Milam and Burleson County
Groundwater Summit

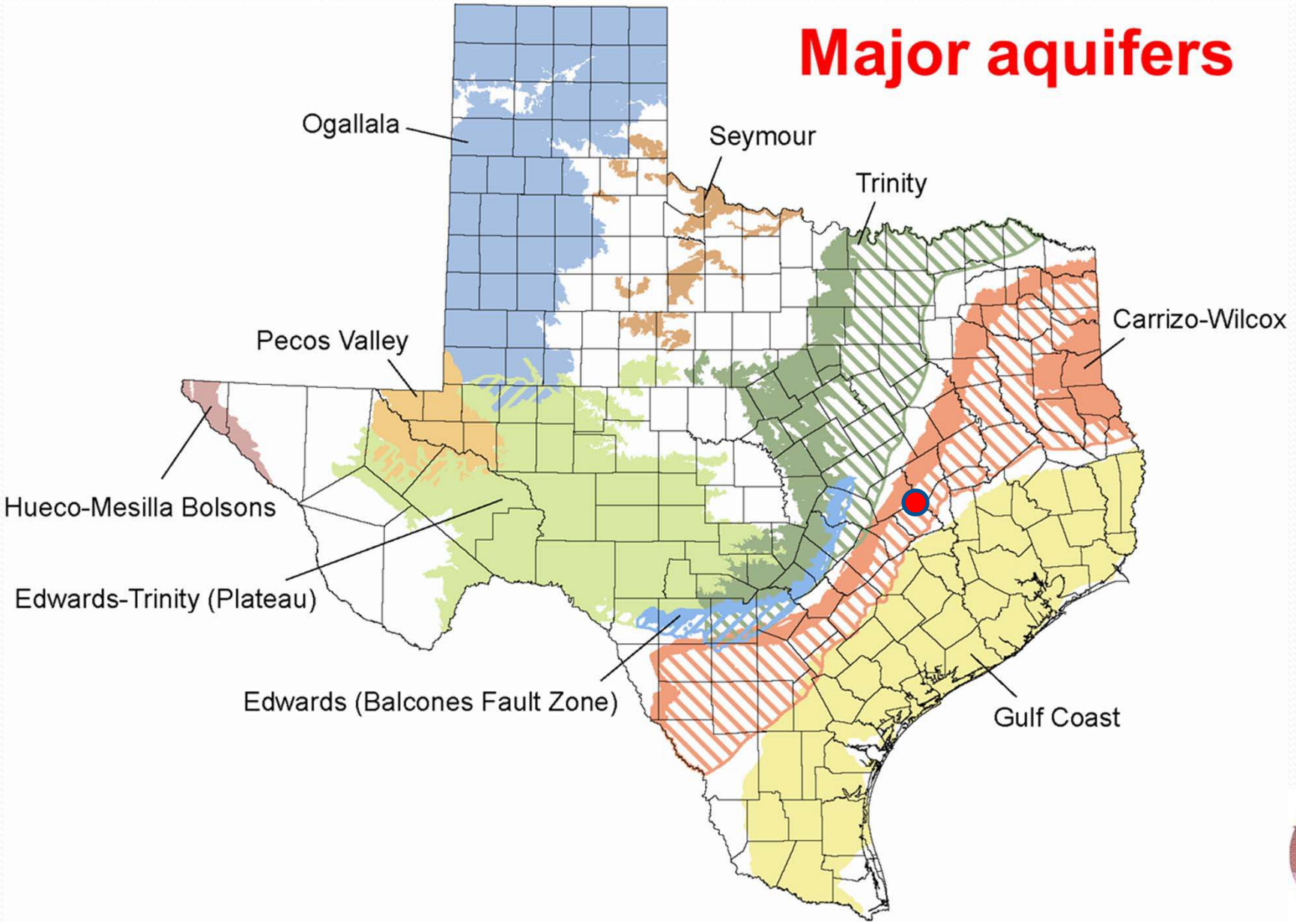
Hydrology Specific to our Central Carrizo-Wilcox Area

James Beach, PG

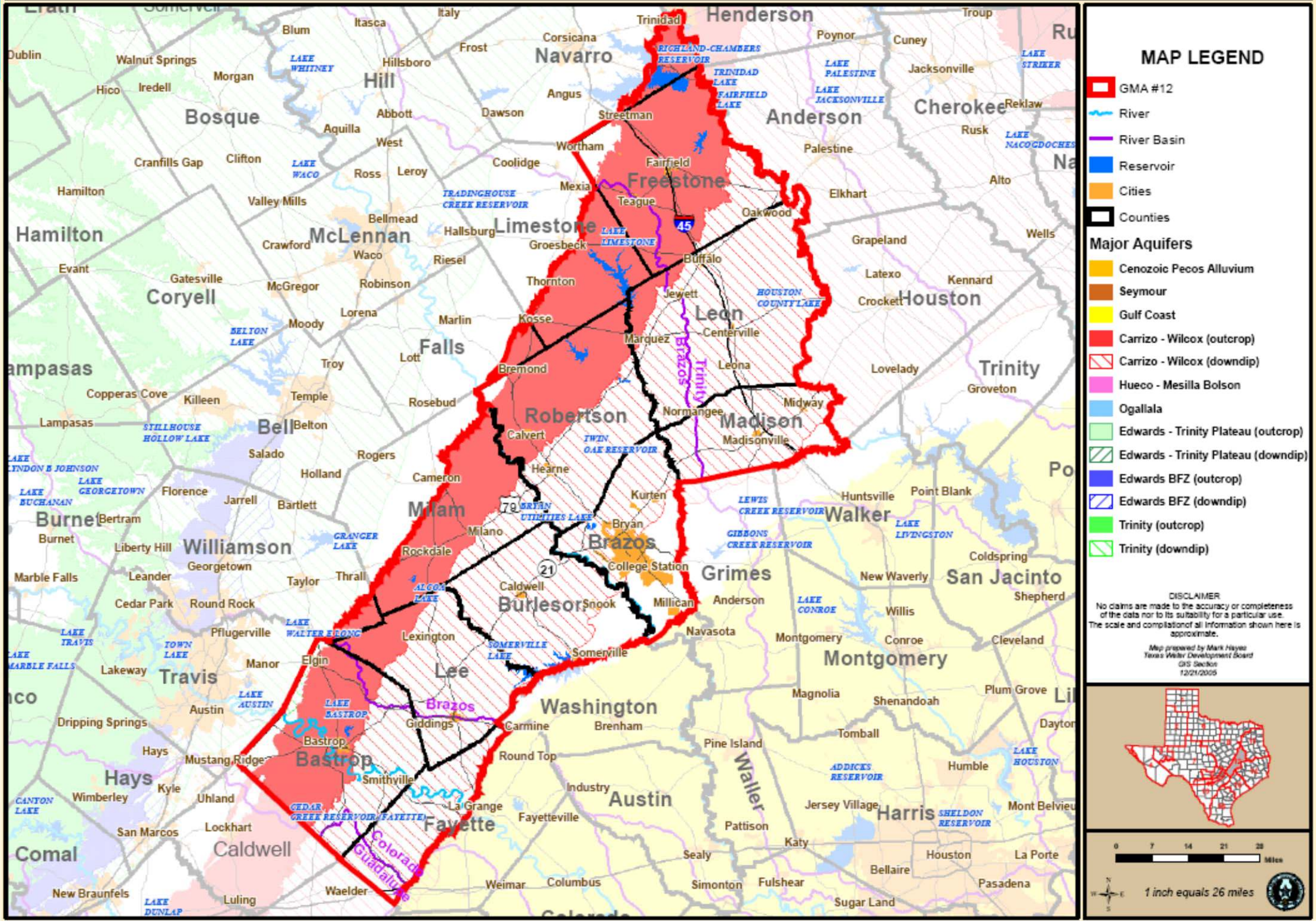
DISCLAIMER

Many slides from other sources.
I did not take time to reference each slide.

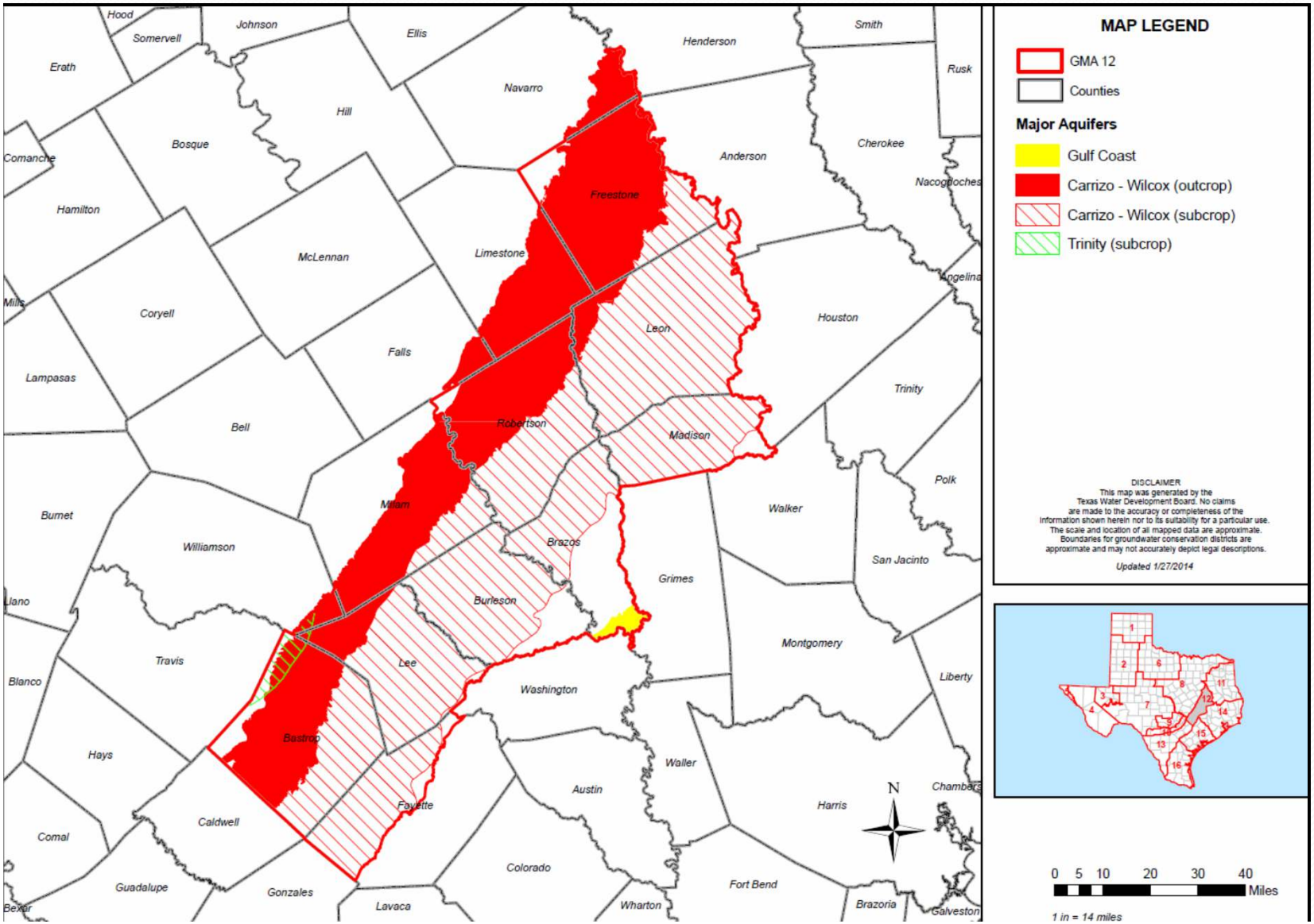
Major aquifers



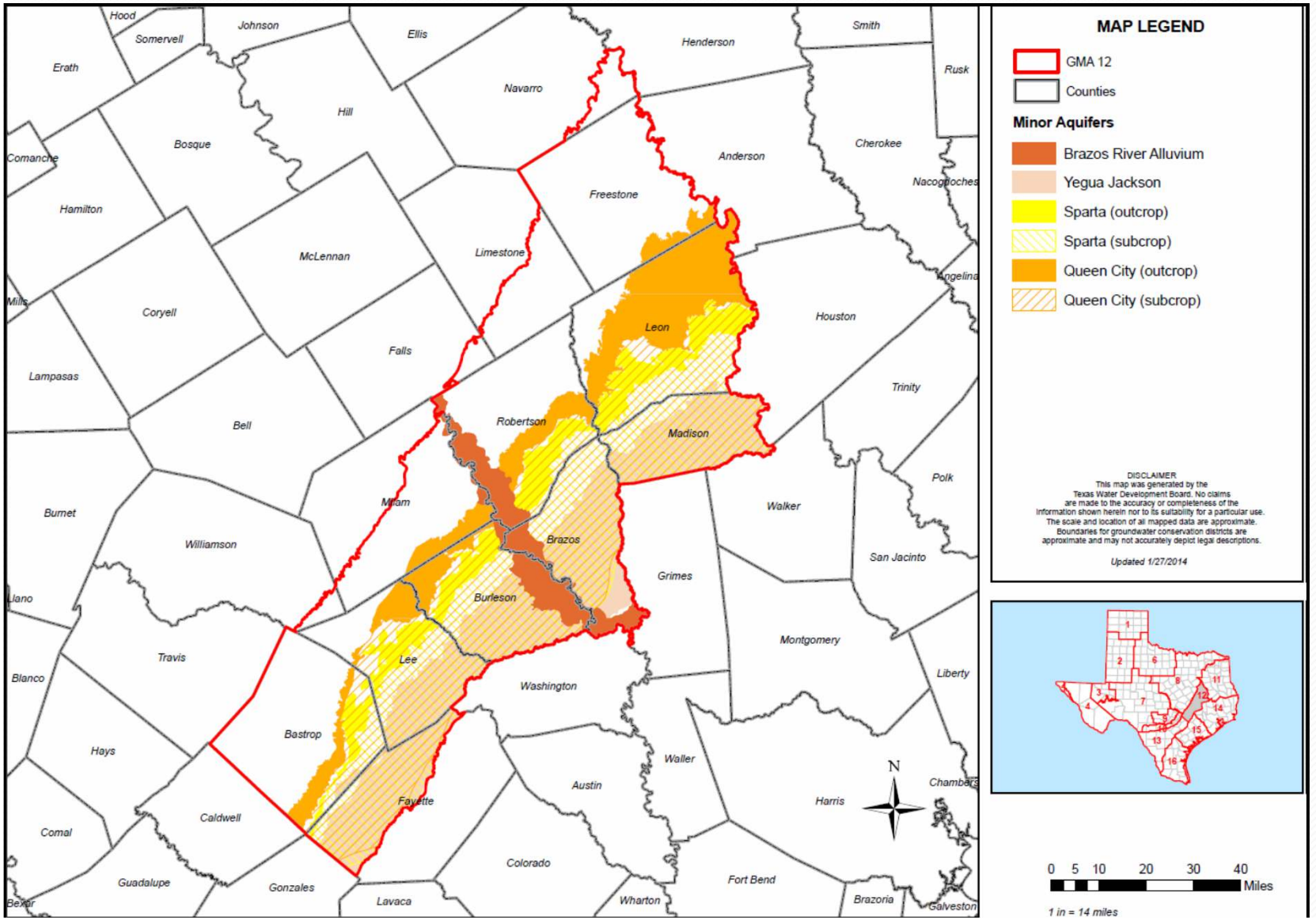
Groundwater Management Area #12



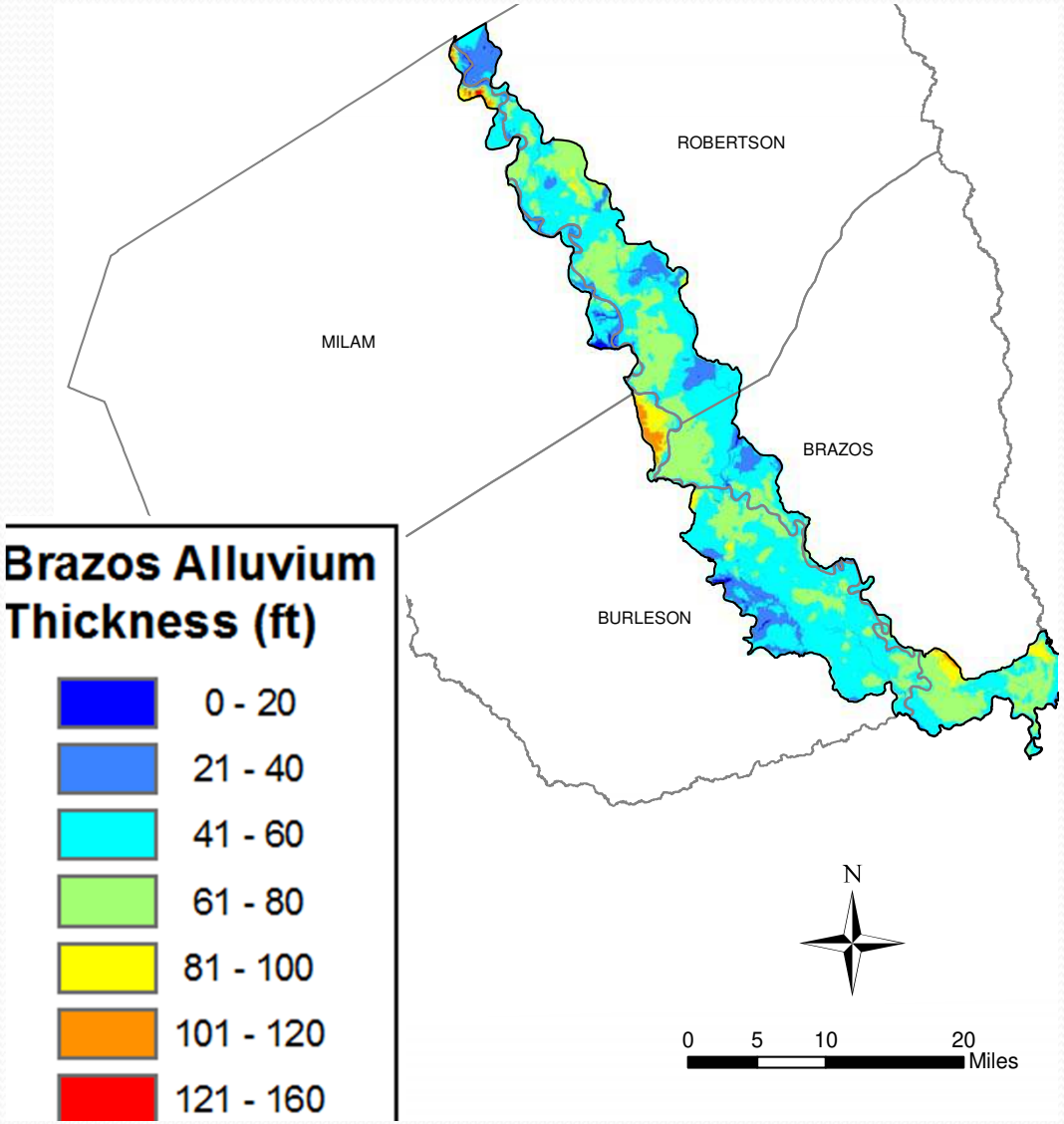
Major Aquifers



Minor Aquifers



Brazos Alluvium: Total Thickness

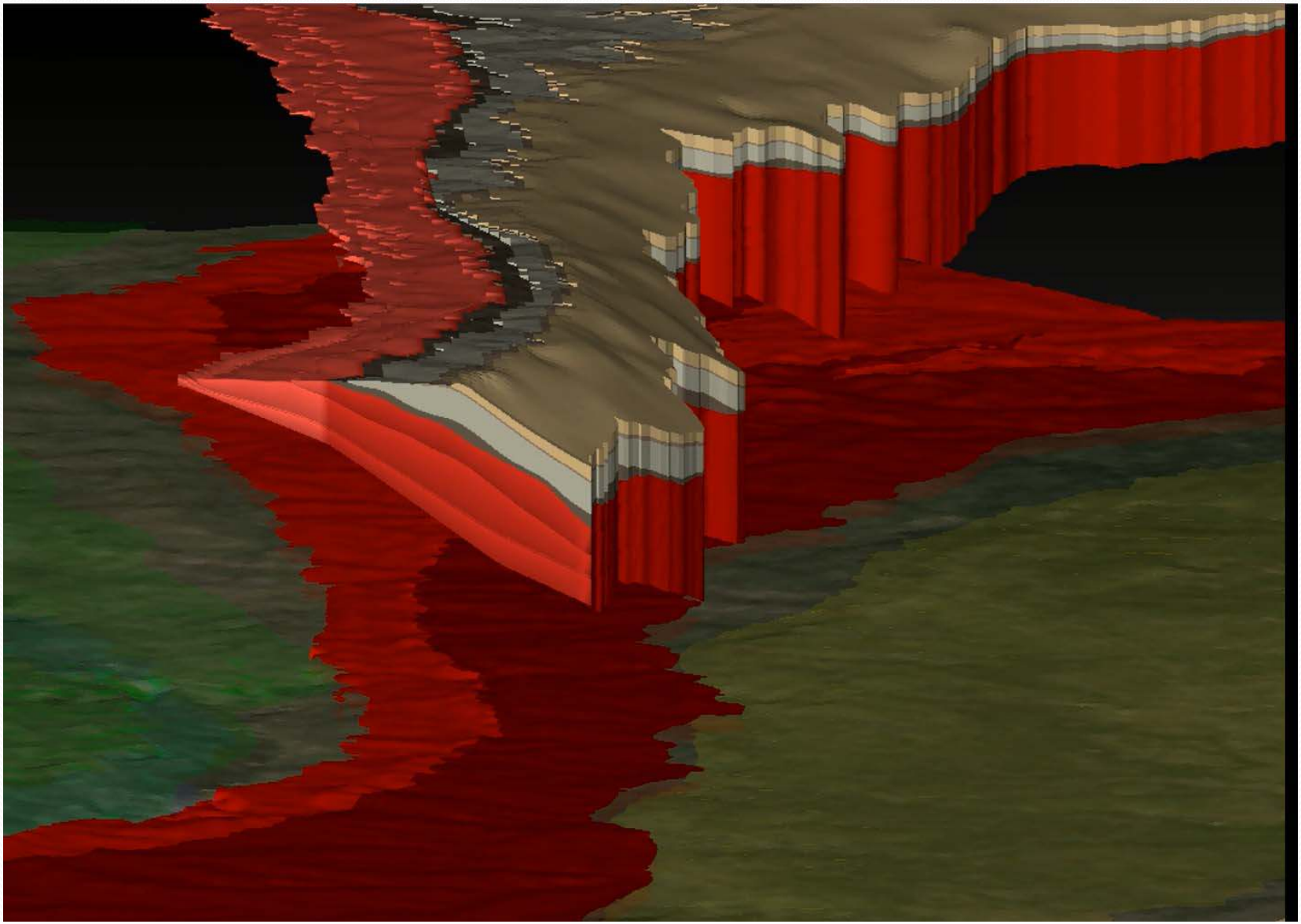


Map from Intera (2015)

