

# Carbon Storage Program Infrastructure Annual Review Meeting

## Characterization of the Triassic Newark Basin in Southeastern New York/Northern New Jersey FE0002352

*November 16, 2011*

John Conrad – Conrad Geoscience Corp. (Presenting)

Daniel Collins & Philip Papadeas - Sandia Technologies, LLC

Chris Brown – Conrad Geoscience Corp.

November 15-17 • Sheraton Station Square • Pittsburgh, Pennsylvania



**CONRAD GEOSCIENCE CORP.**  
One Civic Center Plaza, Suite  
501 Poughkeepsie, NY 12601

- **Acknowledgment**: This material is based upon work supported by the Department of Energy [National Energy Technology Laboratory] under Award Number DE-FE0002352, Contract No. 18131 from the New York State Energy Research & Development Authority [NYSERDA], and “In Kind” Cost Share from Schlumberger Carbon Services, Weatherford Laboratories, National Oilwell Varco, New York State Museum, and Rutgers University.

- **Disclaimer**: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

NYSERDA has not reviewed the information contained herein, and the opinions expressed in this presentation do not necessarily reflect those of NYSERDA or the State of New York

# Focus of this Presentation

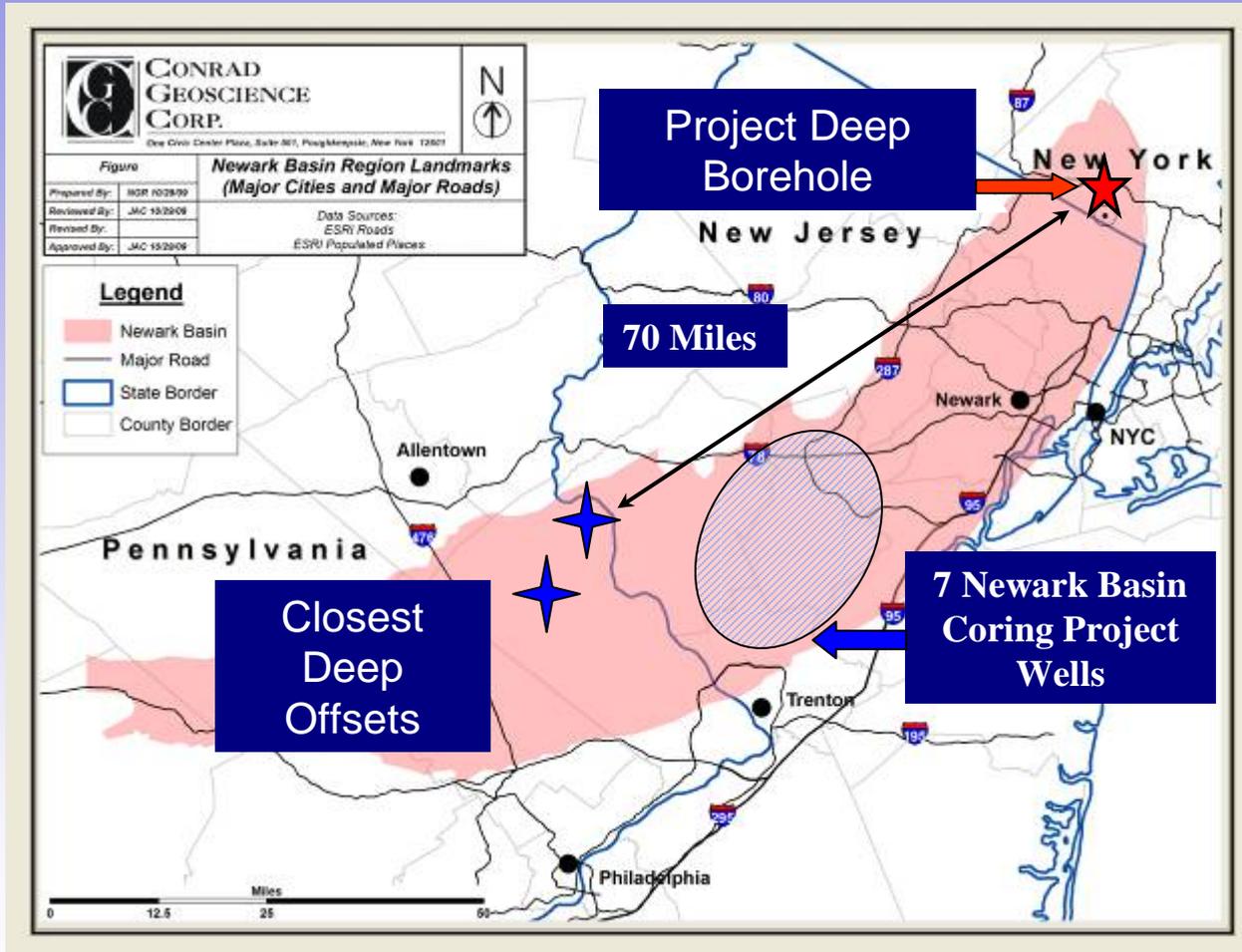
- Public Outreach Efforts



- Drilling of the Deep Stratigraphic Borehole at the NYSTA Exit 14 Location



# Physiogeographic Setting of the Newark Basin



- Newark Basin stretches from Rockland County, New York, southwest across northern New Jersey, and into southeastern Pennsylvania (140 miles long by 32 miles wide)
- Geographic extent ~ 2,700 square miles
- The Newark Basin is in close proximity to large population areas and a heavily industrialized section of the country (28 MM tons/year CO<sub>2</sub> in closest NY/NJ counties)
