

# Groundwater Resources for the Citizens of Western Kentucky

E. Glynn Beck  
KGS Water Resources Section

Kentucky Geological Survey Annual Seminar  
Lexington, Kentucky  
May 15, 2015



# Overview of current groundwater research

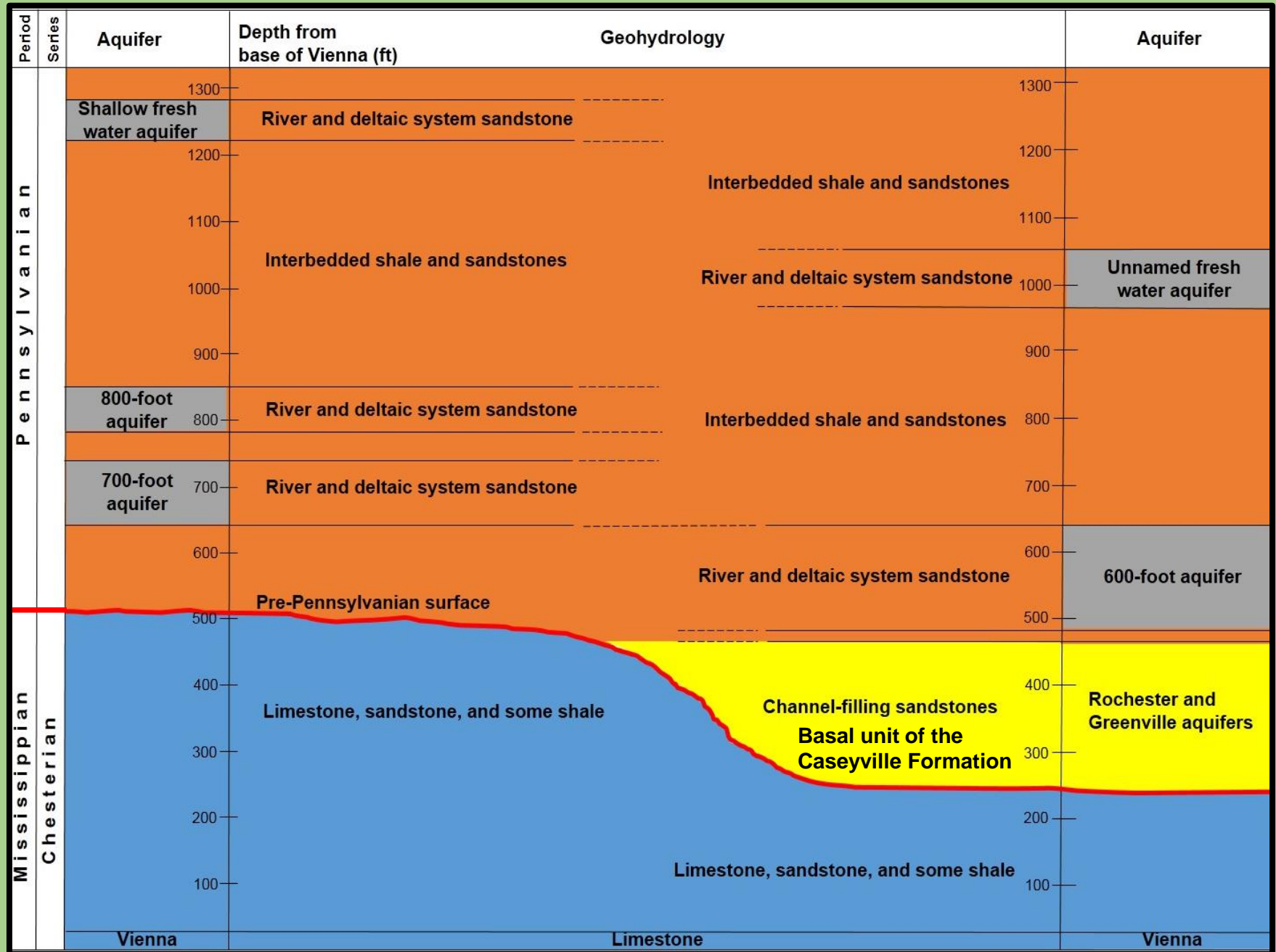
## Western Kentucky Coal Field

- Greenville channel sandstone aquifer,
- Rochester channel sandstone aquifer,
- 600 Foot aquifer

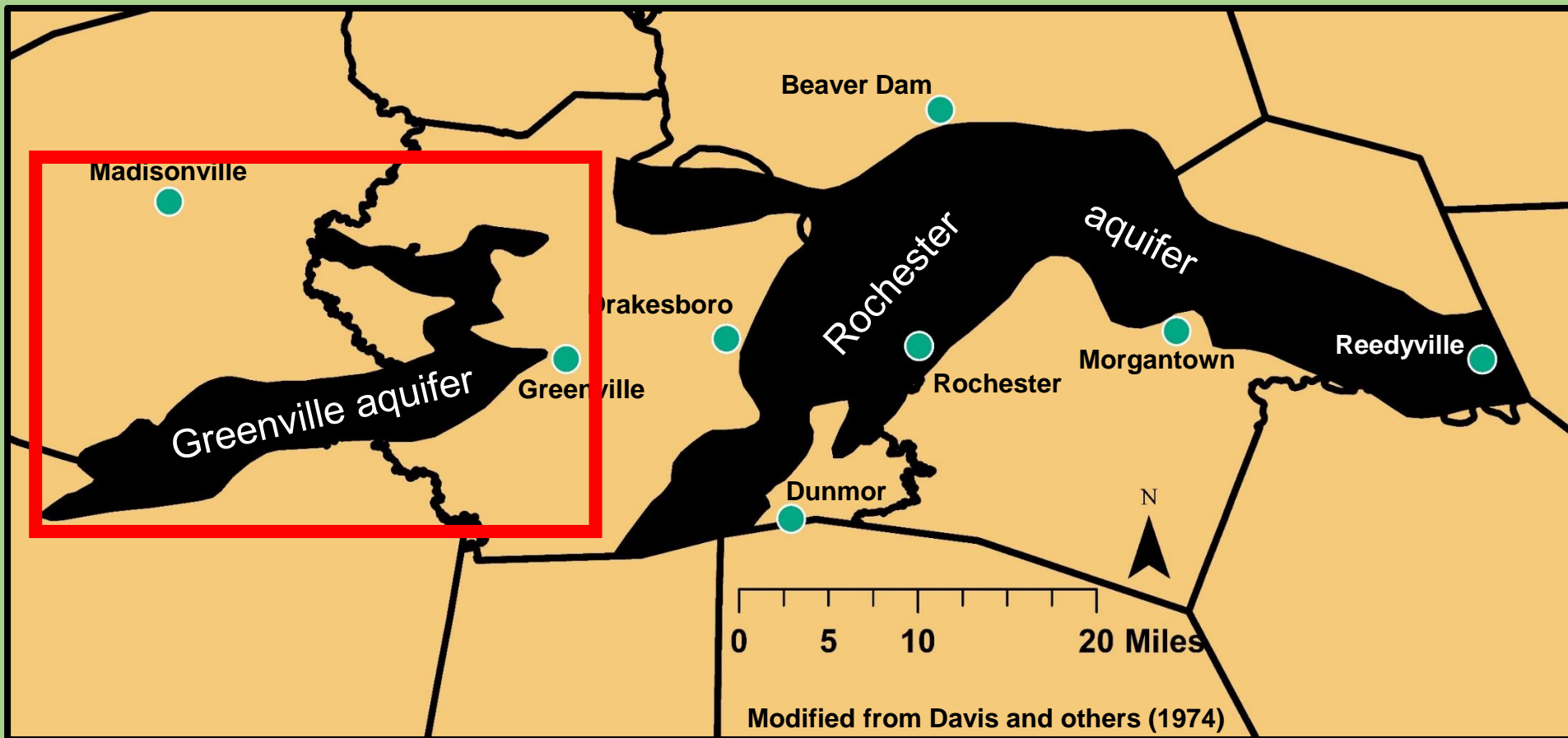
## Jackson Purchase

- Groundwater-quality data,
- Hydrostratigraphy of the Upper Claiborne aquifer and Middle Claiborne confining unit.
- Groundwater-elevation data for the Upper Claiborne aquifer, Middle Claiborne aquifer, and McNairy aquifer.