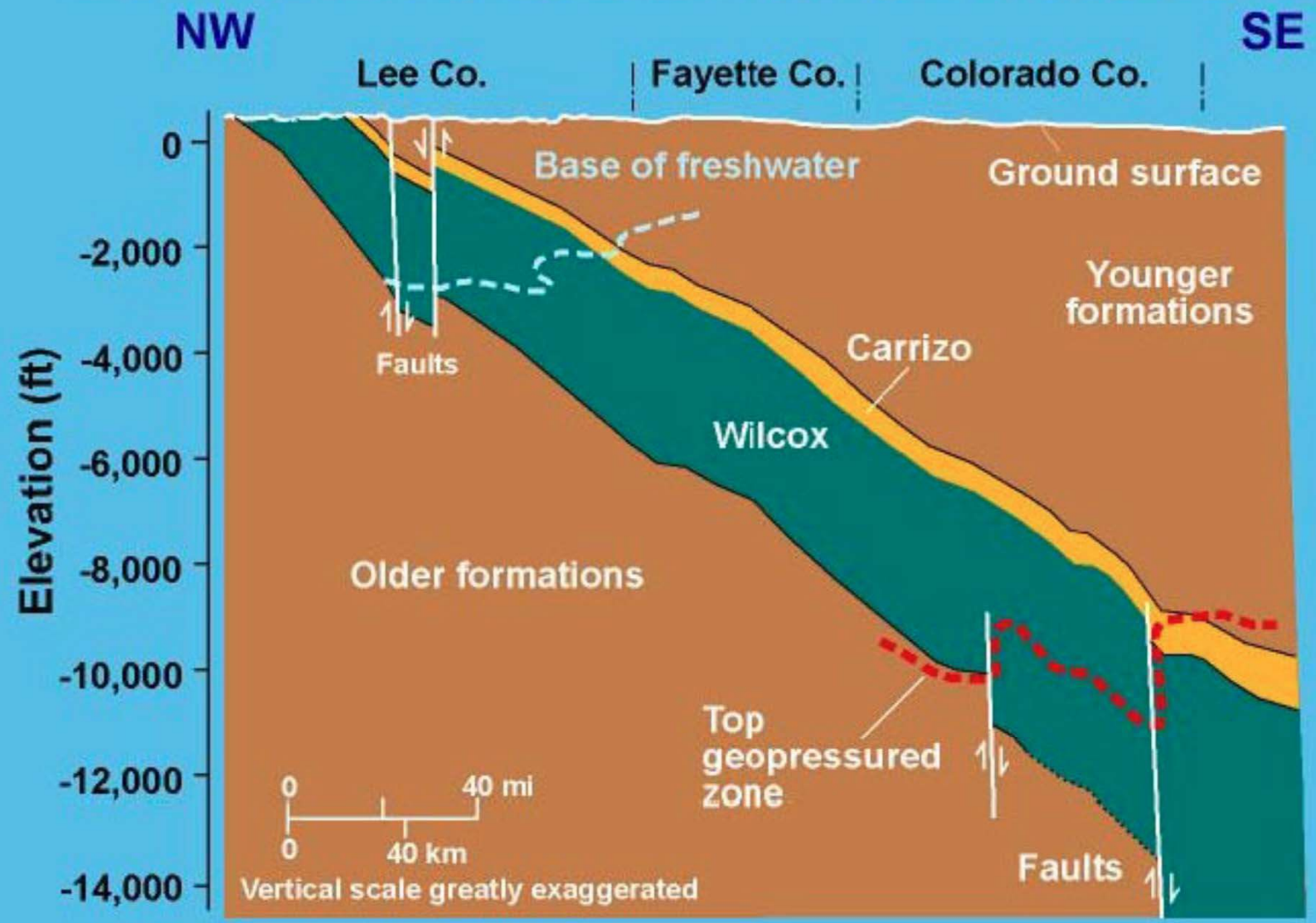
Stratigraphy

Central Carrizo-Wilcox aquifer (this study)		
Stratigraphy		Model layer
Alluvium		1
Jackson Group		
Claiborne Group	Yegua Fm.	
	Cook Mtn. Fm.	
	Sparta Sand	
	Weches Fm.	
	Queen City Sand	
	Reklaw Fm. / Newby Mmbr.	2
	Carrizo Sand	3
Wilcox Group	Calvert Bluff	4
	Simsboro	5
	Hooper	6
Midway Formation		

