiana State University
  - University of Texas - Austin
- Schlumberger Carbon Management Services
- Computer Modeling Group

### ✓ Endorsements

- Scott Angelle, Secretary, Louisiana Department of Natural Resources
- Ken Nemeth, Executive Director, Southern States Energy Board

# Project Timeline





## Project Technology

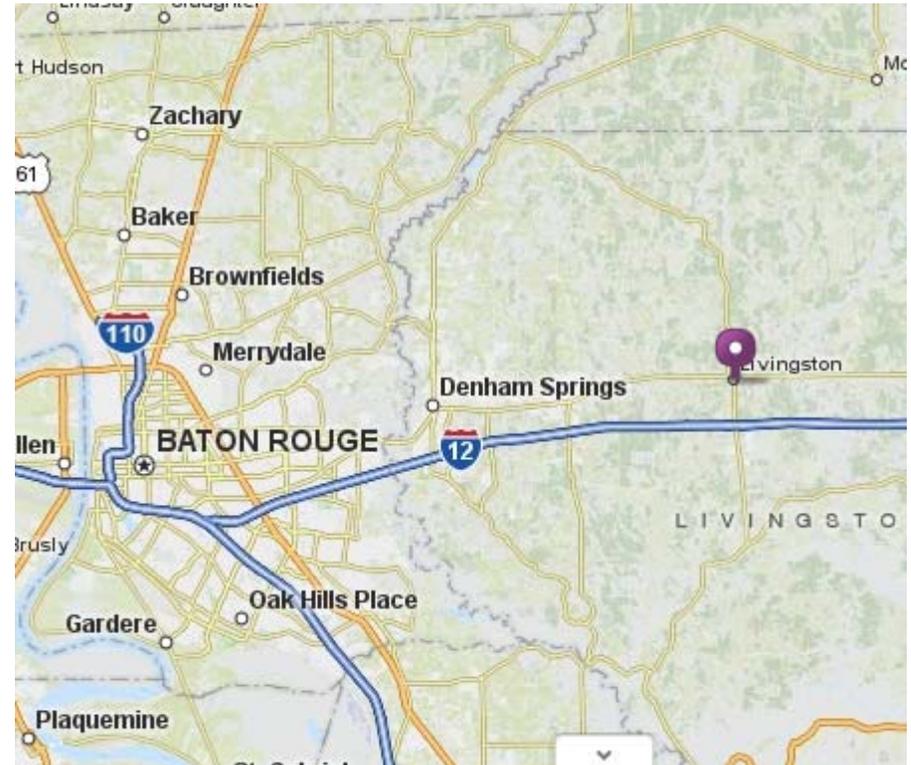
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- ✓ R&D on emerging technology to increase / characterize sequestration
  - 3D (or 4D) seismic to detect CO<sub>2</sub> migration
  - Horizontal injector to improve CO<sub>2</sub> placement
  - Advanced logging tools and fiber optics to monitor CO<sub>2</sub> migration
  - Foam for increased sweep / added storage
- ✓ Establish that CO<sub>2</sub> can be sequestered safely in Gulf Coast Reservoirs



