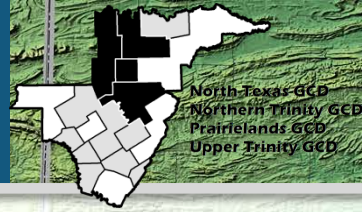
Predictive Simulations



- As part of the NTWO Project 4 predictive simulations were performed:
  - *A re-simulation of the current MAG pumping*
  - A run labeled “highest practicable”
  - A run labeled “conservation”
  - A predictive run assuming current pumping
- These simulations were discussed with representatives of GMA-8 in a meeting on 6/30/14
- All simulations were run through 2070.
- Documented in a memorandum dated 9/3/14

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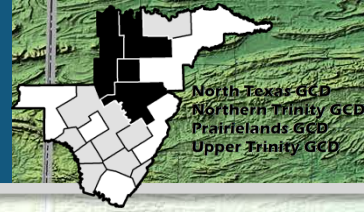
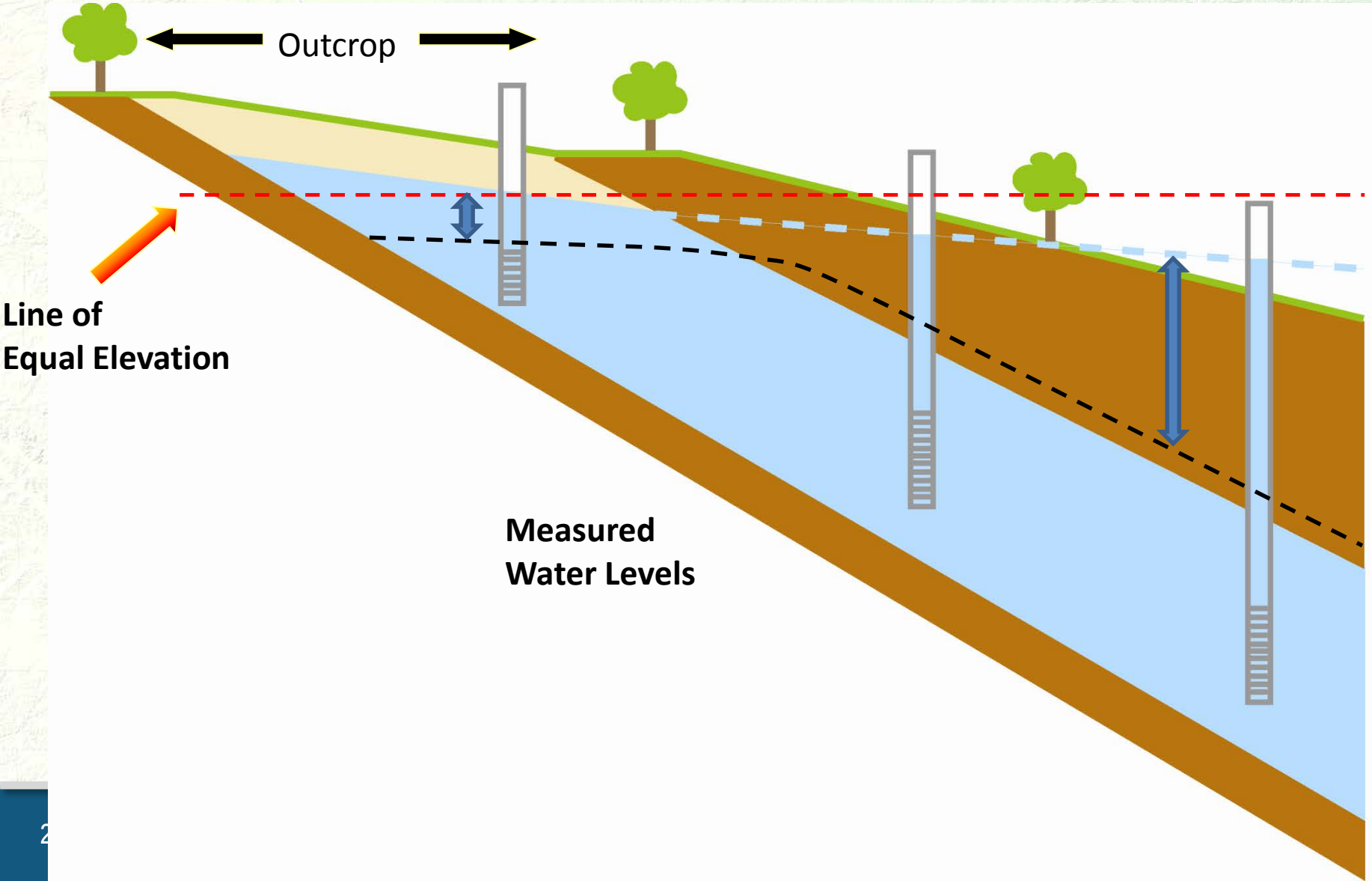
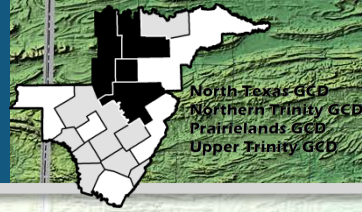
“Highest Practicable”





“Highest Practicable” Simulation



- This simulation was performed but gave results that were correct for the question posed but the condition requested lacked a management context
- Large areas of the model aquifers required injection of groundwater whereas other areas produced large quantities of groundwater.