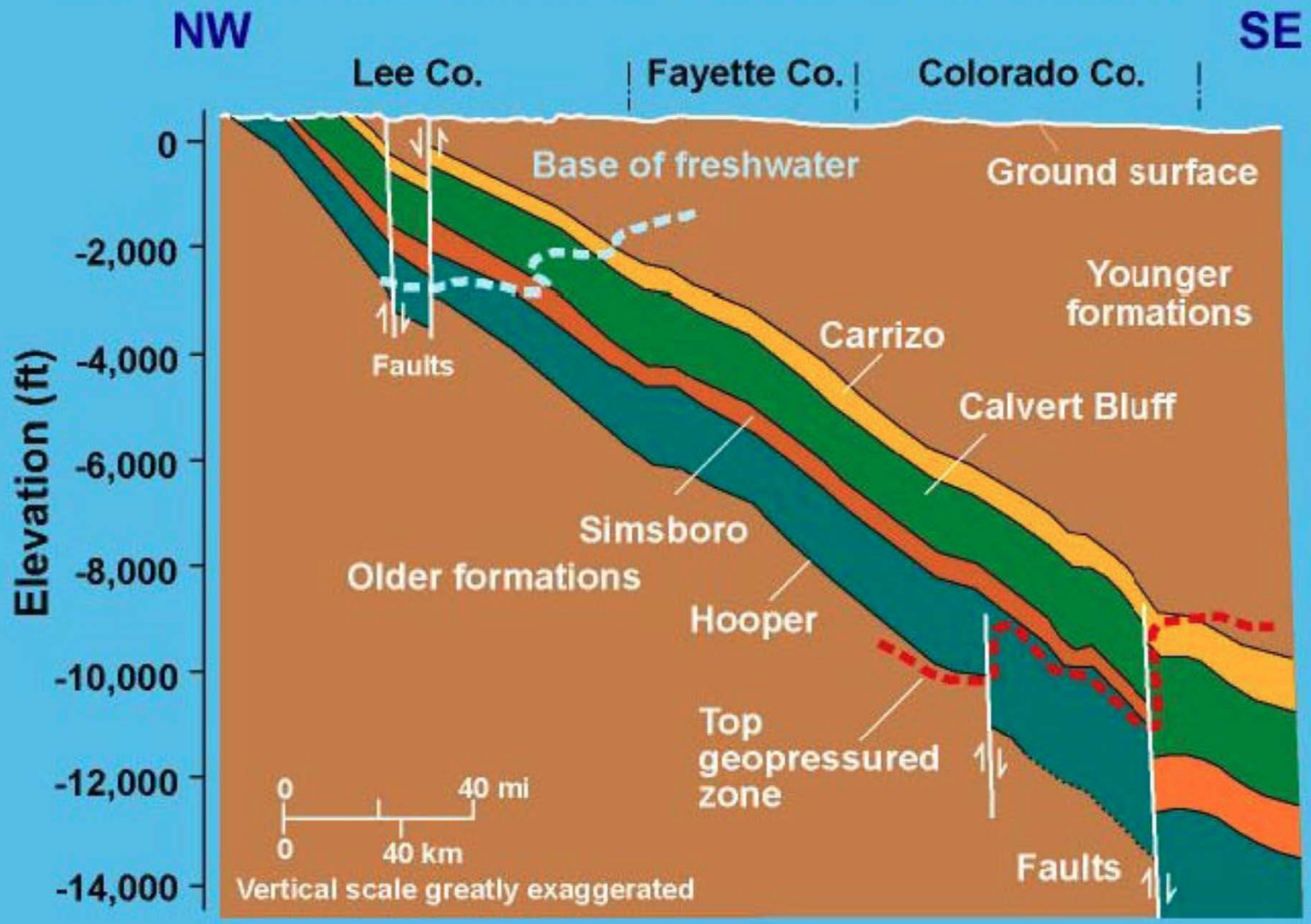
Central Carrizo-Wilcox



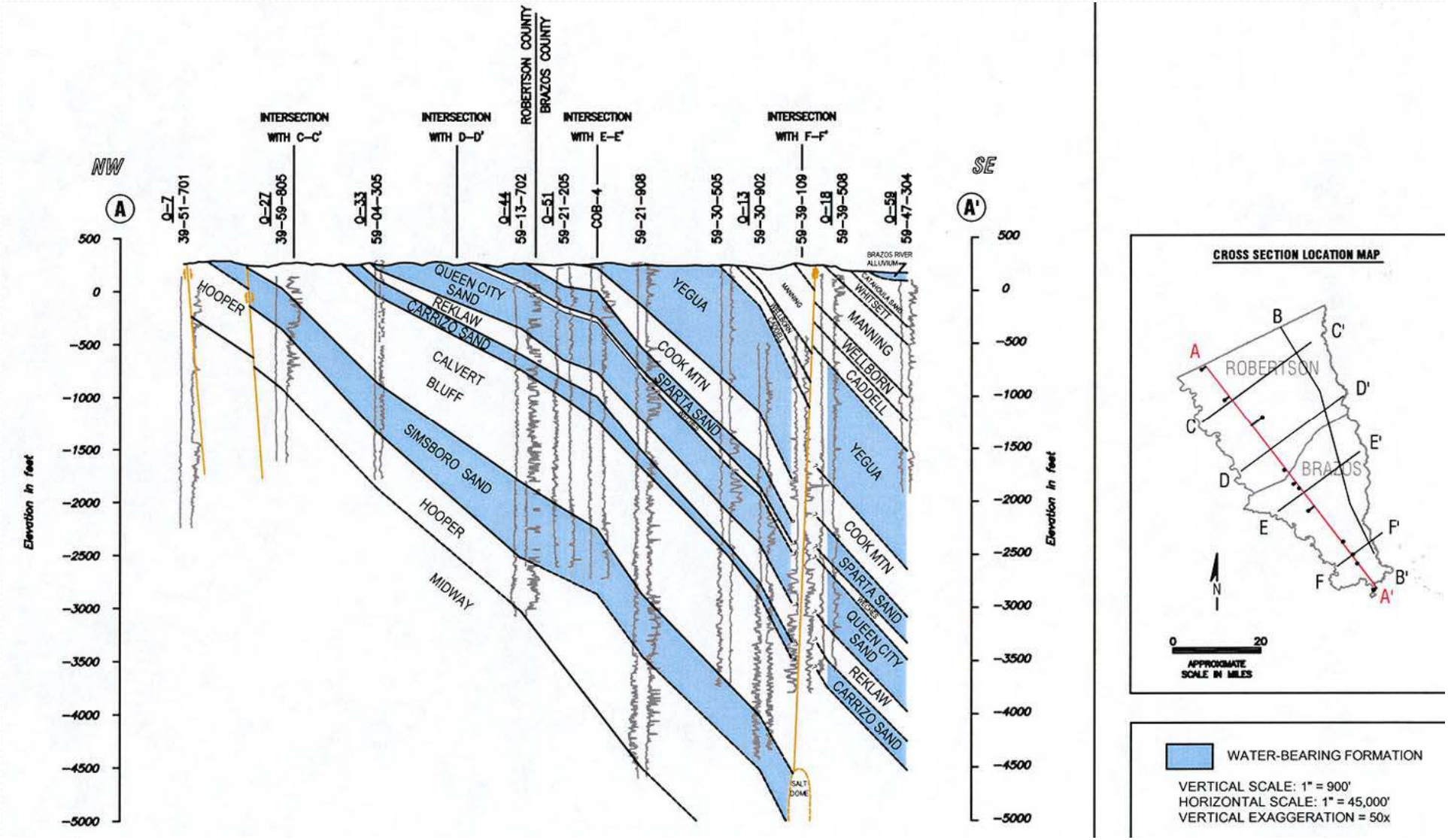
CARRIZO-WILCOX HYDROGEOLOGY



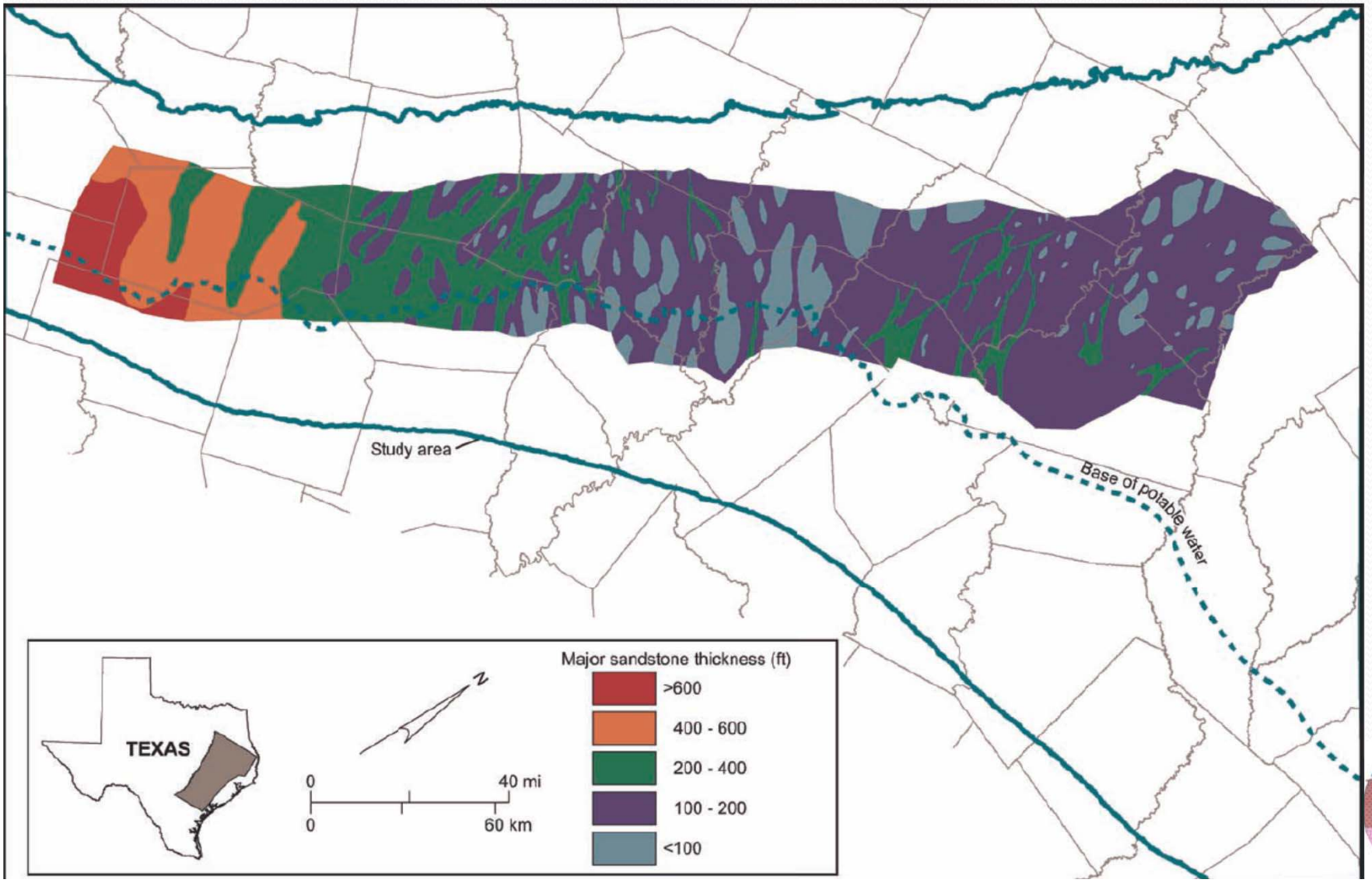
CARRIZO-WILCOX HYDROGEOLOGY



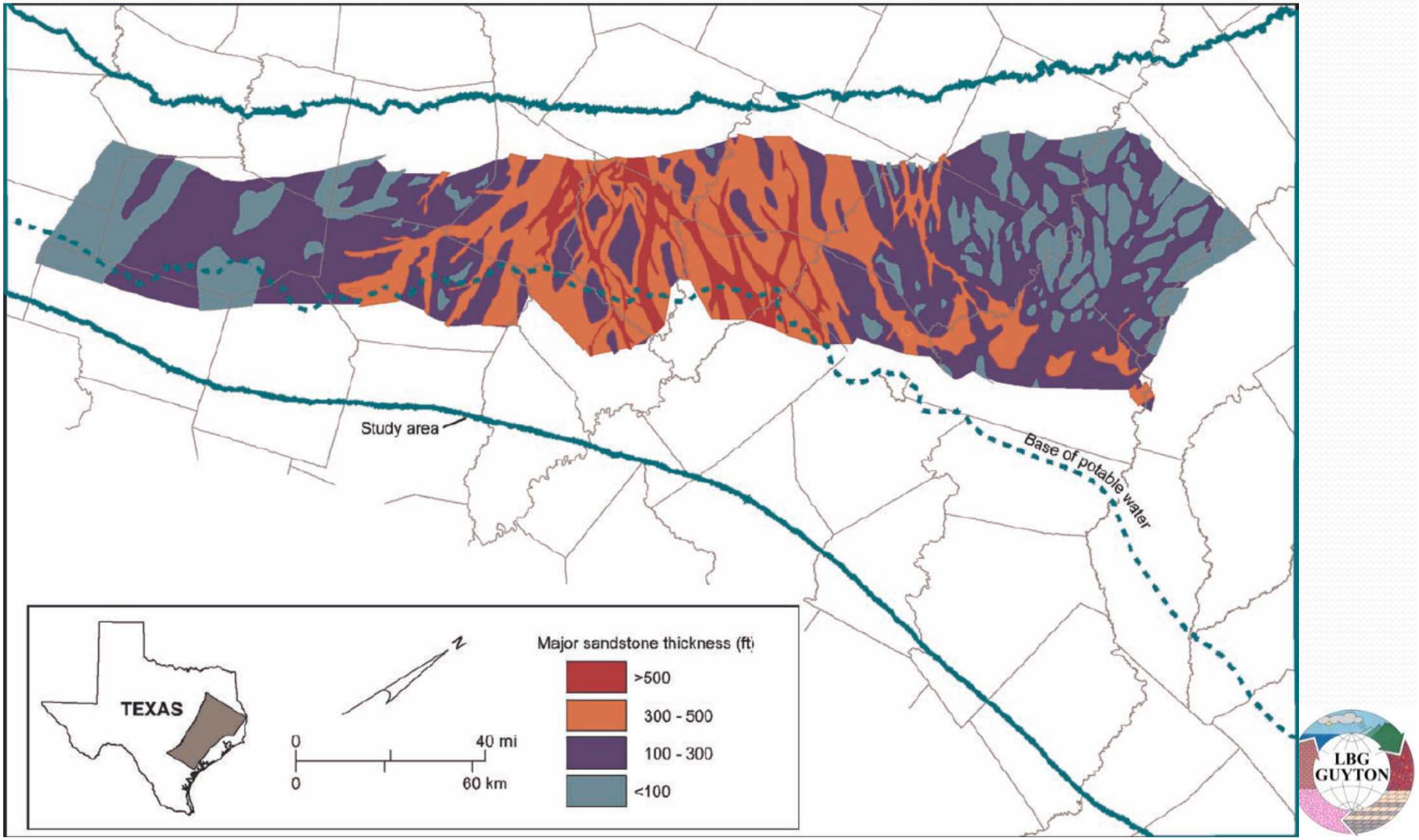
Hydrogeologic Cross-Section



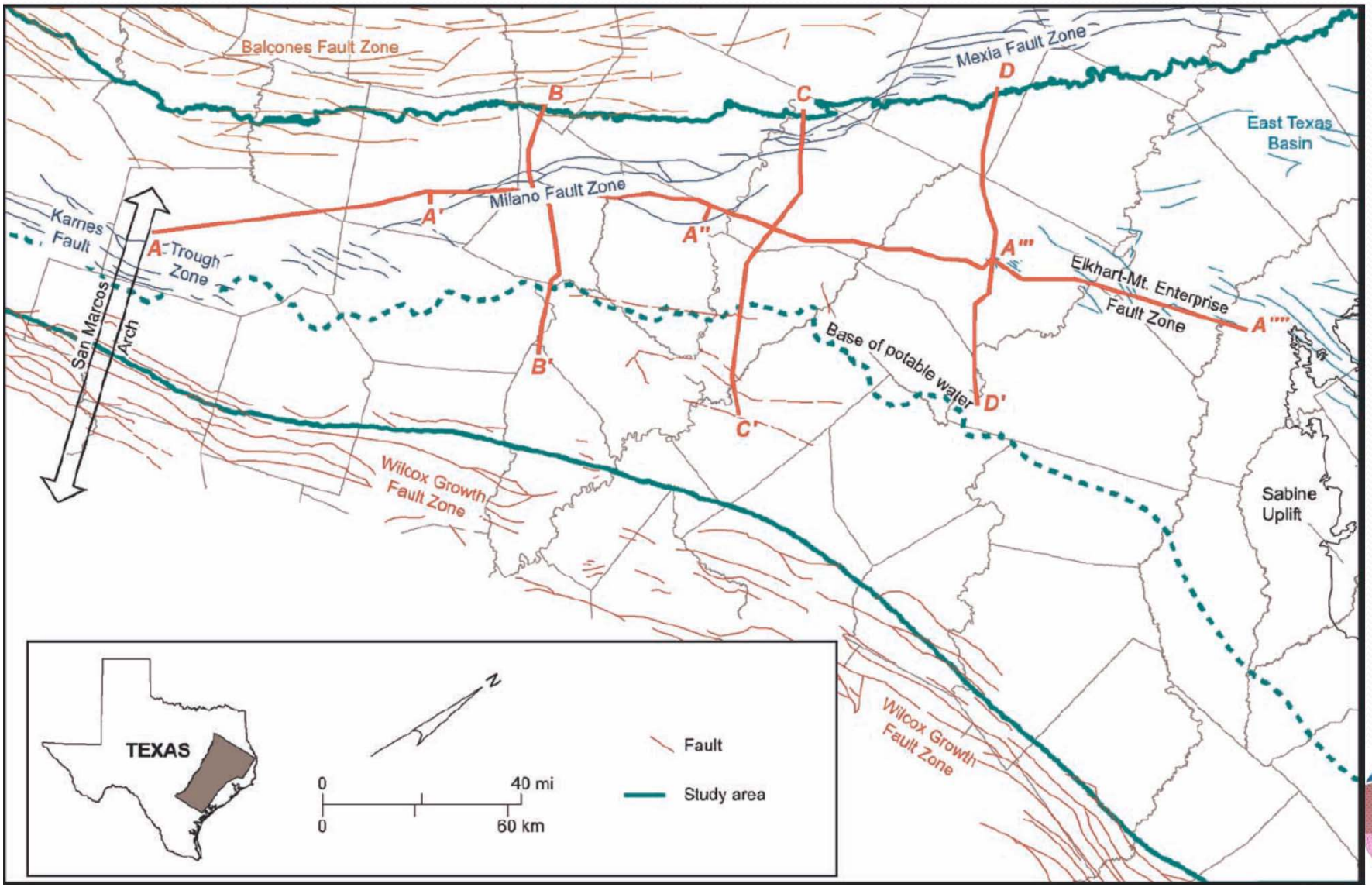
Carrizo Sand Thickness



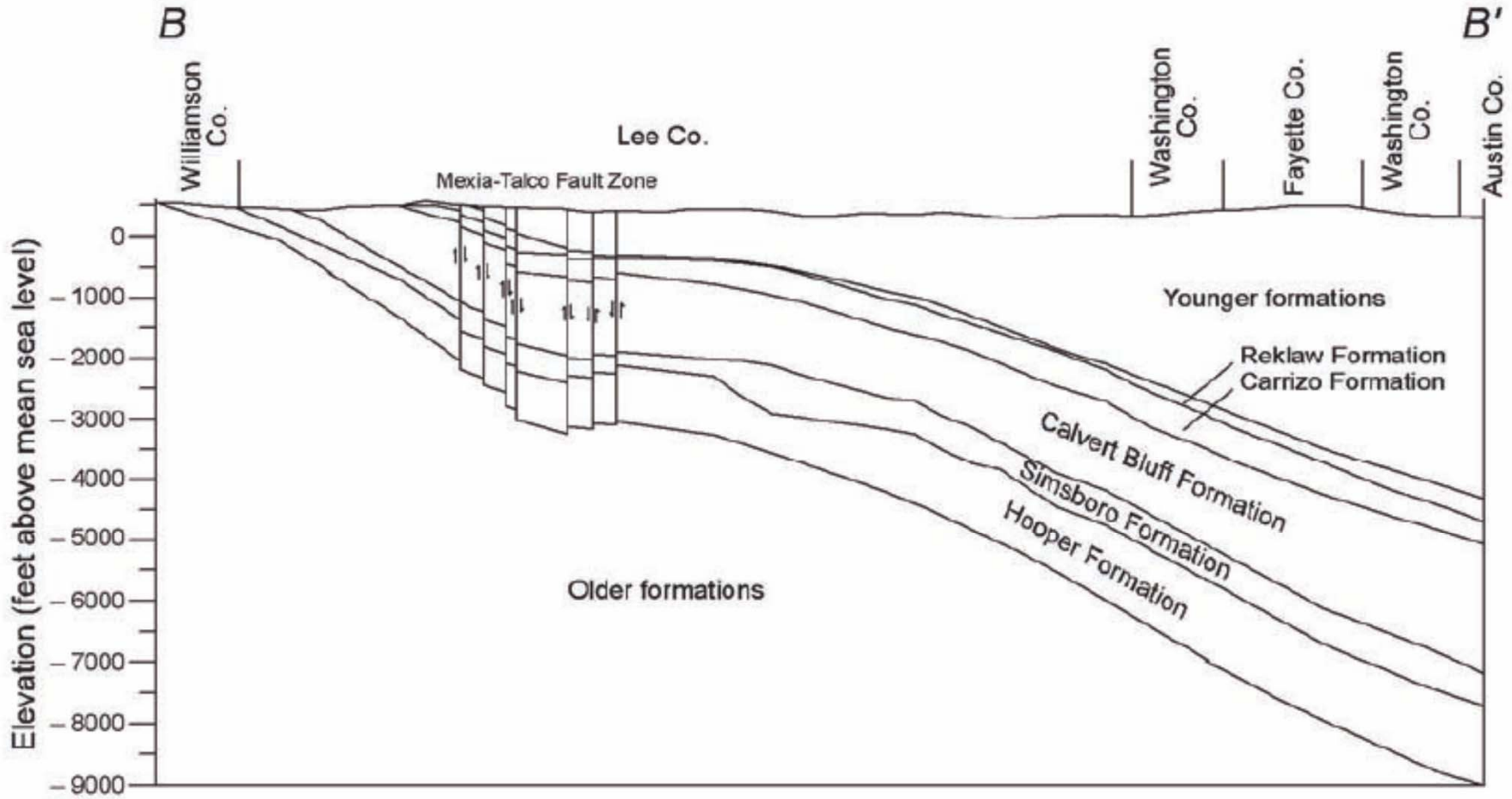
Simsboro Sand Thickness

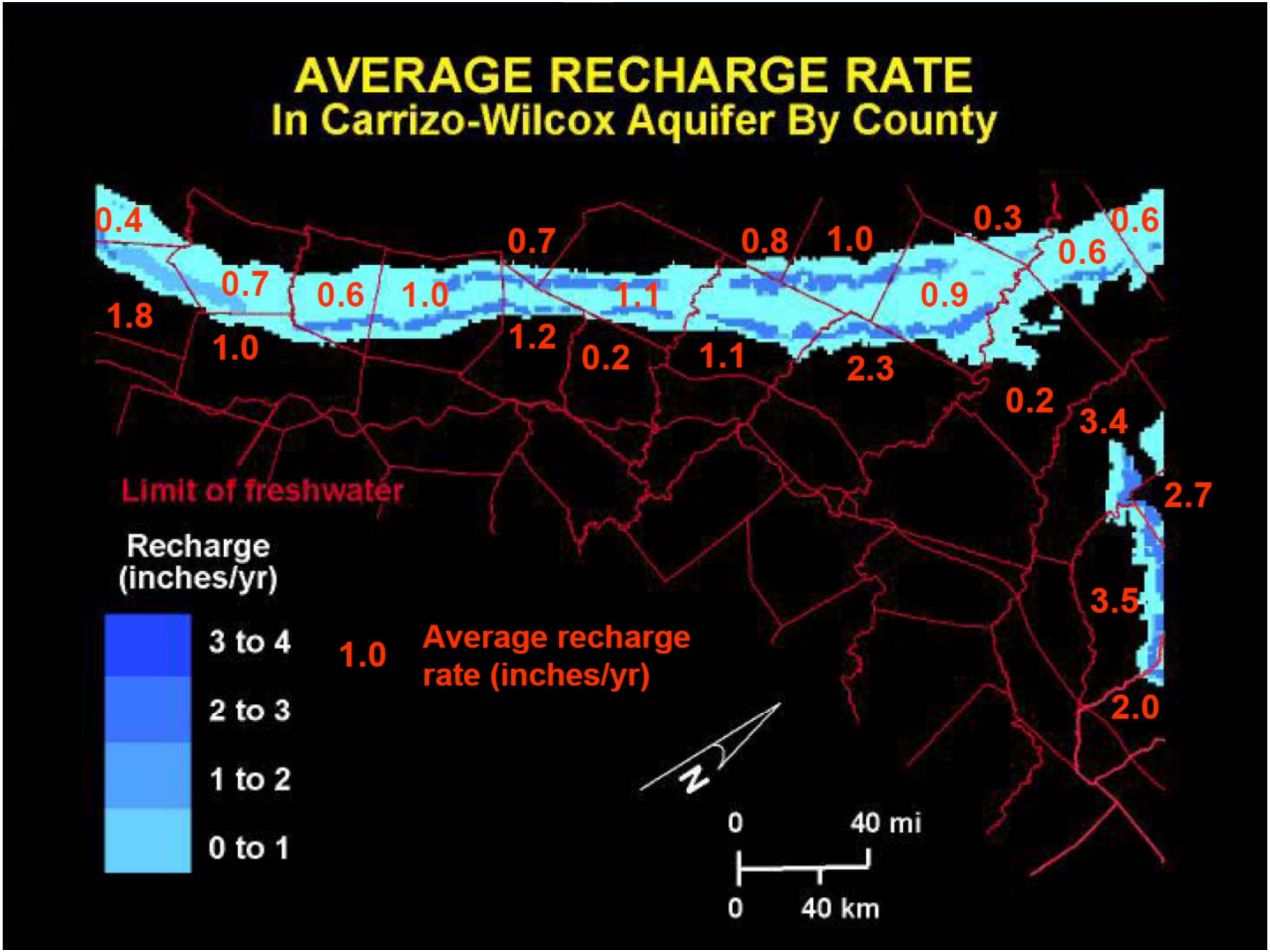


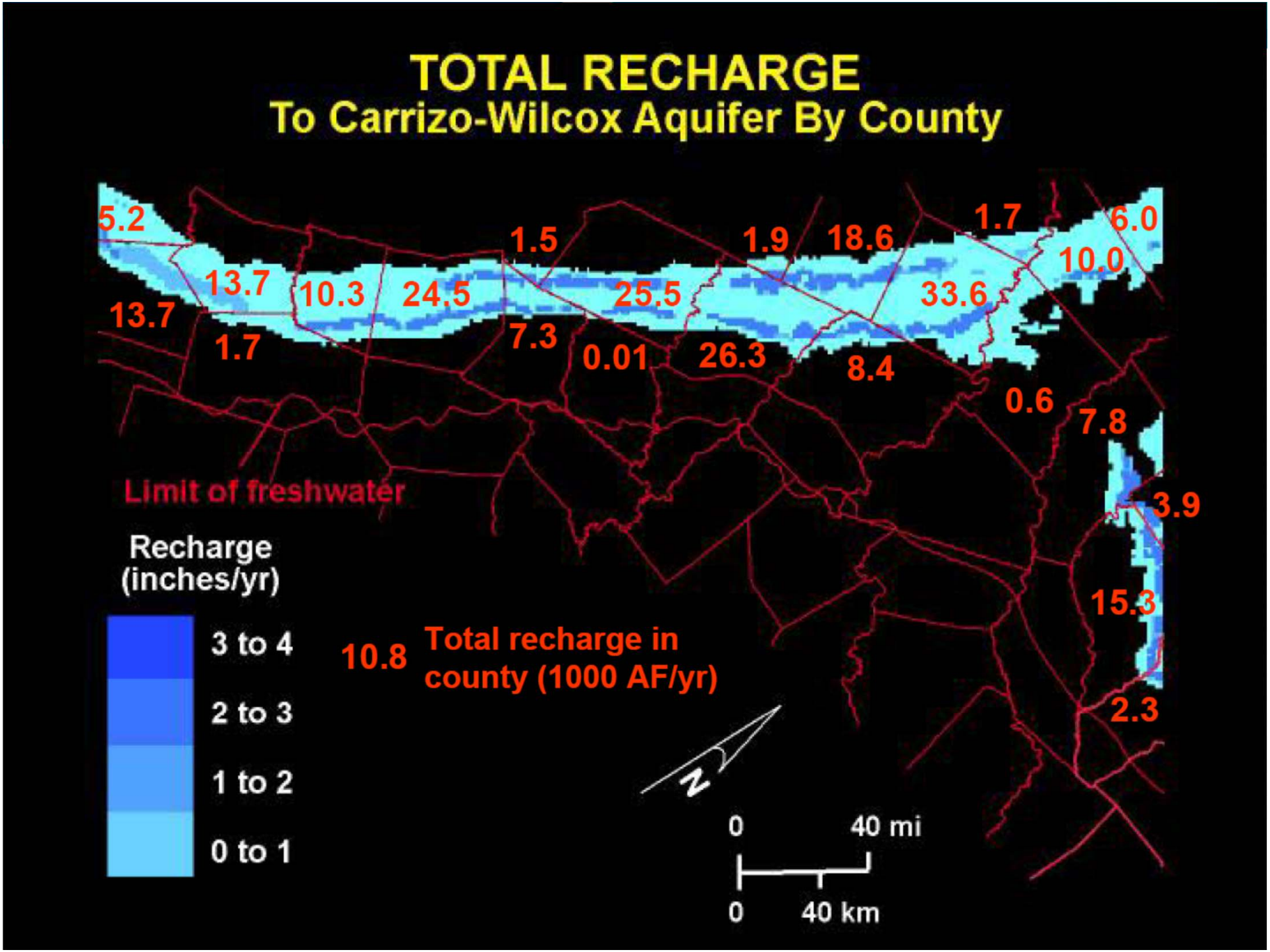
Structure and Faults



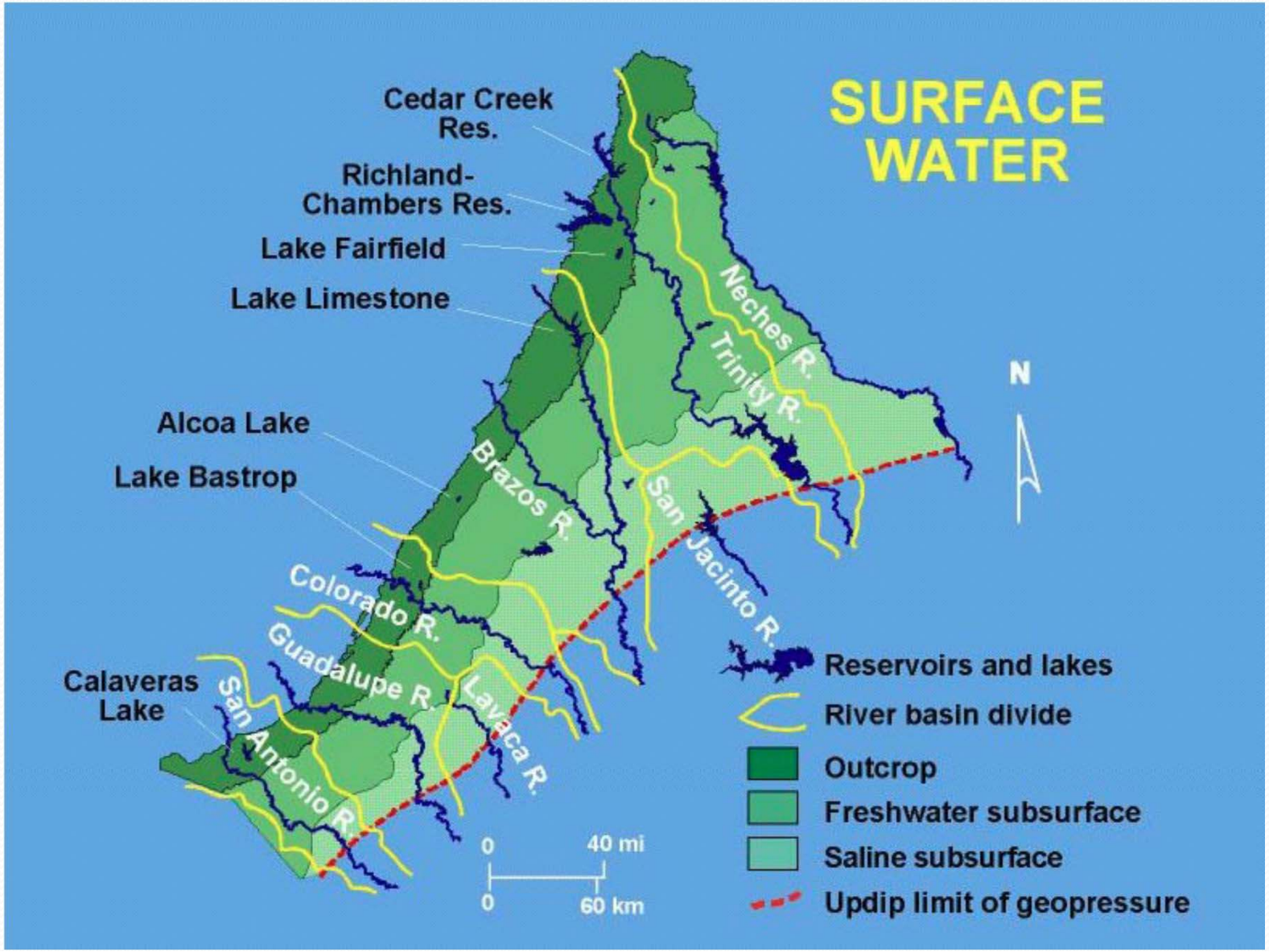
Structure and Faults



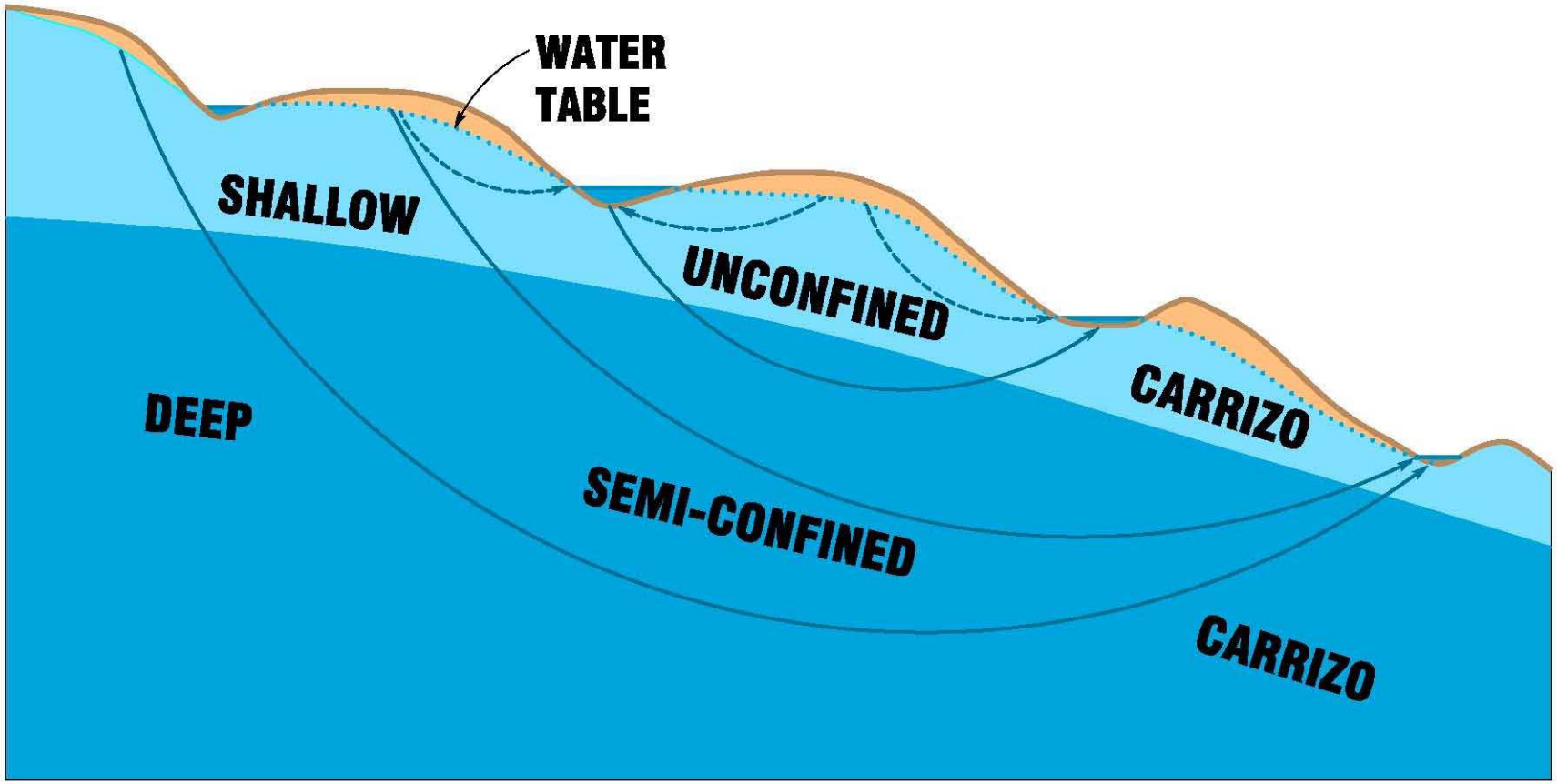

AVERAGE RECHARGE RATE
In Carrizo-Wilcox Aquifer By County
0.4
0.7
0.6
1.0
0.7
0.8
1.0
0.3
0.6
0.6
1.8
1.0
1.2
0.2
1.1
1.1
0.9
2.3
0.2
3.4
2.7
3.5
2.0
Limit of freshwater
Recharge (inches/yr)
3 to 4
2 to 3
1 to 2
0 to 1
1.0
Average recharge rate (inches/yr)
N
0
40 mi
0
40 km