- Deep offsets (mid 1980s) are more than 70 miles away – oil and gas exploration
- 7 Newark Basin Coring Project wells Central New Jersey ~3,500 ft deep – chronostratigraphy focus

# Project is Located in an “Urban/Highly Developed” Environment



- Approximately 300,000 county residents with significant infrastructure
- East-West Line shot along New York State Thruway Authority’s I-87 from Mile Post 17.63 to 30.17 across the basin (March/April 2011)
- North South Line shot along Garden State Parkway from I-87 to Mile Post 165.9 (April 2011)
- Deep Characterization Well drilled at the New York State Thruway Exit 14 Tandem Truck Parking Lot within the northeast I-87 “clover leaf”

# NYSTA Exit 14 Tandem Truck Lot Drilling Location



- Deep Characterization Well drilled on the eastern portion of the New York State Thruway Exit 14 Tandem Truck Parking Lot.
- Lot is located on the north bound I-87 on ramp “clover leaf”
- Improvements for drilling included buildup and leveling the “off pavement” area, relocating lot lighting, and extending paved area to an “equivalent” portion to that used by the project

# Public Outreach Efforts

- Clarkstown Township
  - Supervisor’s Meeting – January 2011
  - Periodic Teleconference Updates/Project Progress
  - July 5, 2011 Town Board “Working Meeting” Presentation
- Rockland County Executive’s Staff Meeting July 5, 2011
- Participated in day long Clarkstown Environmental Summit – March 5, 2011
- Community Mailer – May 2011 - 53,000 listed Contacts
- Local Media –
  - WMAC Northeast Public Radio
  - The New York Times
  - Huffington Post
  - Rockland County Times
  - Lower Hudson News
  - The Nanuet Patch and other local blogs
- “Open House” at Drilling Site (state and local officials/media outlet coverage) – September 7, 2011
- Project Website [www.tricarb.org](http://www.tricarb.org)