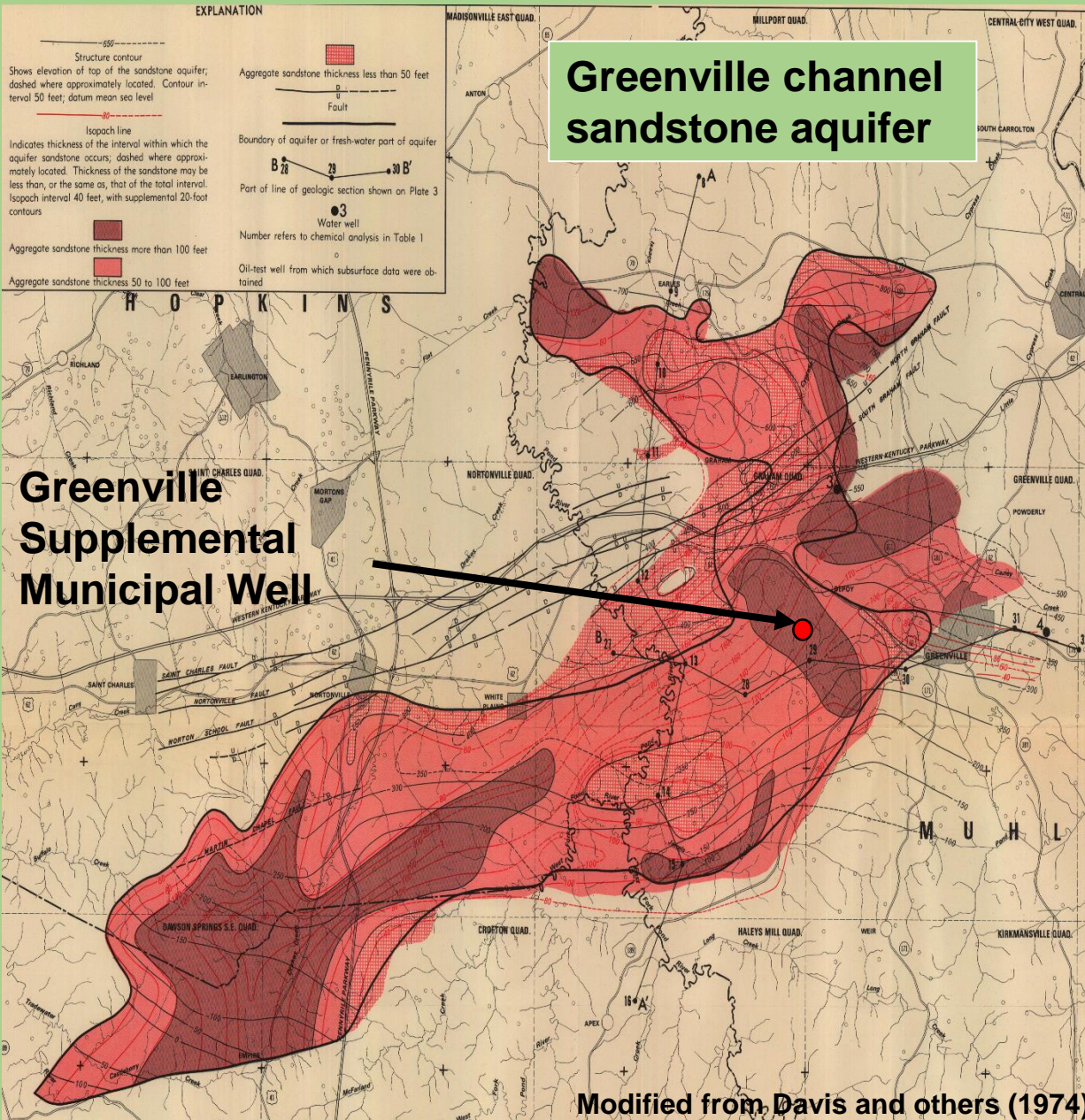
# Pennsylvanian Sandstone Aquifers



# Greenville Channel Sandstone Aquifer







## Greenville channel sandstone aquifer

**KGS Scientists**  
 E. Glynn Beck  
 Steve Webb  
 Junfeng Zhu  
 Scott Waninger  
 Jim Dinger, retired

City of Greenville needed a supplemental water source for Lake Luzerne, which is the municipal drinking water reservoir.

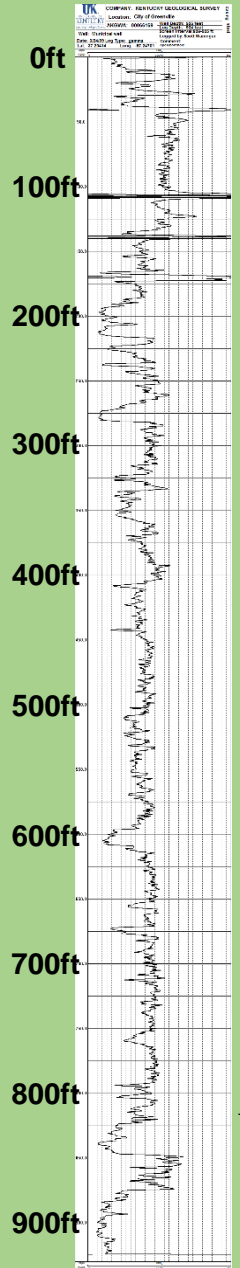
Pre-well installation, KGS scientist helped the City with general hydrogeological data.





Post well installation, KGS scientists collected hydrogeological data for the Greenville aquifer.

Ran gamma-ray log of production well



Greenville channel aquifer producing approx. 100 gal/min

Assisted with pump set up

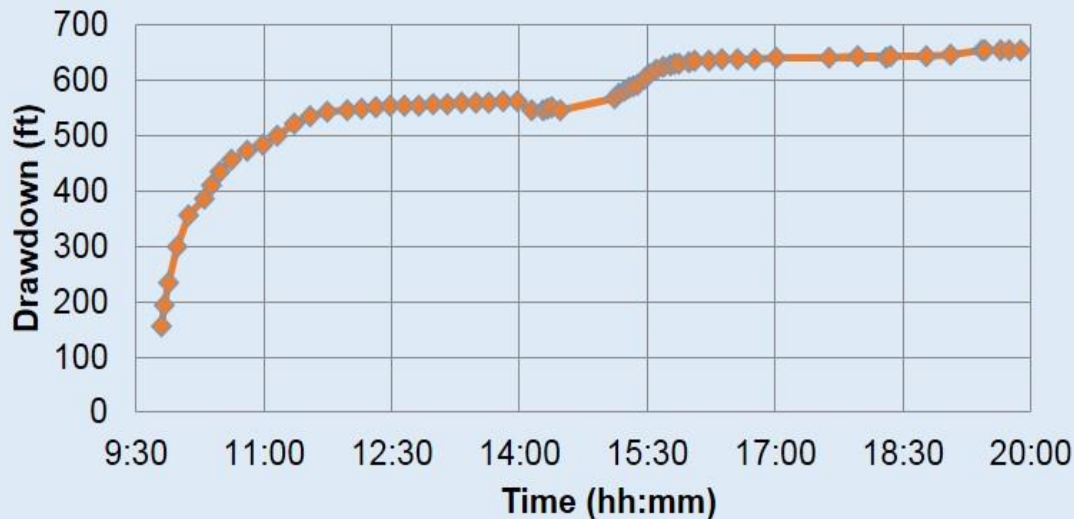


Collected aquifer test data



Collected groundwater-quality data prior to test and during test

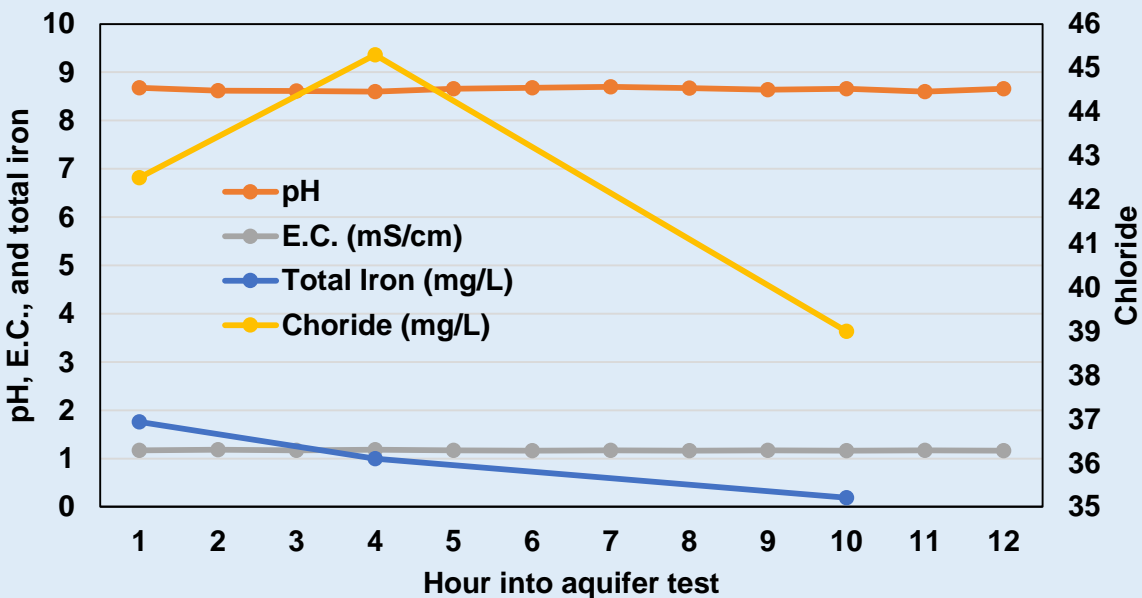




Drawdown curve and aquifer test results

Model	Transmissivity (ft <sup>2</sup> /min)	Storage Coefficient
Papadopulos-Cooper	0.01611	0.00715

## Groundwater-quality data





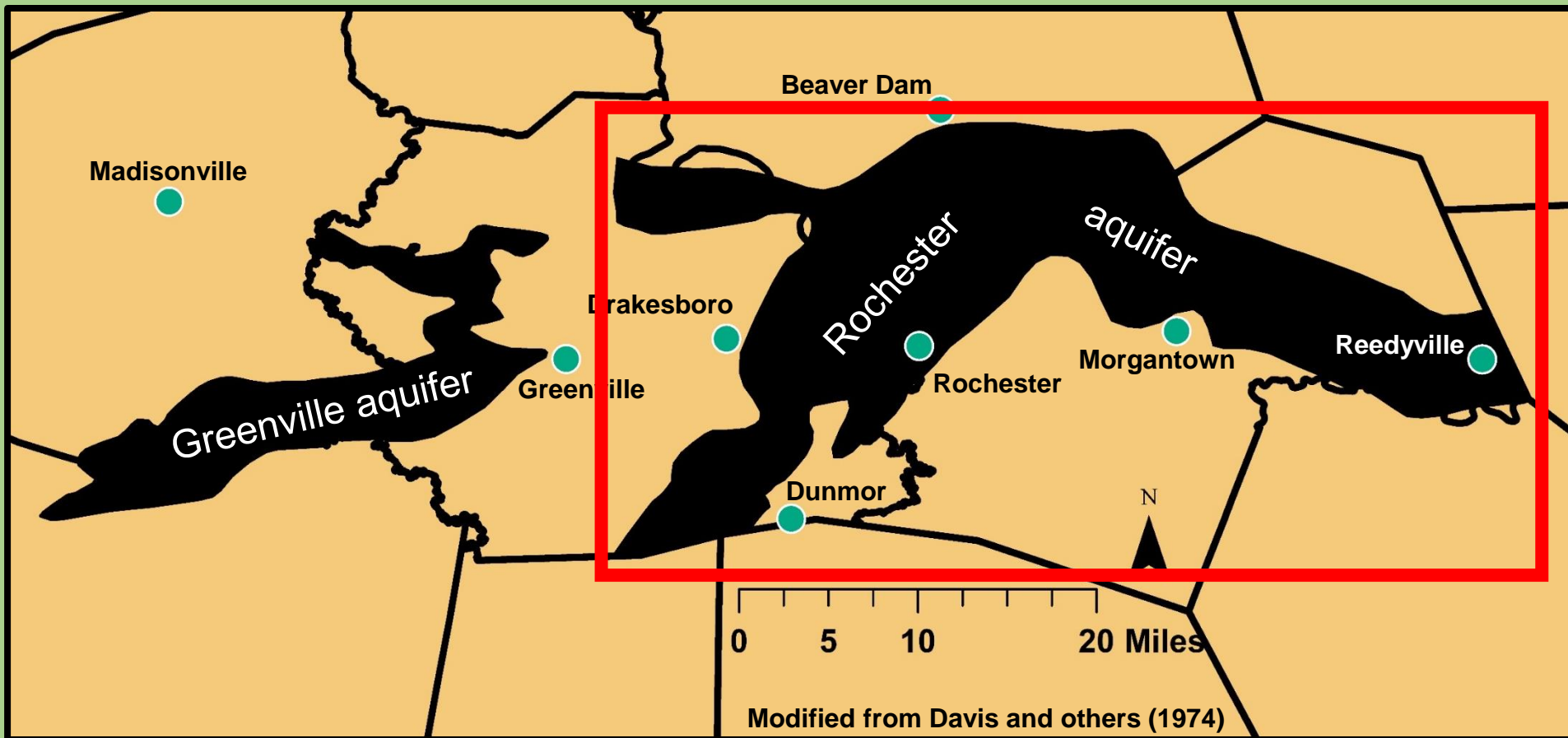
- An informal report summarizing aquifer test and sample results was submitted to the City of Greenville.
- Well is actively being used to supplement Lake Luzerne during drought conditions. Number of citizens benefited: 4,300+