TOTAL RECHARGE
To Carrizo-Wilcox Aquifer By County
5.2
13.7
13.7
1.7
10.3
24.5
1.5
7.3
0.01
25.5
26.3
1.9
18.6
8.4
33.6
1.7
0.6
6.0
10.0
7.8
3.9
15.3
2.3
Limit of freshwater
Recharge (inches/yr)
3 to 4
2 to 3
1 to 2
0 to 1
10.8
Total recharge in county (1000 AF/yr)
N
0
40 mi
0
40 km

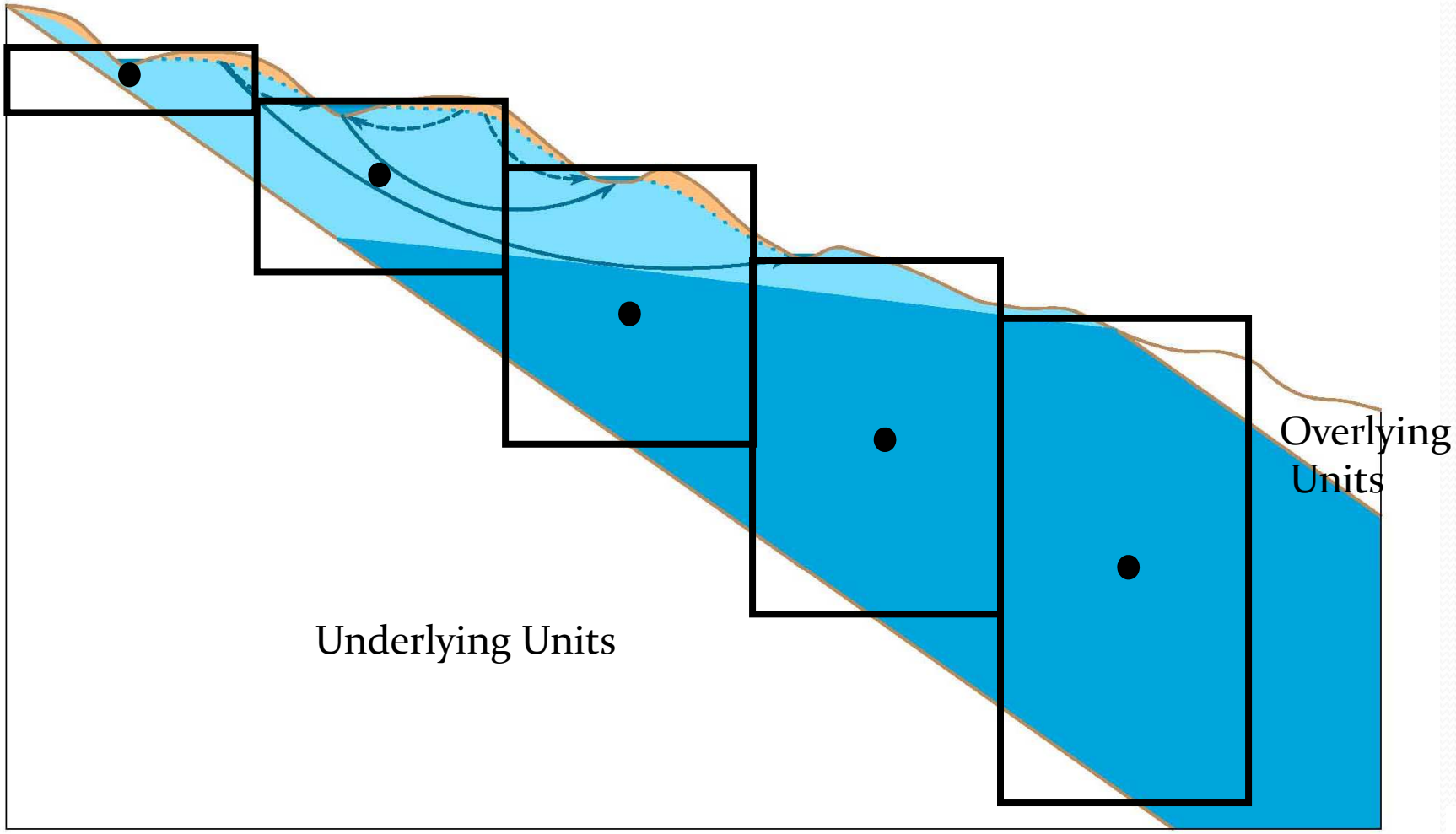
Groundwater and Surface Water



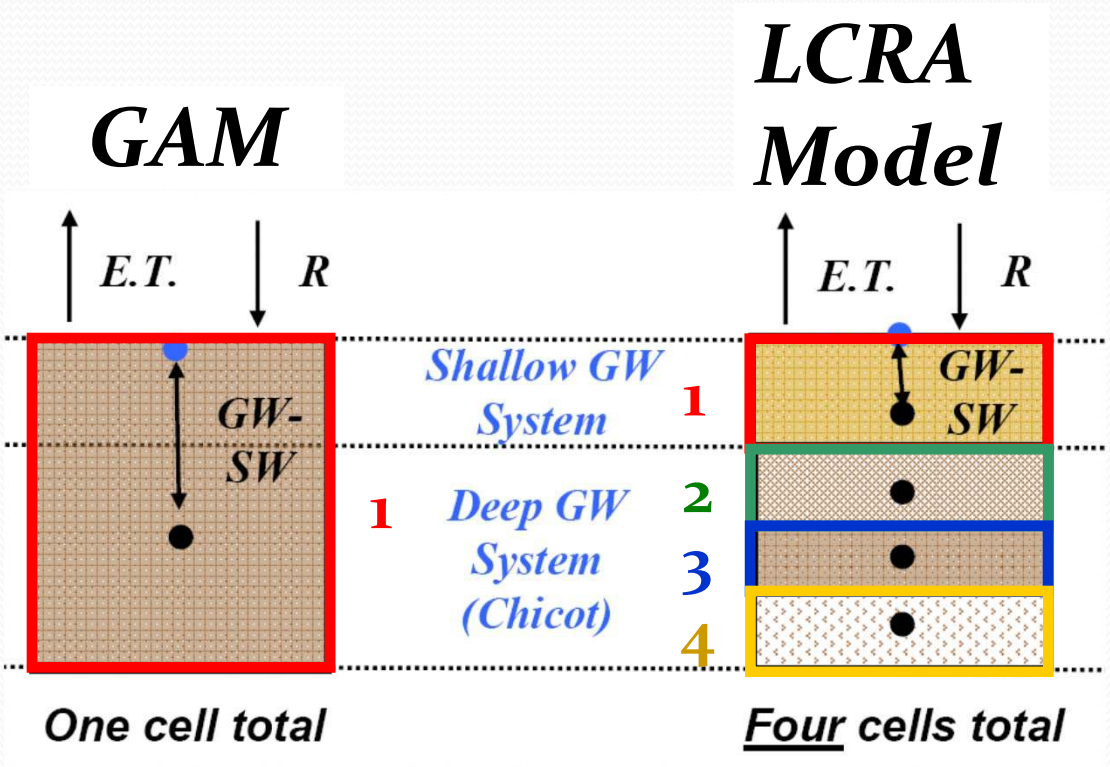
Outcrop Hydrology



GAM Outcrop Hydrology



Model construction affects how models simulate GW-SW interaction



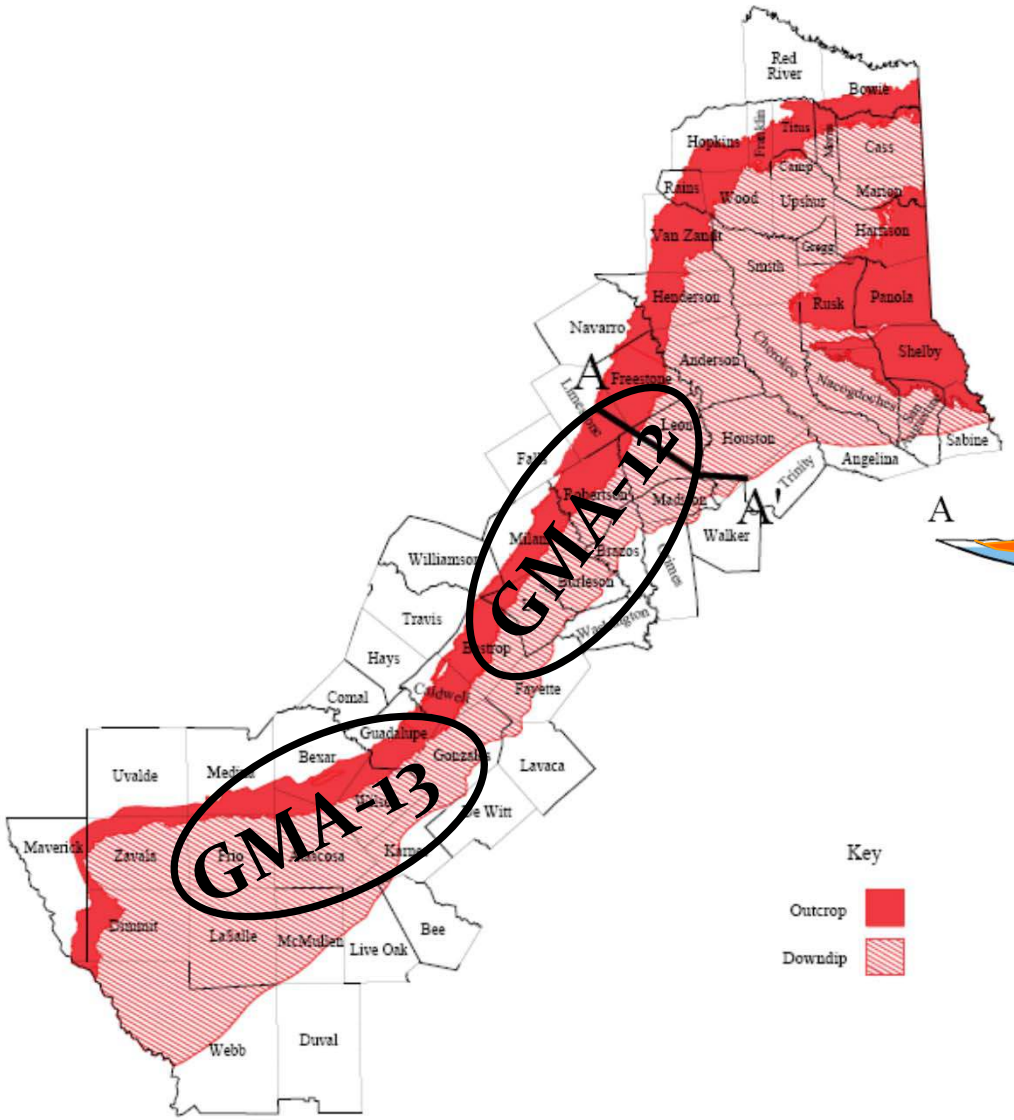
Findings

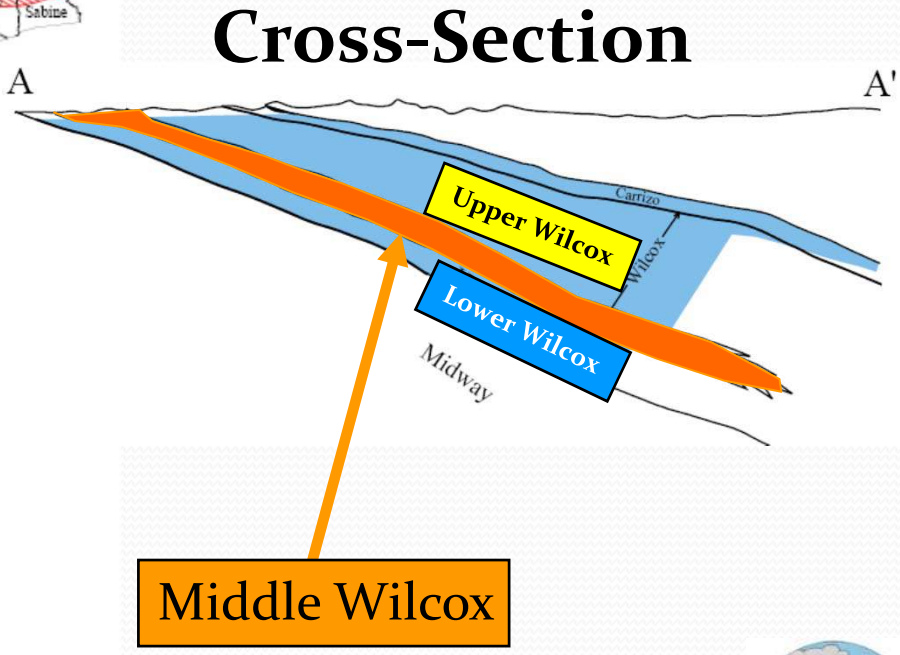
- Modeling thick aquifers with one vertical cell limits accuracy of SW-GW interaction
- One-cell model over-estimated stream impact from deep production

Stream-Aquifer Interaction

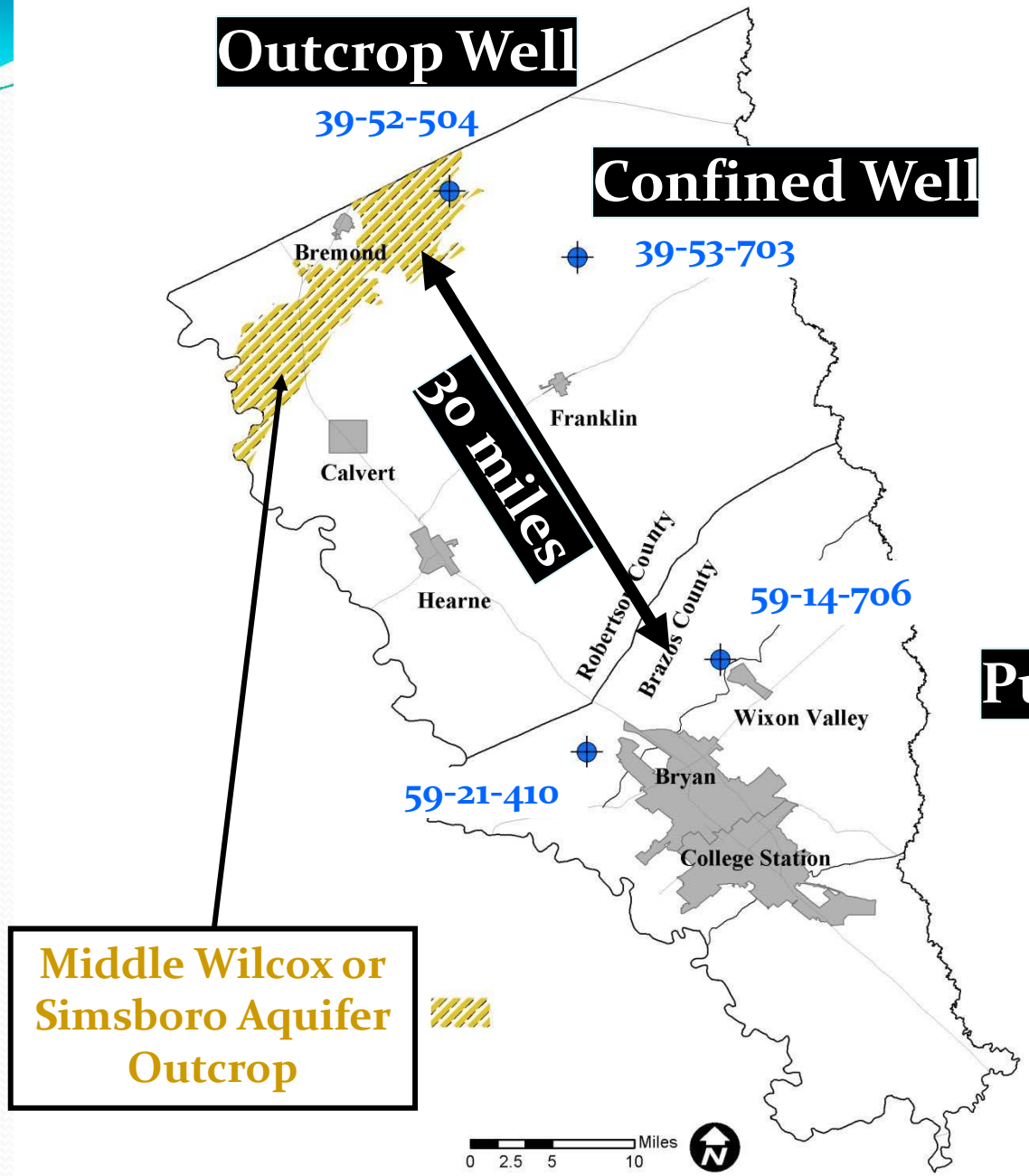
1. **Pumping from the shallow outcrop:**
   - reduces water levels in the outcrop
   - has the potential to impact streams (especially pumping close to streams)
2. **Pumping from deep confined aquifer:**
   - Has less impact on water levels in outcrop
   - May not significantly impact streamflow
3. **Historical data confirm this conclusion for Carrizo and Wilcox**