- Why?

Model solved for Q = aquifer volumetric flow rate

Q = K (dh/dl) A

K = Hydraulic conductivity (ft/d)
dh/dl = hydraulic gradient
A = aquifer area normal to groundwater flow

Constants set By our question And model calibration

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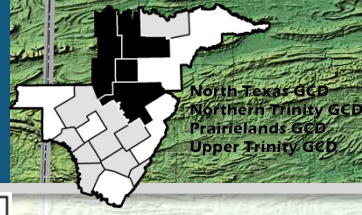
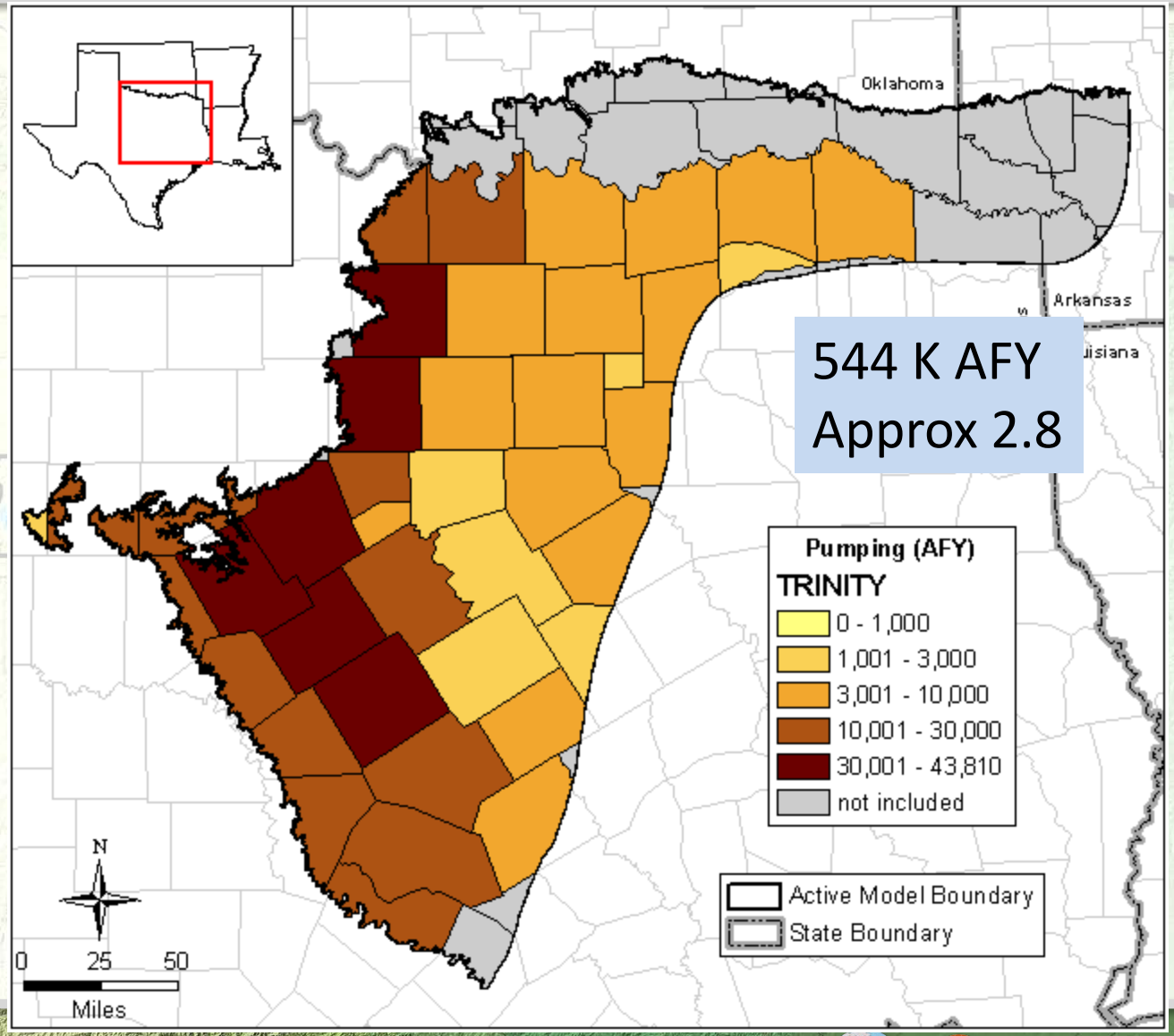
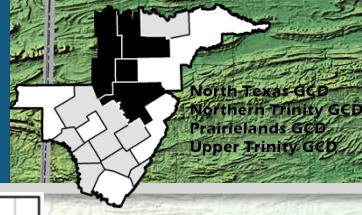
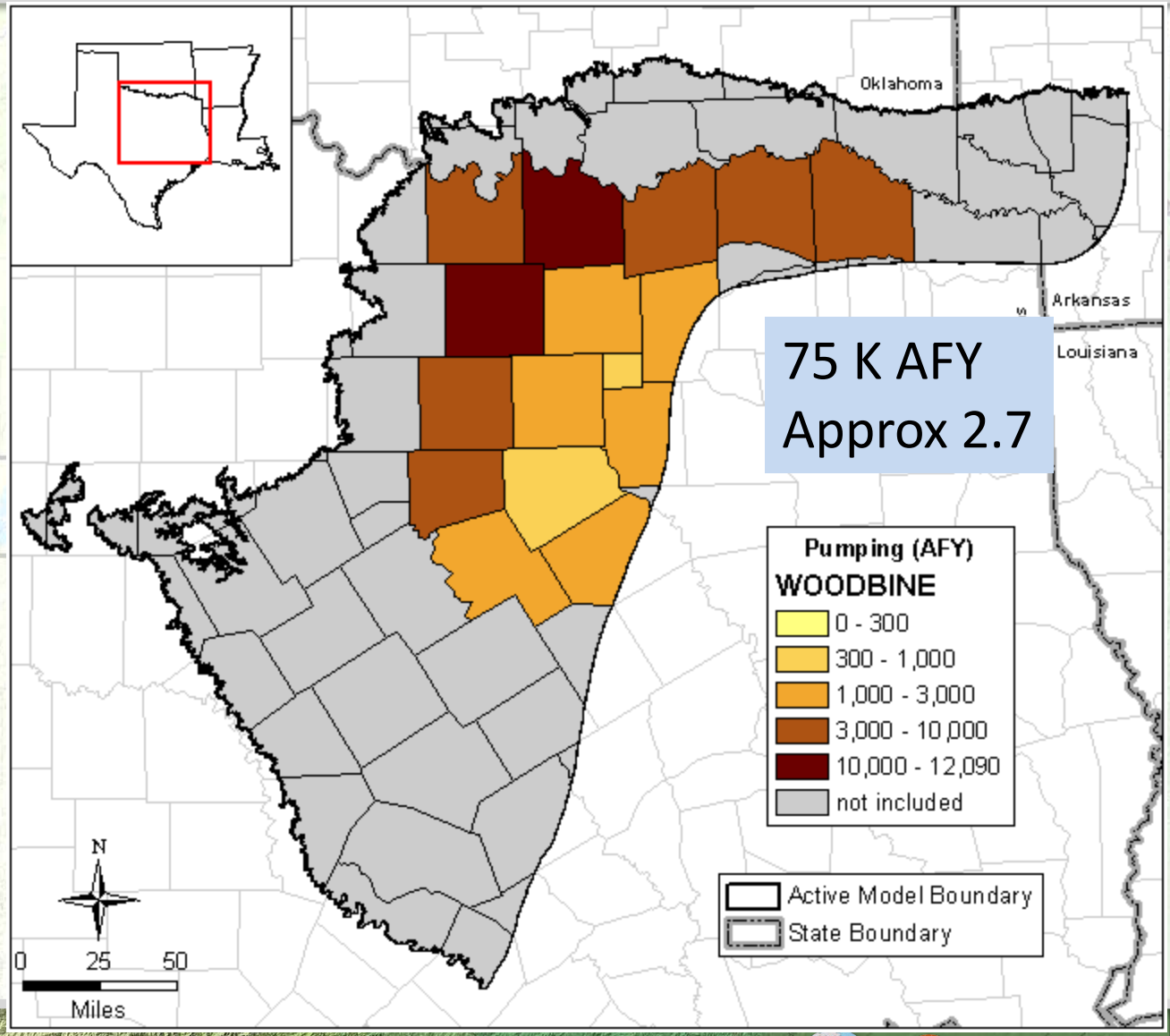
“Highest Practicable” - Trinity