# Public Outreach Event – September “Open House” At the Drilling Site

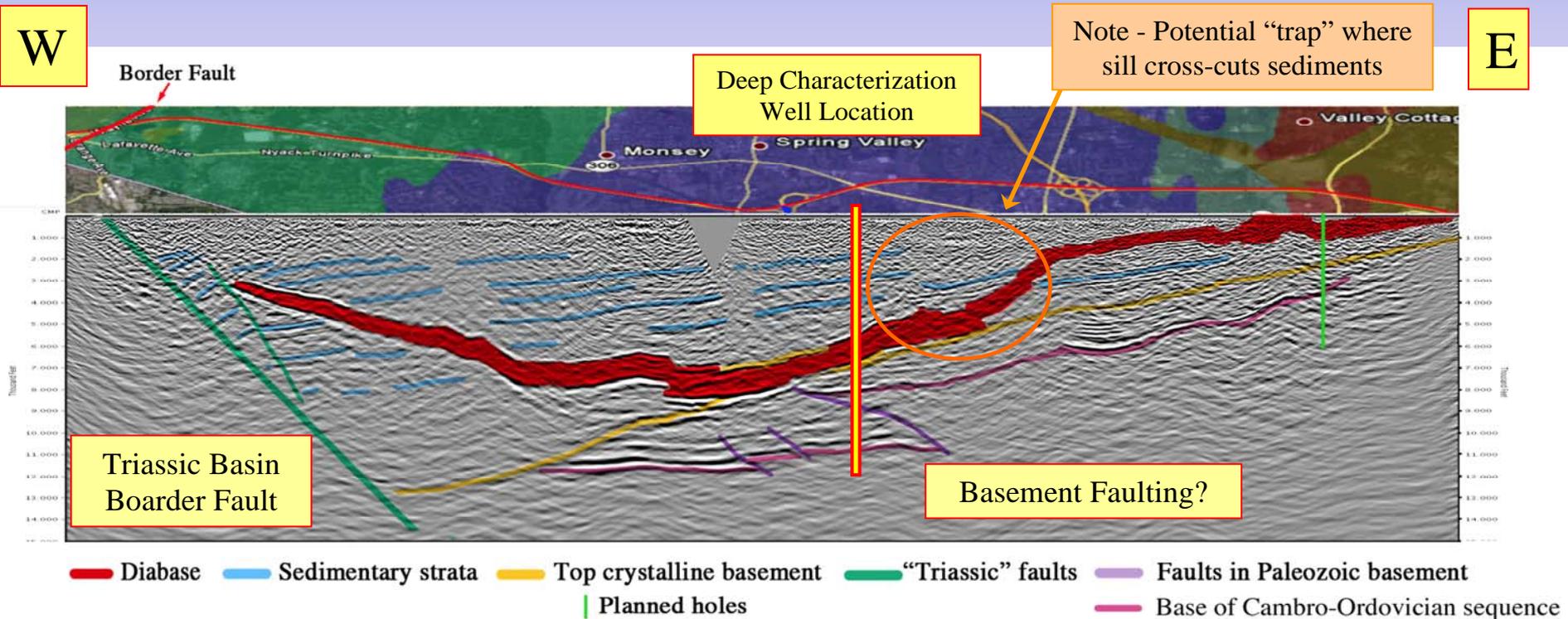


# Public Outreach

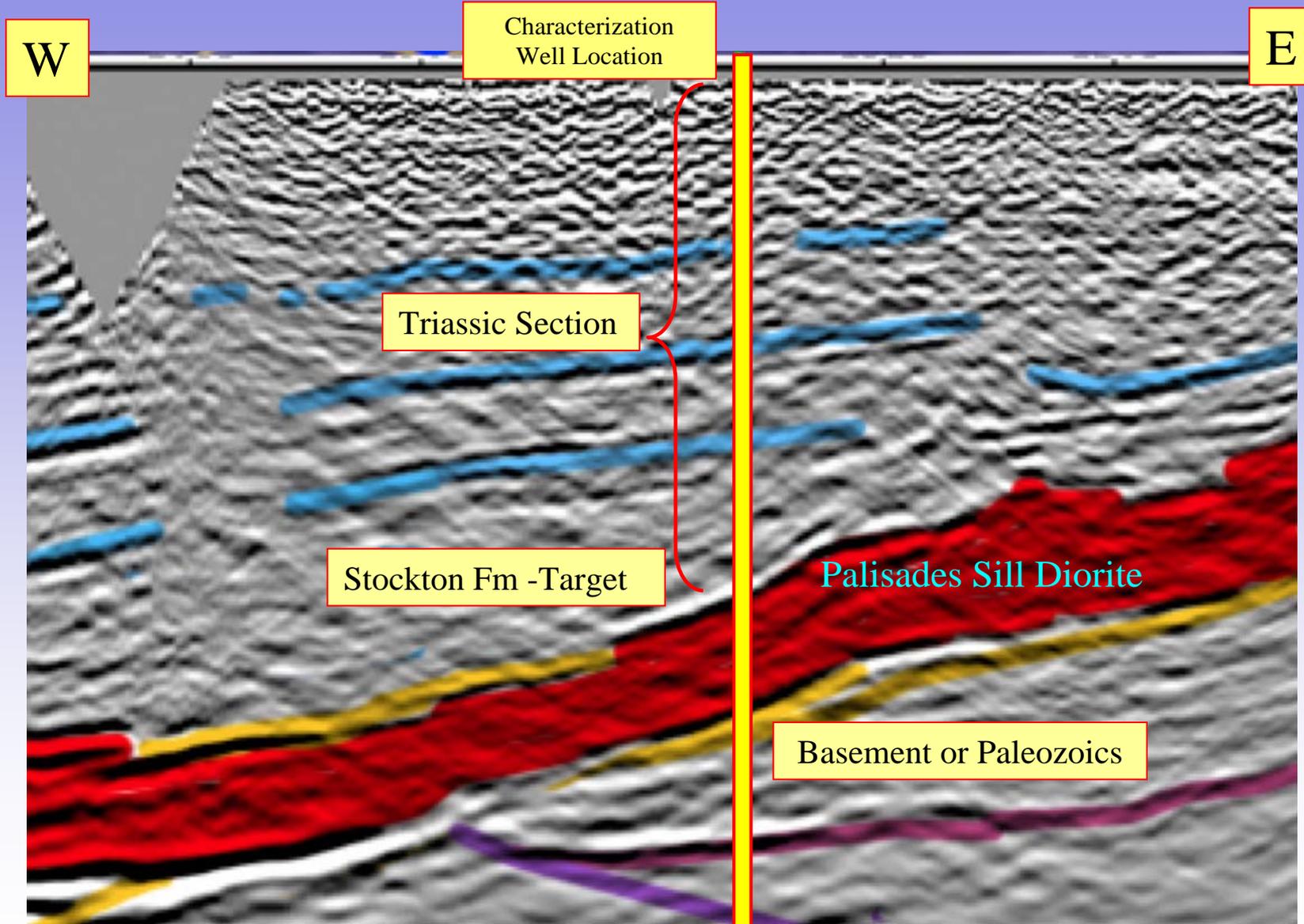
- Top Question – “What are you Doing?”
  - Explained Project & Objectives
- Generally Followed by “What are you REALLY Doing?”
- Are you doing some of that “FRACK DRILLING”?

# Seismic Data – East/West Line Pre-drill Look

- Anticipated Triassic-aged section down to top of Palisades Sill at +/-5,700 feet
- Anticipated +/- 1,300 – 1,400 feet of Palisades Sill Diorite



# Seismic Data – East/West Line - Detail



# Conductor Drilled with Dual-Tube Rotary Method on Air/Mist

- Method uses 24" casing w/carbide insert bit & 10-3/4" drill rod with 23" air hammer bit to drill the well
- Drilled through surficial glacial outwash and 10 feet into Triassic bedrock
- Tremie grout 20" to surface while pulling the 24" outer casing