Carrizo and Wilcox Aquifers in Texas

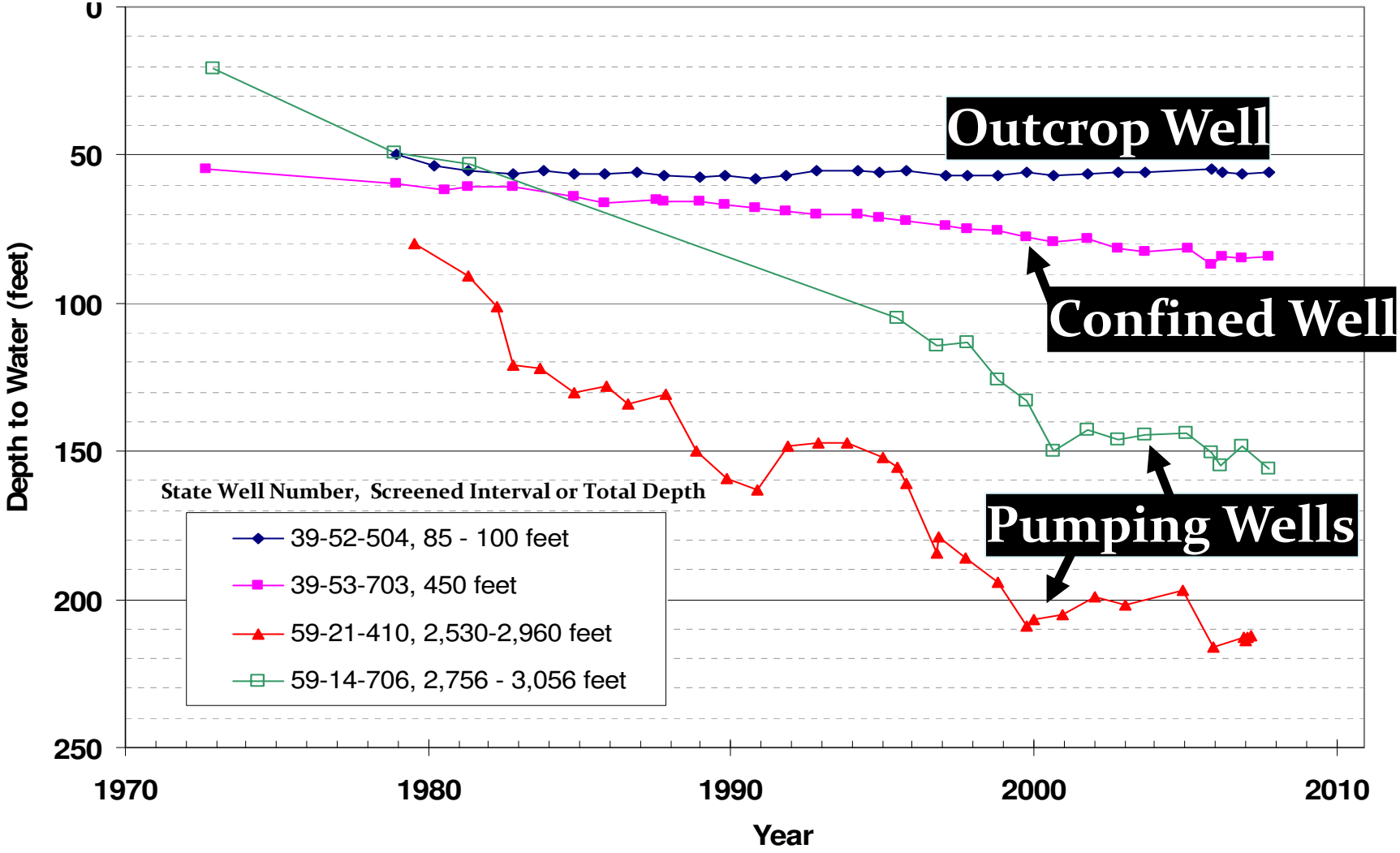




Aquifer Well Locations

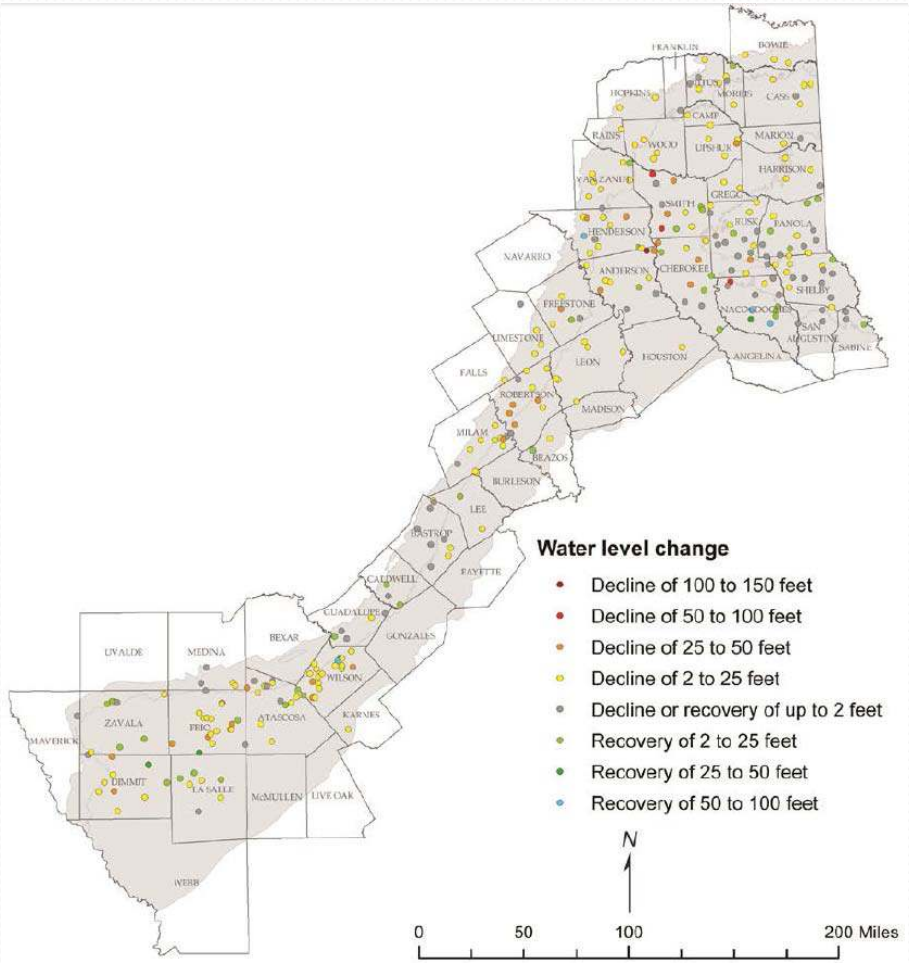


Outcrop and Downdip Hydrographs in Brazos and Robertson Counties



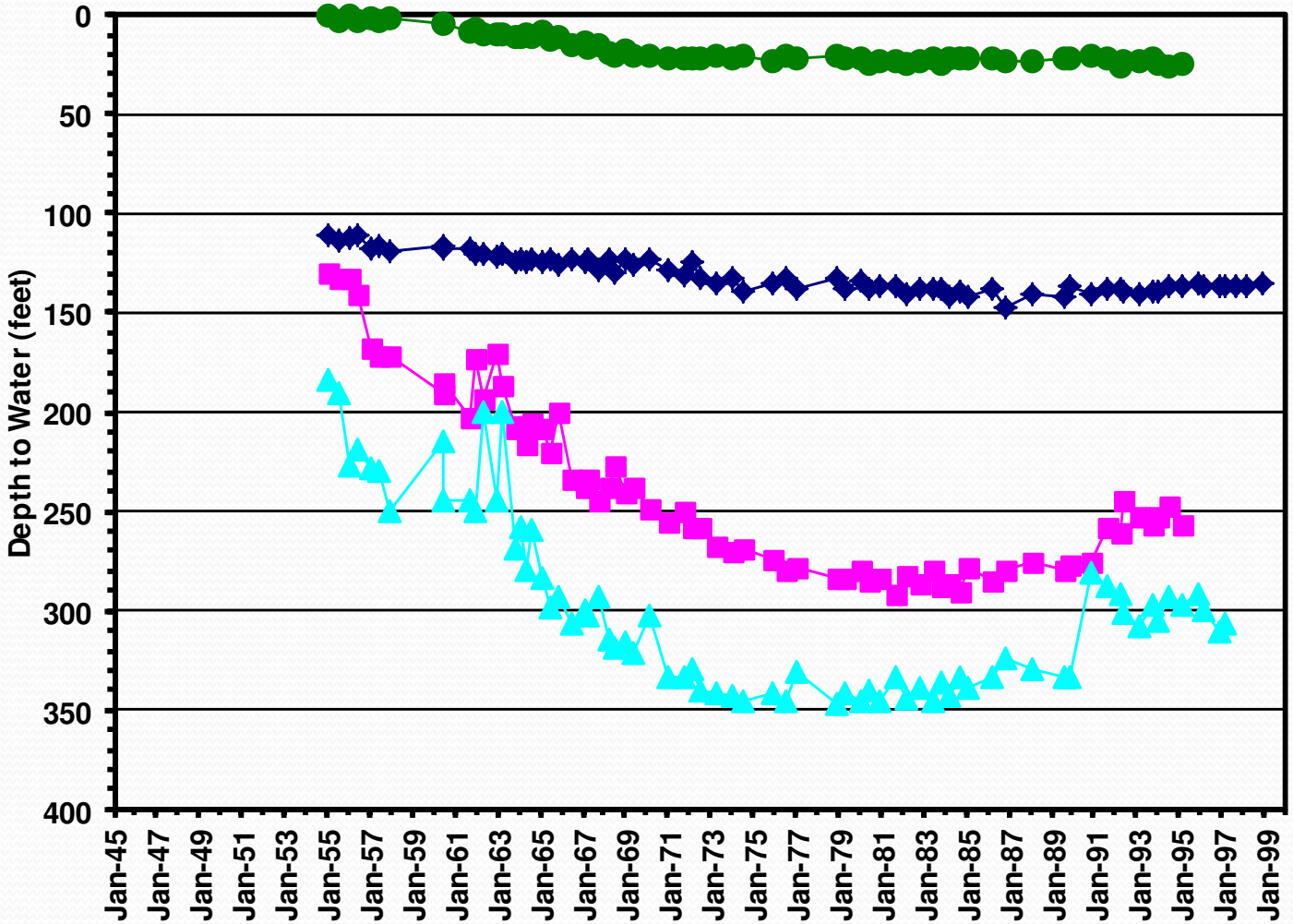
Carrizo-Wilcox Aquifer Water Level 1995 to 2005

- Measurements from 299 wells
- Most wells showed a decline in water levels of less than 25 feet
- Greatest declines occurred in the northeast



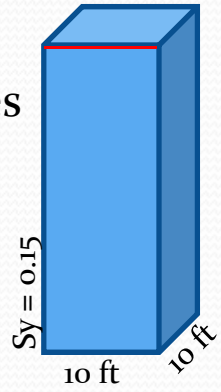
Source: Boghici, Radu, "Changes in Water Levels in Texas, 1995 to 2005" Texas Water Development Board, Report 379, July 2011.

Carrizo water level decline in East Texas

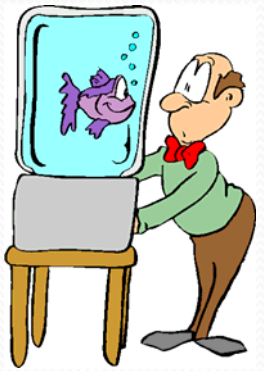


Water Level Changes

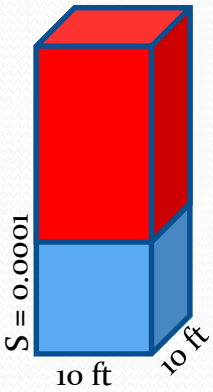
- Unconfined aquifer
  - Removal/Addition of water from aquifer pores
  - More water for smaller change in water level



½ inch = 5 gal

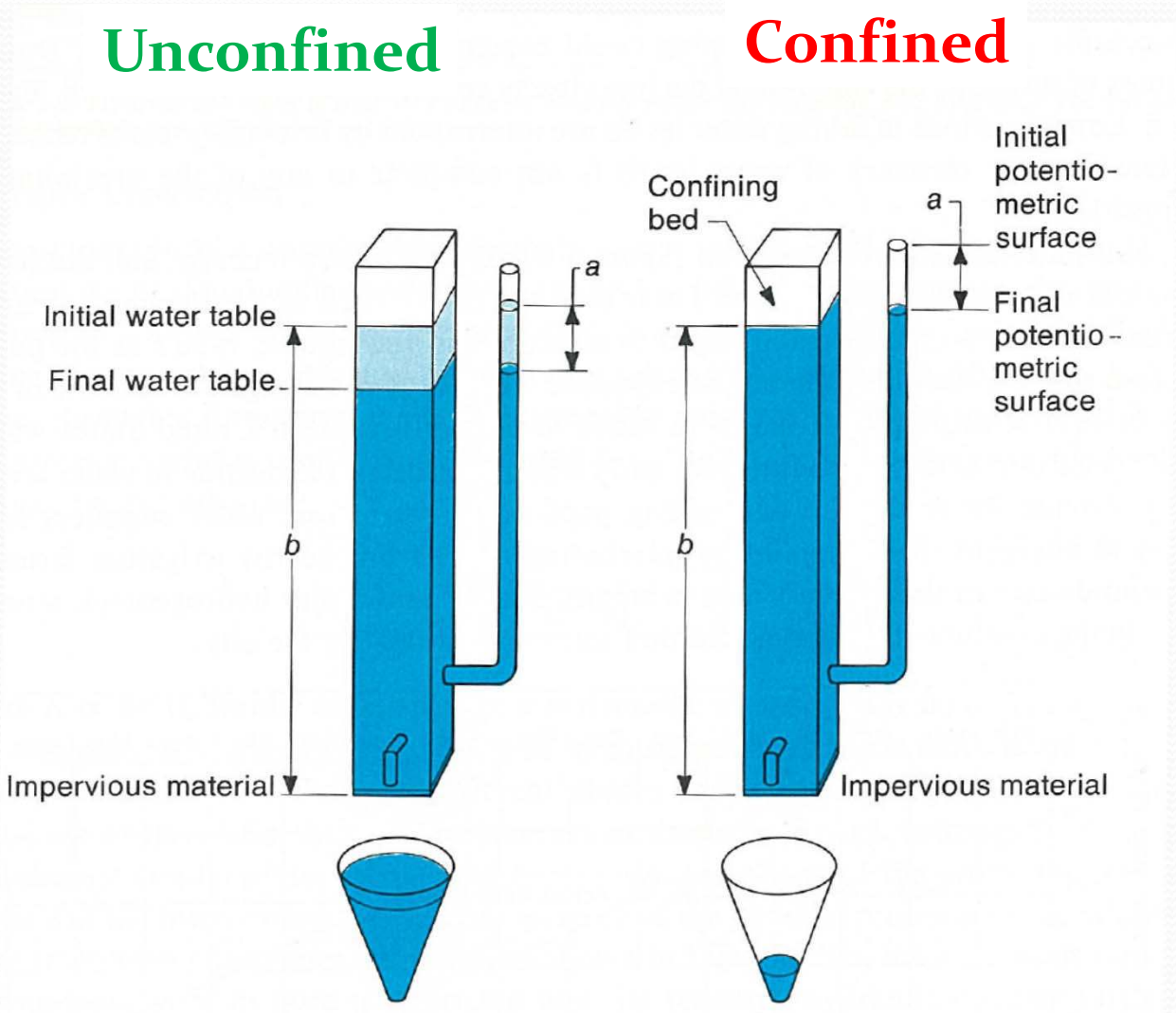


- Confined aquifer
  - Removal/Addition of pressure in the aquifer
  - More change in water level for less water

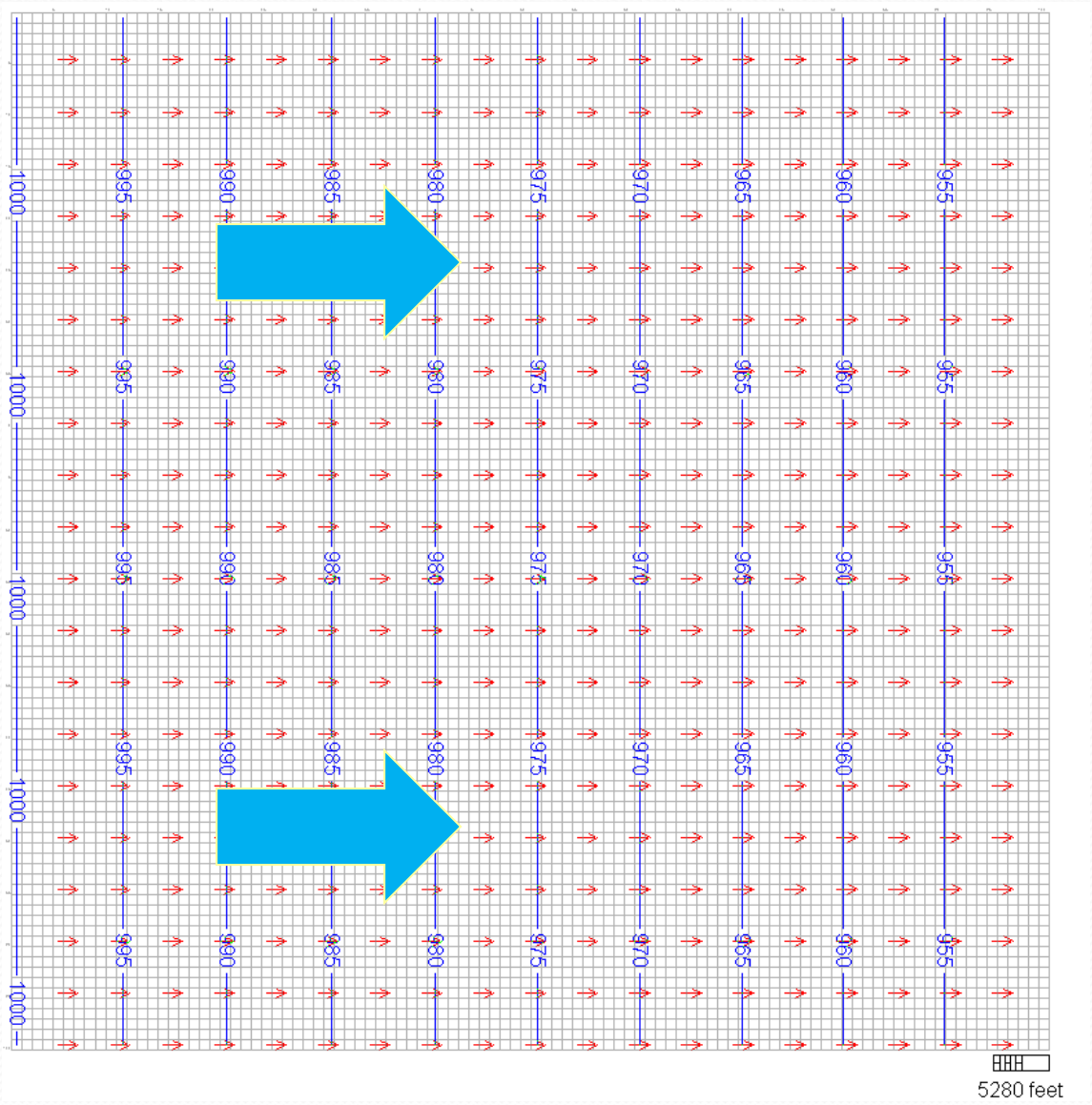


67 feet = 5 gallons

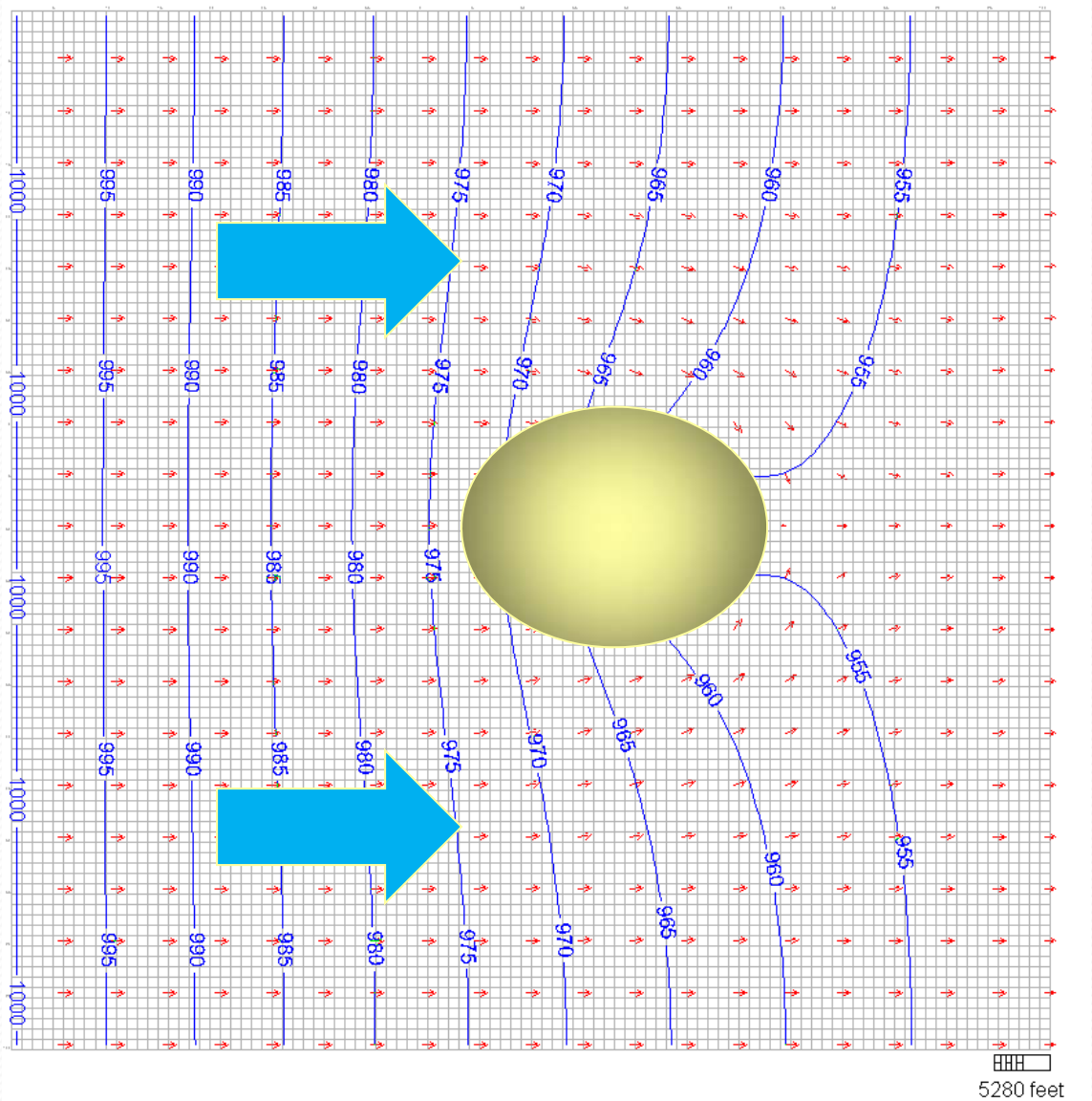
Why do you care?