### **Active research**

- Locate additional water wells installed in the Greenville channel aquifer and collect hydrogeological data to better characterize the aquifer.
- Determine sustainability of long-term use of the confined aquifer.



# Rochester Channel Sandstone Aquifer



# Perdue Farms Complex (poultry processing plant)

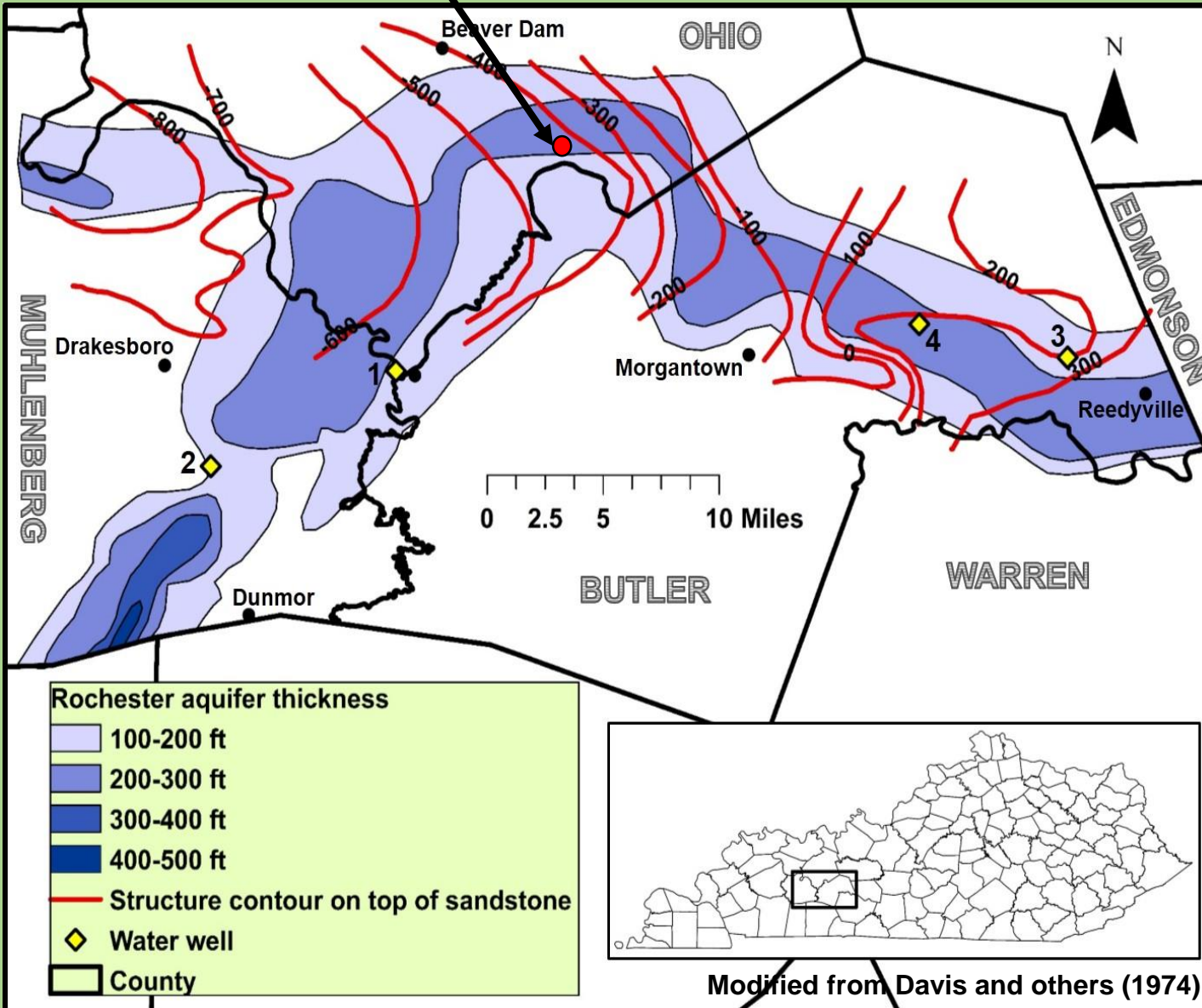
**KGS Scientist**  
E. Glynn Beck

Perdue Farms looking for alternate/ supplemental source of water (1.4 million gal/day) for processing plant near Cromwell.

Groundwater will reduce cost of cooling and heating water.

KGS scientist helped Perdue with general hydrogeological data.

Well installation on hold (cost and lack of data).



## What's the benefit of the poultry industry to Kentucky?

## What's the benefit of groundwater to the poultry industry/producers?

- #1 Agricultural Commodity in Kentucky, #1 Food Commodity
- #7 in the nation in terms of broiler production (NASS 2013, with 309 million broilers)
- \$1.2 Billion industry in 2014
- Over 850 large scale poultry farms, 3000 poultry houses in 42 counties and still growing in all sectors of the industry. *(Groundwater is either the primary or secondary source of water for a large percentage of these poultry farms).*
- The broiler-breeder industry in Kentucky employees approximately 6,300 people across the state and generates an additional 20,444 jobs in both the supply and ancillary industries.
- *The Perdue Farms Complex near Cromwell is 1 of 4 processing plants in Kentucky.*

Source: Kentucky Poultry Federation Website

[\(http://www.kypoultry.org/pfacts/\)](http://www.kypoultry.org/pfacts/)

Underlined italics added by Beck.





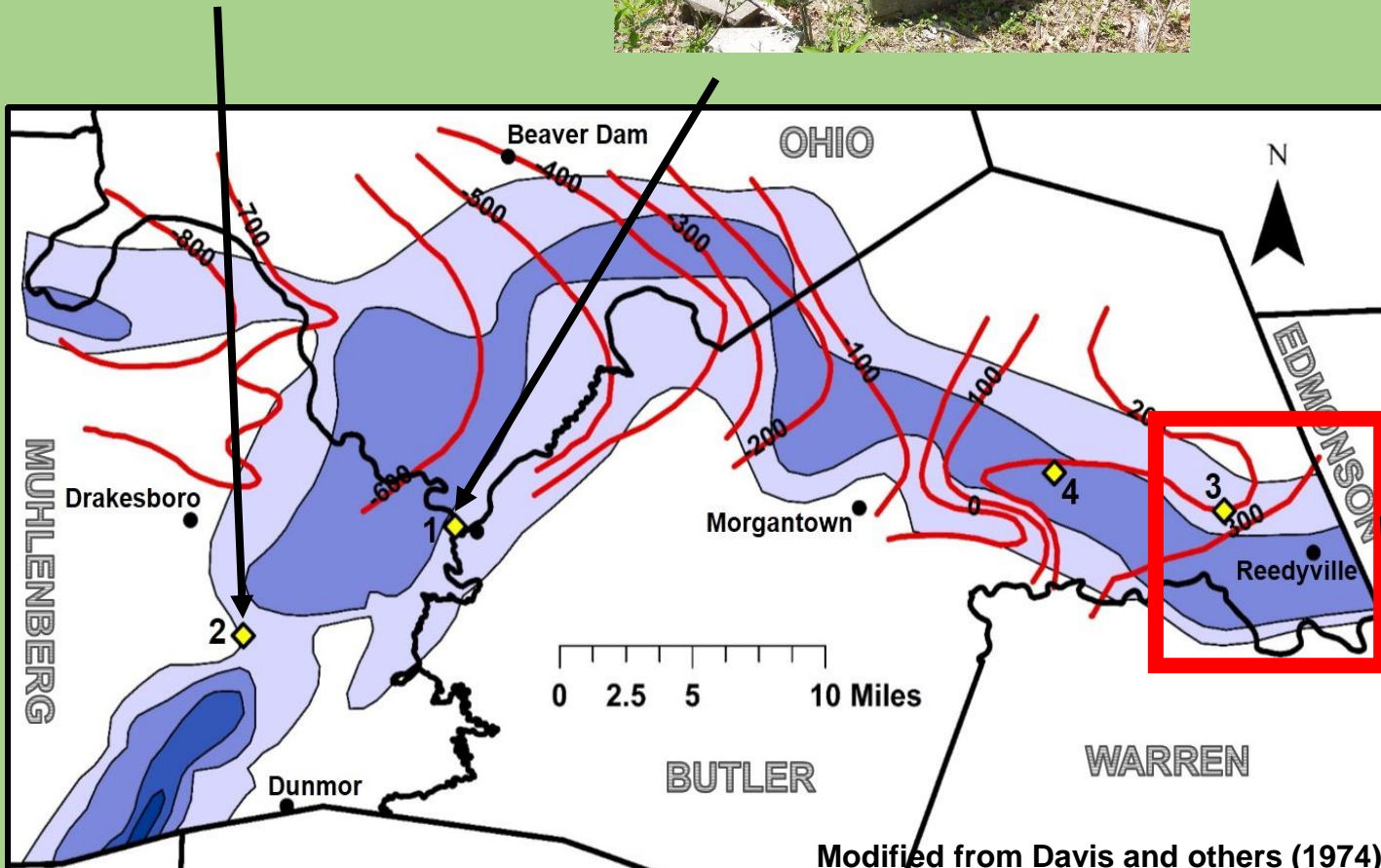
Fox livestock well: active

Craig domestic well: abandoned and buried

### Future Research

Locate additional water wells.