## Livingston Reservoir

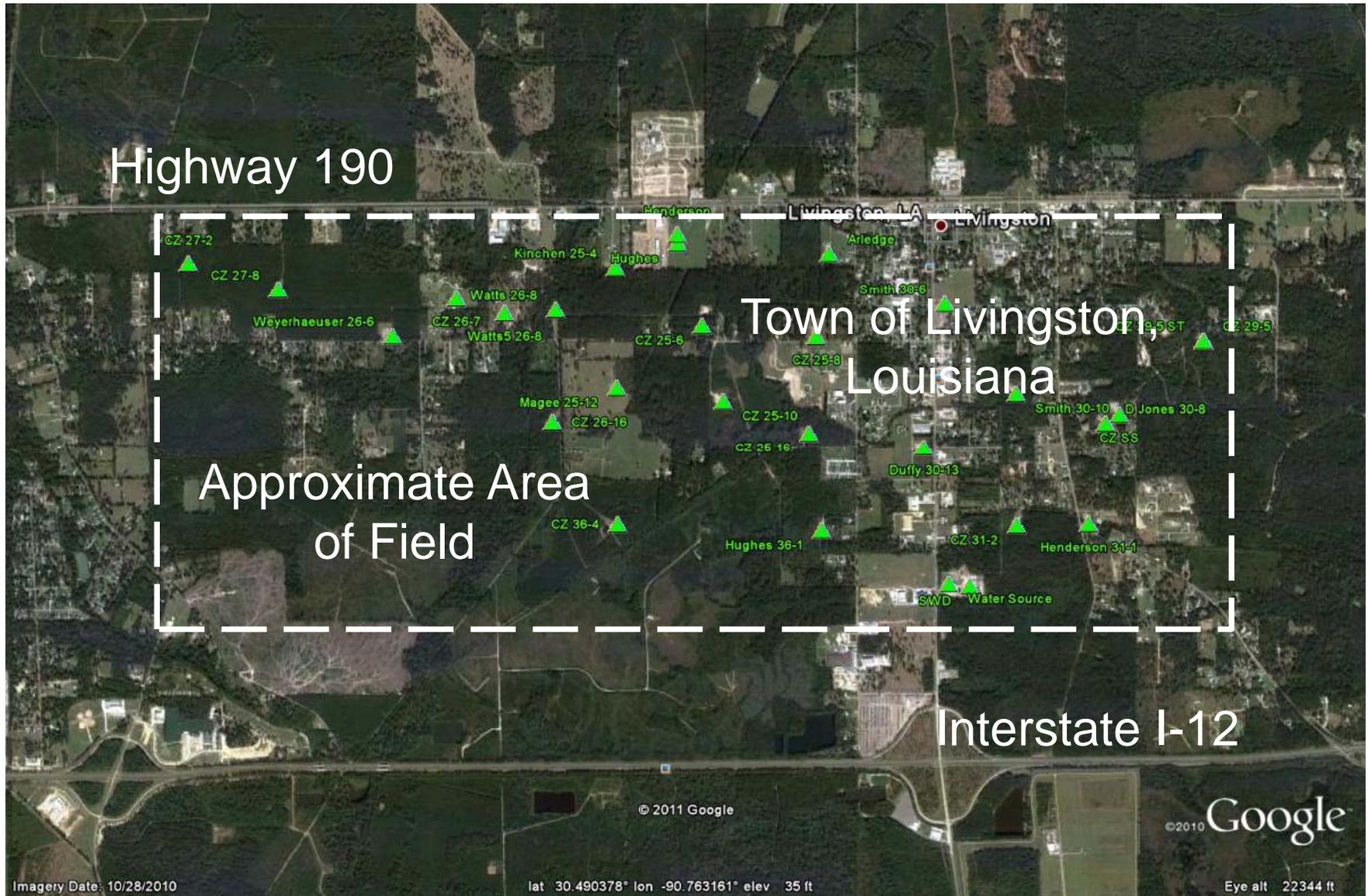
- ✓ Approx 26 miles east of Baton Rouge
- ✓ Discovered in 1983
- ✓ Productive Formation: Wilcox
  - 10,000 ft deep
  - 2,200 acres
  - Structural trap against fault



### Production History

- ✓ OOIP 28 MM Bbls of 39° API oil
- ✓ Waterflooding began in 1987 by Amoco
- ✓ Primary and waterflood recovery 8.2 MM Bbls (29% OOIP)

