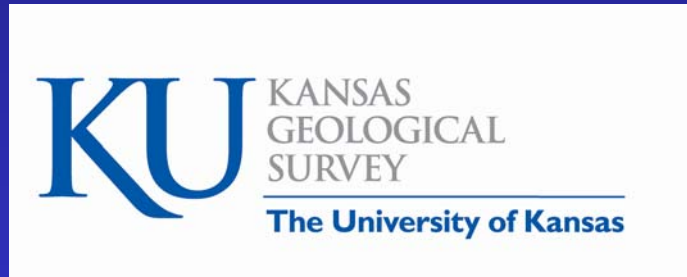


Index Well Program Update

Kansas Water Office
March 3, 2009



Geohydrology Section
Kansas Geological Survey

The index well program was developed to support delineation and enhanced management of aquifer subunits in the Ogallala-High Plains aquifer

Annual water-level network is good for what it was designed for, but is not adequate to support enhanced management of subunits

Index well program is obtaining more measurements in space and time, calibrating with annual network measurements (improving network)

How (else) can we improve the annual network?

What can we learn about aquifer characteristics?

How far can we extrapolate measurements?

One index well installed in each of the three western Kansas GMDs – in Haskell, Scott and Thomas counties

Elevation surveys of index and surrounding annual wells

Continuous (hourly) monitoring of water levels in each index well with pressure transducers

Telemetry systems transmit data to a database every two hours

Data available from web site in near real-time

Thomas County
site (typical
installation)



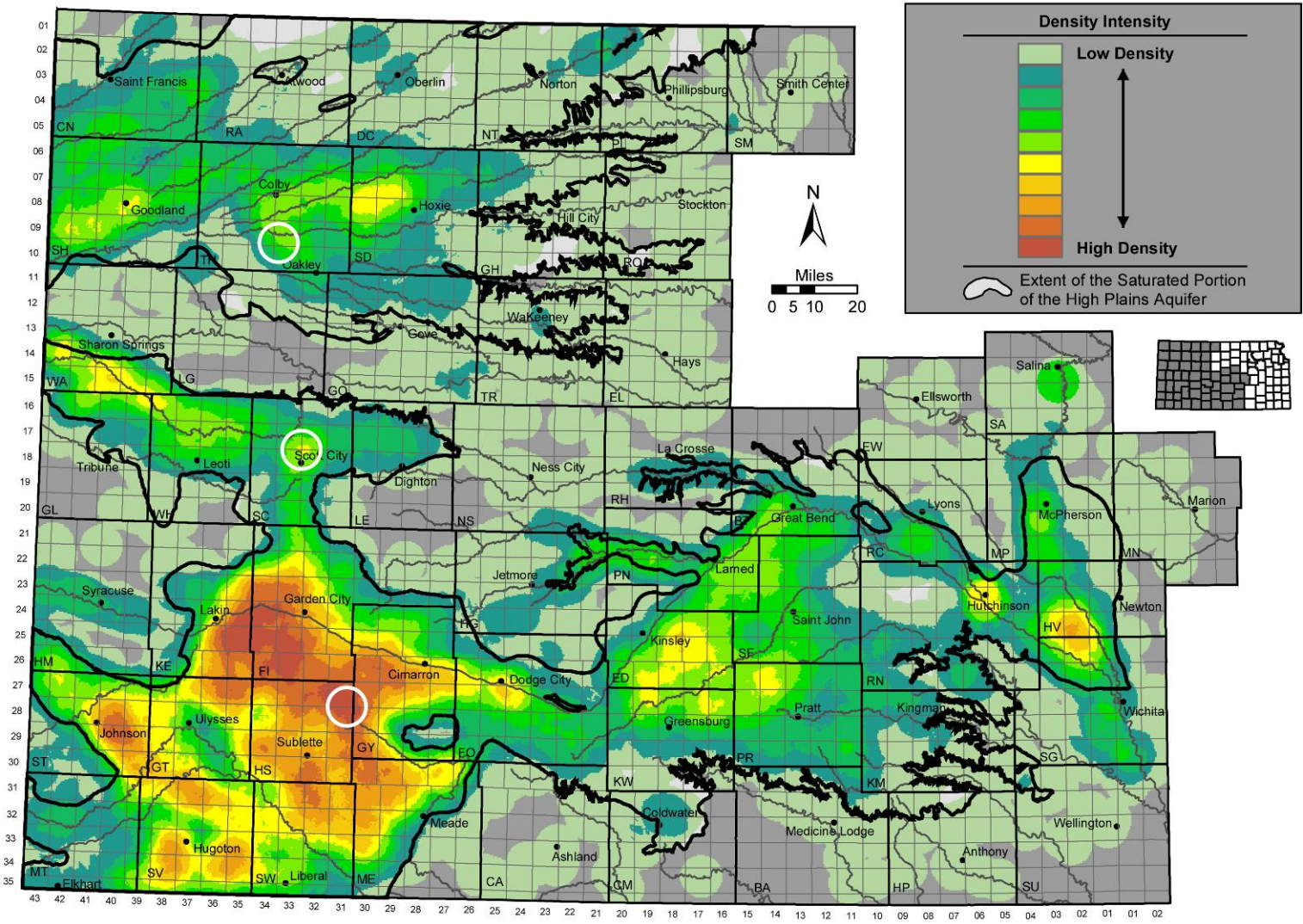
Solar panels

Telemetry system
and batteries

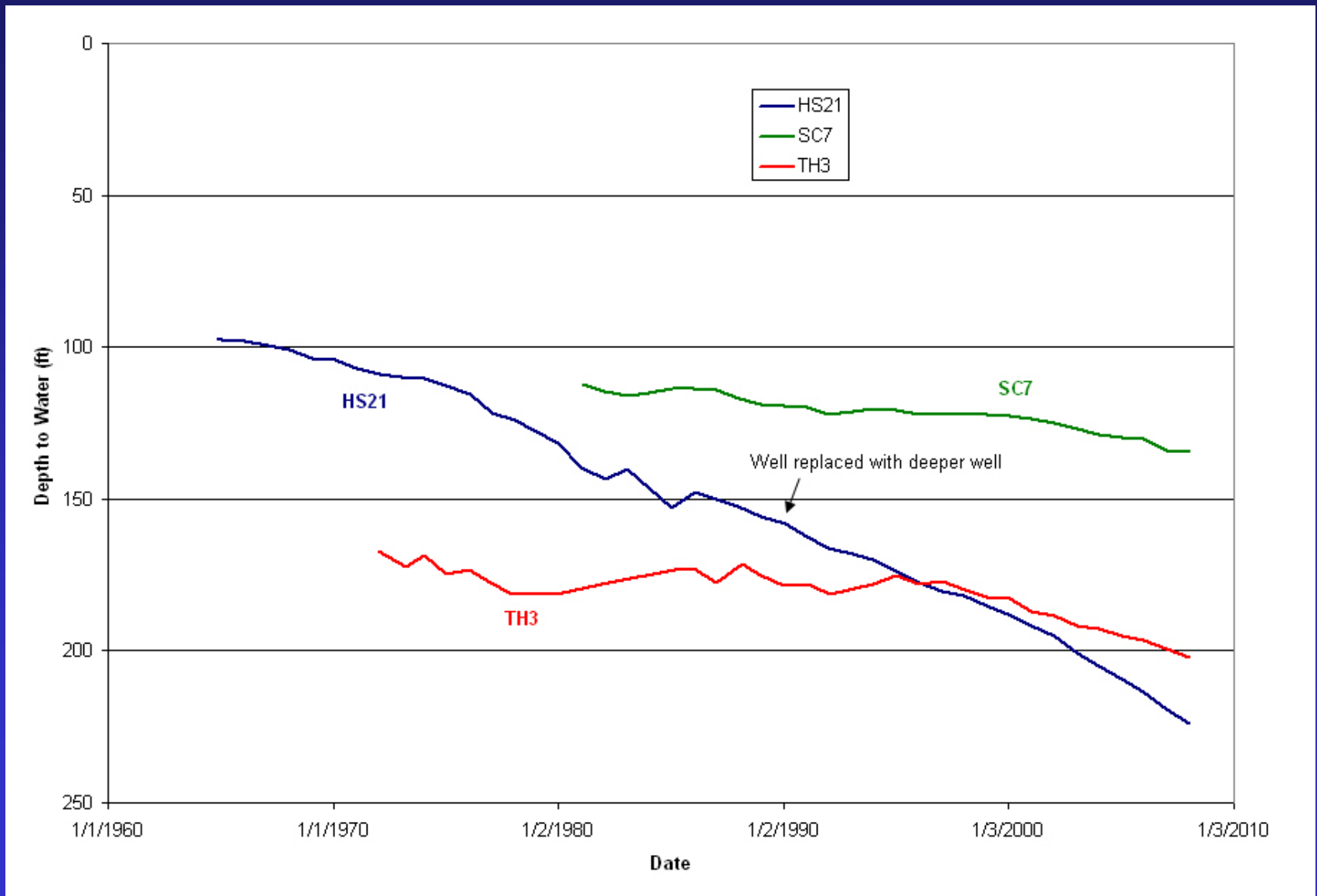
2" PVC well with
steel wellhead
protector