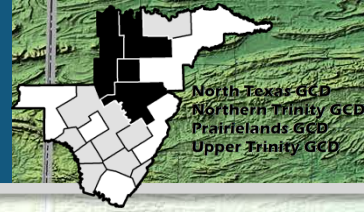


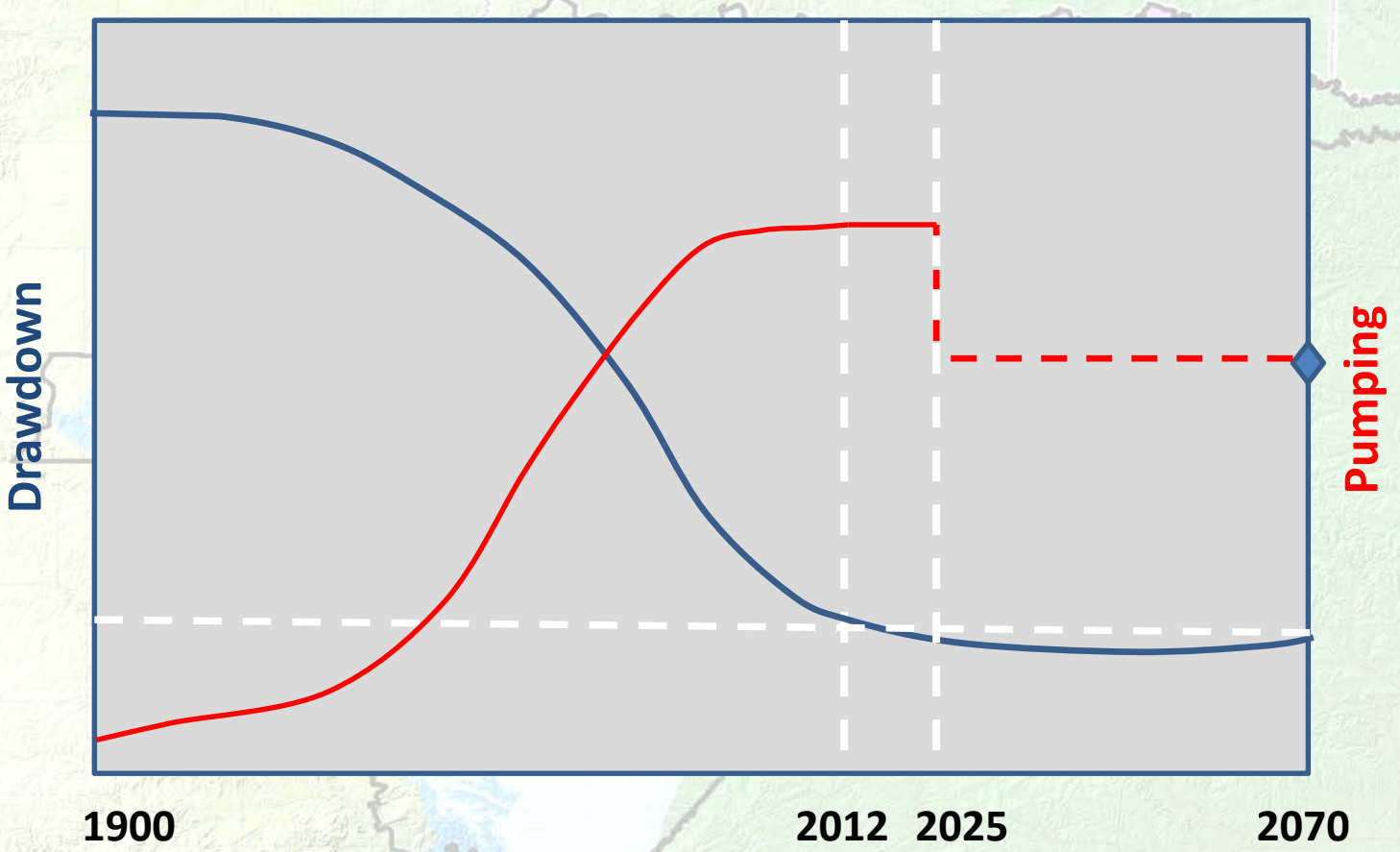
“Highest Practicable” Woodbine





“Conservation Run”