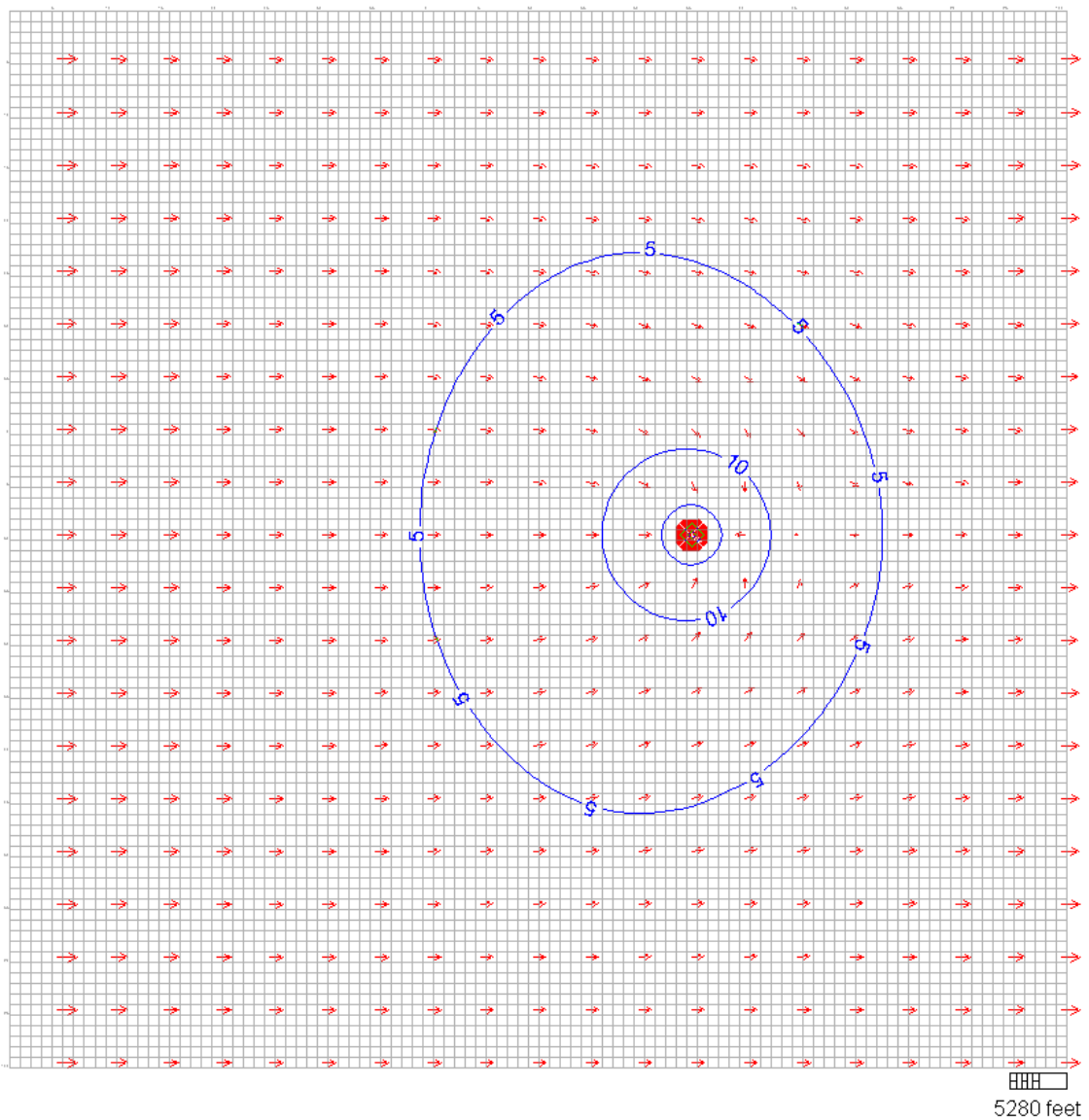
Simple regional flow (sand)



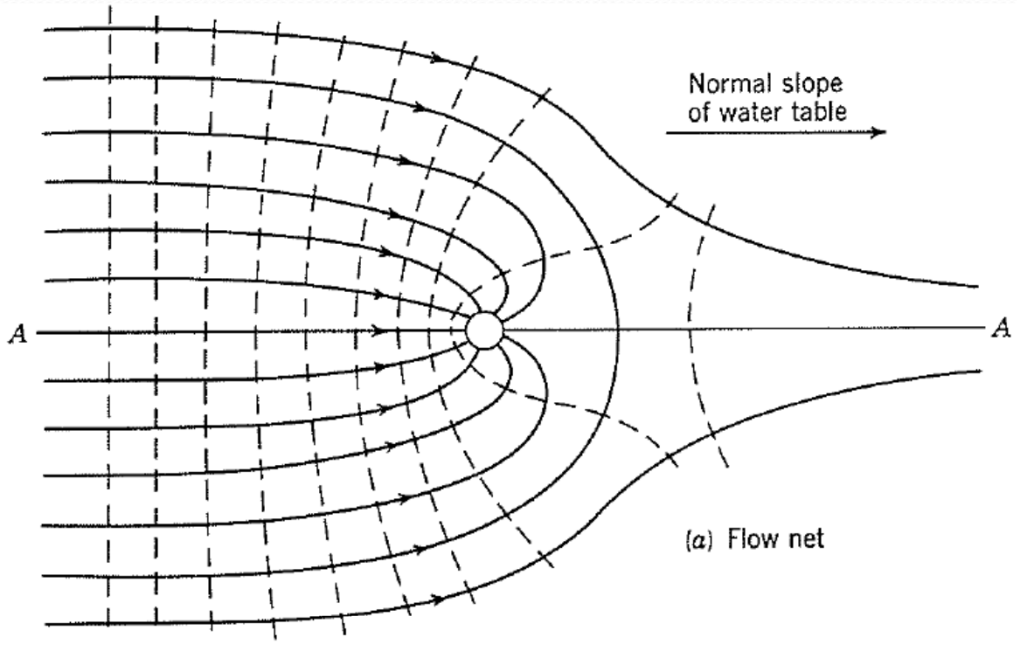
Simple regional flow + well

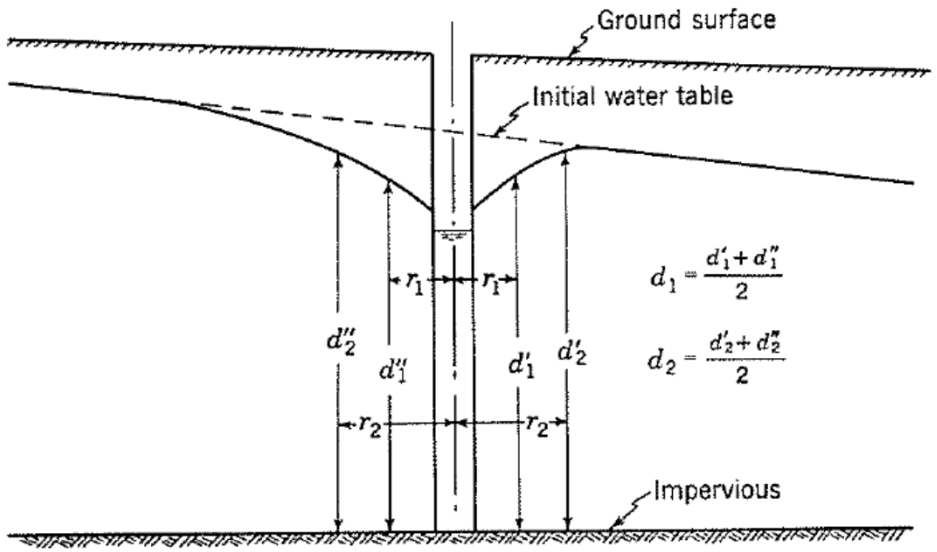


Drawdown caused by well

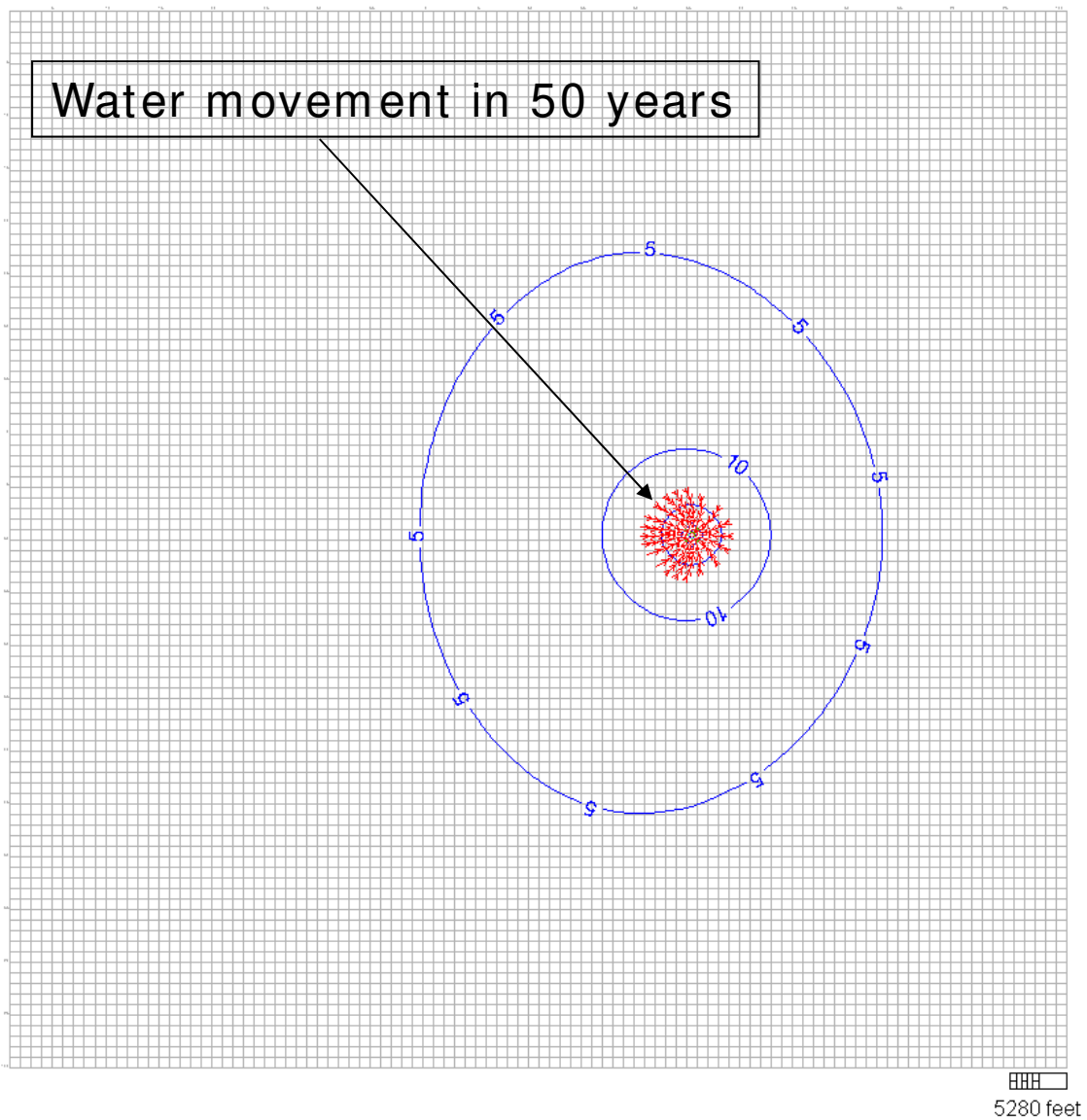


Drawdown caused by well

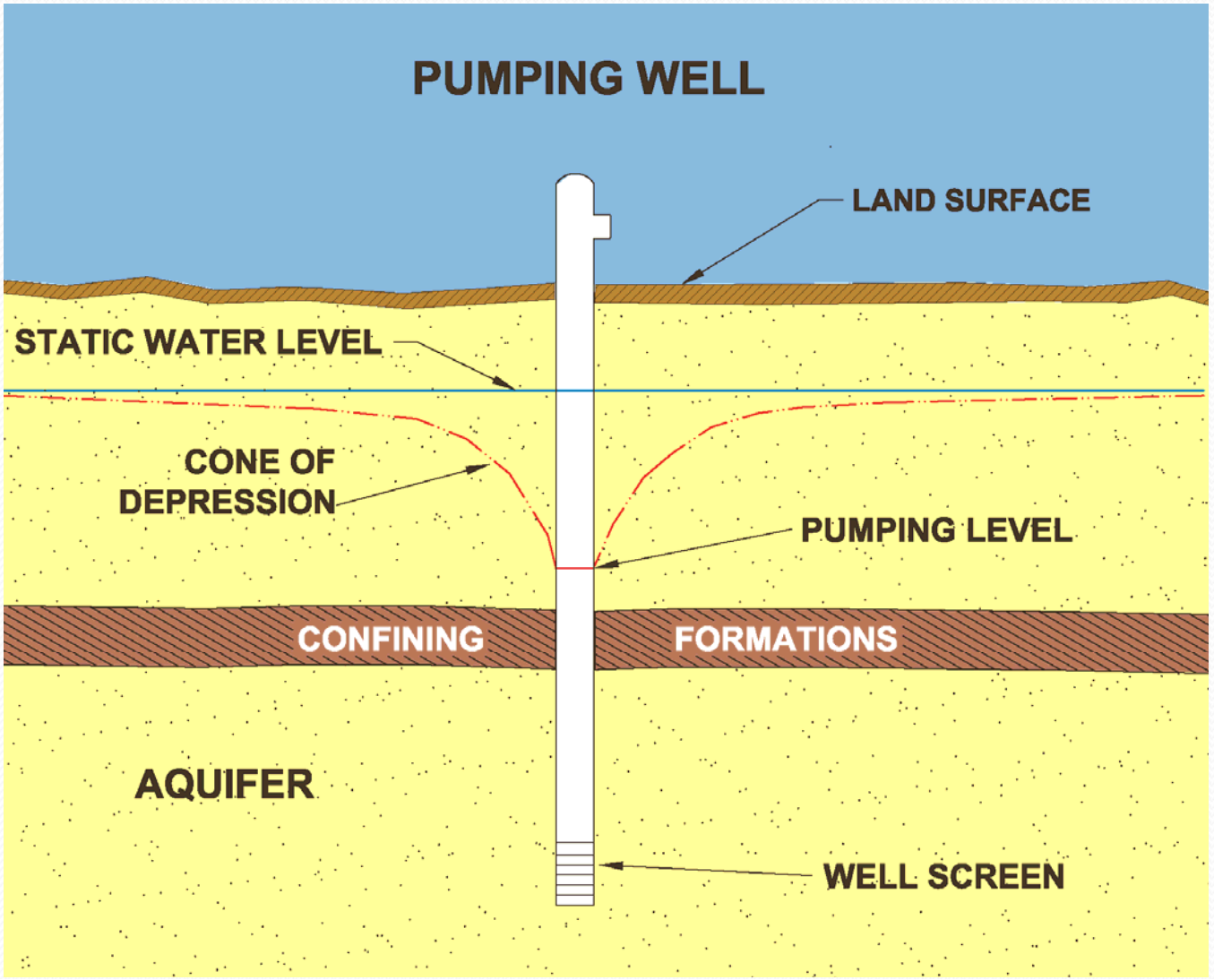




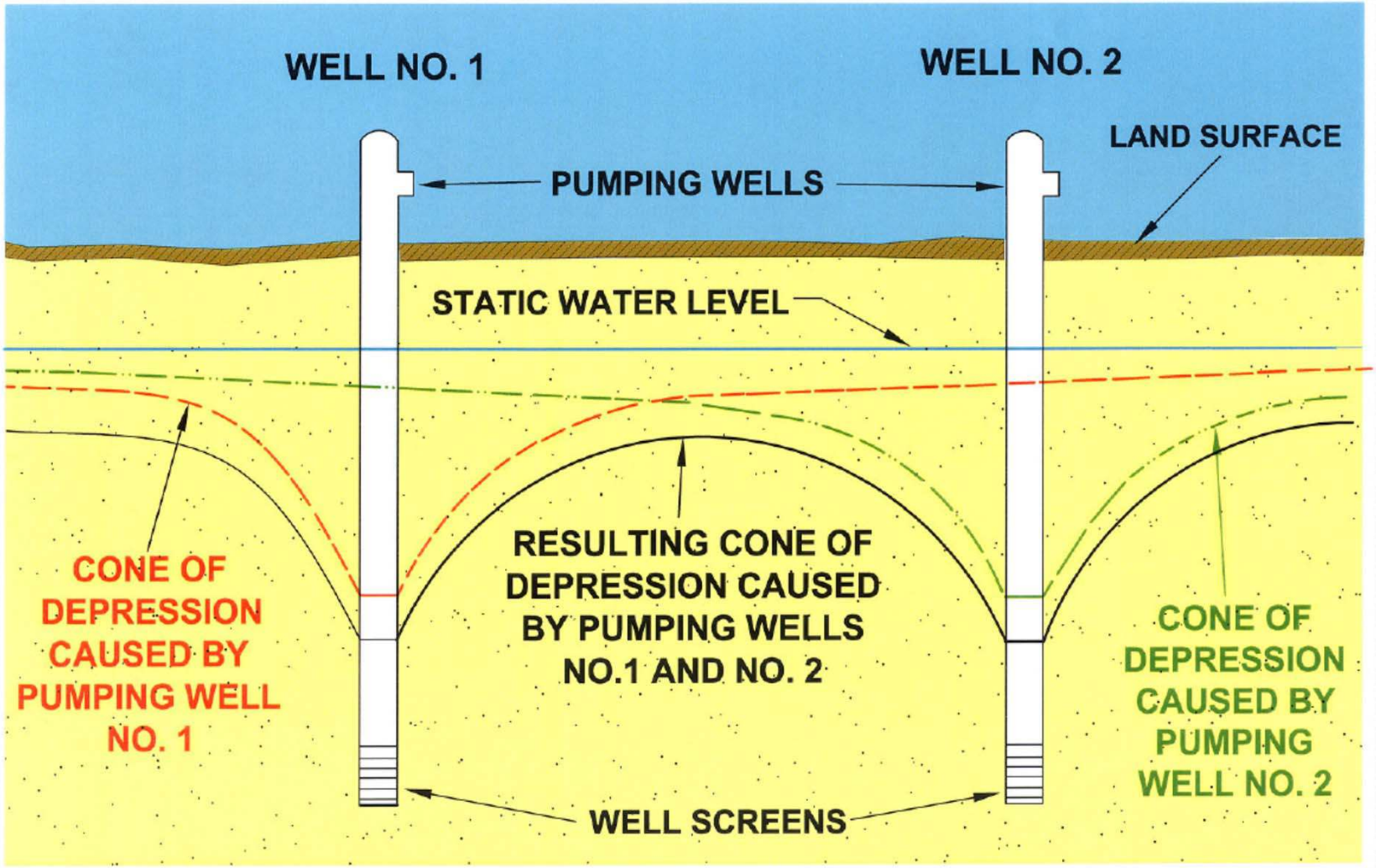
Groundwater movement to well



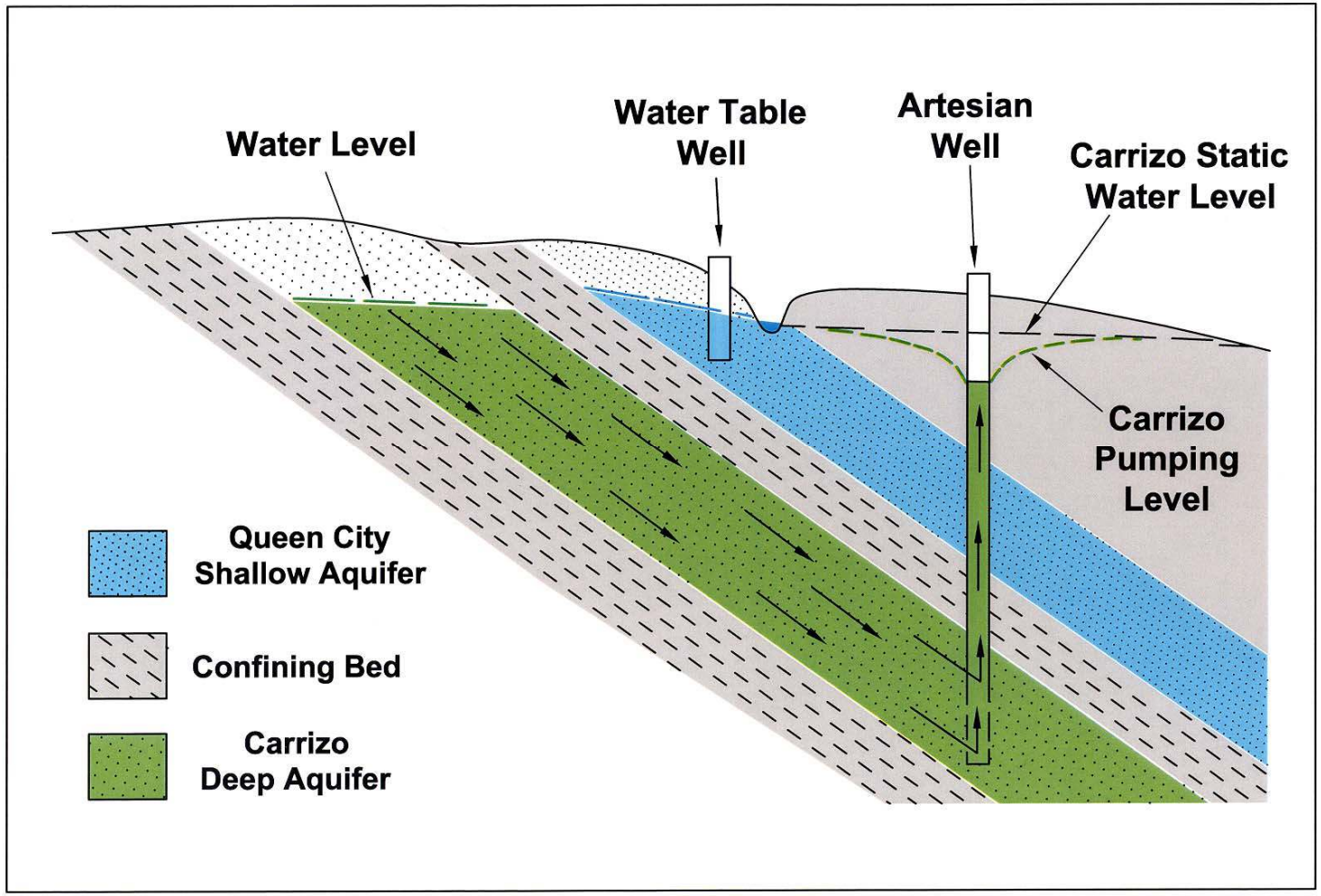
Drawdown, water level decline, pressure decline