Cable from
pressure transducer
in well to telemetry
system

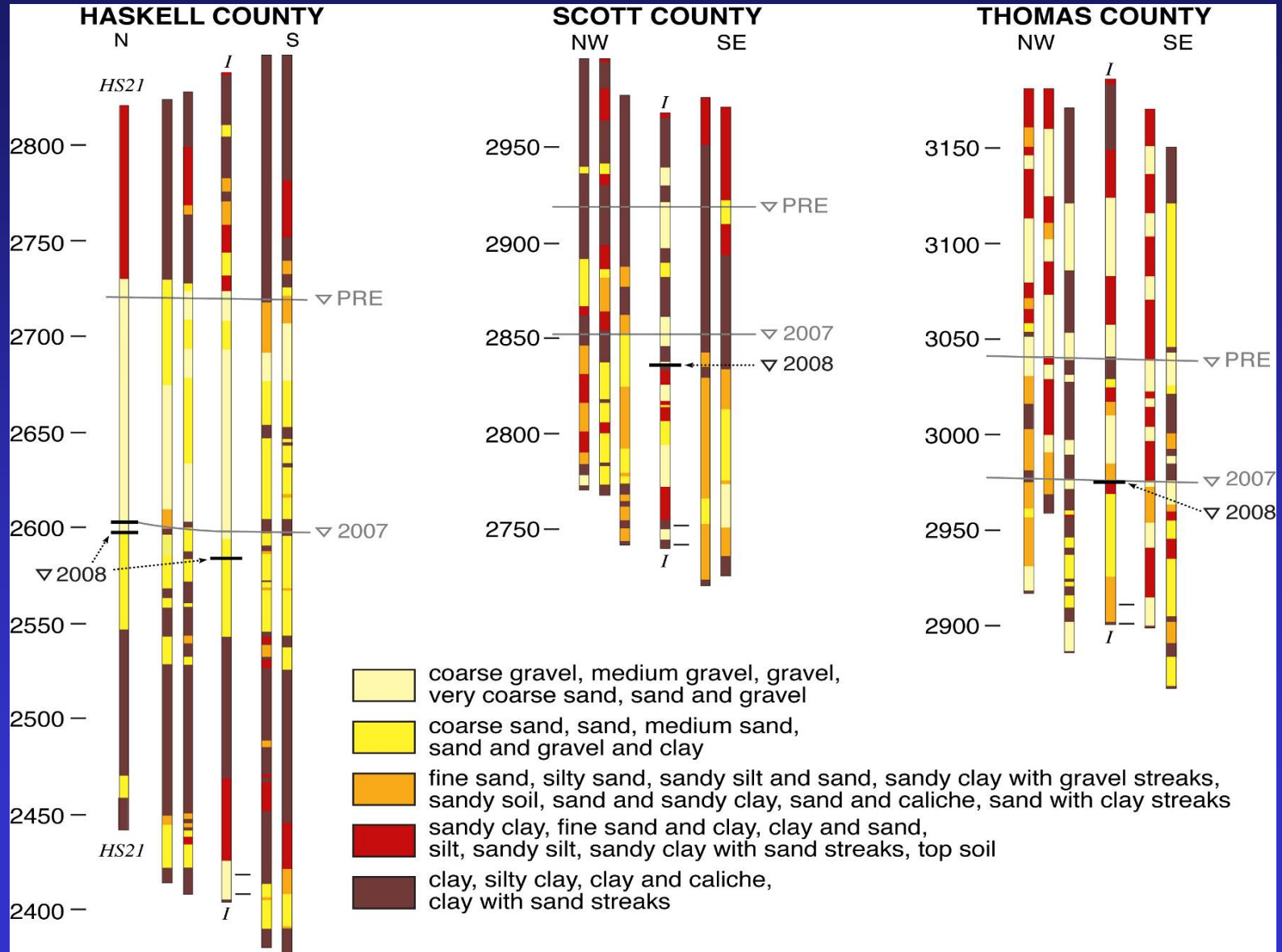
Density Distribution (5 Mile Radius) of Average Reported Ground Water Used by Water Rights, 1996 to 2004, Around the High Plains Aquifer in Kansas



Long-term records from annual wells near each index well site



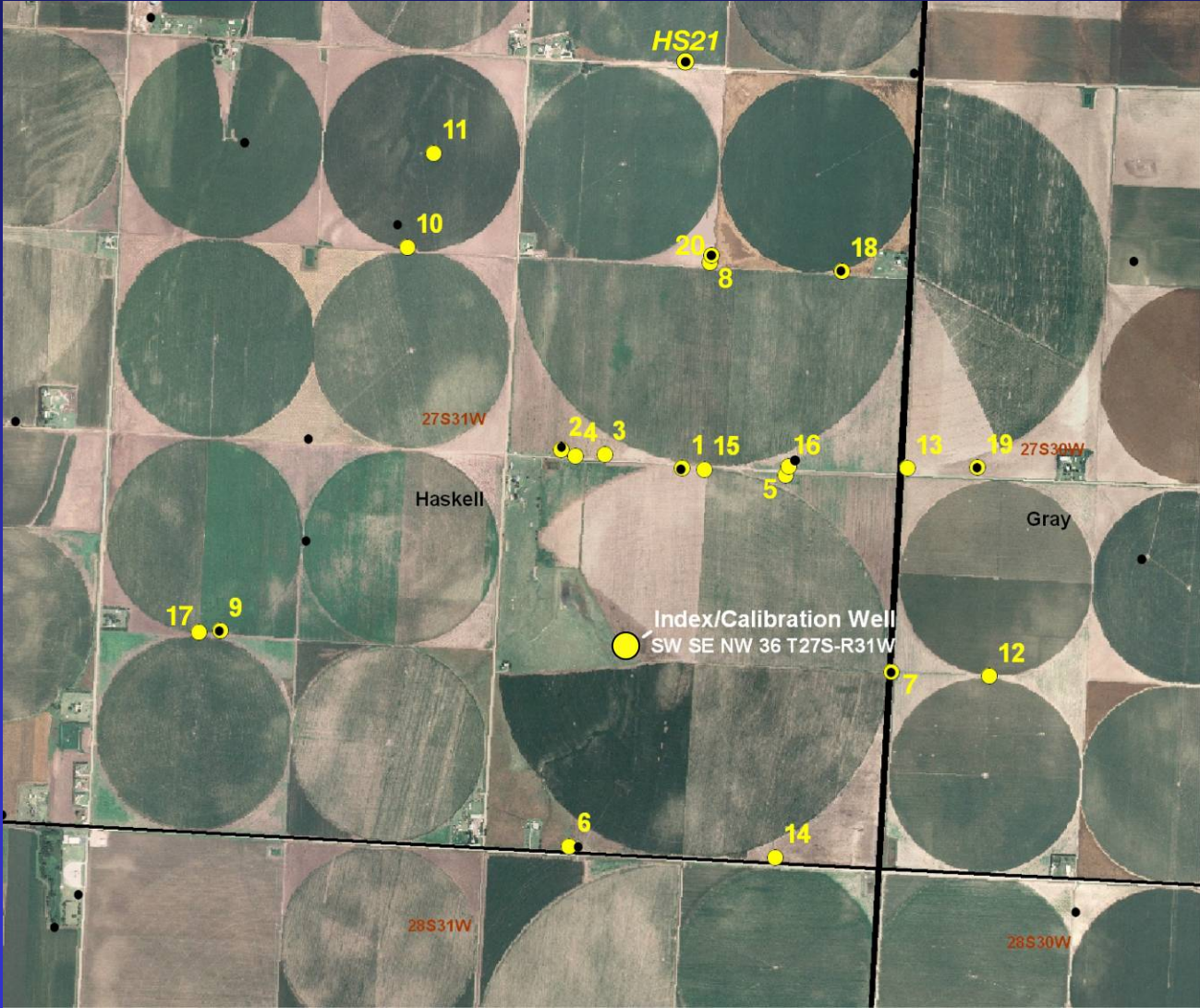
Lithologic cross sections showing distribution of permeable (light) and impermeable (dark) zones