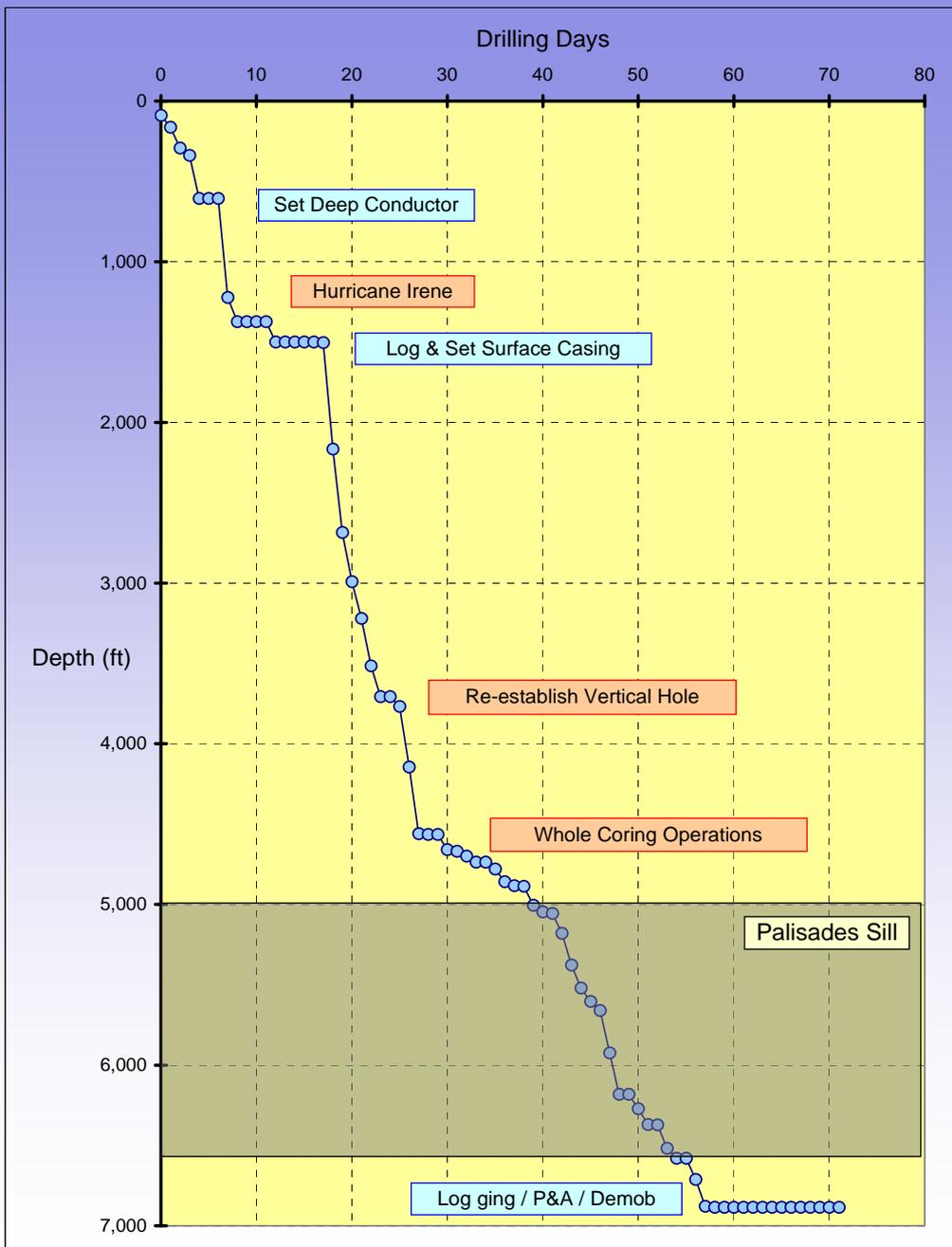


# NYSTA Exit 14 Tandem Lot No. 1 Well



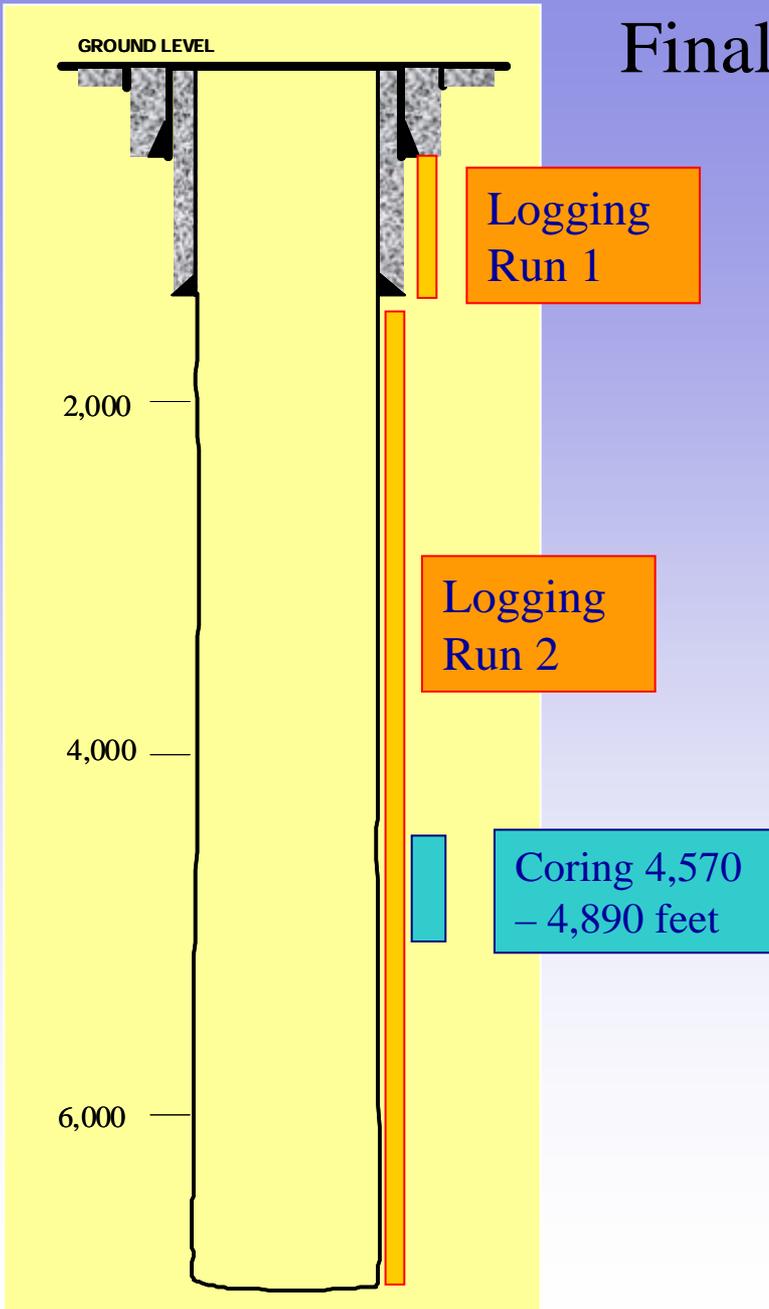
- Standard “oil field” drilling techniques, however, deep conductor hole drilled with air-assist lift to minimize mud losses in utilized freshwater zones
- Standard mud rotary below 600 feet
- Rig started mobilization on August 11<sup>th</sup> and drilling was initiated on August 17<sup>th</sup> following completion of rig up and a safety audit
- Well reached a total depth of 6,885 feet on October 15<sup>th</sup>
- Open hole logging and testing was conducted until October 21<sup>st</sup>
- Well was plugged & abandoned and the rig was demobilized by the end of October