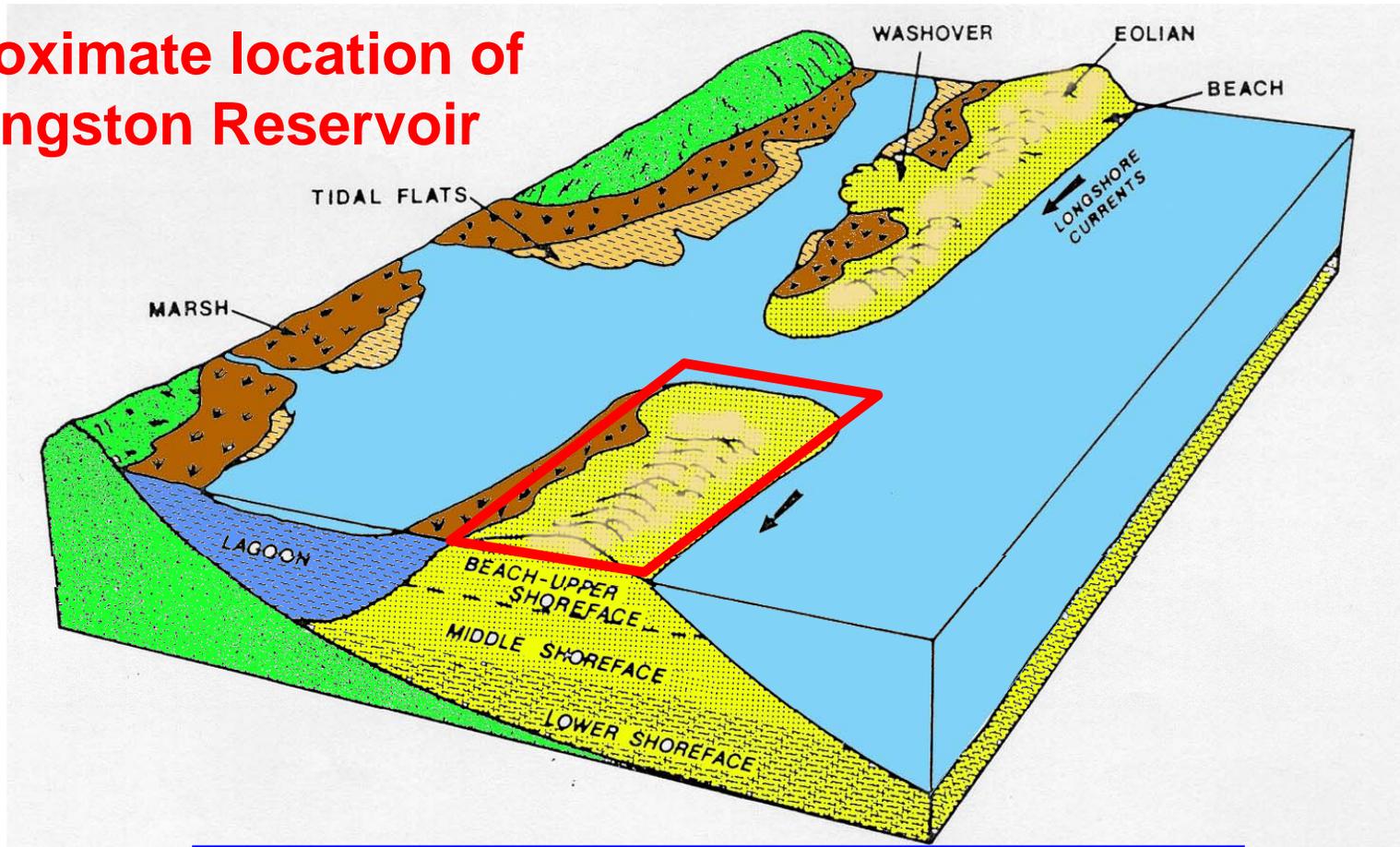
# Livingston Reservoir Location





# Livingston Reservoir

Approximate location of  
Livingston Reservoir