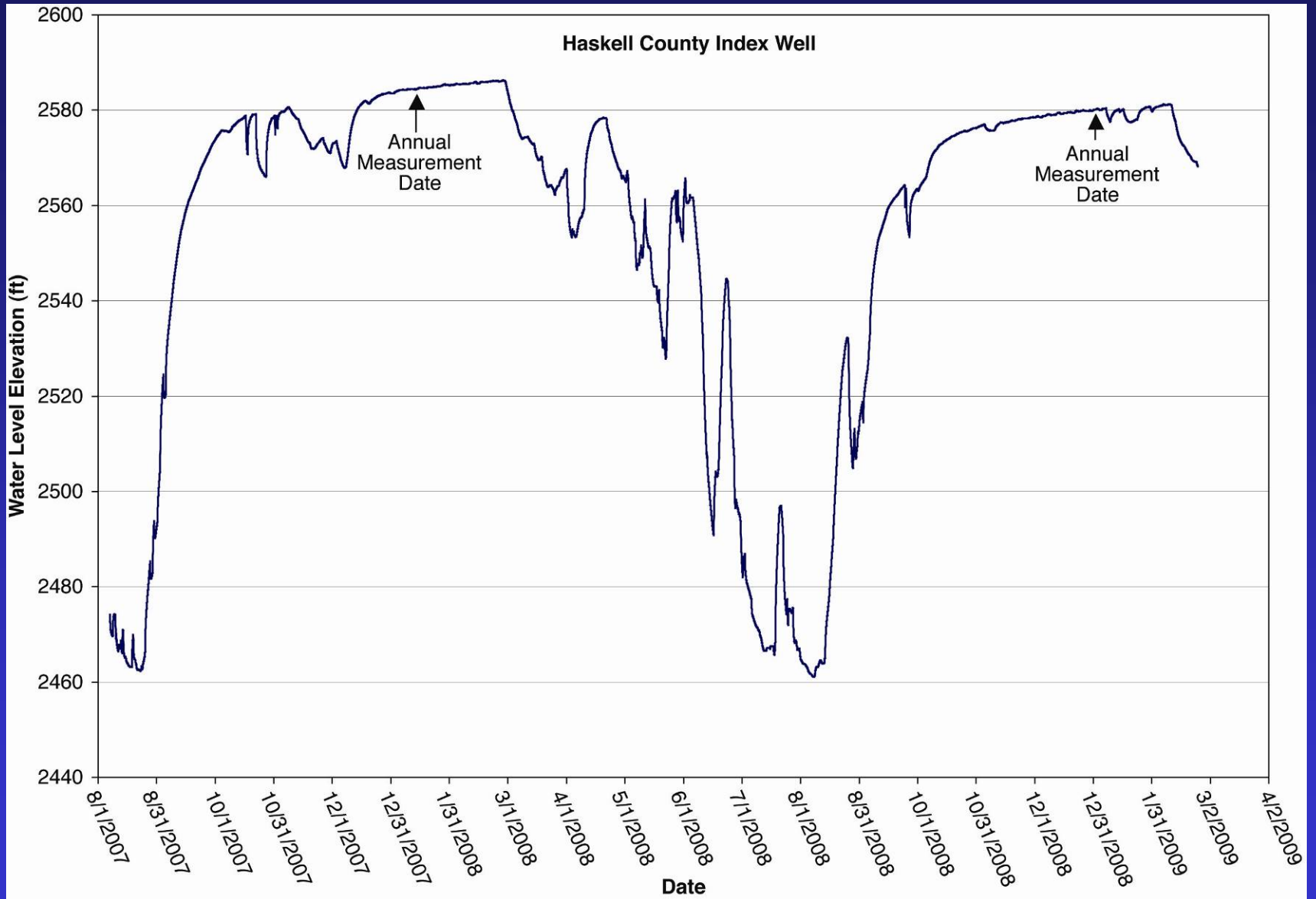


Haskell County Annual and Production Wells

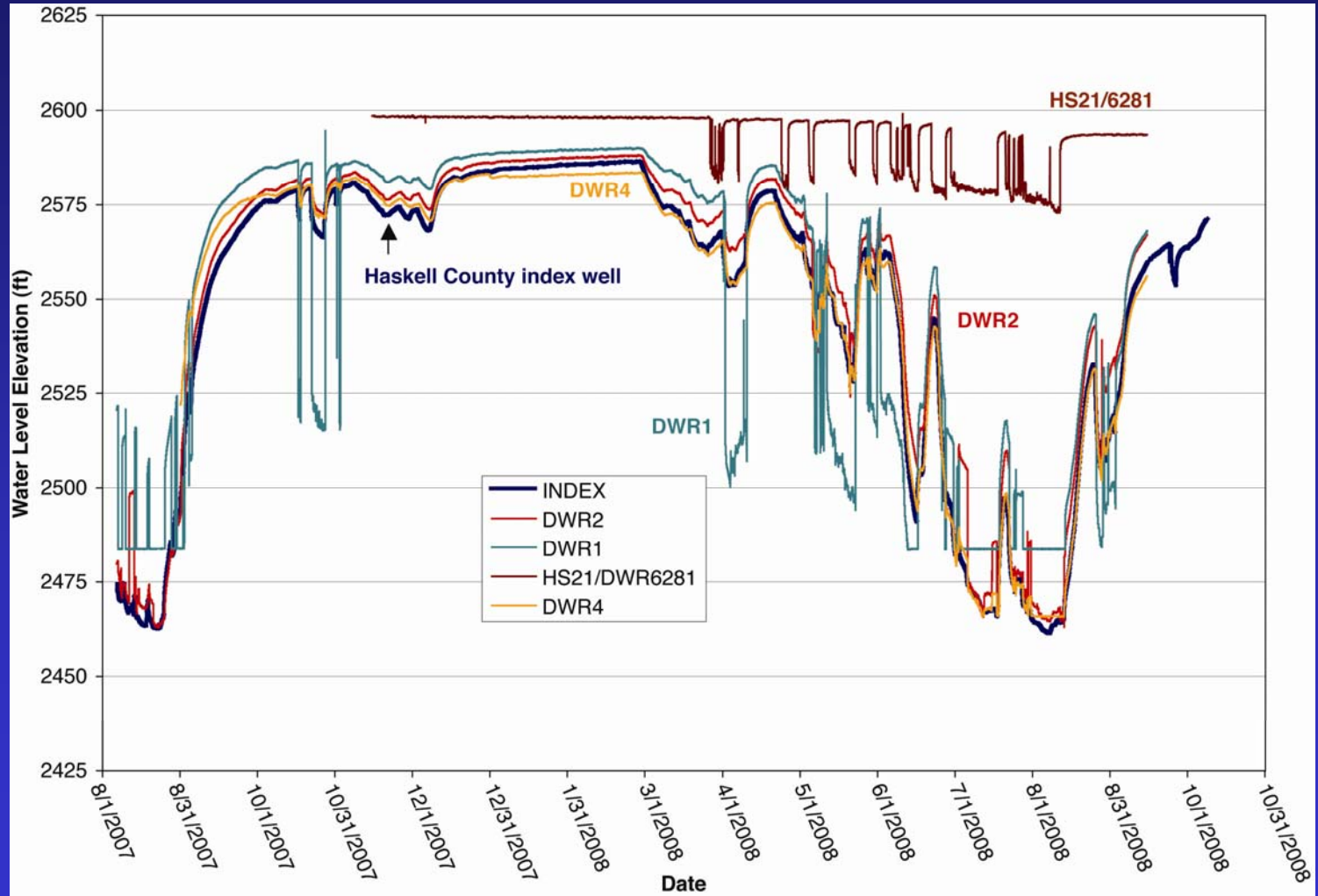


Haskell DWR Wells

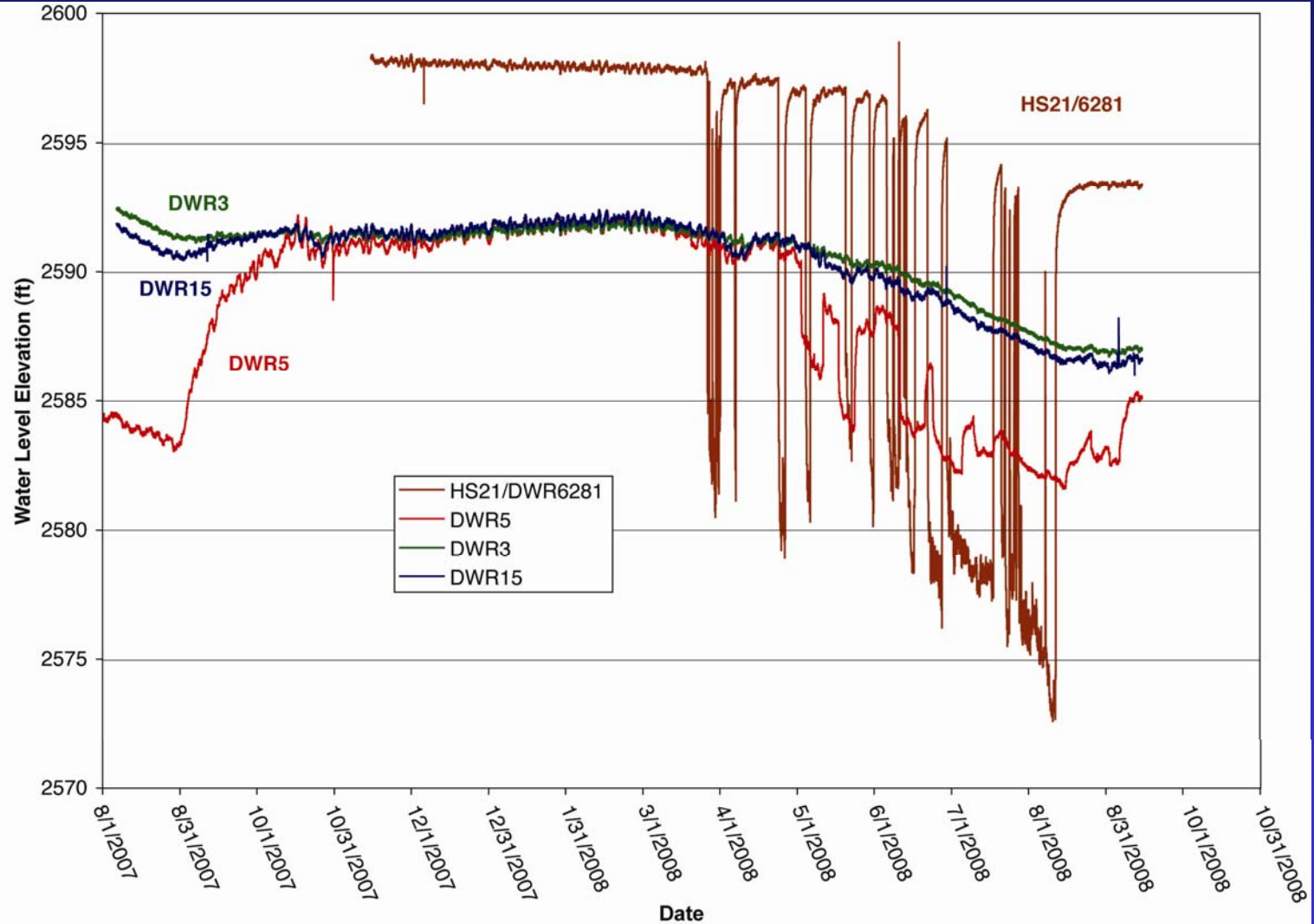




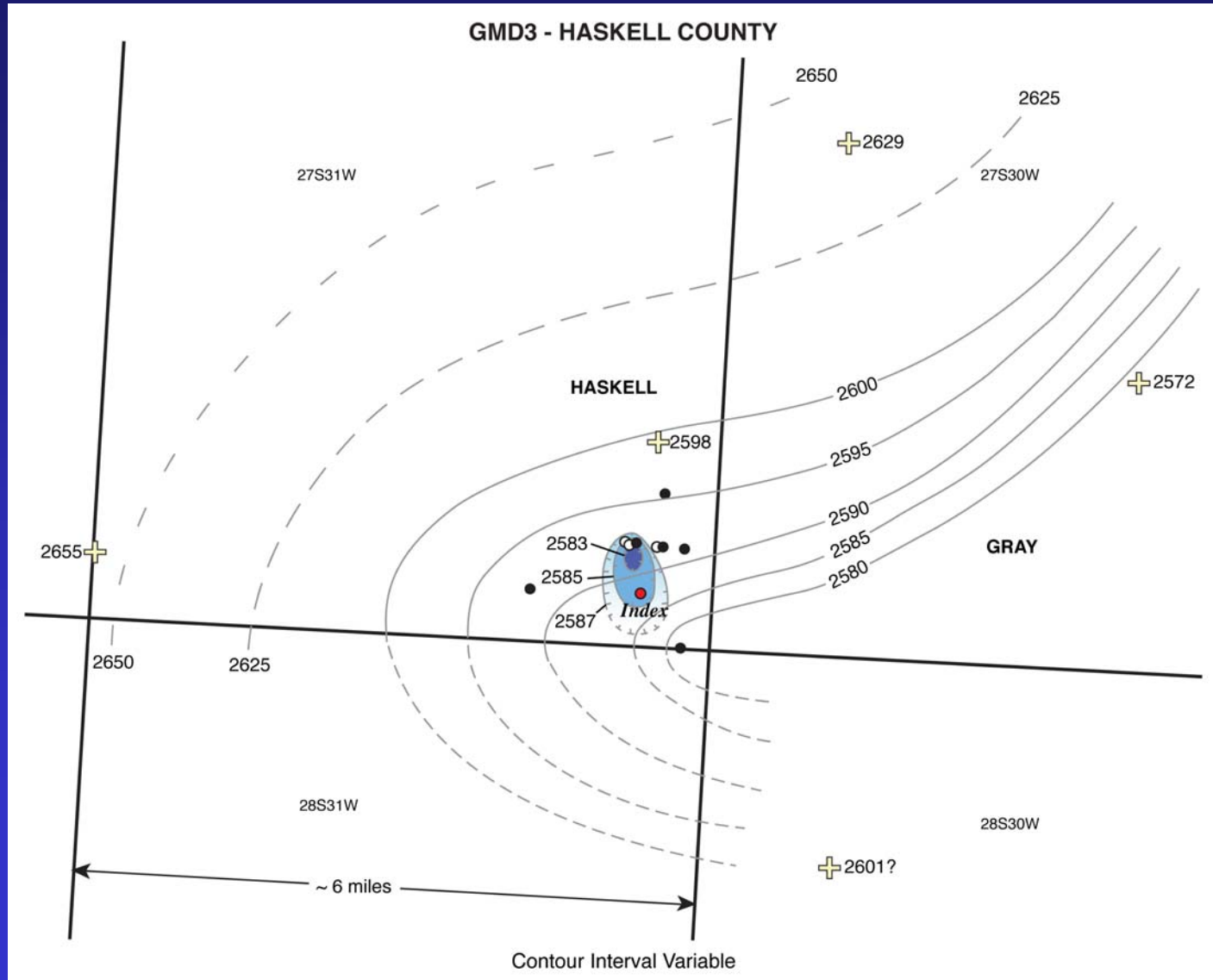
Haskell "Deep" Wells



Haskell "Shallow" Wells



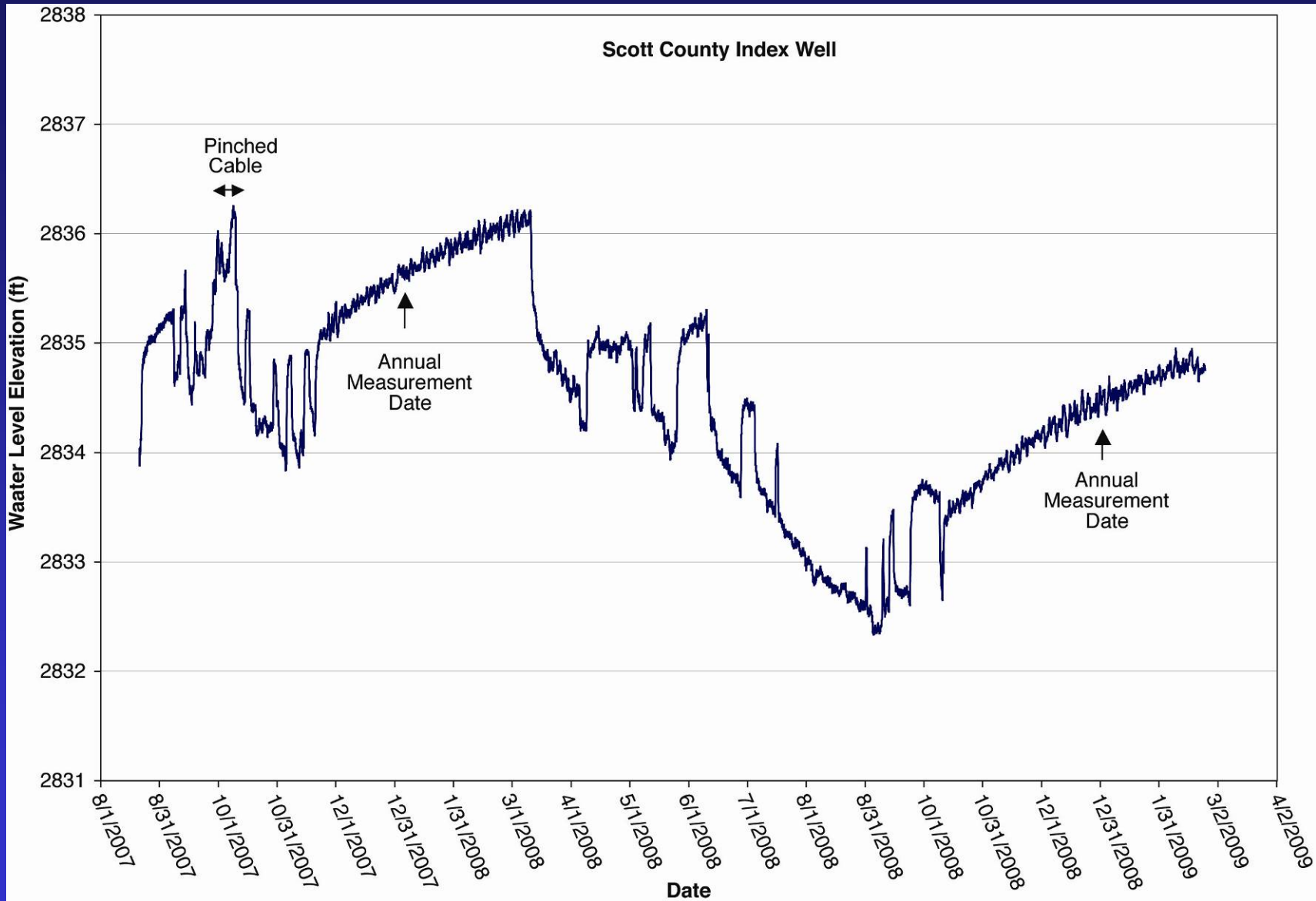