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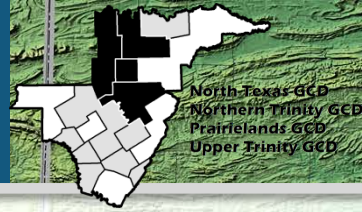
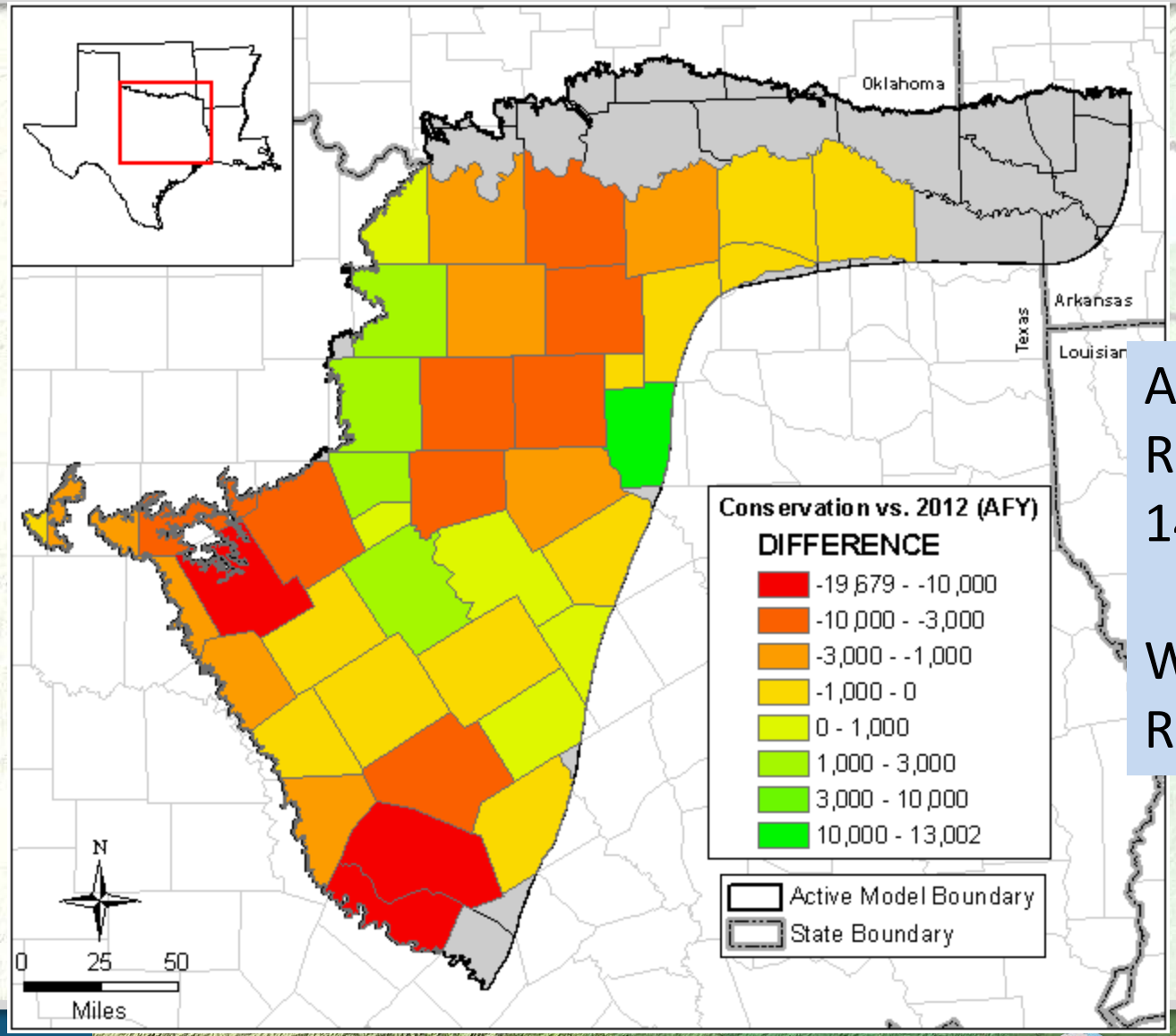
“Conservation”