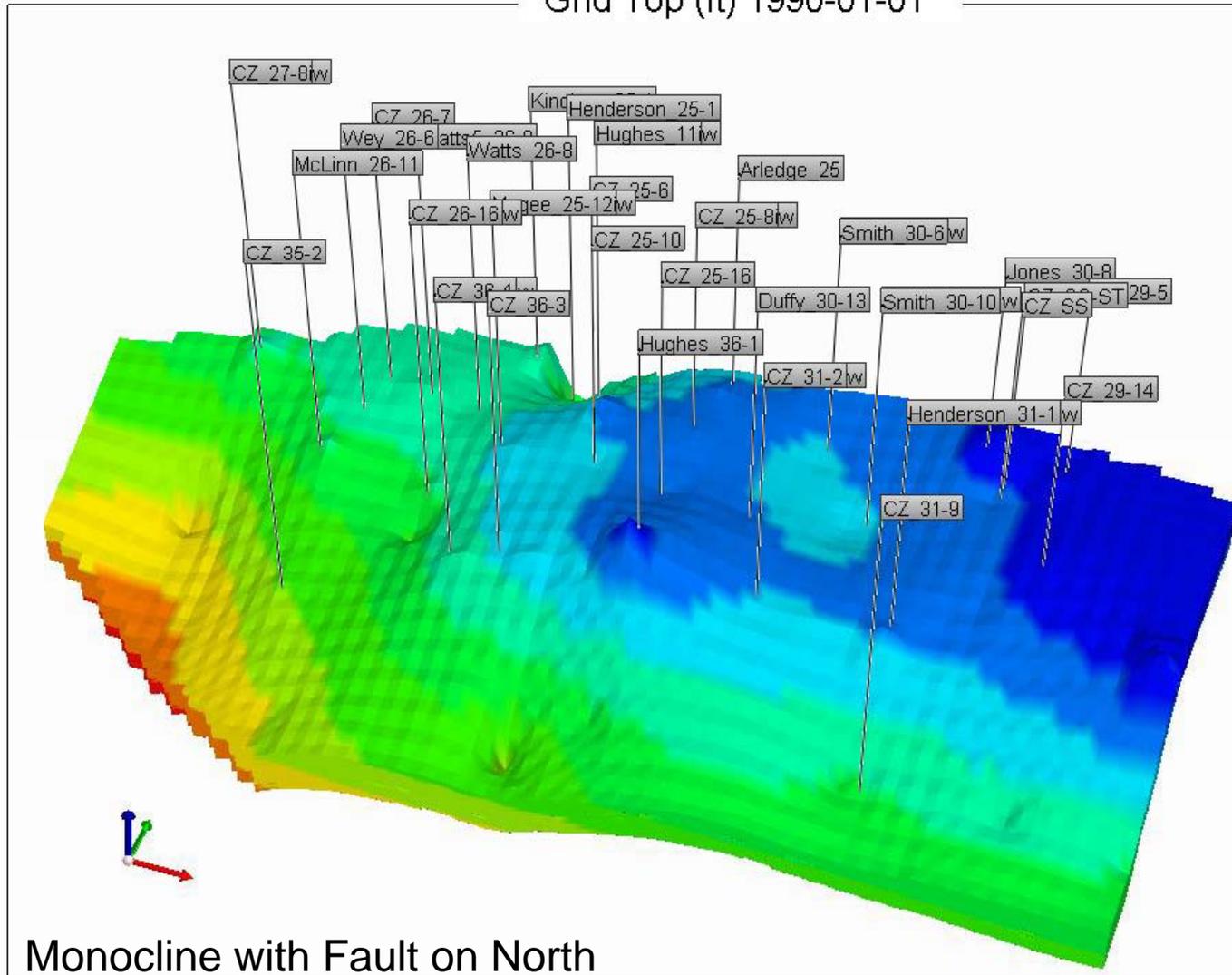
**DEPOSITIONAL MODEL FOR WILCOX  
SANDSTONE BARRIER ISLAND**

(After Moslow & Reinson, 1984)