Haskell site water table and deep potentiometric surface contours indicate depressions, downward vertical gradient



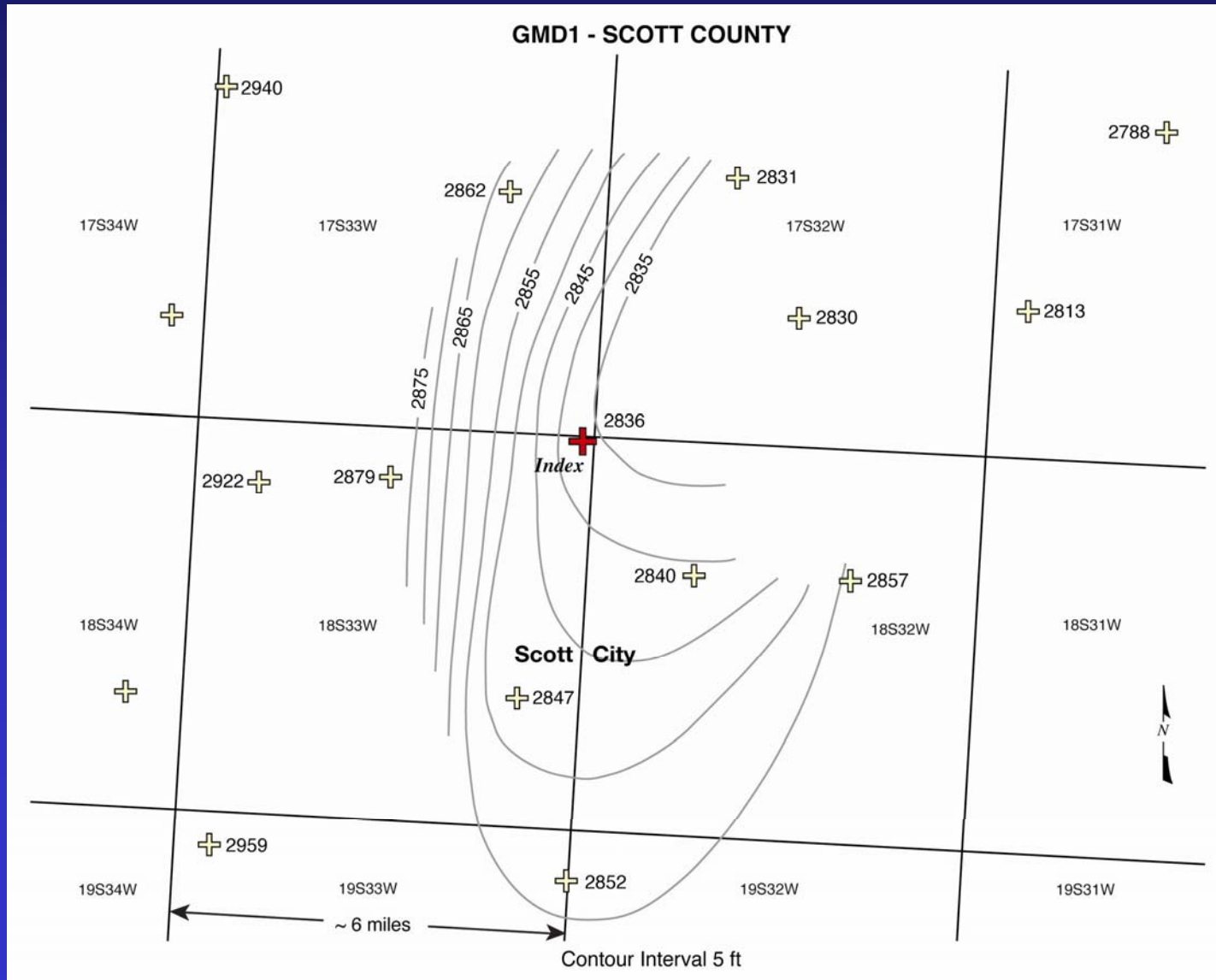
Scott County Annual and Production Wells



Scott County Index Well

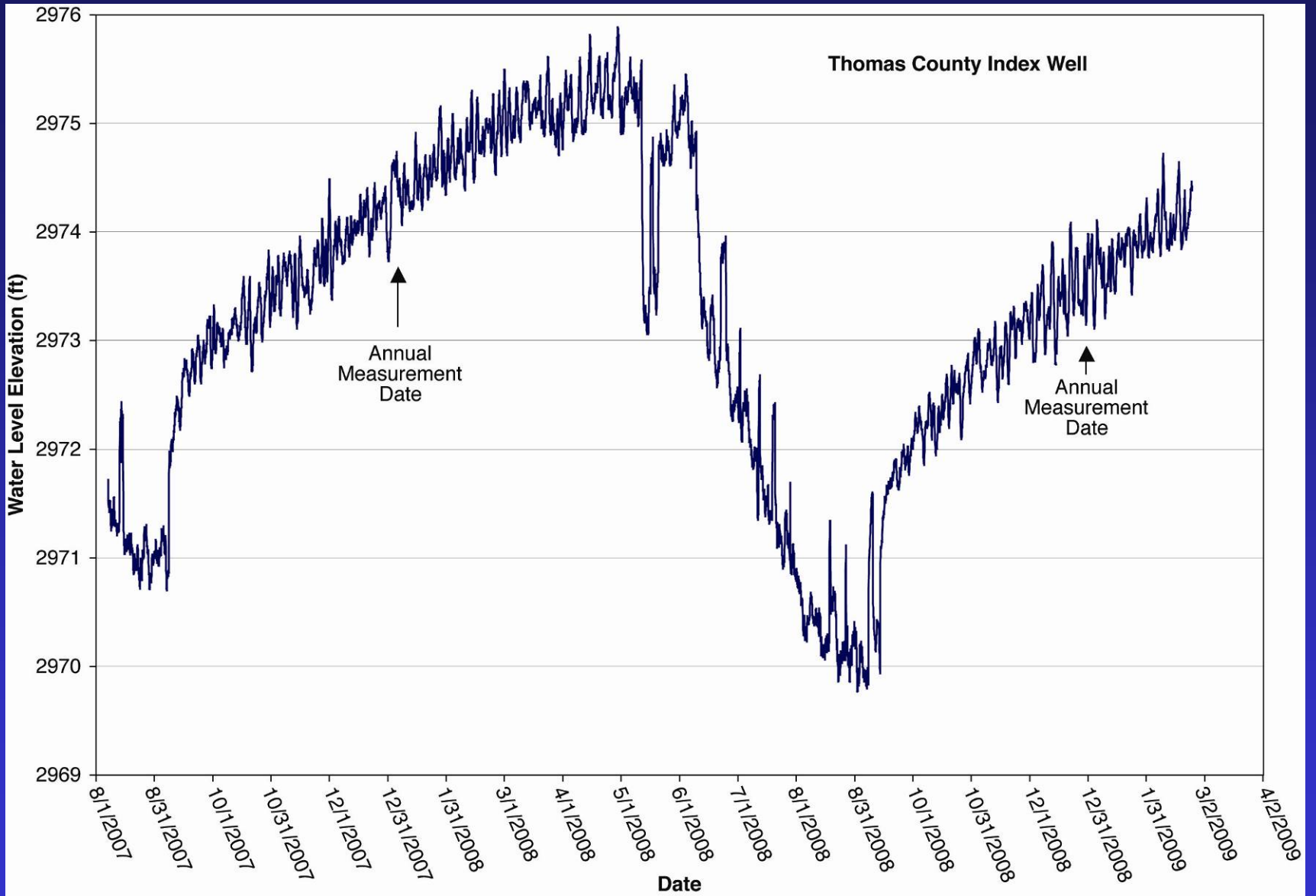


Scott County site water-level contours indicate a depression in the water table north of Scott City