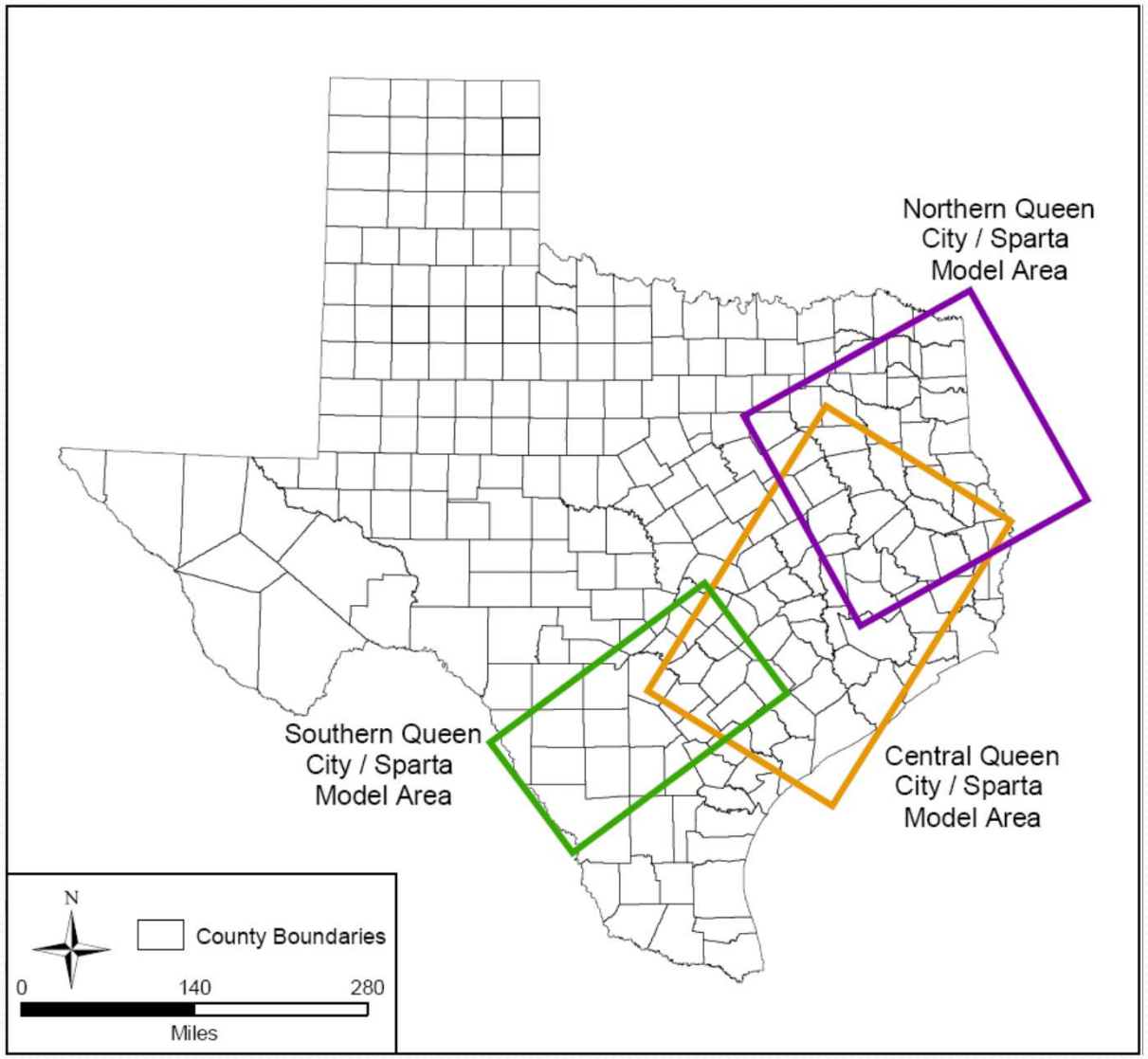
Pumping impacts



Aquifer Schematic



TWDB GAM


Northern Queen City / Sparta Model Area
Southern Queen City / Sparta Model Area
Central Queen City / Sparta Model Area
N
County Boundaries
0
140
280
Miles

Modeling Basics

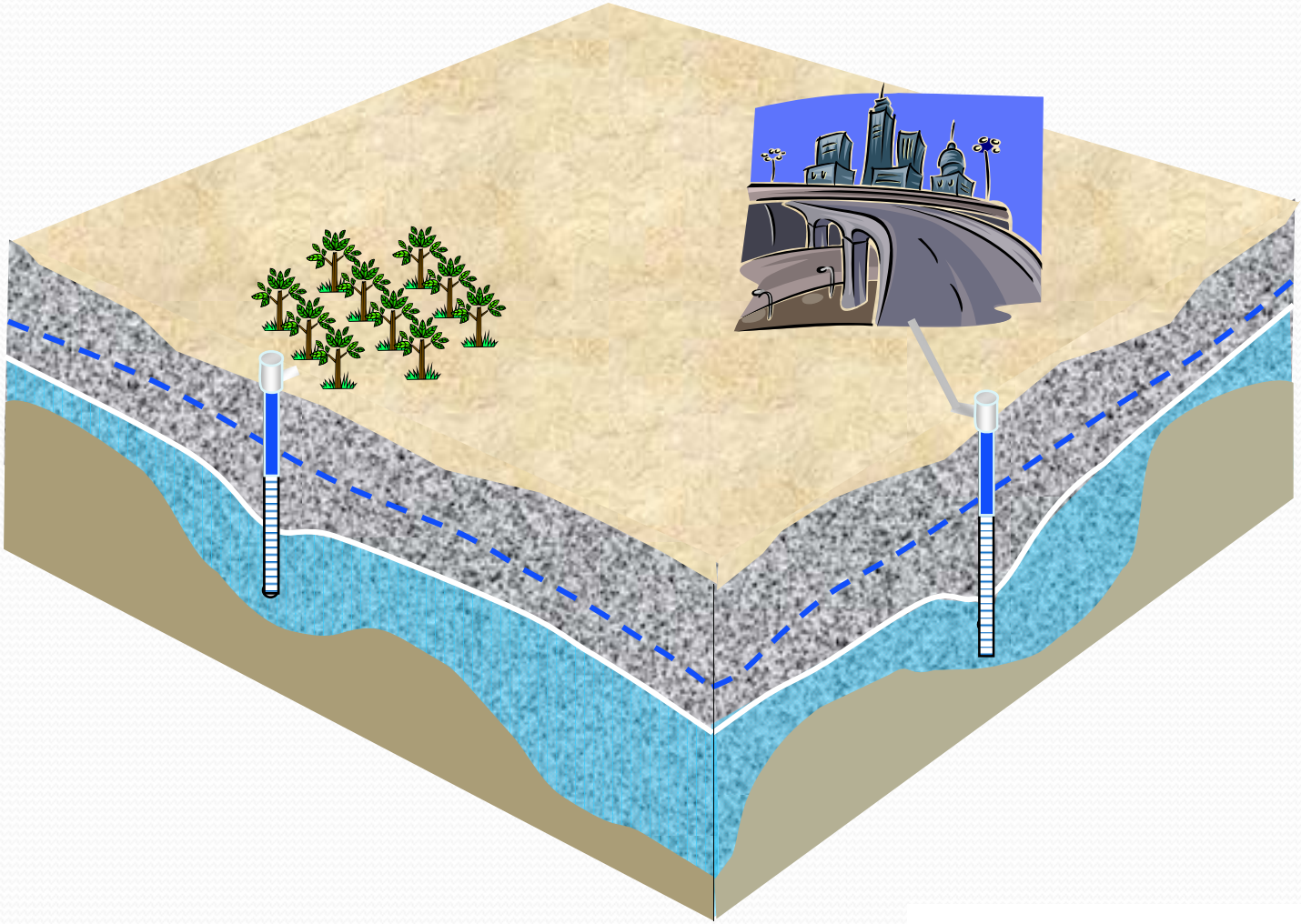
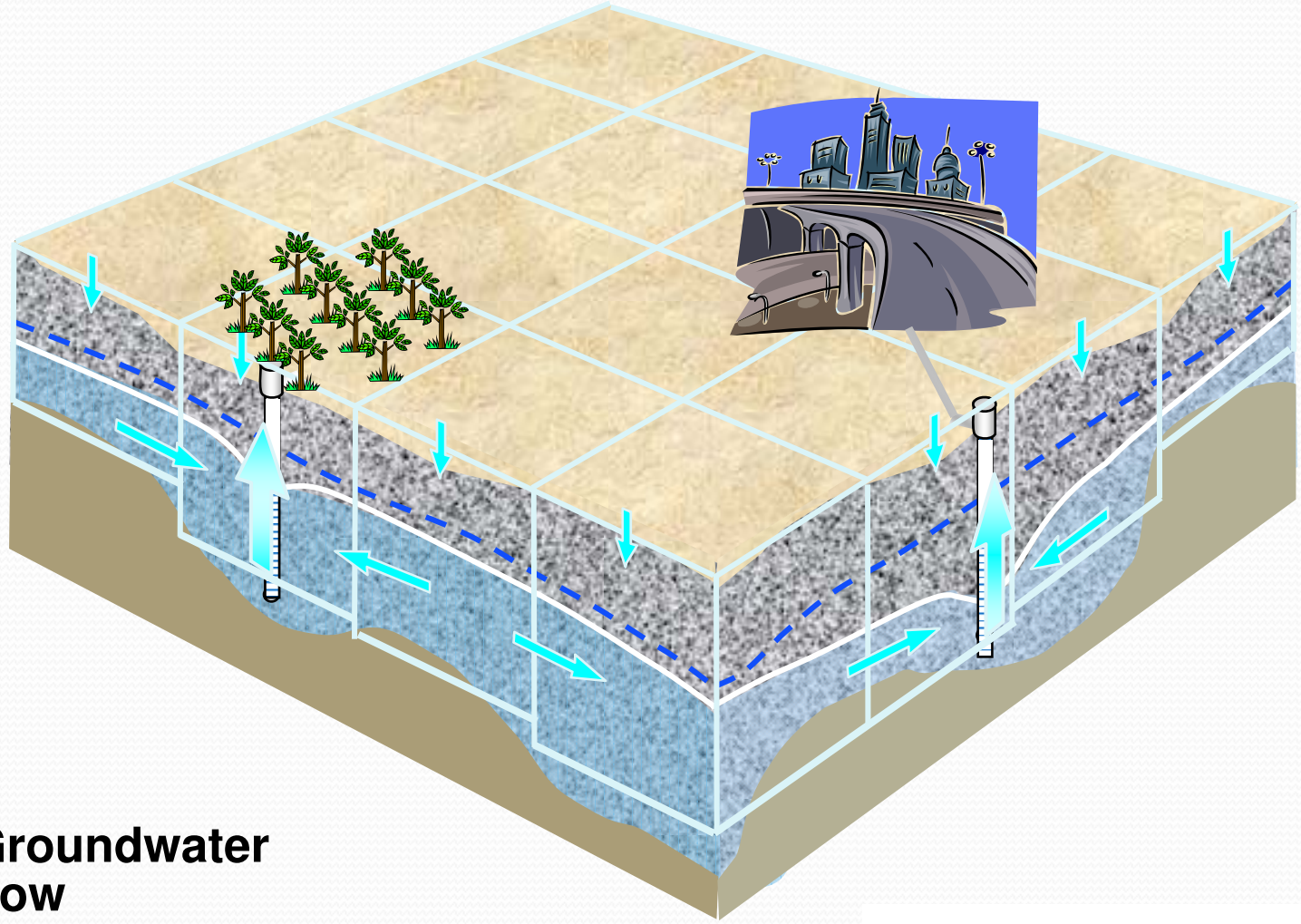


Figure from Daniel B. Stephens & Associates

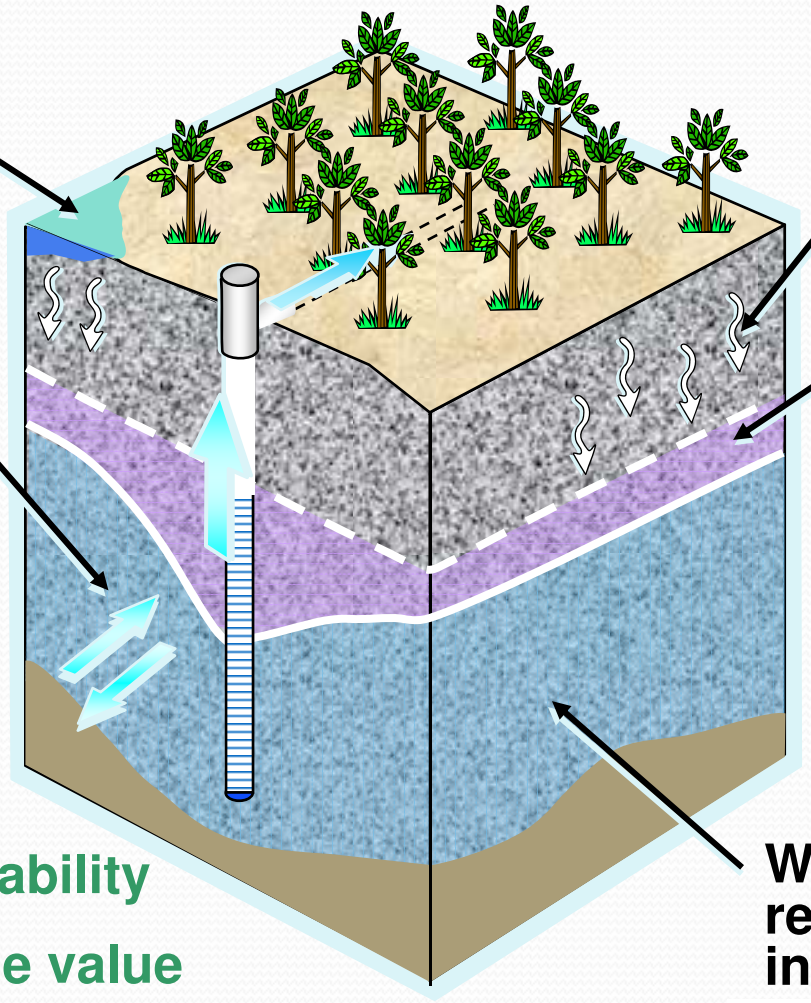
Cells "Communicate"



Groundwater flow

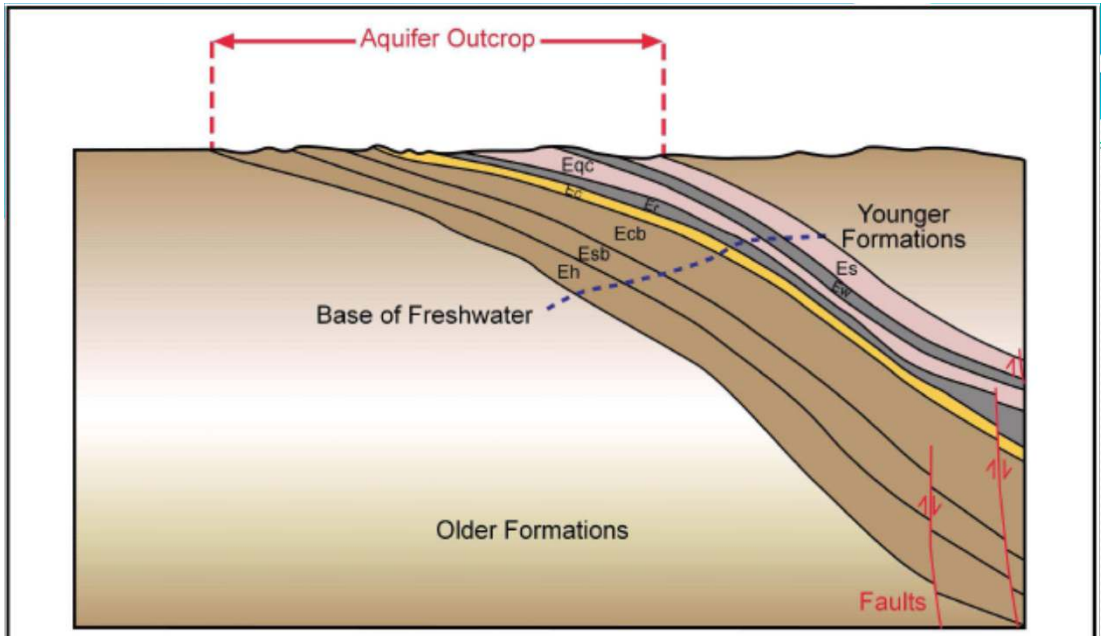
Figure from Daniel B. Stephens & Associates