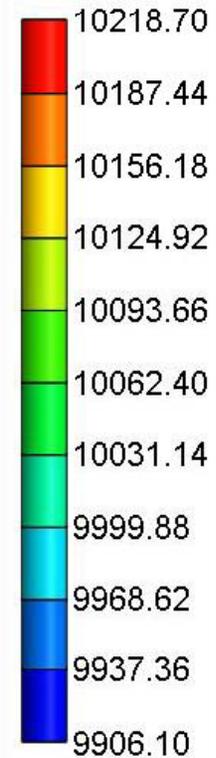
# Livingston Structure

Livingston Field Model 2011  
Grid Top (ft) 1990-01-01

File: Livingston 20  
User: Myron Kuhl  
Date: 10/24/2011  
Z/X: 27.00:1



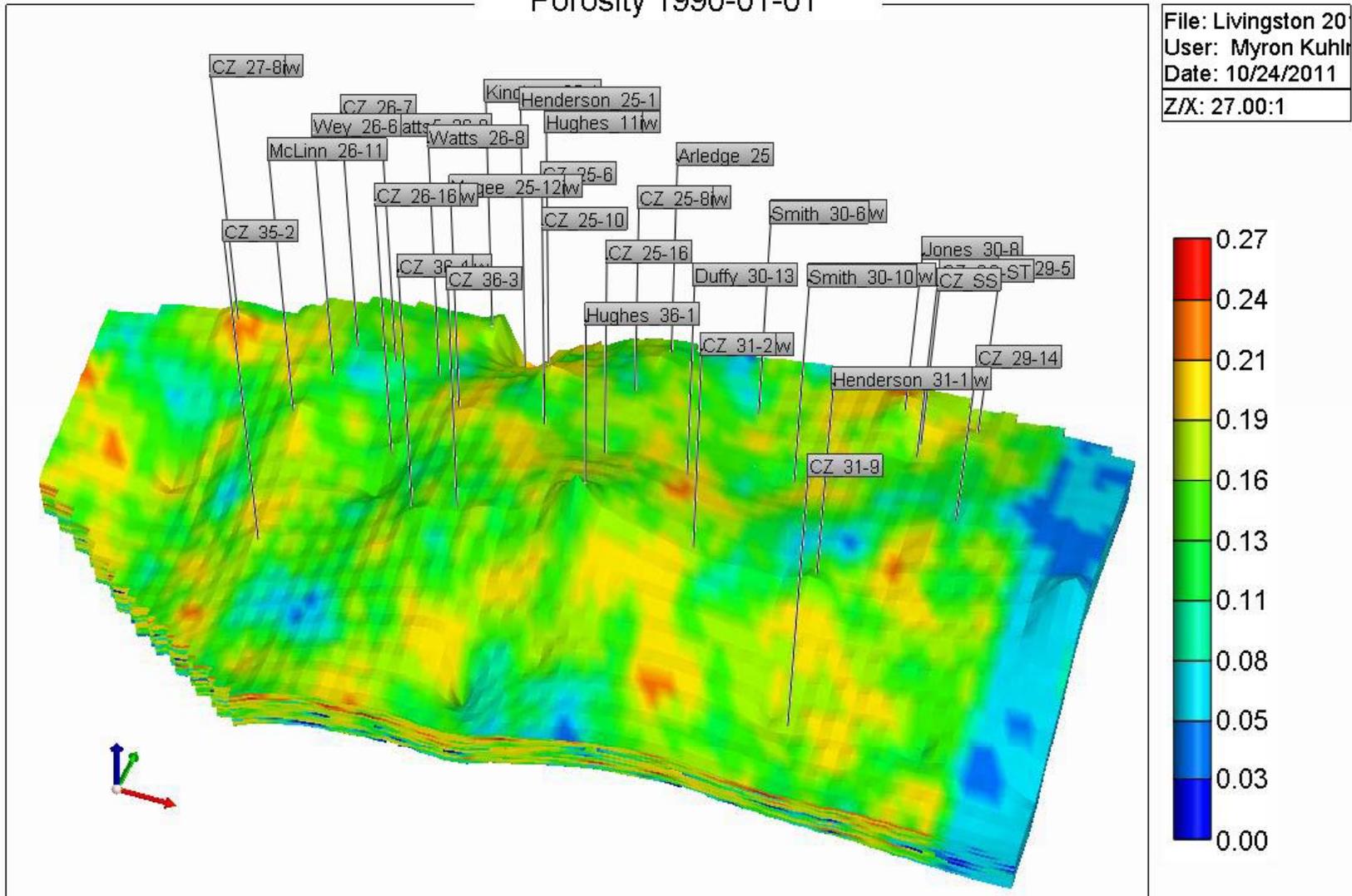
Subsea depth, ft



Monocline with Fault on North

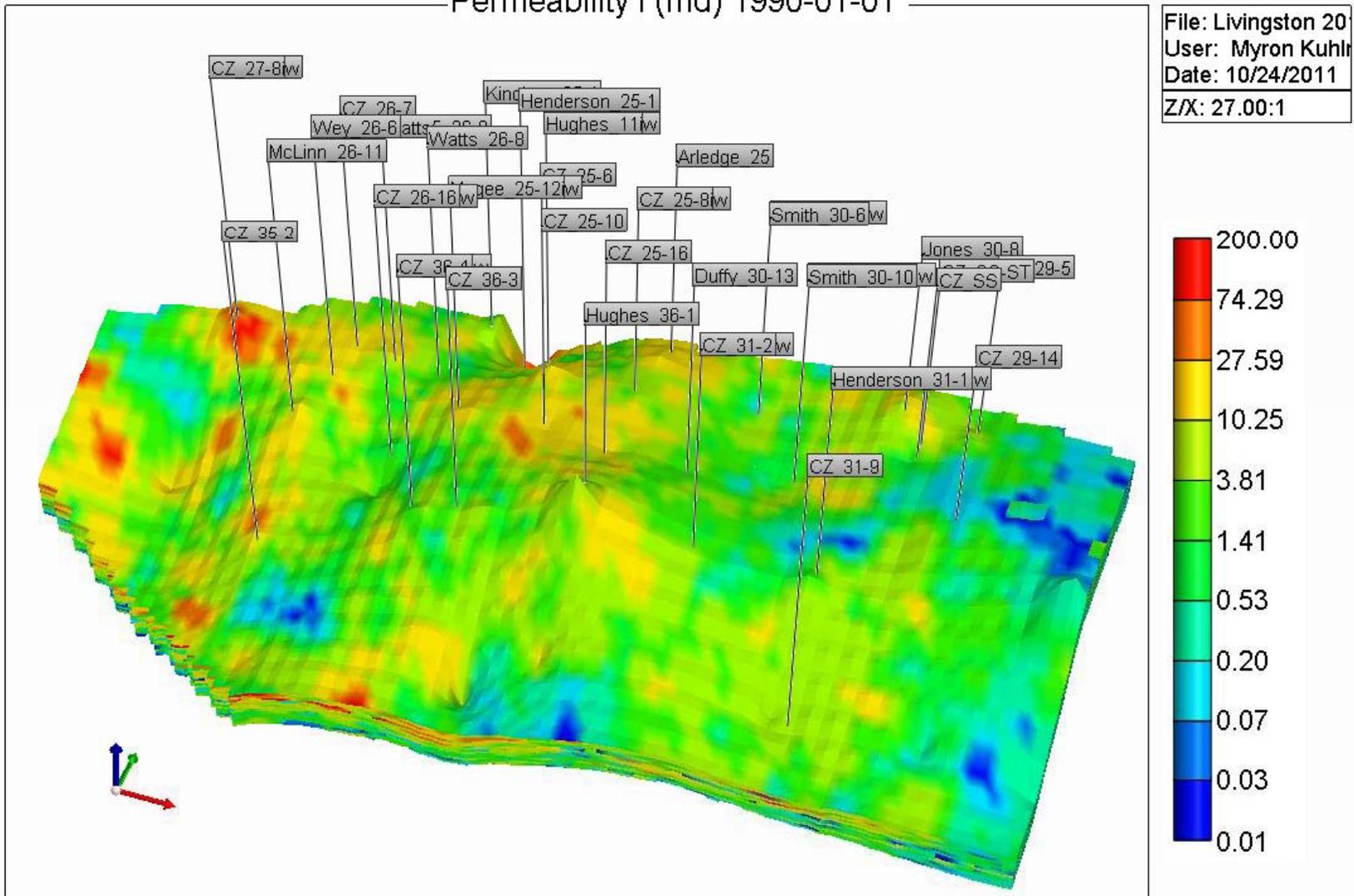
# Porosity Distribution

Livingston Field Model 2011  
Porosity 1990-01-01