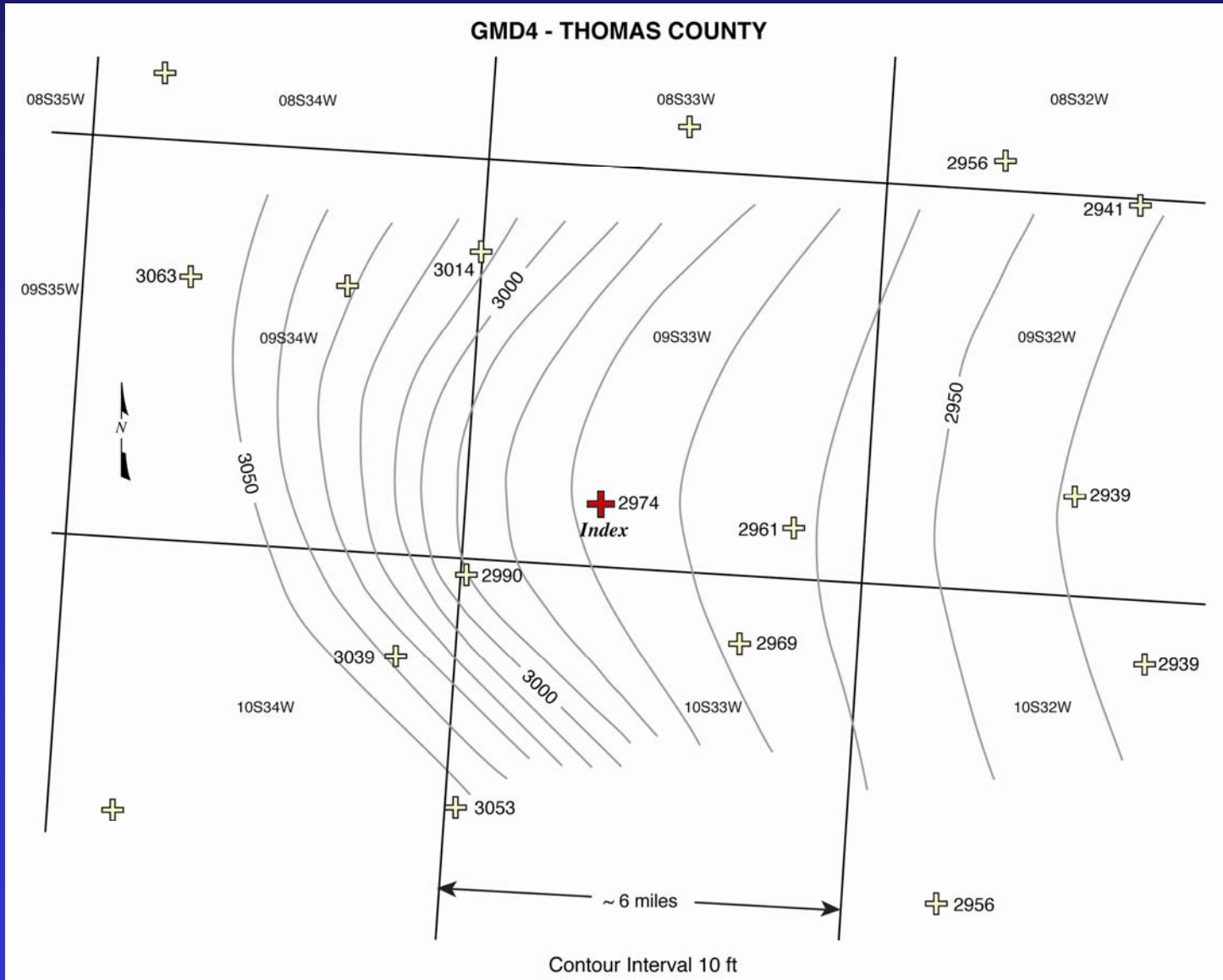


Thomas County Annual and Production Wells

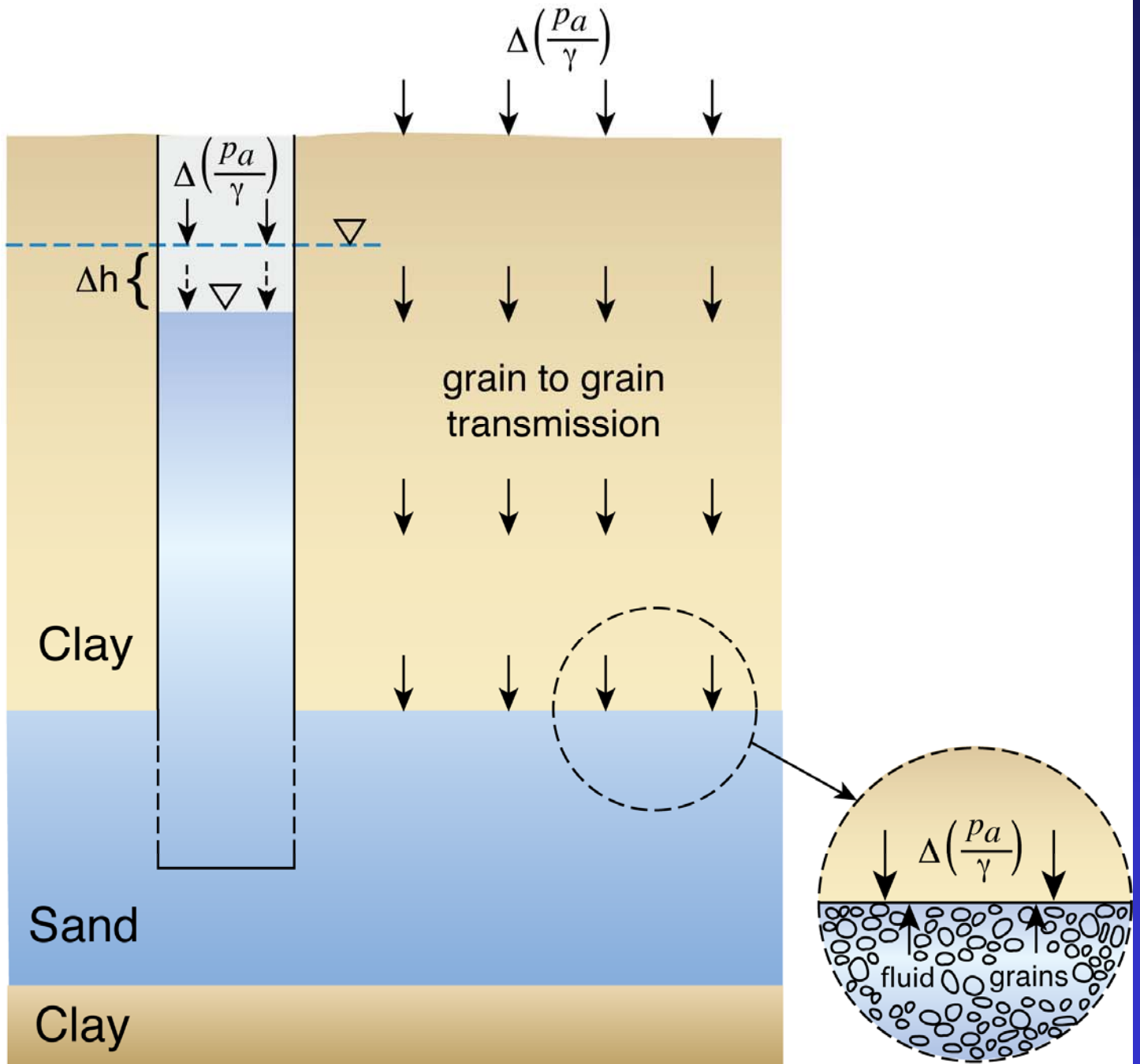




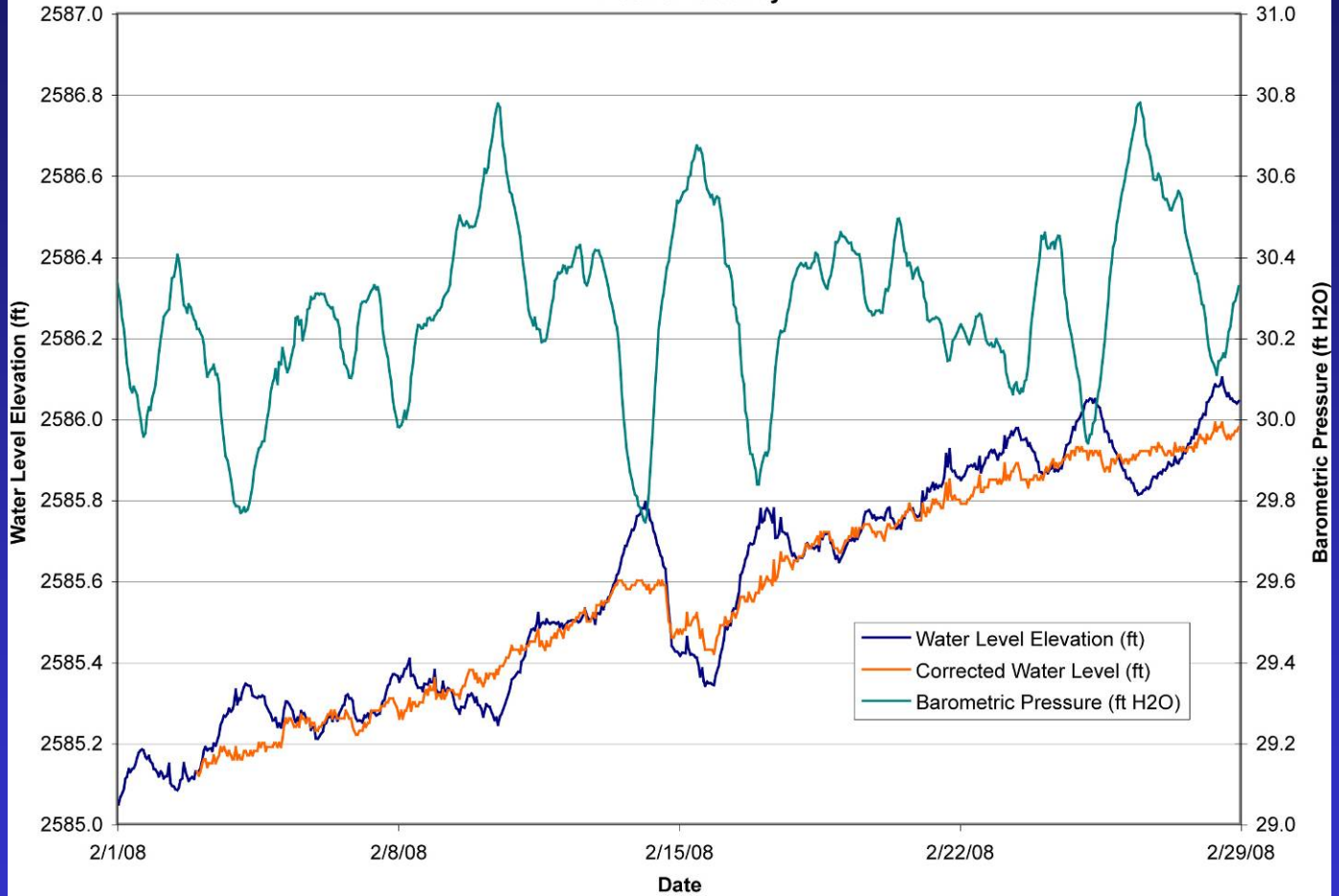
Data from the Thomas County index well confirms the steep water-table gradient SW of the site



