Regional Groundwater Modeling

Update for Northeast Illinois

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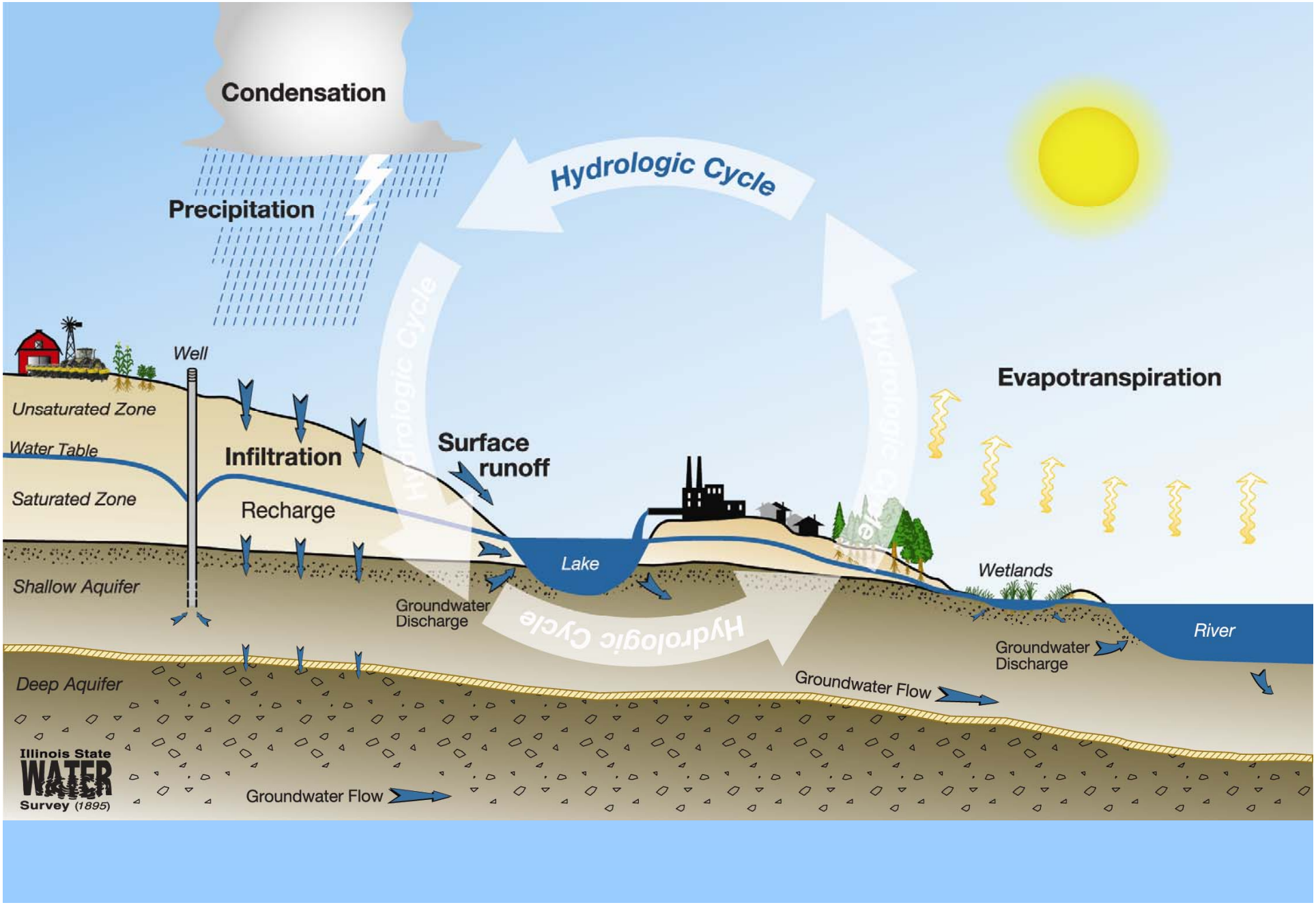
REMINDER

We are analyzing impacts, not truly assessing availability

Model runs used pumping rates from the various aquifers based on the proportional split of the 2005 pumping rates – sources were not shifted if a source ran out or levels went below a certain level

We used prescribed demand scenarios to evaluate impacts primarily in the form of drawdowns & critical water levels – future impacts on streamflows are being assessed – historical & current impacts follow

We have not assessed the shallow bedrock yet or all model cells that went “dry” – new info on deep bedrock follows


Condensation
Precipitation
Hydrologic Cycle
Evapotranspiration
Well
Unsaturated Zone
Water Table
Saturated Zone
Shallow Aquifer
Infiltration
Recharge
Surface runoff
Lake
Wetlands
River
Groundwater Discharge
Groundwater Discharge
Groundwater Flow
Deep Aquifer
Groundwater Flow
Illinois State WATER Survey (1895)

Streamflow capture occurs by two mechanisms:

(1) by diversion into shallow wells of recharge that would otherwise discharge to stream,
(2) by direct inducement of streamflow to leak from stream channels

Streamflow capture estimated by:

Calculating the difference between the simulated pre-development groundwater discharge and the simulated groundwater discharge for chosen post-development dates (e.g., 1985, 2005, 2025, 2050) for selected stream reaches

Groundwater discharge reductions may not be easily observed.