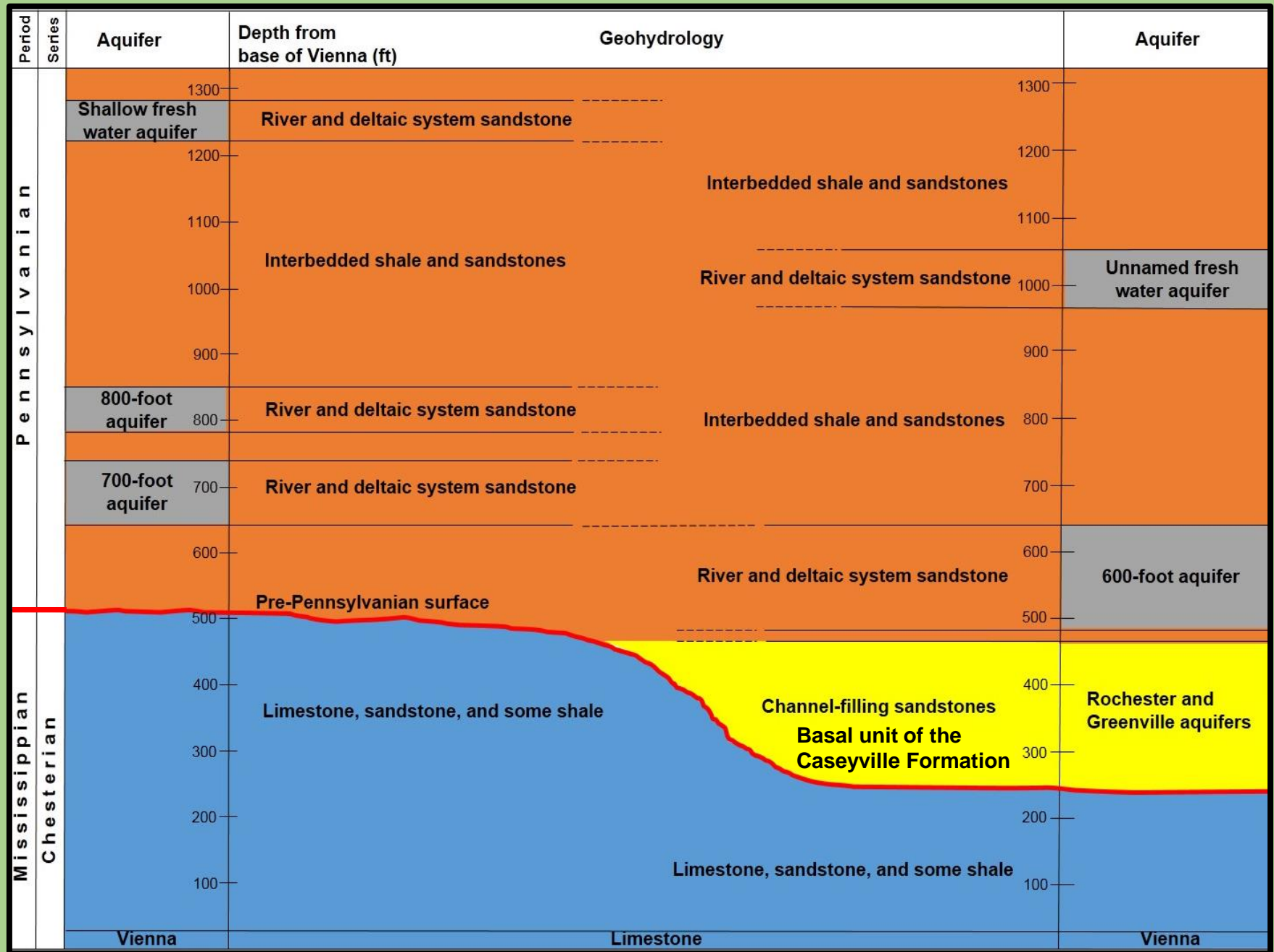
Collect new hydrogeological data to better characterize unconfined aquifer.



Reported aquifer recharge zone



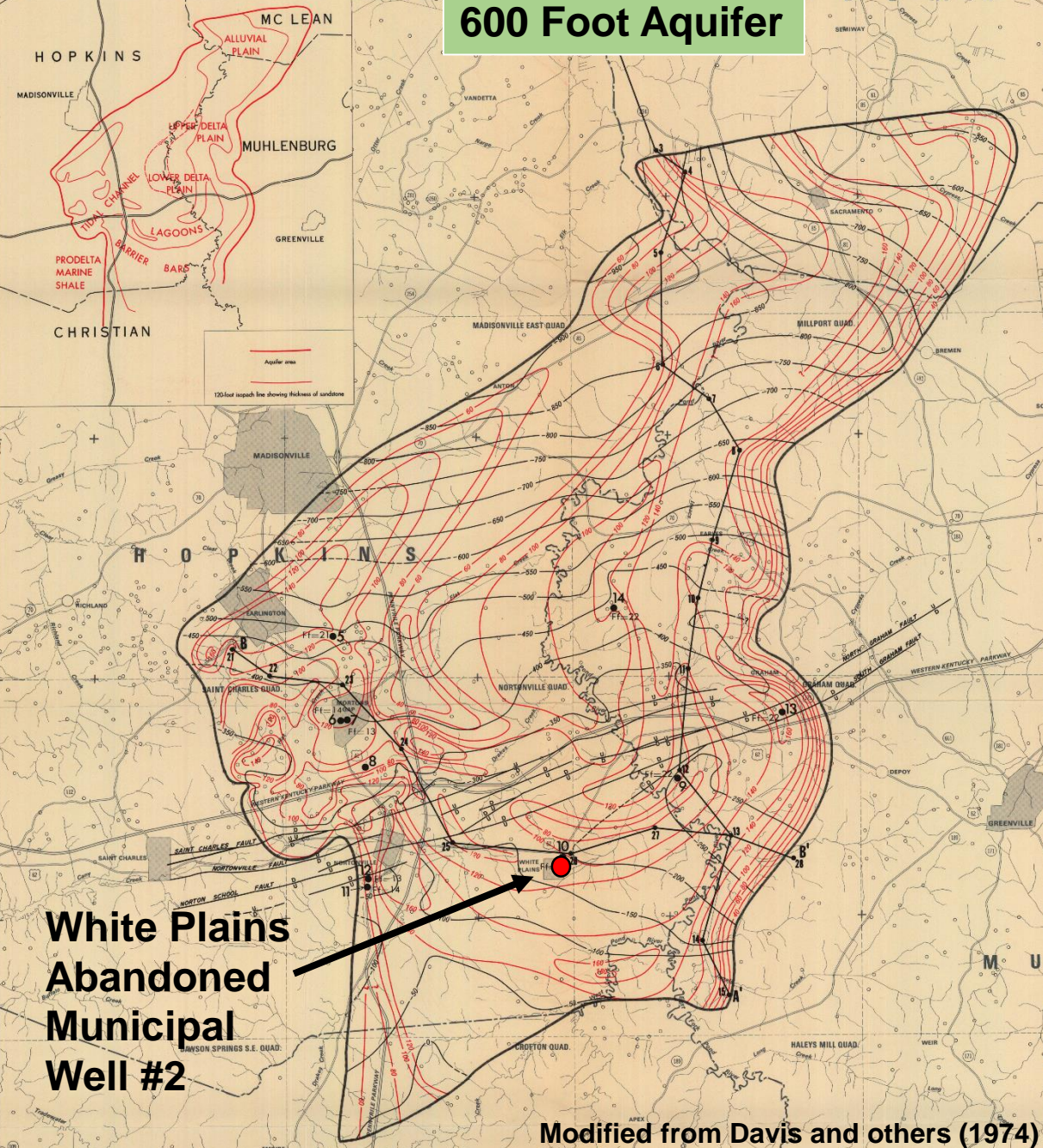
# Pennsylvanian Sandstone Aquifers





DEPOSITIONAL ENVIRONMENTS OF THE 600-FOOT AQUIFER  
(VIENNA DATUM)

# 600 Foot Aquifer



**White Plains  
Abandoned  
Municipal  
Well #2**

Modified from Davis and others (1974)