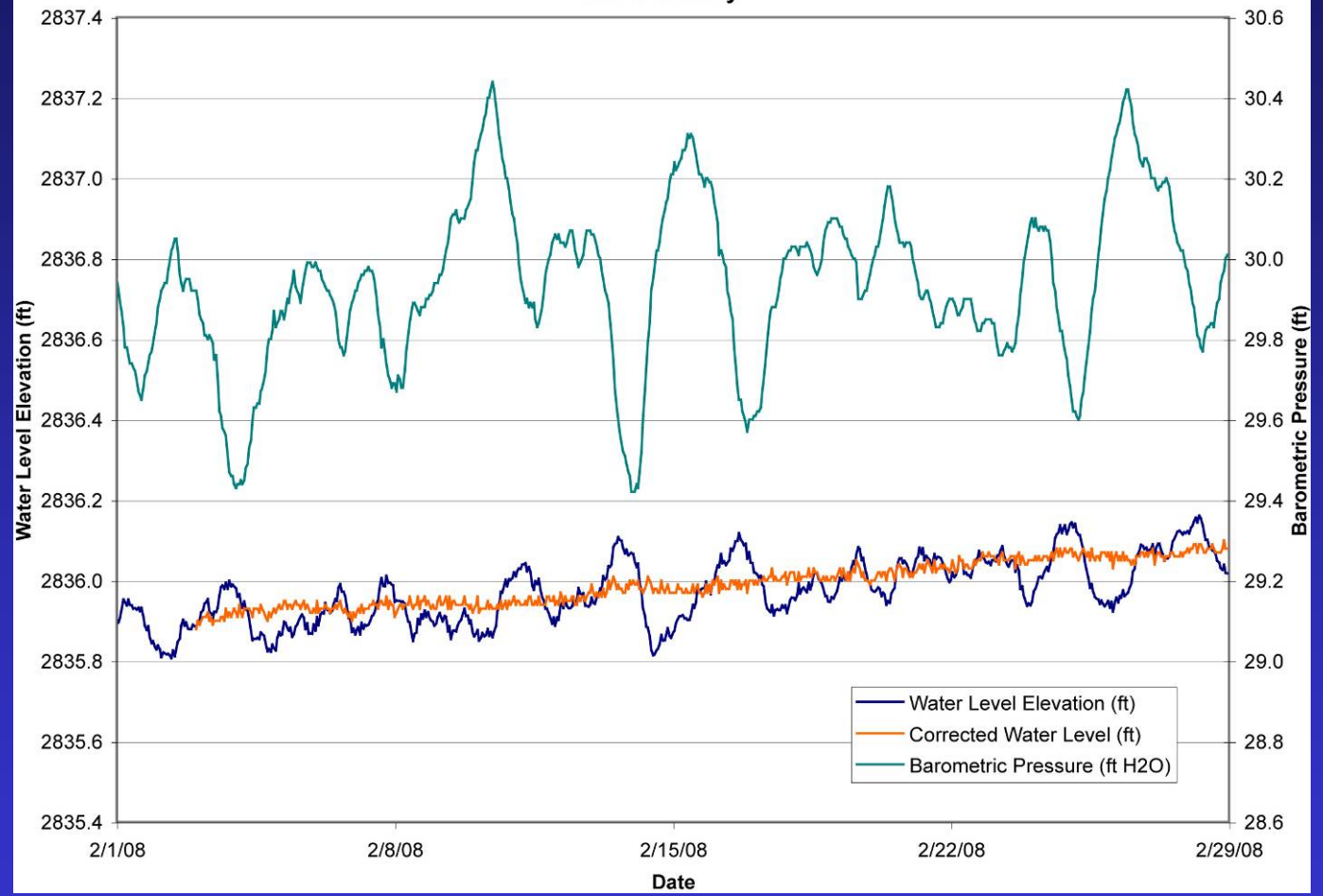
Barometric Efficiency



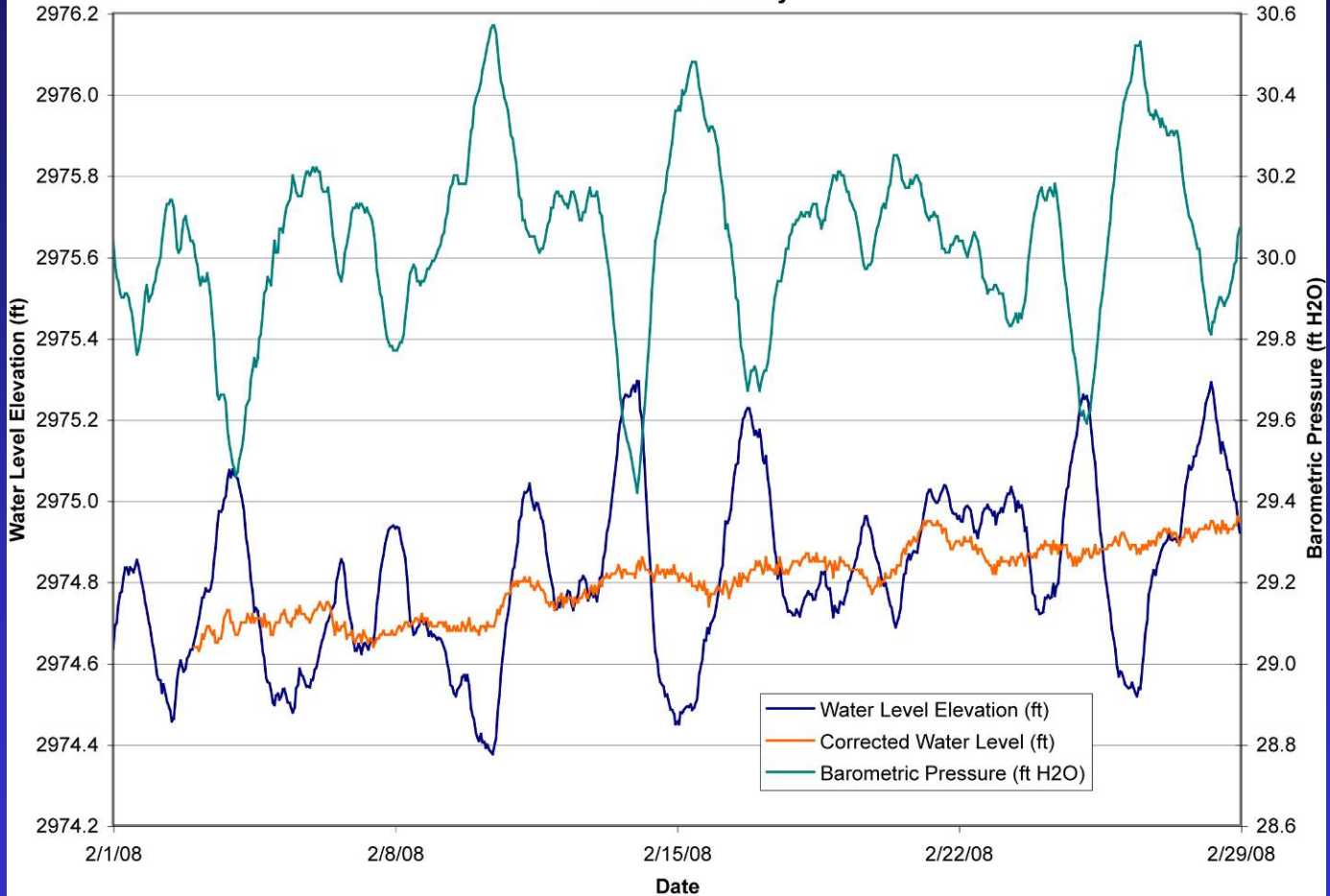
Haskell County



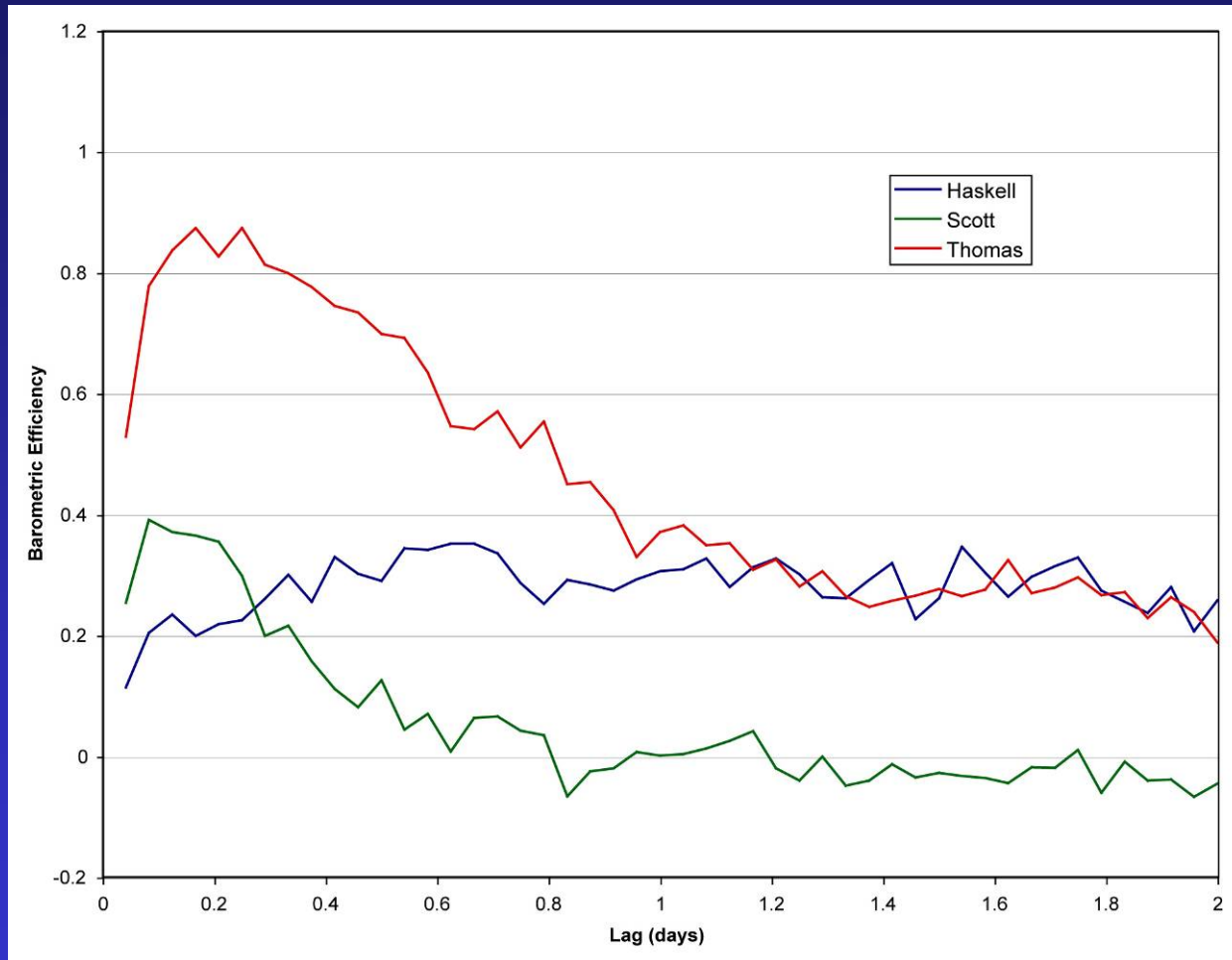
Scott County



Thomas County



Barometric lag time responses



Barometric Response Work Summary

Barometers are now deployed at all index sites

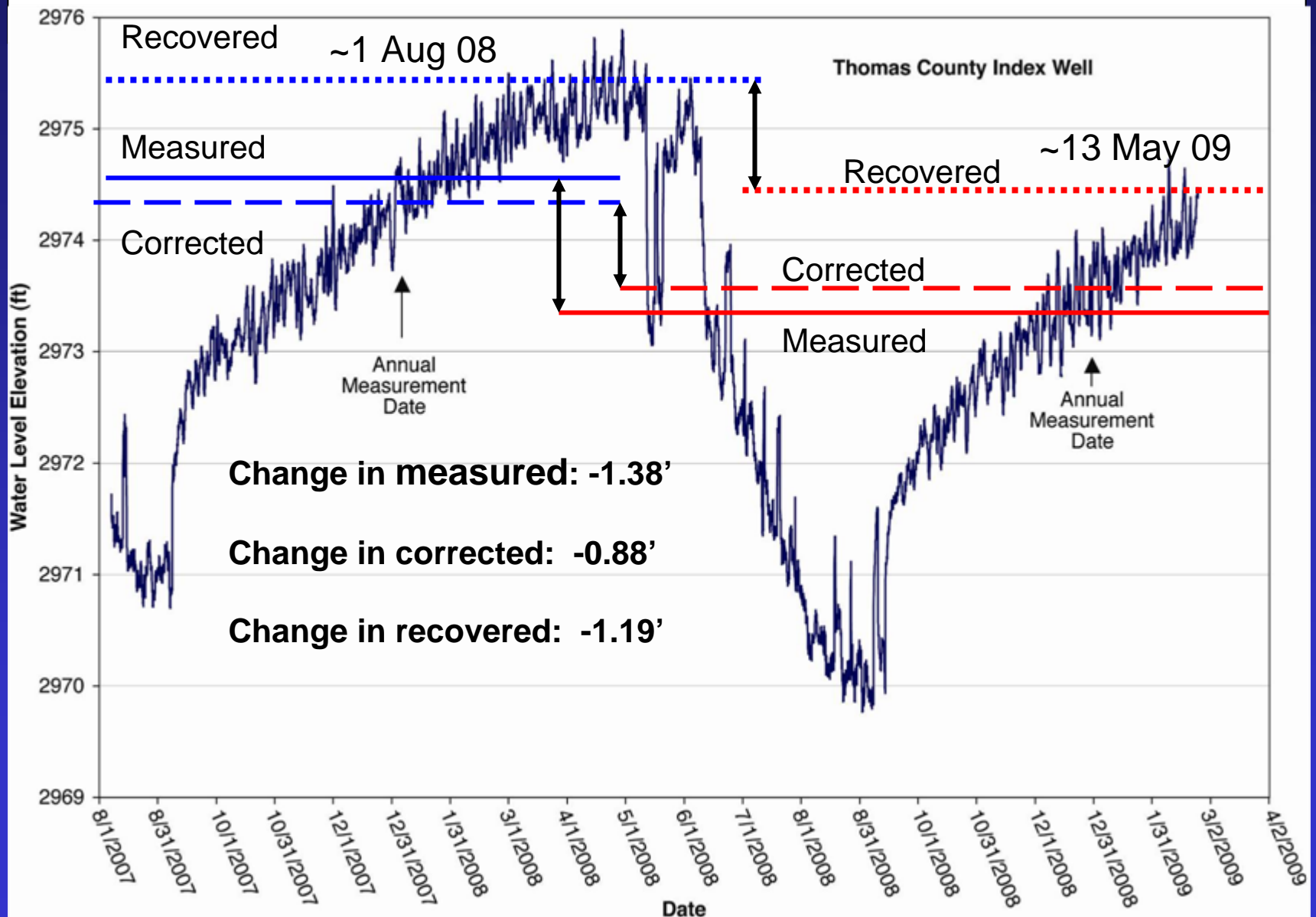
Potential/expected applications:

- Reduce uncertainties (in the annual network) caused by barometric pressure fluctuations
- "Fingerprinting" and pattern matching
- Assess similarities and differences between wells and areas
- Provide guidance on the useful range to which index well observations can be extrapolated
- Assess or even design proposed management units

Deploy transducers temporarily to calibrate annual wells?

Recovery Analysis

Thomas Co index well – annual measurements, barometric corrections, and curve-fit extrapolations to full recovery



Well observation results summary