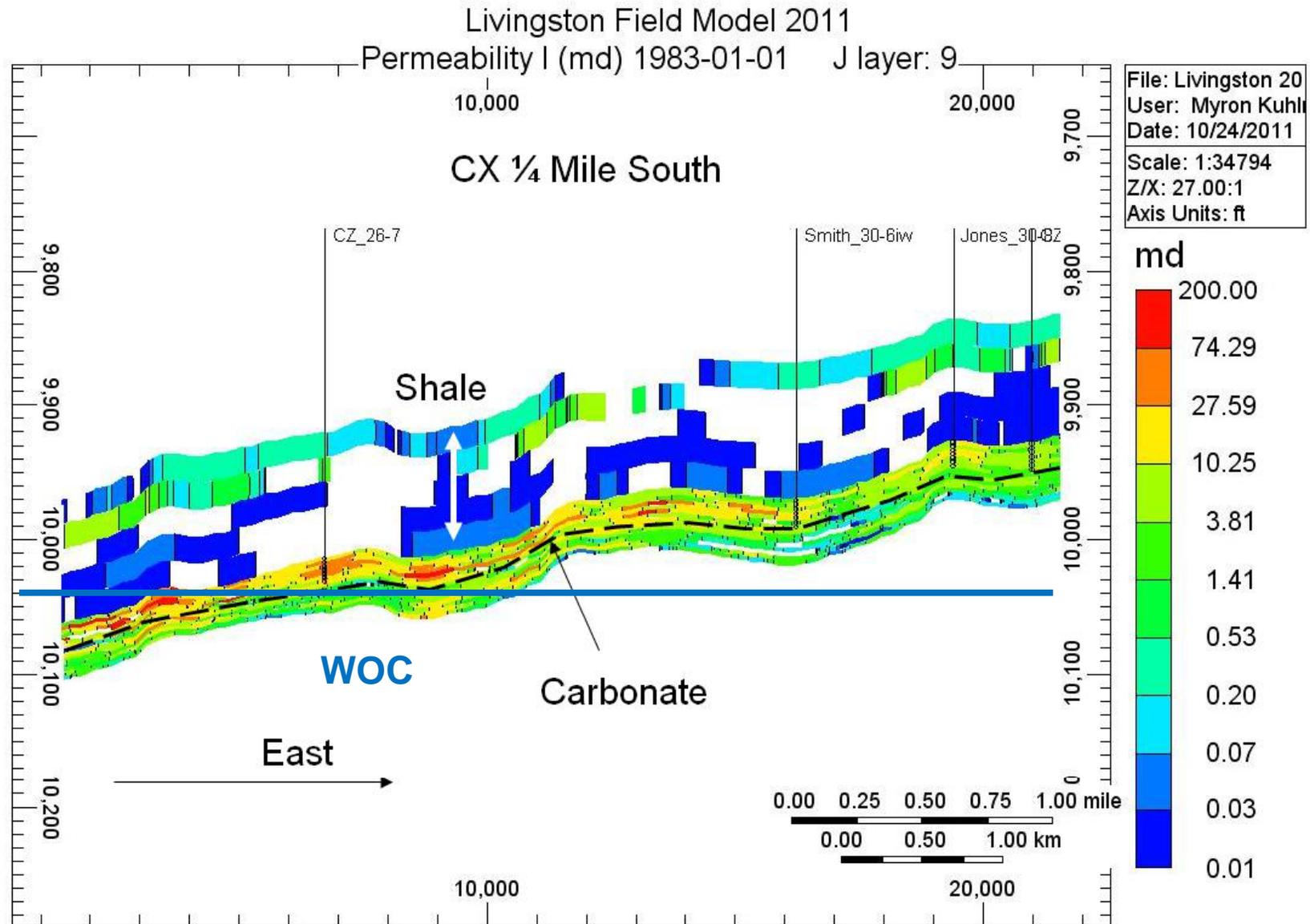
# Permeability Distribution

Livingston Field Model 2011  
Permeability I (md) 1990-01-01





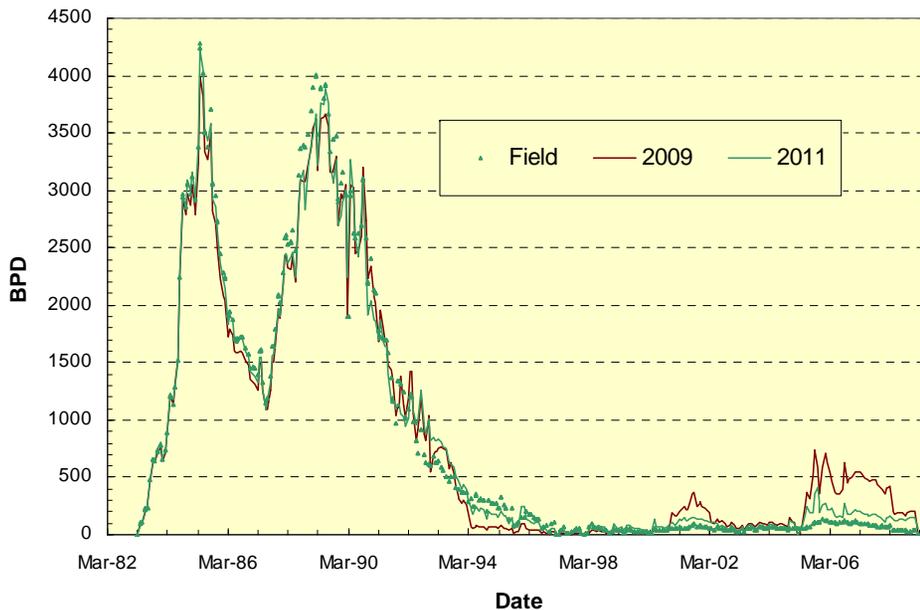
# East-west Cross Section



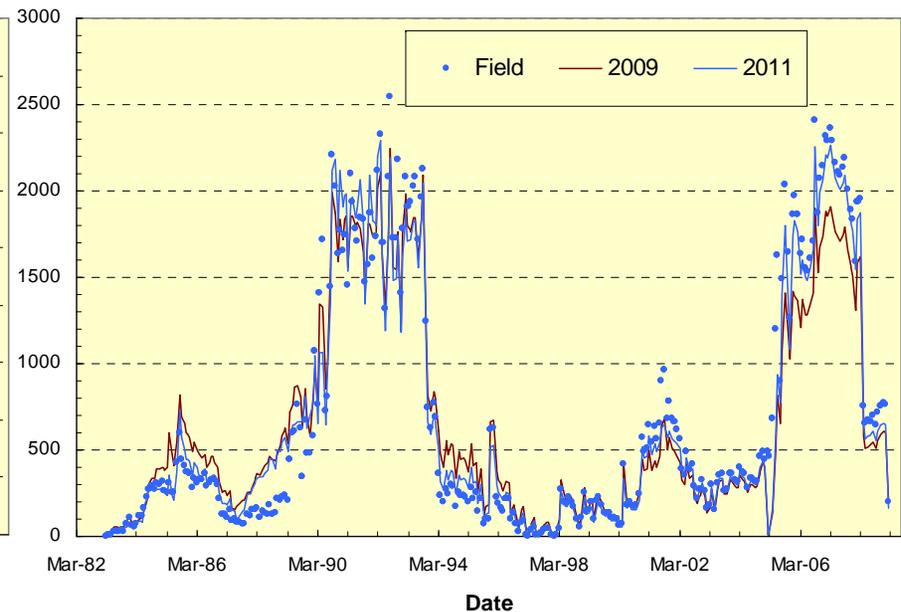
# History Match

- ✓ Matched oil and water production to calibrate model for CO<sub>2</sub> forecast
- ✓ Good match of both

Livingston Model Oil Production