## KGS Scientists

E. Glynn Beck  
Steve Webb  
Bart Davidson

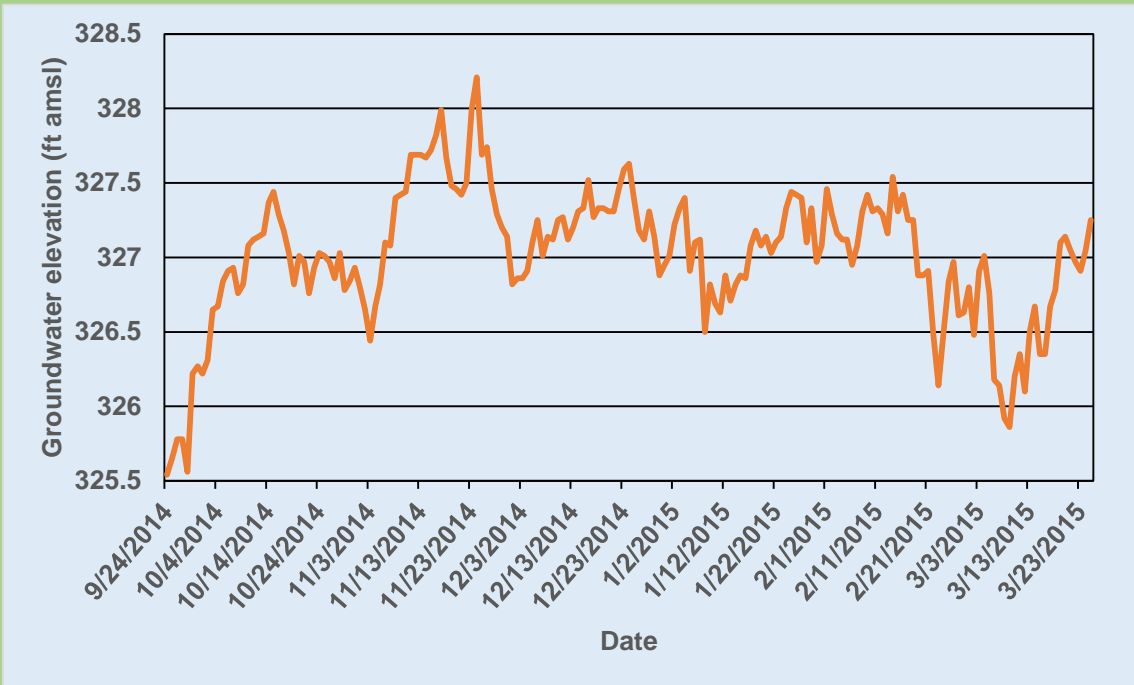
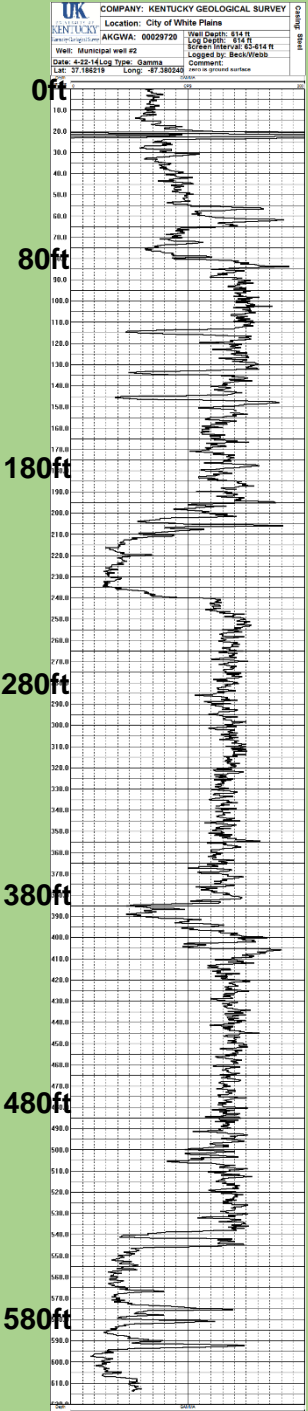
### Videod and gamma-ray logged well



### Installed pressure transducer







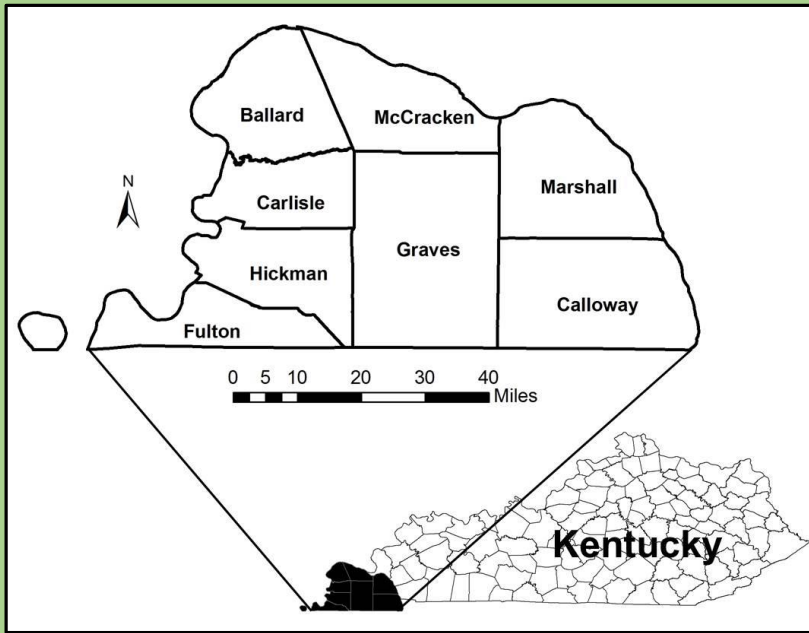
**Future research**

- Continue to collect groundwater-elevation data.
- Collect groundwater-quality data from newly installed municipal well.
- If possible, conduct aquifer test.
- Expand data collection efforts to Nortonville.

Determine sustainability of long-term use of the confined aquifer.

Number of citizens benefited: 2,300+

# Groundwater Quality in the Jackson Purchase



**KGS Scientists**  
E. Glynn Beck  
Jim Dinger, retired  
Many Geological Technicians

Research funded, in part, by the Kentucky Senate Bill 271 Research and Education Program, which is administered by the UK College of Agriculture, Food and Environment.

Summarized research goals:

- 1) Develop a current groundwater-quality database.
- 2) Determine links between local groundwater quality, land use, hydrogeology, and well construction.
- 3) Provide groundwater-quality data and educational material to private well owners.



## Research Goal #1

- Develop a current groundwater-quality database

646 domestic wells were sampled for the following various constituents:

- Field parameters (pH, conductivity, temperature, and DO)
- Anions (chloride, fluoride, sulfate, bromide, and nitrate)
- Herbicides (triazine, alachlor, and metolachlor)
- Total and dissolved metals
- Alkalinity and bicarbonate
- Total coliform and *E. coli*
- Nitrogen isotopes
- Caffeine

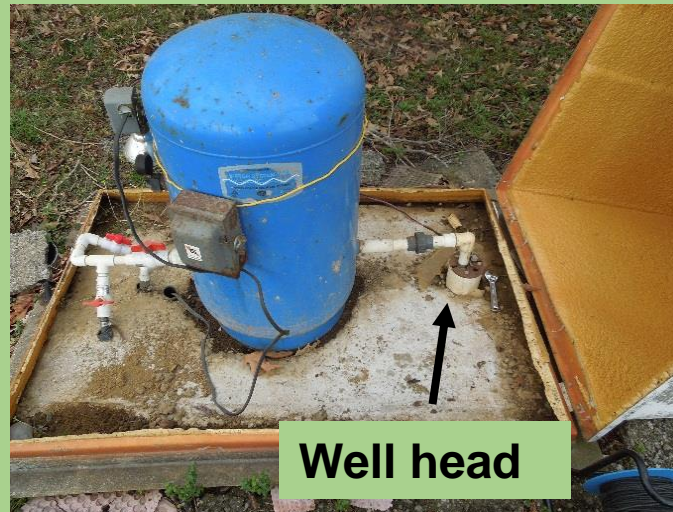


## Two domestic well construction types

### Research Goal #2

- Determine links between local groundwater quality, land use, hydrogeology, and well construction.

Drilled well (PVC casing)



Bored well (Cement tile casing)



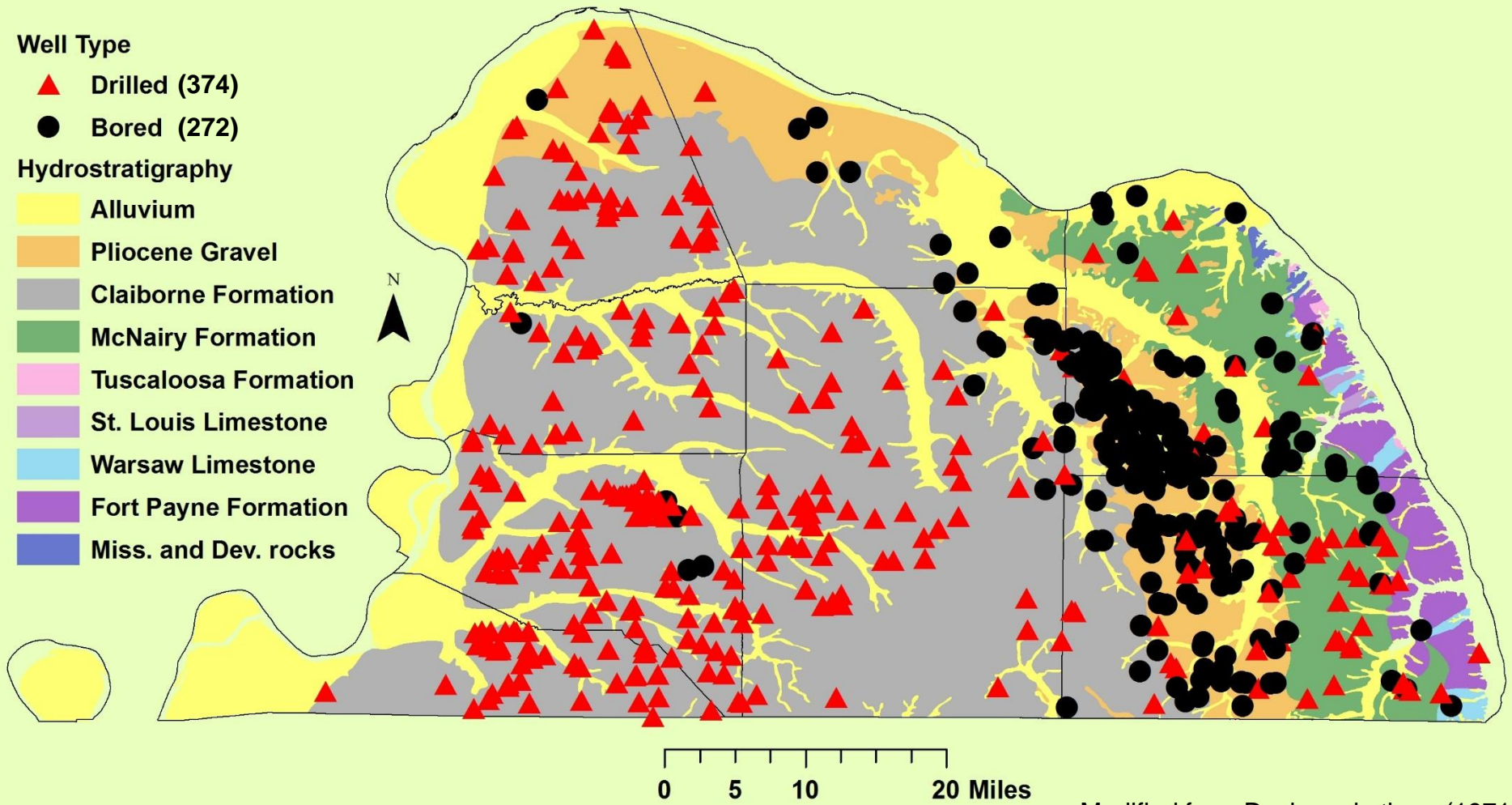
# Distribution of Sampled Domestic Wells