# Drilling Curve



- Upper section to Deep Conductor depth drilled erratically with high torque – likely due to presence of cobbles (observed in nearby road cuts)
- Remainder of Surface Hole drilled quickly w/exception of down days due to Hurricane Irene
- Hole deviation built quickly below 3,000 feet –required correction with directional drilling
- Initial whole core run was the most successful, remaining runs displayed excessive bit wear and frequent jamming
- Palisades Sill was very abrasive on rock bits, even hard rock bits (good runs and bad runs) – bits looked progressively worse
- Expansive logging program took 5+ days to run, however, no reconditioning trips were needed
- Well was plugged according to NYSDEC and County rules
- Site restoration will be completed this month

# Final “As Built” Well



- 20-inch Shallow Conductor set through surficial glacial till & 10 feet into bedrock. Casing grouted to surface
- 13-3/8-inch Deep Conductor set through “utilized” water zones to 604 feet & cemented to surface (County Permit Requirement)
- 9-5/8-inch Surface Casing set to 1,500 feet and cemented to surface (State Permit Requirement)
- 8-1/2-inch open hole drilled & selectively cored to 6,885 feet. Palisades Sill penetrated from 4,993 to 6,568 feet (1,575’ total) – Seismic indicated top of sill at 5,700 feet, however, encountered shallower.

# Extensive Open Hole Logging Program for Characterization

Surface Hole 600 to 1,500 feet

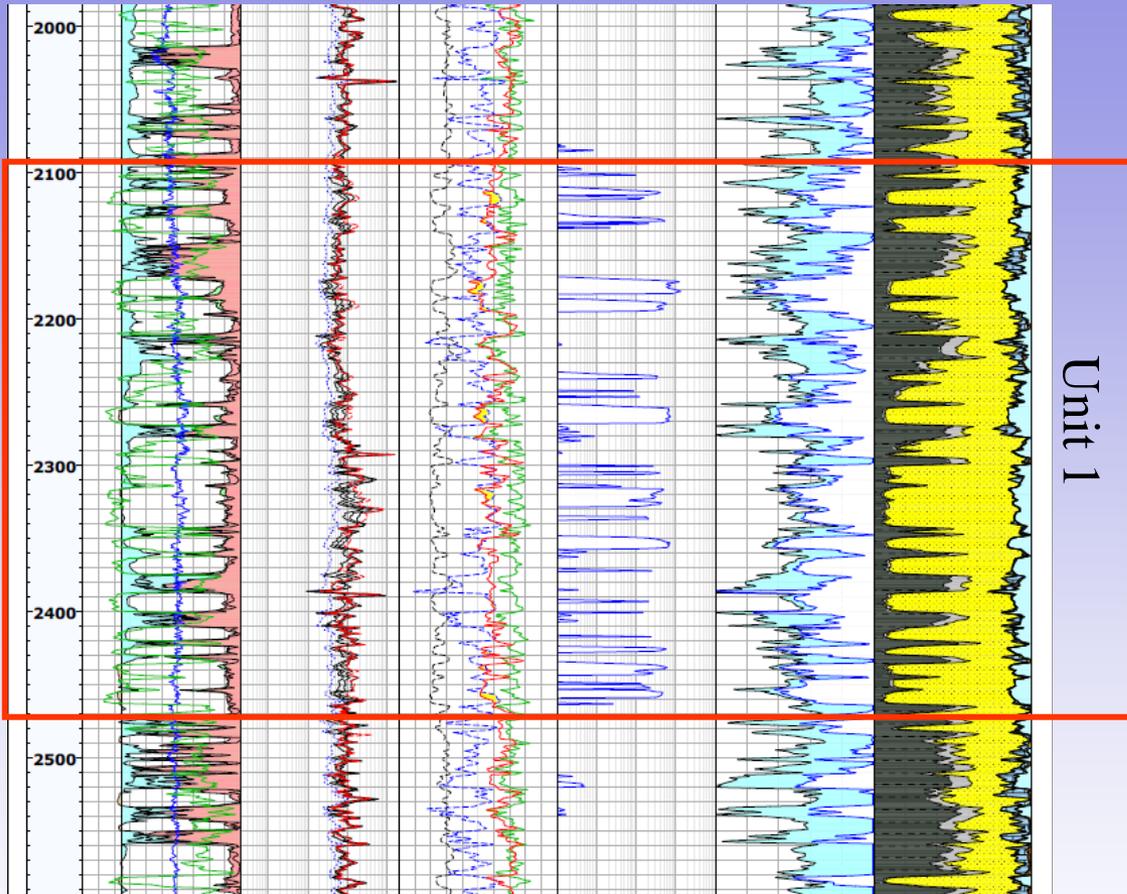
- Platform Express-Neutron/LithoDensity
- Sonic Scanner
- Elemental Capture Sonde
- Combinable Magnetic Resonance
- Formation MicroImager
- Modular Dynamics Tester
- Horizontal Rotary Cores