TH, SC are both unconfined aquifer wells, but with rather different response characteristics. HS is clearly a confined aquifer situation, with an unconnected upper unconfined zone that is mostly dewatered (water use is shifting to the deep thin confined zone)

Recovery curves make it obvious that the differences between measured level and full recovery can be as much as the amount of annual change, and are not consistent from year to year

Barometric signal “noise” can impose deviations from the mean of up to 0.5’ (TH) on one-time (tape) measurements, but we can correct for this where we have an interval of transducer and barometric pressure data

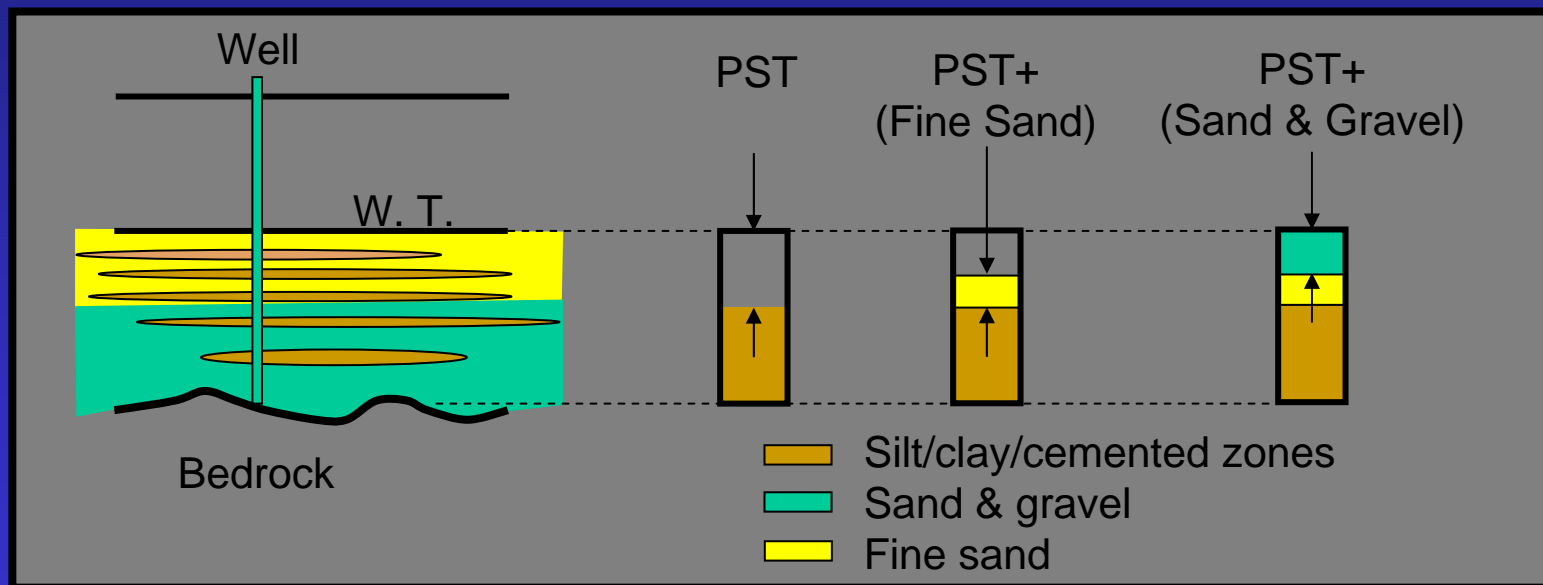
Index wells and PST+

Both studies focus on the relationship between water use and water level change –

- PST+ addresses the aquifer characteristics and the nature of the relationship over time and depth, with implications for management strategies;
- Index wells address the problems involved in accurately measuring the relationship and testing predictions of management effects.