## Well Type

- ▲ Drilled (374)
- Bored (272)

## Hydrostratigraphy

- Alluvium
- Pliocene Gravel
- Claiborne Formation
- McNairy Formation
- Tuscaloosa Formation
- St. Louis Limestone
- Warsaw Limestone
- Fort Payne Formation
- Miss. and Dev. rocks



Modified from Davis and others (1971)

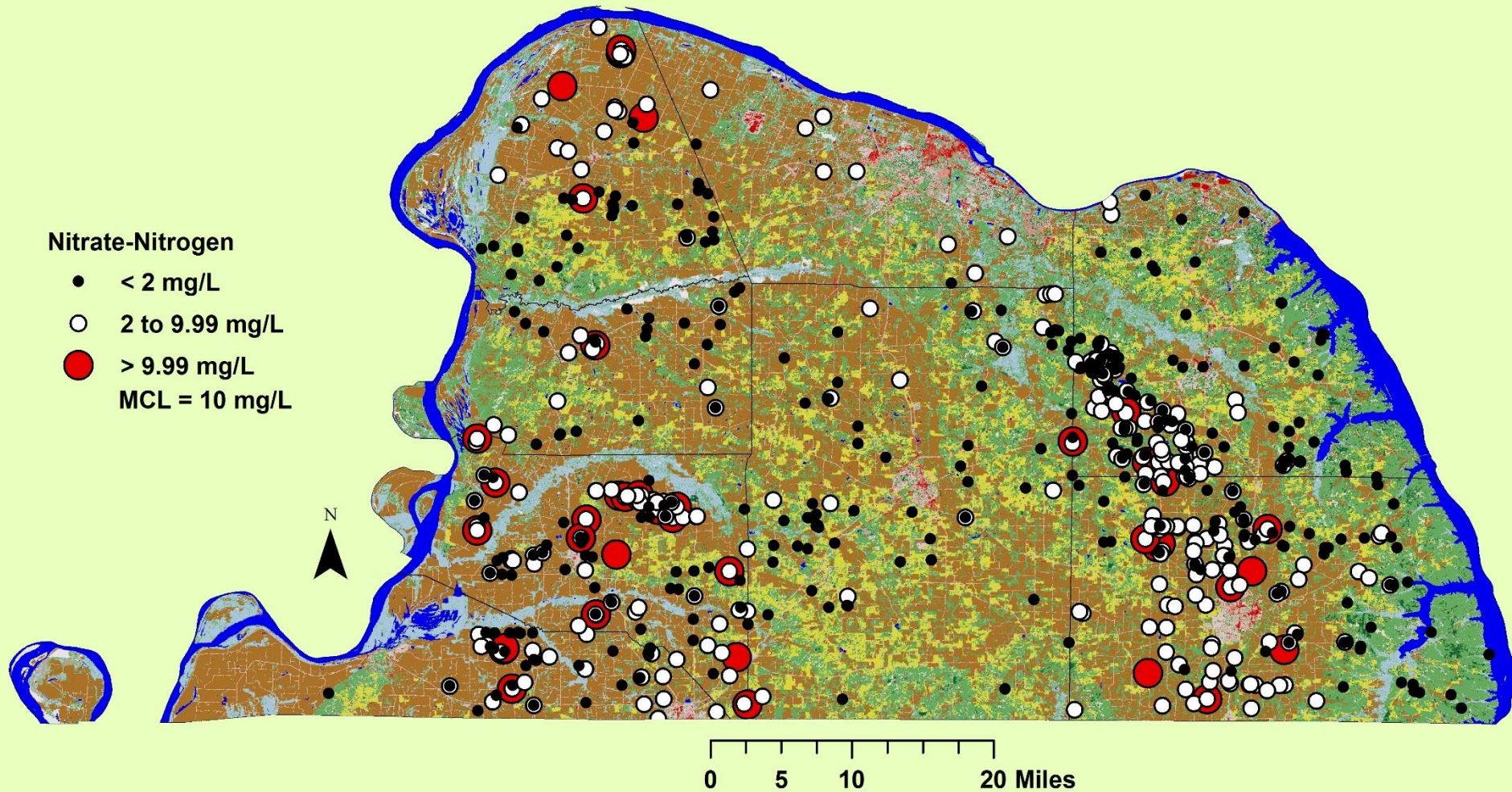
646 domestic wells sampled



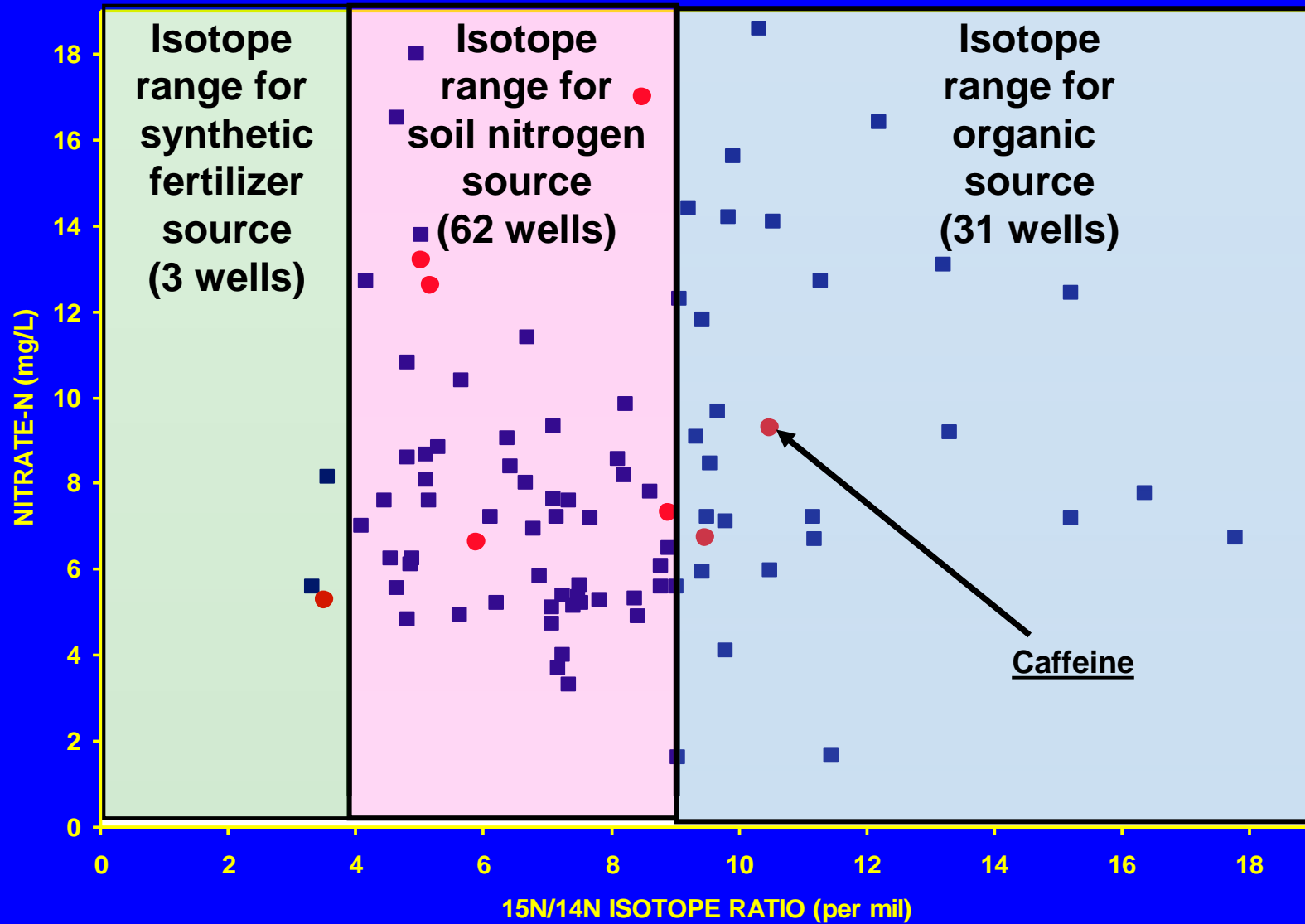
# Distribution of Nitrate-Nitrogen

## Nitrate-Nitrogen

- < 2 mg/L
  - 2 to 9.99 mg/L
  - > 9.99 mg/L
- MCL = 10 mg/L



# Nitrogen Isotope and Caffeine Data





## Research Goal #3

- Provide groundwater-quality data and educational material to private well owners.
- Result letters and laboratory reports were mailed to all 646 well owners.
- Groundwater quality and well maintenance educational sheets were mailed to all owners.
- KyDOW well inspection forms were completed and mailed to all owners.