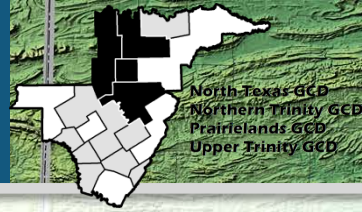




Approx 26% Reduction 140K

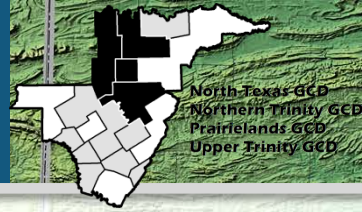
Woodbine 30% Reduction 19K

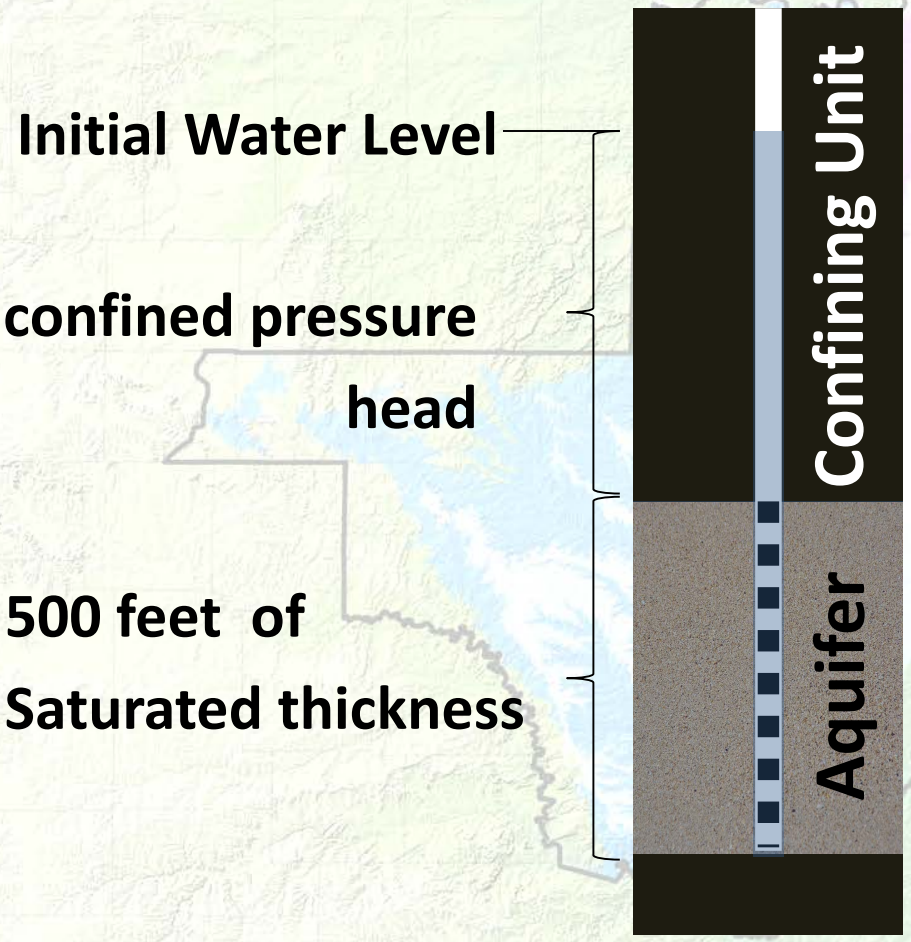
Comparison



- A comparison of “highest practicable” to “conservation” in some cases leads to unexpected results with the “conservation” value > “highest practicable”
- This is because “highest practicable” is simply a groundwater storage calculation whereas the “conservation” simulation honors Darcy’s Law and allows aquifer lateral and cross groundwater flow

Storage Volume Calculation



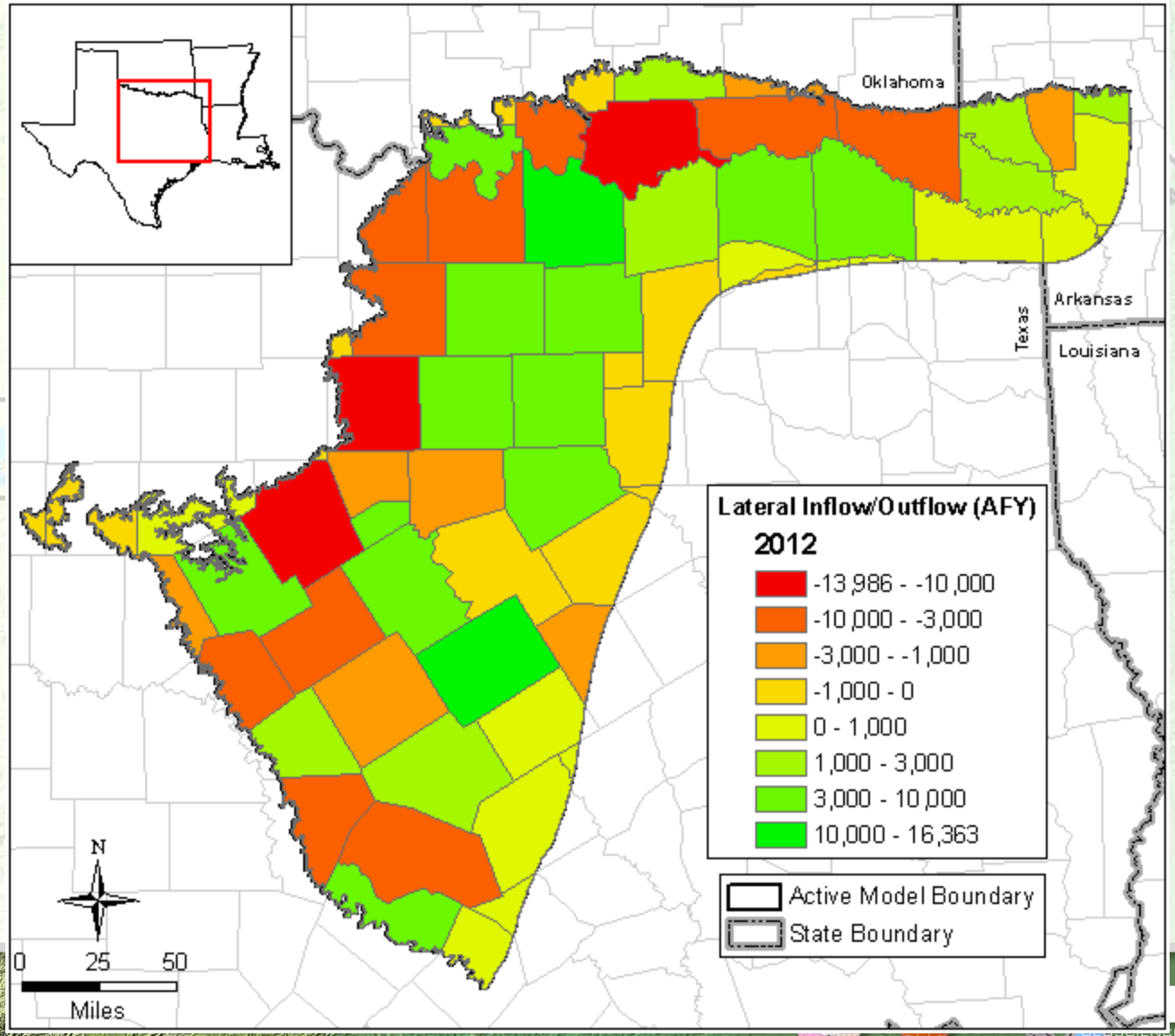


Estimating volume in storage is not
A hydraulic calculation constrained
By the equations governing groundwater
Flow