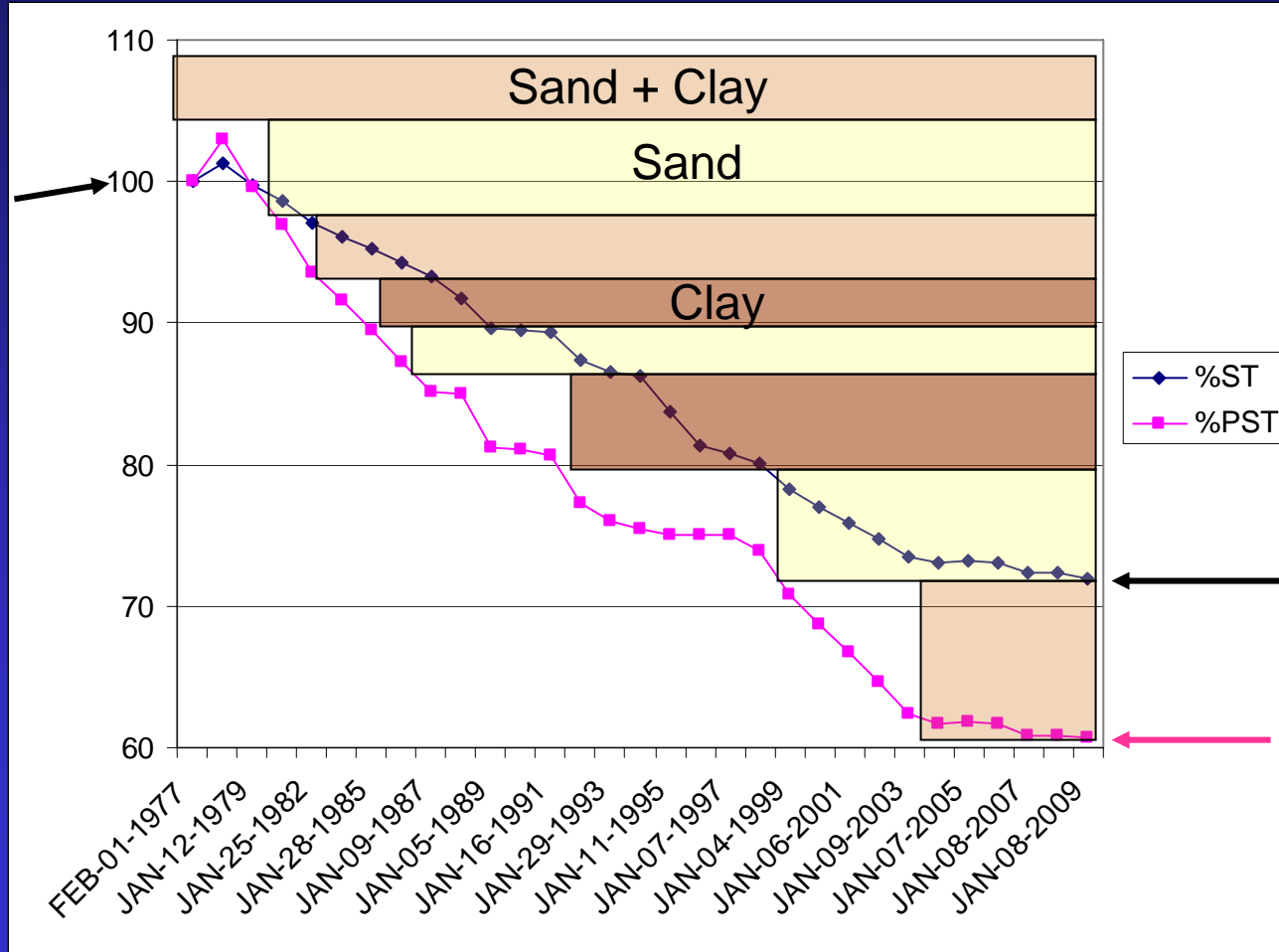
Practical Saturated Thickness Plus (PST+)

PST+ Definition: The saturated portion of the Ogallala aquifer that yields water based quantitatively on grain size and by implication, potential yield.



Changes in total and percentage of saturated thickness and practical saturated thickness in relation to lithology for a Haskell County well near the Index site

350' ST →
160' PST



ST = 252'

PST = 96'

Proposed PST+ Work in GMD1

An integrative study is in preparation: GMD1 and KGS will identify relationships between PST+ and changes in water rights and water use over time in Scott and Wallace counties

Areas of investigation and interaction

Expand lithologic characterization around index well(s) and determine how to best use PST+ to explain and predict how water use affects water in storage.

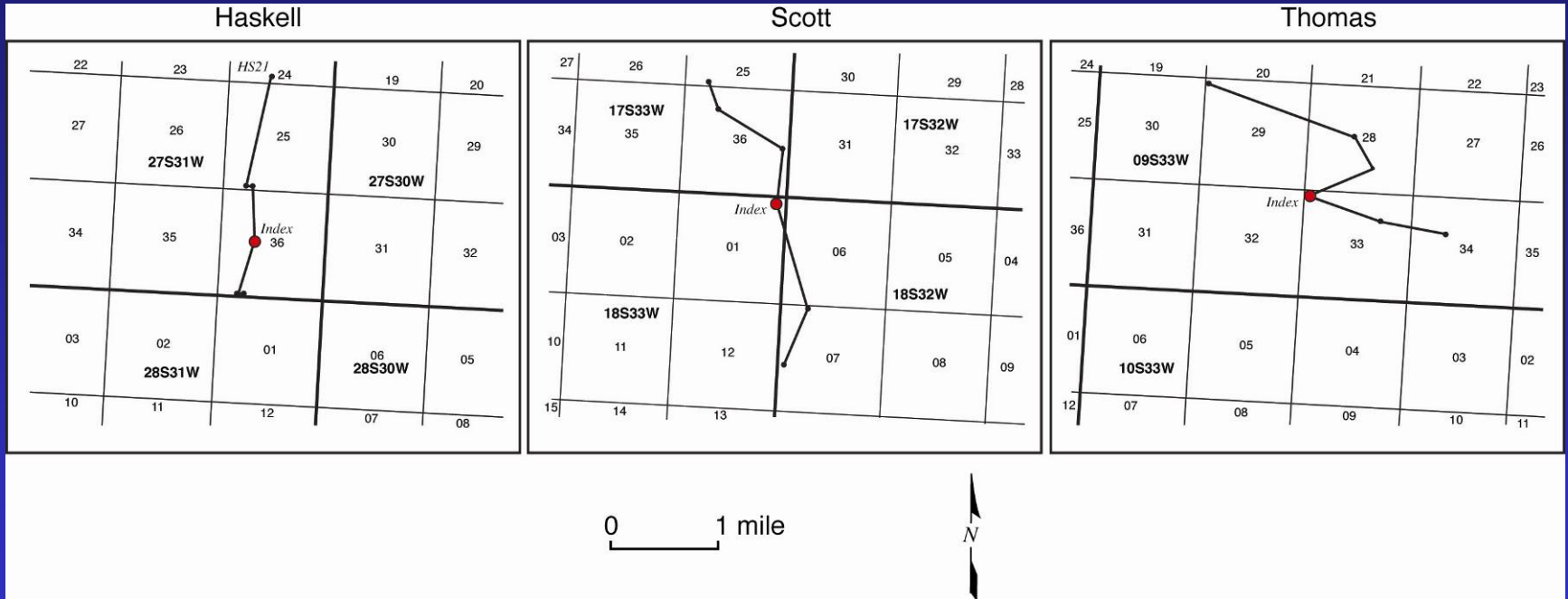
Study observed and theoretical relationships between well recovery characteristics, barometric responses, and PST+.

- Look into “type curve” analysis (e.g., decline rates/water use per unit time) as a means of grouping and characterizing wells or regions.
- Examine rates of WL change in relation to lithology and water use, and compare
 - ✓ Between different geohydrologic settings
 - ✓ Between different wells within settings
 - ✓ In individual wells with time as water levels have declined
- Relate findings to the histories of water allocation and use

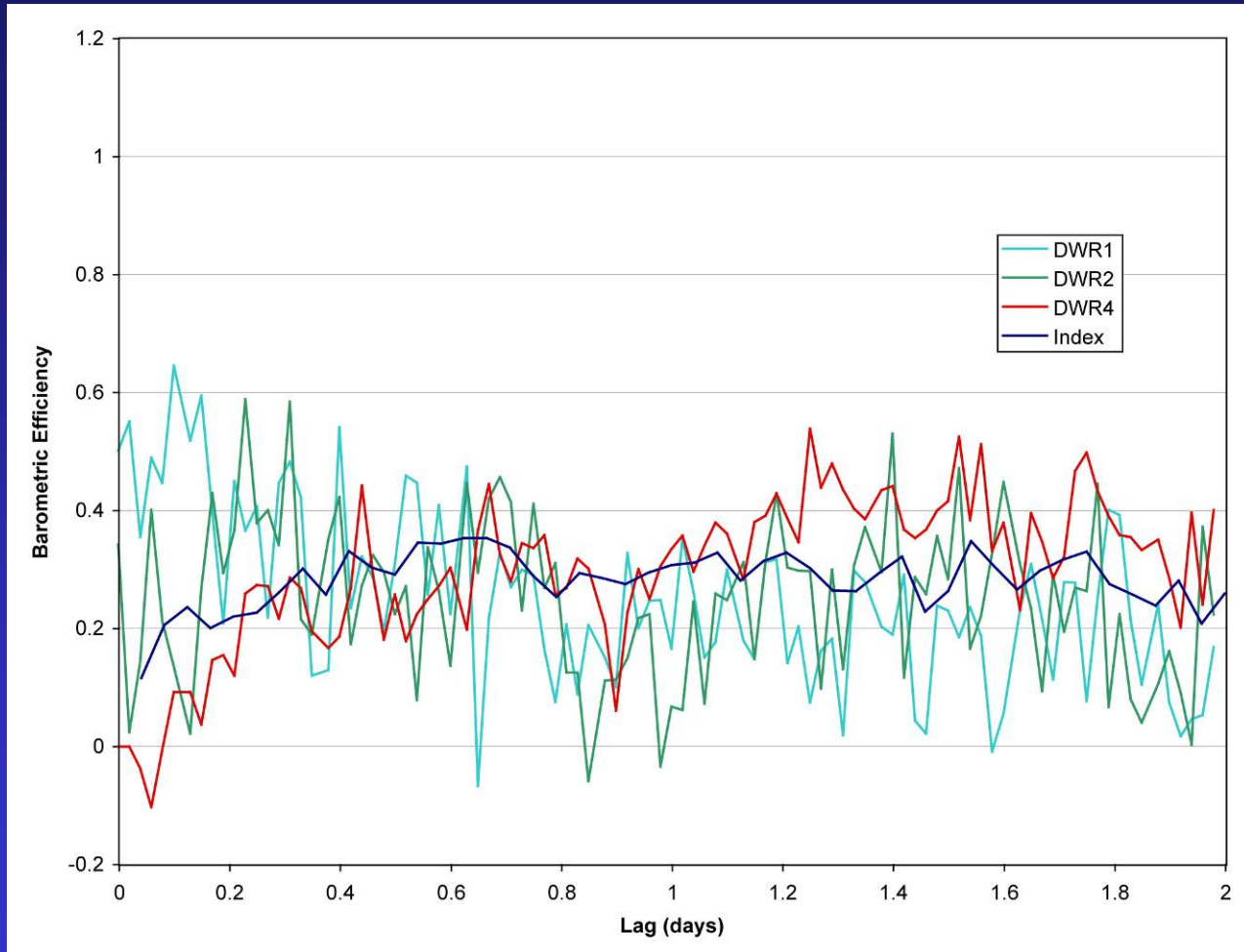
Index Well Program reports and other information available at

http://www.kgs.ku.edu/HighPlains/OHP/index_program/

Lithologic cross section well log locations



Barometric lag time responses (Haskell site “deep” wells)



Barometric lag time responses (Haskell site “shallow” wells)