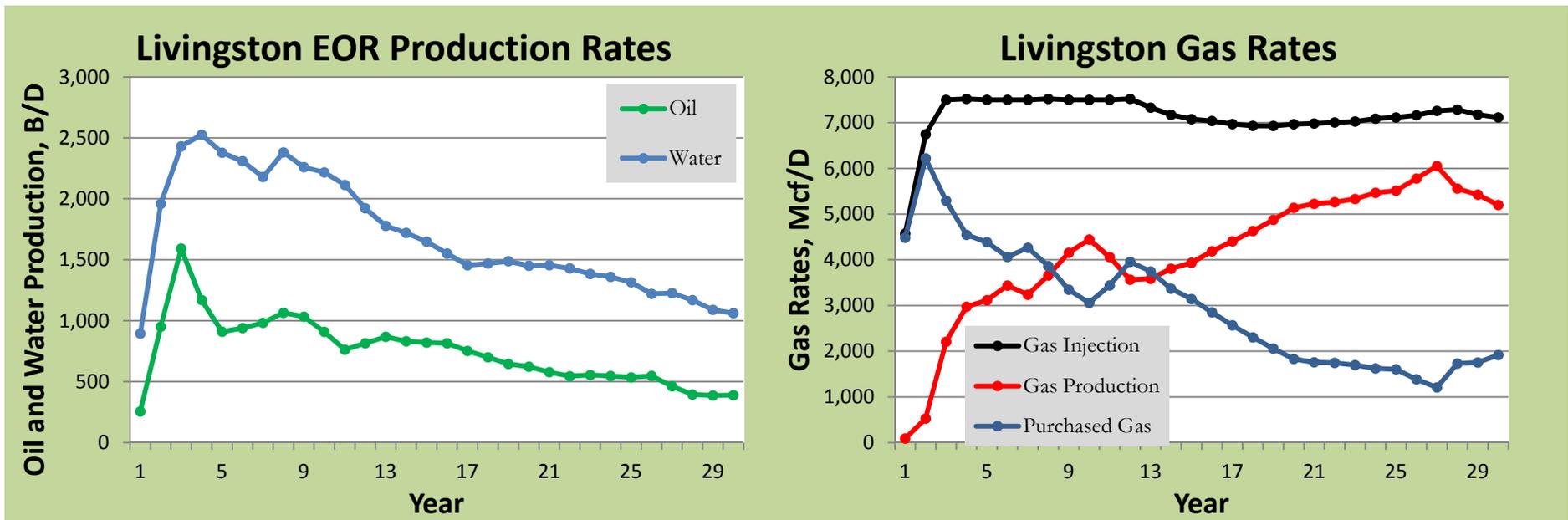
Livingston Model Water Production





# CO<sub>2</sub> Injection Forecast

- ✓ 30 year production life
- ✓ Production of 8.2 MMB Oil (29 % OOIP), 18.6 MMB Water, and 45.6 Bcf Gas
- ✓ CO<sub>2</sub> injection = 78.1 Bcf Gas, including 32.6 Bcf of purchased CO<sub>2</sub> (net utilization 4.0 Mcf/Bbl)
- ✓ Overall recovery of 16.4 MMBbls after CO<sub>2</sub> flood (59% OOIP)





## Summary

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### EOR Project

- ✓ Livingston is a CO<sub>2</sub> EOR project with good profitability

### Sequestration R&D Project

- ✓ EOR project provides a ready location to study sequestration
- ✓ Establish that CO<sub>2</sub> can be sequestered safely in Gulf Coast Reservoirs

### Both Projects

- ✓ Provide synergy for each