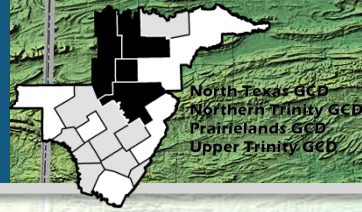
Storage vol = storativity X change in water level

An inherent assumption of the calculation
Is that each portion of an aquifer has zero
Communication with another portion

Lateral Net Flow (AFY) 2012

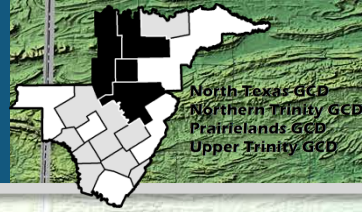


Conclusions



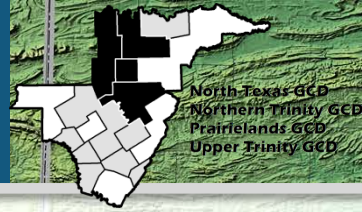
- The simulations and calculations performed are educational for GMA-8 and illustrate several important issues described below.
- The desired condition of drawing down heads to 10 feet above the top of each aquifer is physically unrealistic and cannot be simulated using the principles of groundwater flow without injection of groundwater.
- This implies that TERS calculation methodology likely results in un-achievable estimates of recoverable storage

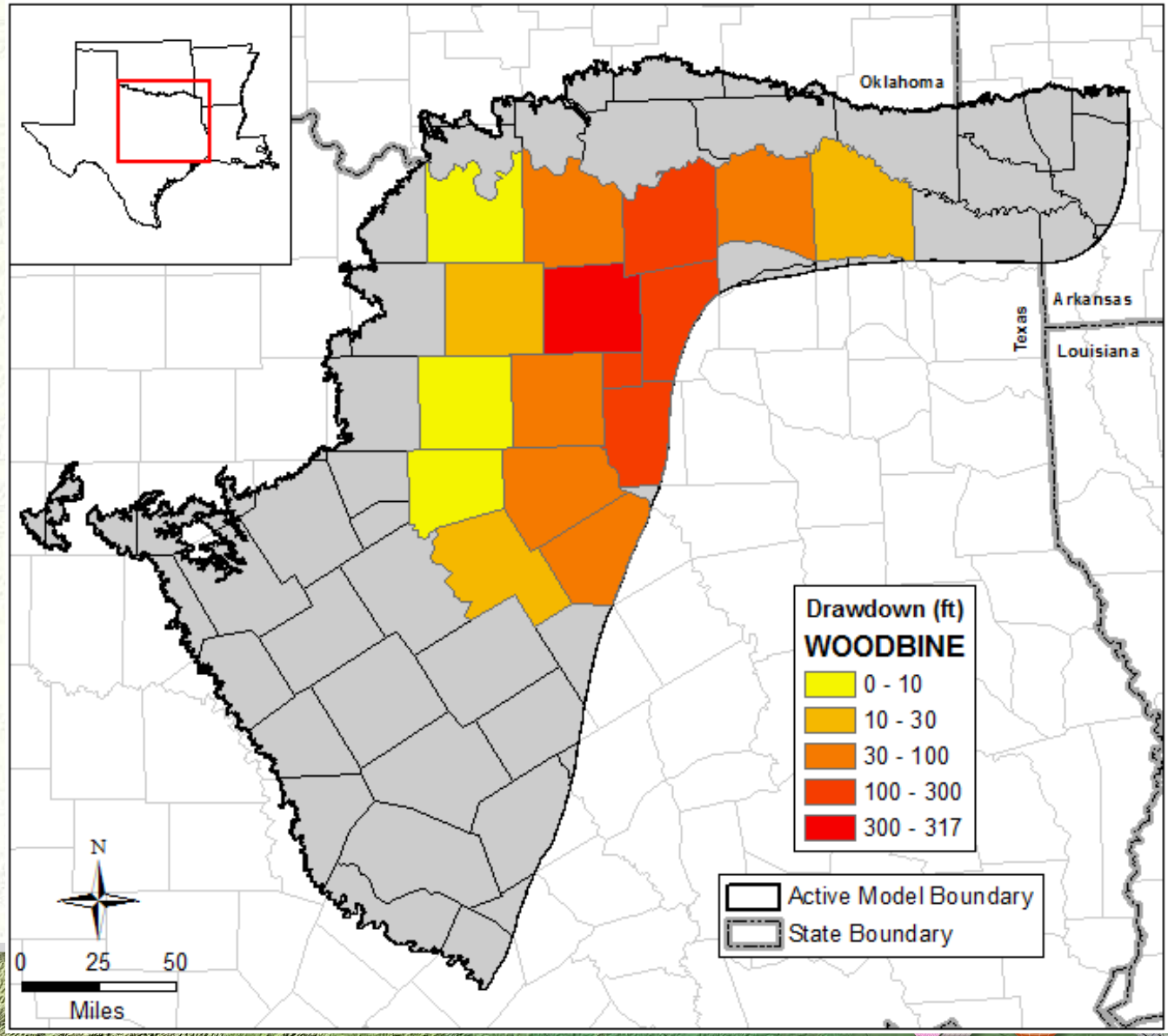
Current Pumping



- Used 2010 pumping and simulated to 2070.
- Provides insight into the importance of initial conditions
  - For example, if pumping were higher before the year selected to use for prediction, rebound can occur
- Future simulations should be wary of this and perhaps select a 10 year maximum