In addition, KGS scientists continue to work closely with the following groups to disseminate research results and educational material:

- University of Kentucky Cooperative Extension Service,
- USDA-NIFA Southern Regional Water Quality Program, and
- Kentucky Agriculture Science and Monitoring Committee (KASMC)



The aforementioned research has directly benefited 646 citizens and indirectly benefited countless citizens. 69% of 200,000 residents utilize groundwater as drinking water.

# Current Research

## Regional hydrostratigraphic model versus local hydrostratigraphy

Collaboration with Ed Woolery and Marie Cooper; Dept. of Earth and Environmental Sciences



### KGS Scientists

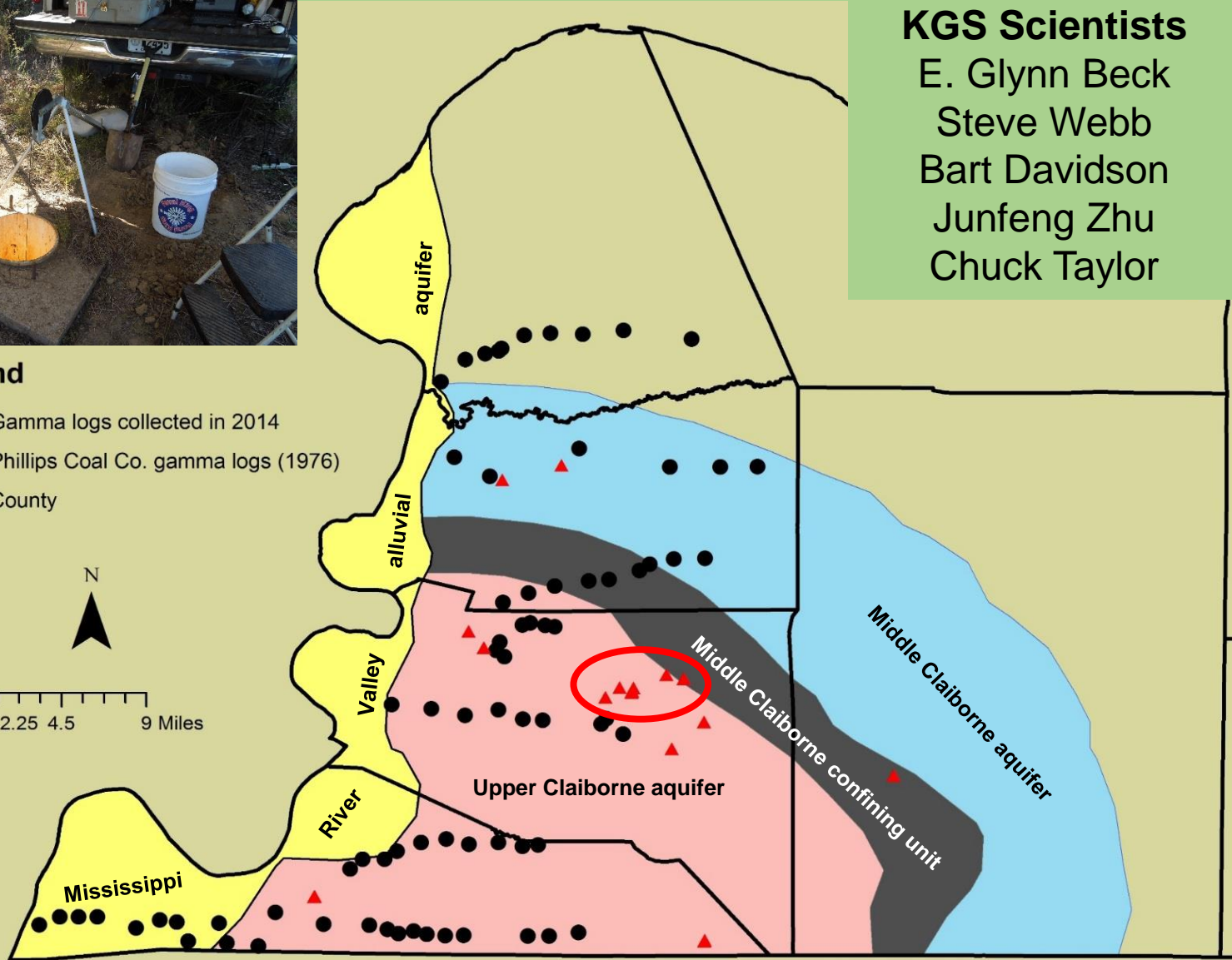
E. Glynn Beck  
Steve Webb  
Bart Davidson  
Junfeng Zhu  
Chuck Taylor

### Legend

- ▲ Gamma logs collected in 2014
- Phillips Coal Co. gamma logs (1976)
- County

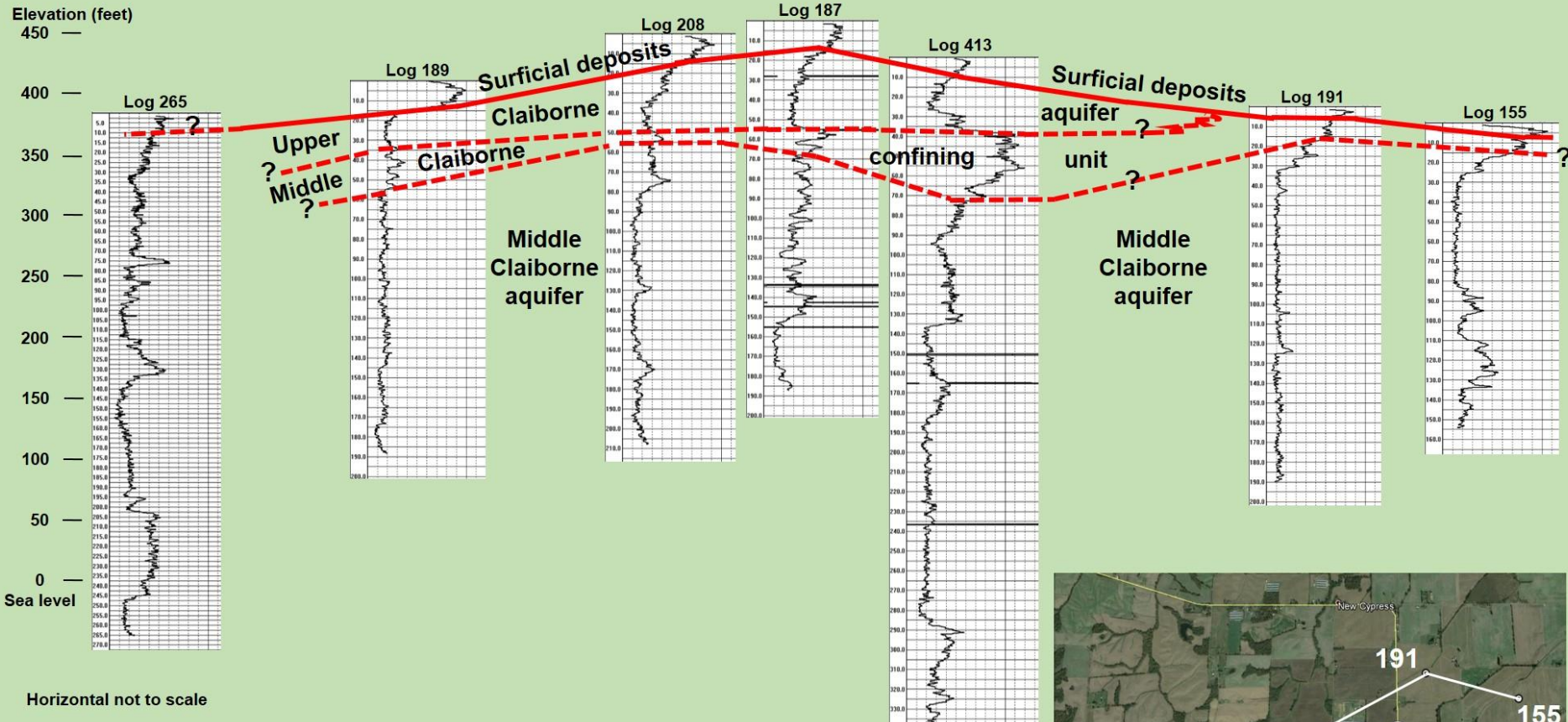


0 2.25 4.5 9 Miles



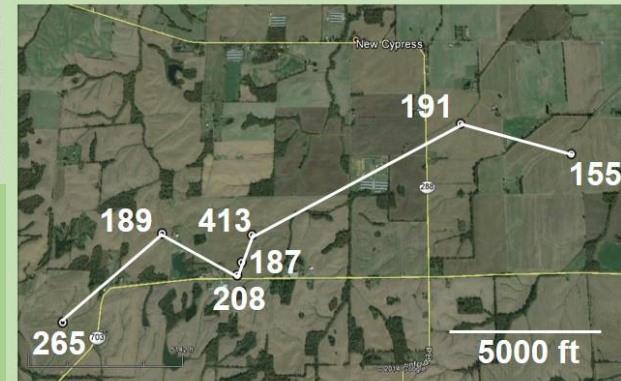
Modified from Lloyd and Lyke (1995)

# Preliminary Cross Section



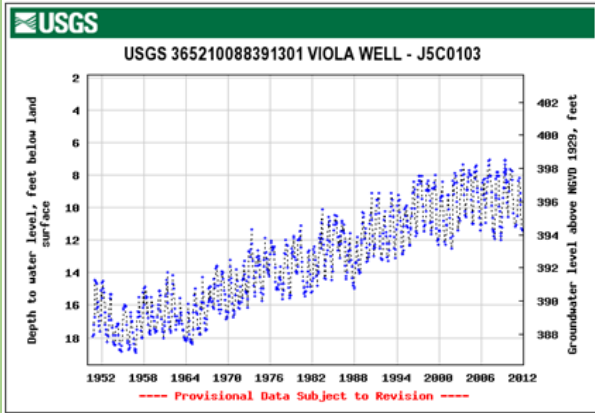
## Curent Research

- Collect additional gamma logs
- Create 4 regional cross sections using Petra
- Evaluate the use of seismic and ER to map confining unit
- Use core and drill cutting samples to better delineate local geology
- How continuous is the Middle Claiborne confining unit?
- What is the hydraulic connection between the Upper and Middle Claiborne aquifers?