Deep Hole >1,500 feet

- Platform Express-Neutron/LithoDensity
- Sonic Scanner
- Elemental Capture Sonde
- Combinable Magnetic Resonance
- Formation MicroImager
- Modular Dynamics Tester
- Horizontal Rotary Cores
- Vertical Seismic Profile
- Magnetic Susceptibility – LDEO

# Open Hole Logging Snapshot – Reservoir Unit Example



- Logs indicate three potential flow units (Unit 1 ~2,100 to 2,500 ft, Unit 2 – 2,800 – 3,200 ft, Unit 3 ~ 3,650 – 4,250 ft)
- Note first unit would need to be followed deeper into the basin for “supercritical” conditions

# Whole Core Via Wireline Retrievable System



- Palisades Sill came in much shallower than anticipated by 700 feet. Project Objective was >1,000 feet of core above the sill with continued coring below the sill
- The formations were significantly more abrasive to the PDC coring bits than anticipated – inner cutters showed limited rotating hours life
- Whole Cored Intervals:
  - 4570' – 4,650' = 80 feet
  - 4,660' – 4,735' = 75 feet
  - 4,850' – 4,890' = 40 feet

# Preliminary Results

- At this location, best sandstone development is in the shallower portions of the well (Unit 1 ~2,100 to 2,500 ft, Unit 2 – 2,800 – 3,200 ft, Unit 3 ~ 3,650 – 4,250 ft)
- Formation Pressures indicate a freshwater gradient, placing supercritical CO<sub>2</sub> window below a depth of 2,500 feet
- Pump-through water resistivities at 2,322 feet and 3,058 feet indicate brackish waters only (~3,000 ppm NaCl). “Quicklook” log calculations to total depth indicates mainly <10,000 ppm NaCl (i.e. would be classified as underground sources of drinking water). Need to look deeper in the basin (New Jersey/Pennsylvania).
- Confirmed presence of abundant lithified mudstones that can act as confining caprock layers. Minifrac testing of two intervals up to tool limits of +/-5,500 psi (3,055 feet and 3,510 feet), greater than 1.5 psi/ft minimum breakdown pressure.
- Potential trapping mechanism in homoclinal dip of sediments being cross-cut by the Palisades Sill

# Next Steps

- Preliminary processing of wireline data is complete by Schlumberger (ELAN, Sonic Anisotropy, Formation MicroImager). Will be finalized once whole and rotary sidewall core data is available (early 2012)
- New York State Museum began preliminary analysis of the whole core in October (cleaned and photographed). Sampling of core is the next step.
- Weatherford Laboratories working on routine and special analysis of 75 rotary sidewall cores. Will perform similar analyses on whole core samples.
- Core to be forwarded to Lawrence Berkeley National Laboratory for reaction experiments and geochemical modeling – complete by end of 2012.
- Shallow well (mineral core well) to be drilled at Lamont Doherty Earth Observatory Campus – first half of 2012).
- Refined analysis of seismic, integrated with wireline, and core data for final northern basin model and injection simulation scenarios by Schlumberger Carbon Services ~ Summer/Fall 2012.
- Project report and NATCARB integration complete by March 31, 2013.

# Questions??