County Average Drawdown (2010-2070)





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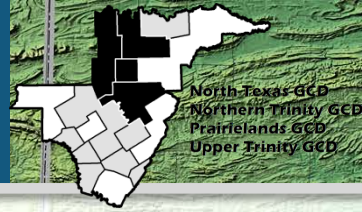
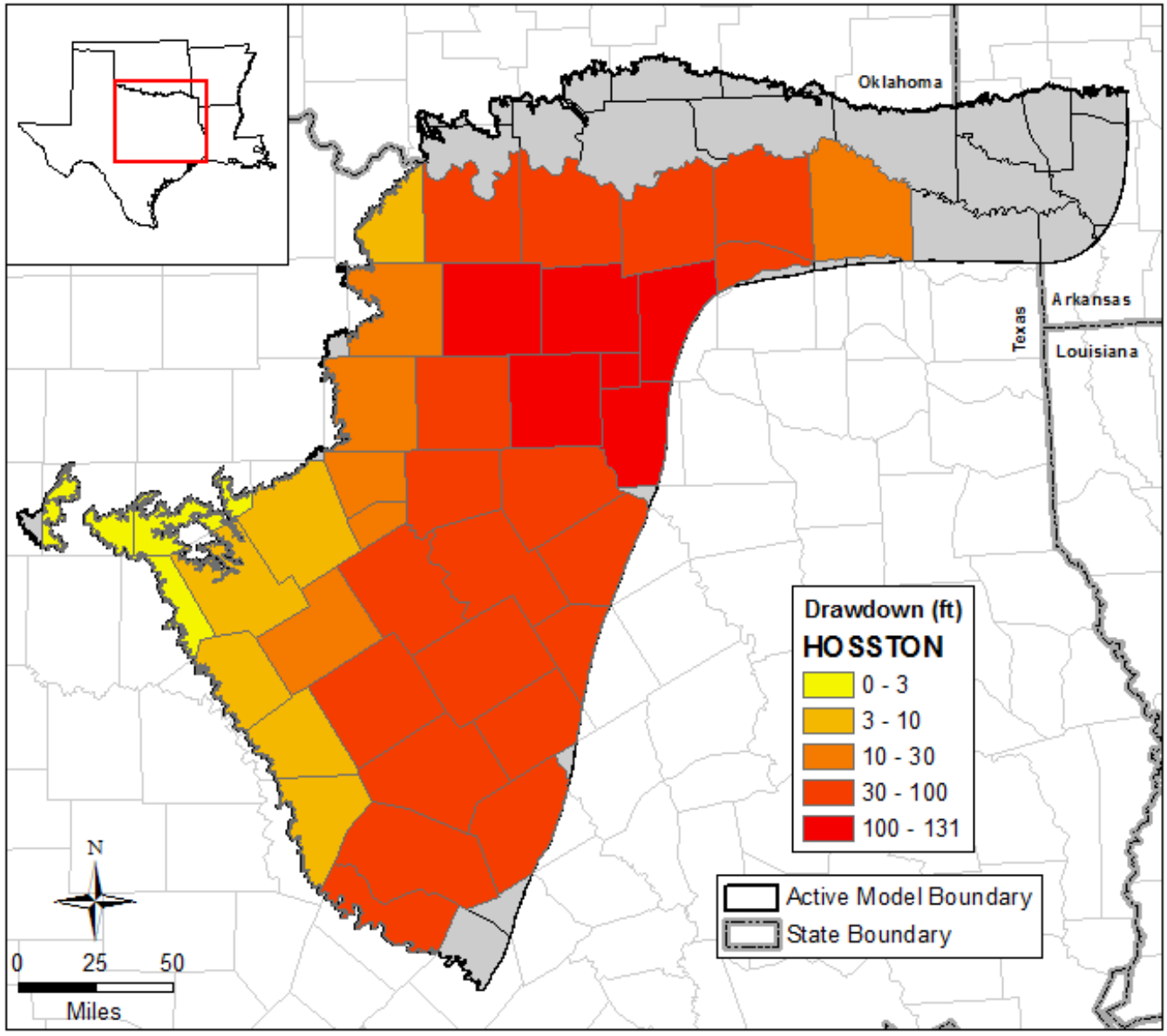
County Average Drawdown (2010-2070)





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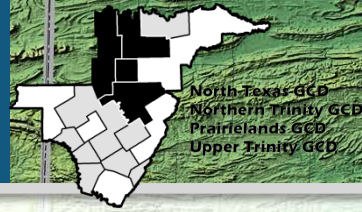
Conclusions



- Historically, currently and over the future course of the planning time period, significant volumes of groundwater flow between counties and districts. This means that planning to meet a specific future condition requires coordination with your neighbors.

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