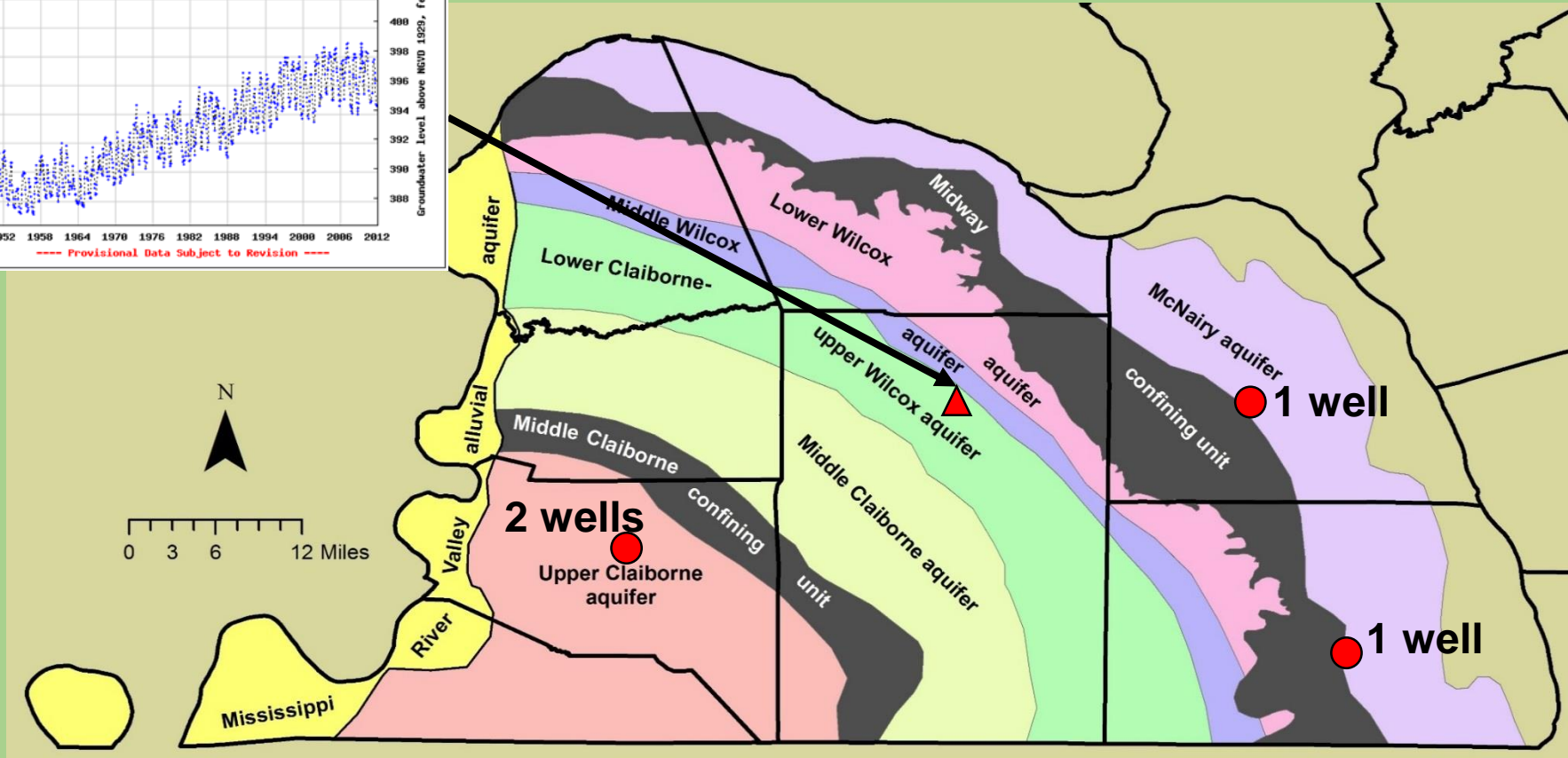




# Long-Term Groundwater-Elevation Monitoring



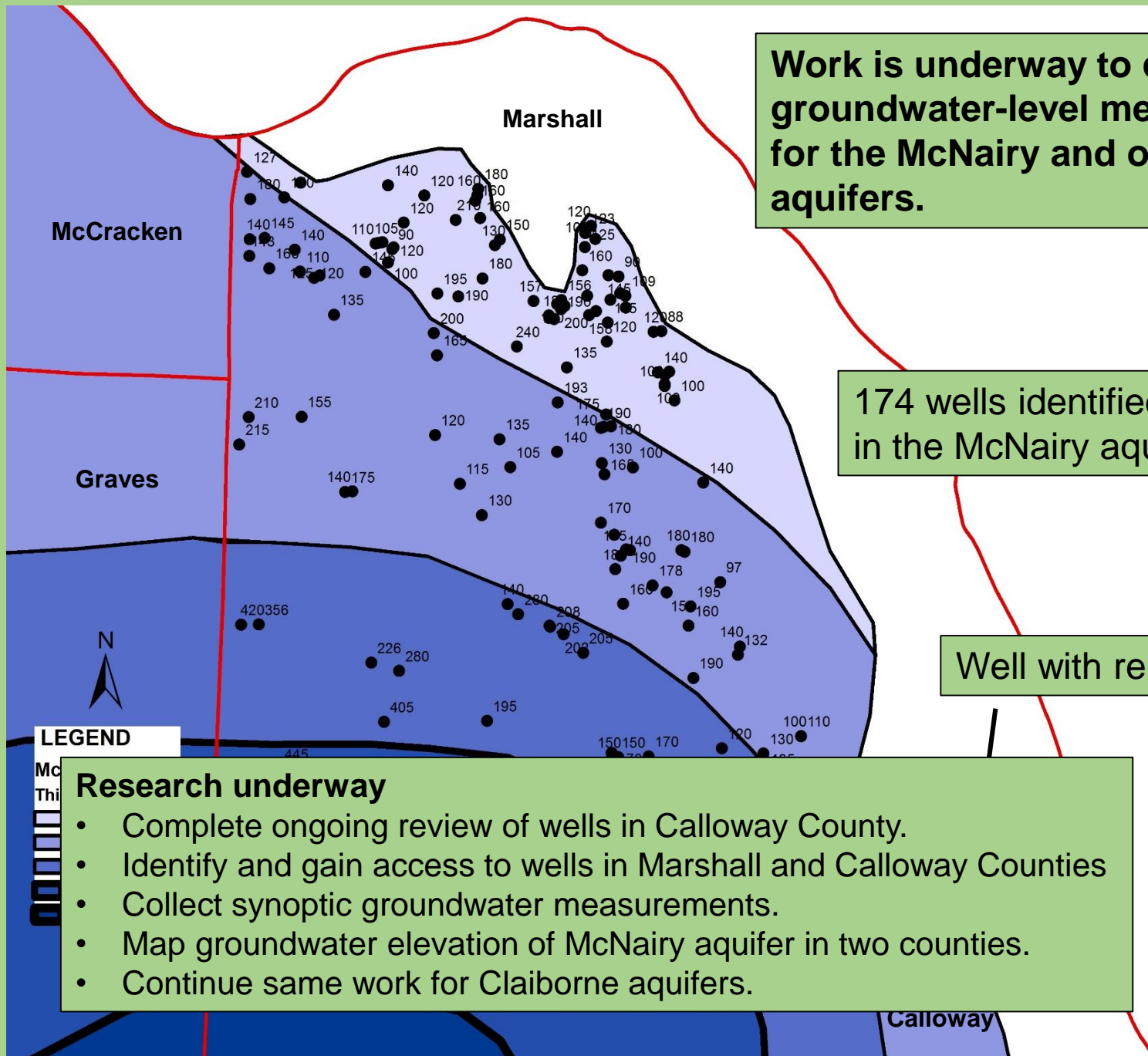
Only long-term station in Kentucky



Work is underway to instrument 4 new stations in the Jackson Purchase.

**STATEWIDE INITIATIVE**

In addition.....



Work is underway to collect synoptic groundwater-level measurements for the McNairy and other major aquifers.

174 wells identified as completed in the McNairy aquifer (KyGWDR)

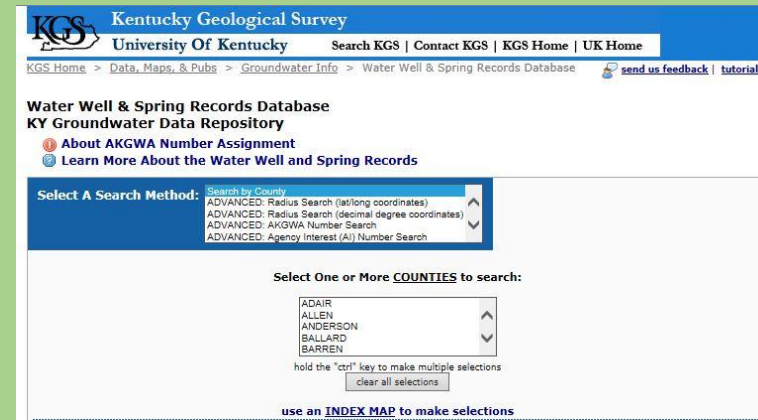
Well with reported total depth



# Kentucky Groundwater Data Repository

Managed by Bart Davidson, KGS

All groundwater-quality data, gamma logs, and other data associated with the aforementioned research are accessible to the citizens of the Commonwealth.



<http://kgs.uky.edu/kgsweb/DataSearching/Water/WaterWellSearch.asp>

## Kentucky Geological Survey Laboratory Services Personnel

Jason Backus and Andrea Mitchell





Thank you for coming and **ENJOY LUNCH!**

# Increased groundwater withdrawals

Increased number of high-yield irrigation wells (center-pivot irrigation systems)

From Google Earth aerial photography

- 2012 photos: 74 center-pivot systems identified
- 2013 photos: 185 center-pivot systems identified