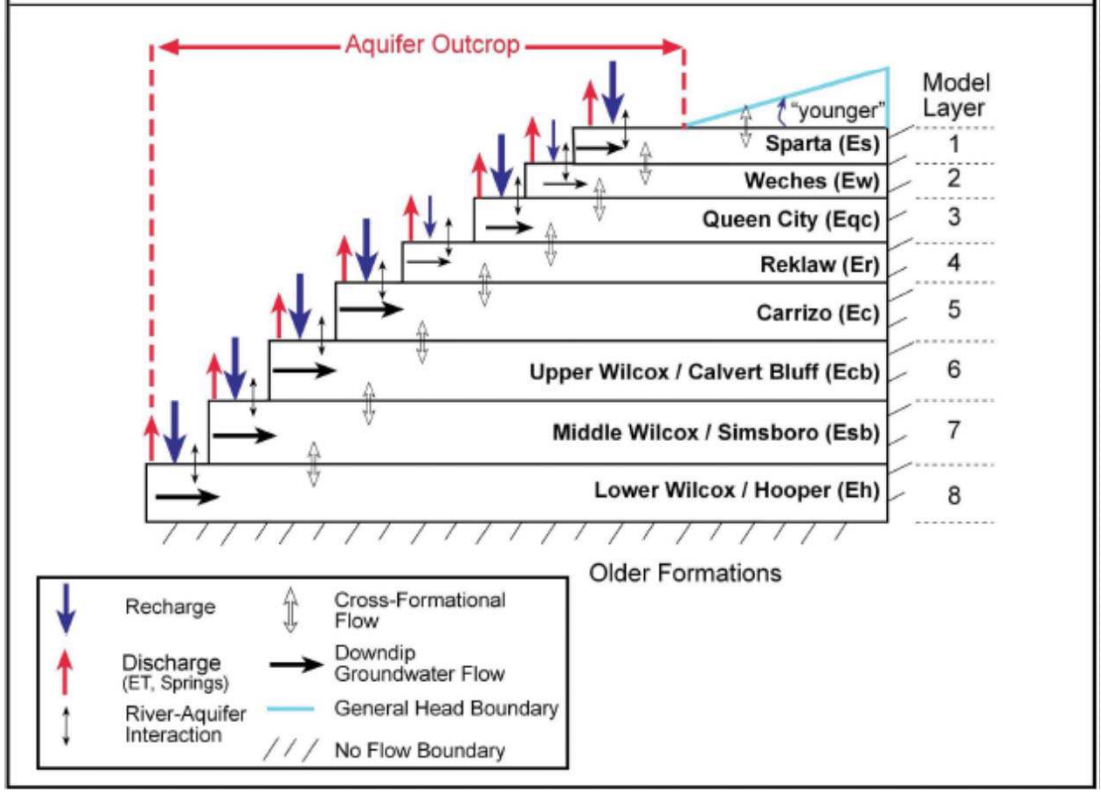
Gridblock Accounting



- Permeability
- Storage value
- Thickness

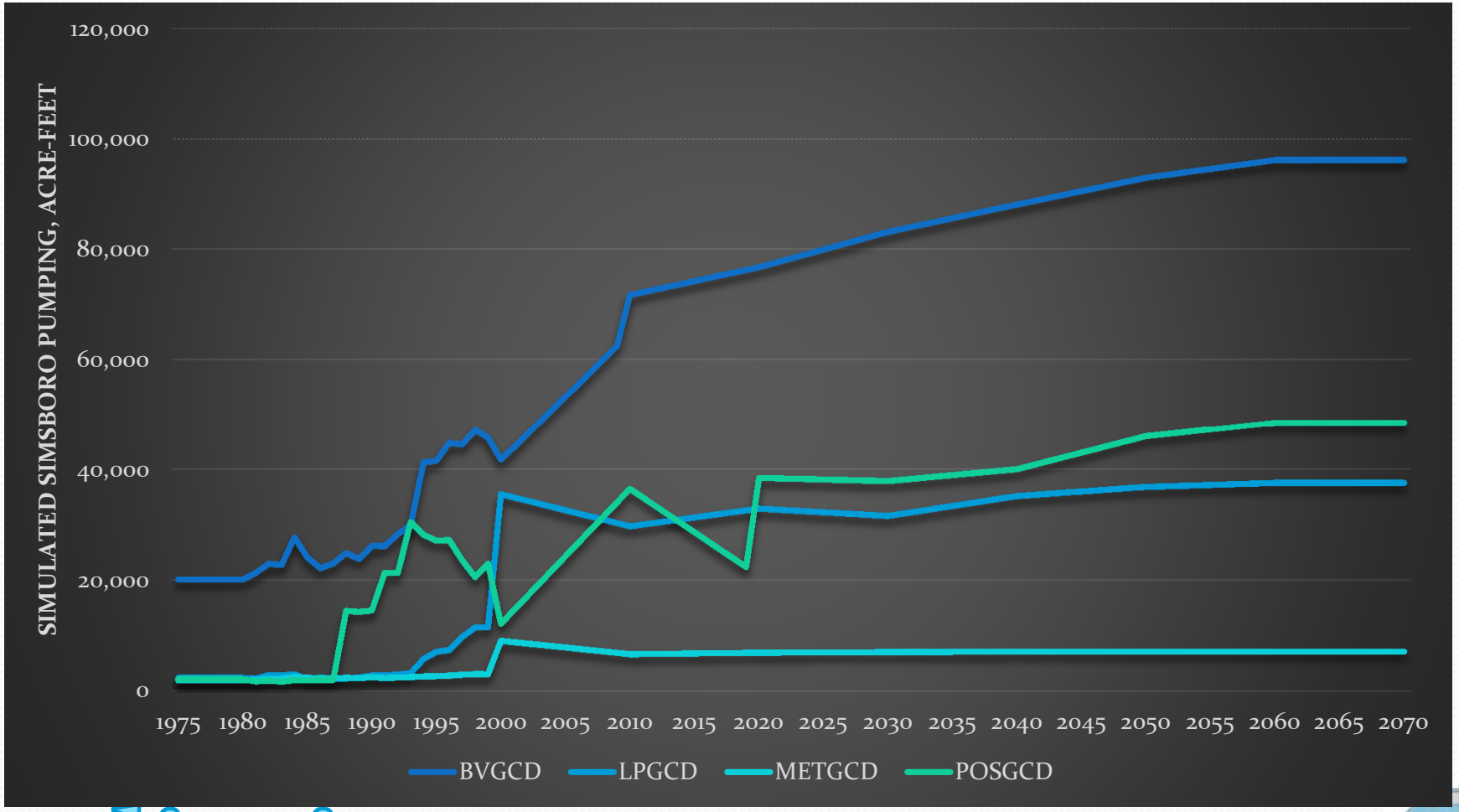
Figure from Daniel B. Stephens & Associates


Aquifer Outcrop
Eqc
Er
Ec
Ecb
Esb
Eh
Younger Formations
Es
Ew
Base of Freshwater
Older Formations
Faults


Aquifer Outcrop
"younger"
Model Layer
Sparta (Es) 1
Weches (Ew) 2
Queen City (Eqc) 3
Reklaw (Er) 4
Carrizo (Ec) 5
Upper Wilcox / Calvert Bluff (Ecb) 6
Middle Wilcox / Simsboro (Esb) 7
Lower Wilcox / Hooper (Eh) 8
Older Formations
Recharge
Discharge (ET, Springs)
River-Aquifer Interaction
Cross-Formational Flow
Downdip Groundwater Flow
General Head Boundary
No Flow Boundary

TWDB GAM

Simsboro Pumping

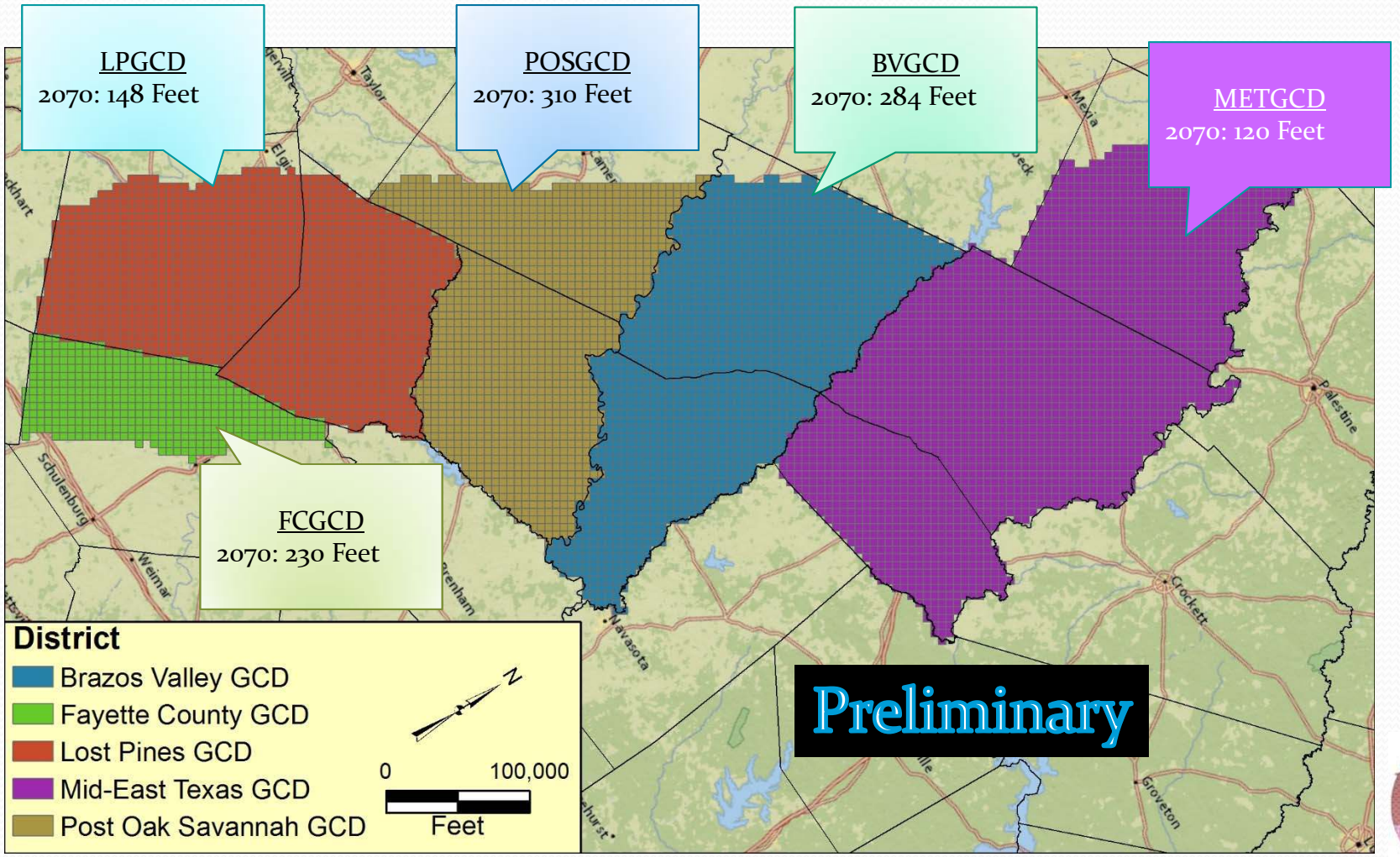


Preliminary

LBG GUYTON

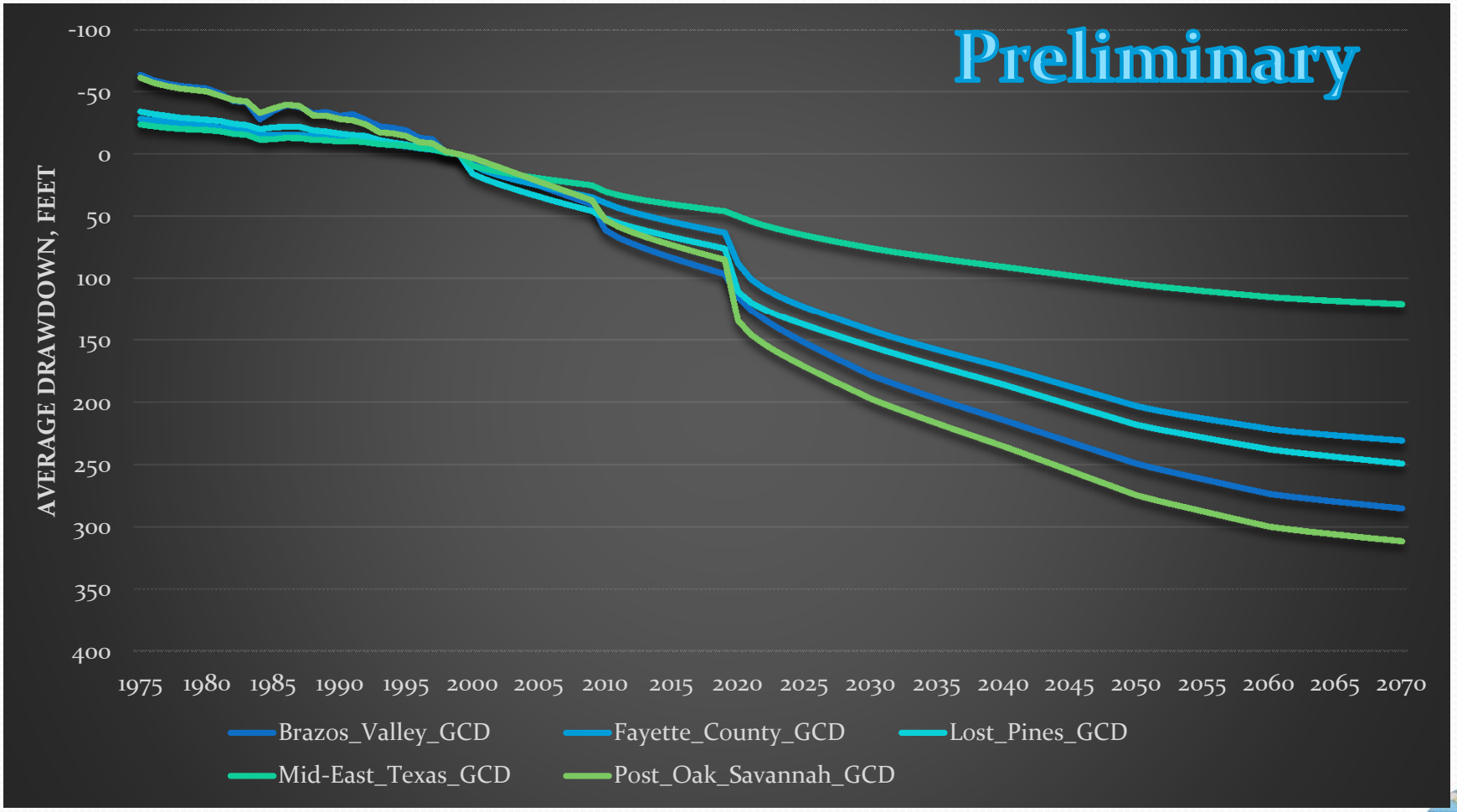
Simsboro Aquifer

Simulated 2070 water level decline (one estimate)



Simsboro Aquifer

Average Simulated Drawdown



LBG GUYTON

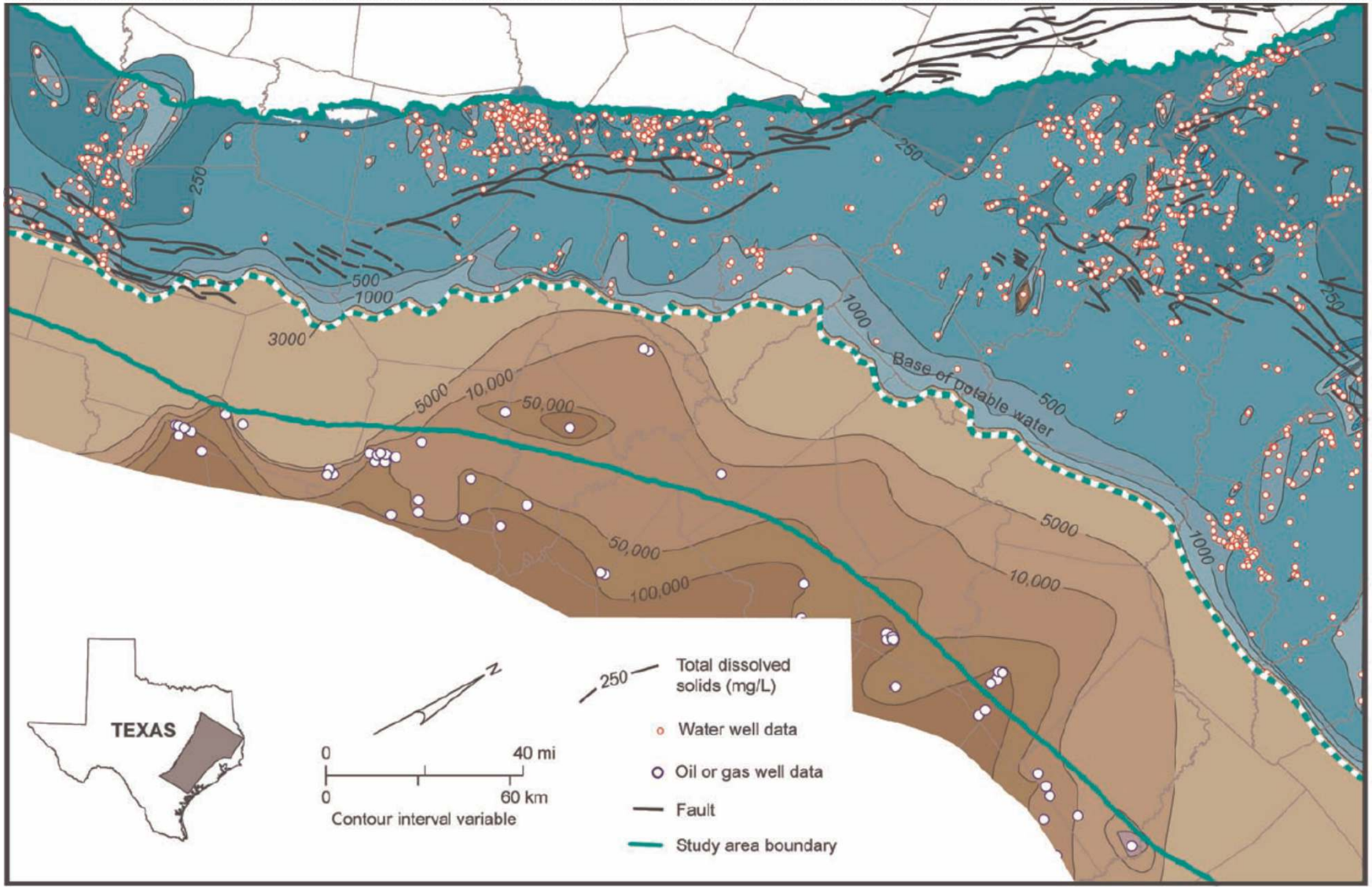
Water Quality

- Practical Definition: Brackish groundwater contains from 1,000 to 10,000 mg/L TDS

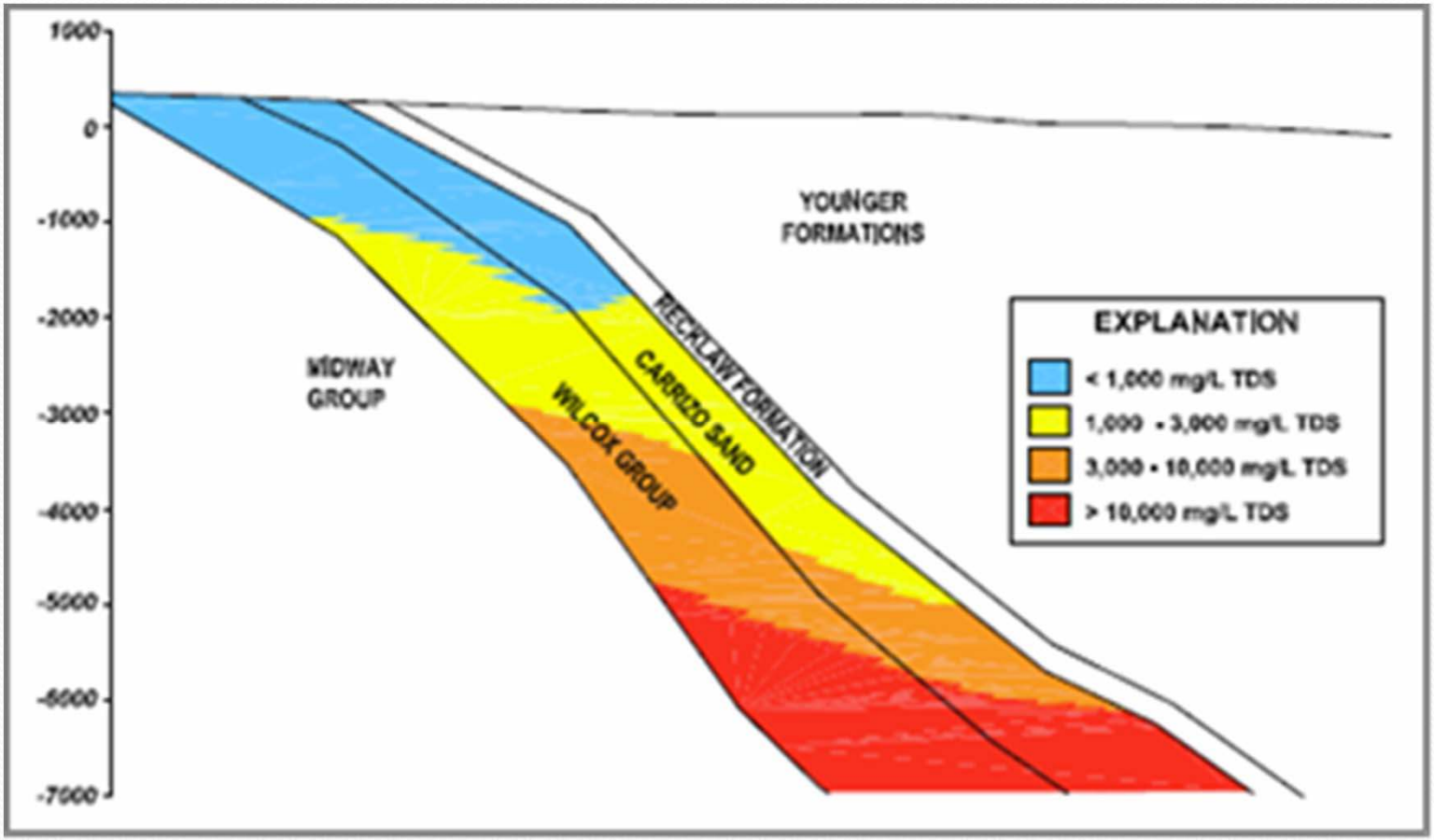
Fresh	Brackish	Saline
1,000 mg/L	3,000 mg/L	10,000 mg/L

LBG GUYTON

Water Quality



Water quality




Thanks!
Any Questions ?
LBG
GUYTON