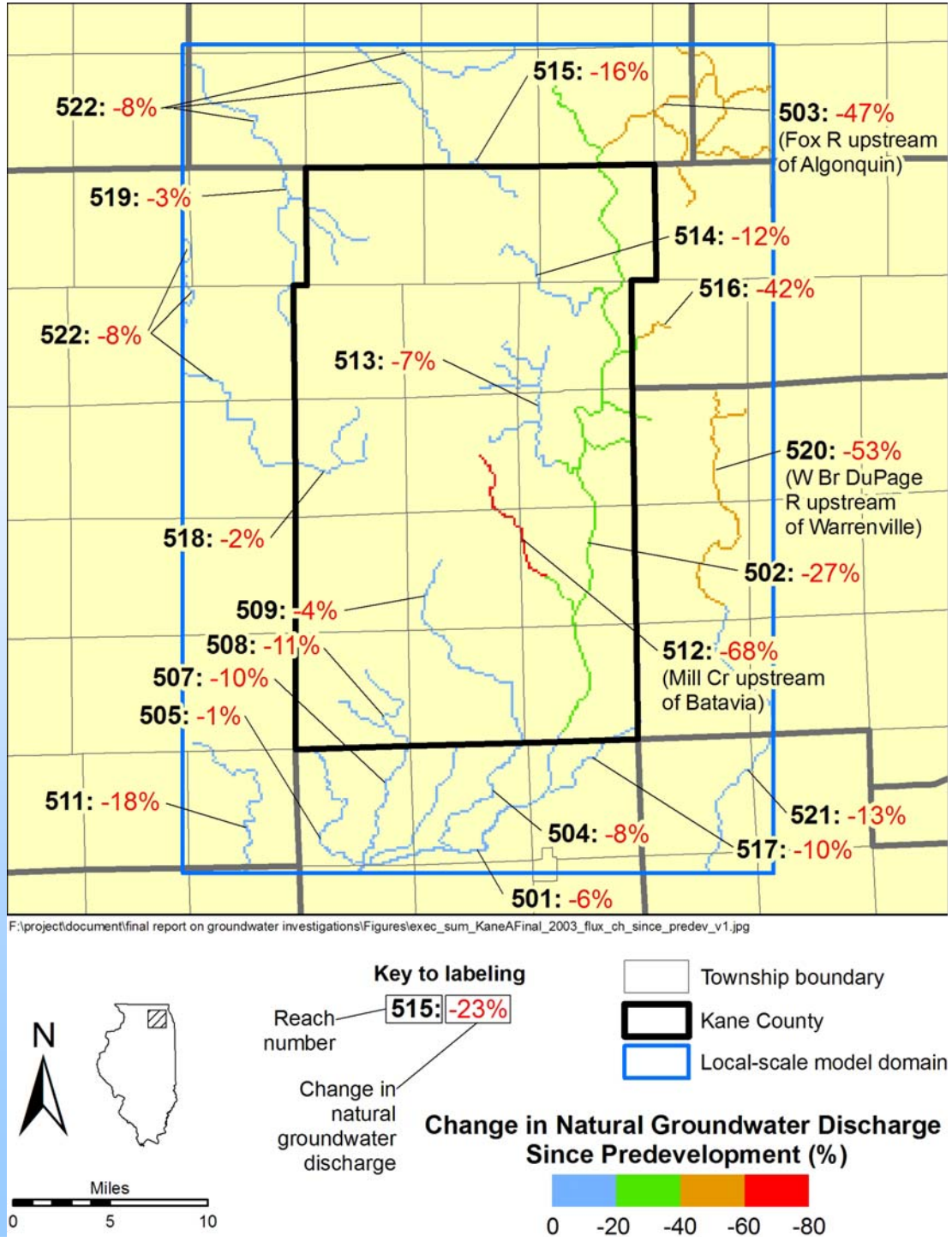
Discharges of wastewater effluent likely will compensate for base flow reductions on receiving streams (e.g., Fox River).

Reductions may be noticeable during low flow periods on perennial tributary streams that do not receive effluent. Such streams may potentially go dry more often and may do so already. For ephemeral streams, dry periods potentially may become more prevalent and/or extend for longer periods.

Other changes within the watershed that can influence streamflow are not being modeled (e.g., urbanization).

Change in Natural Groundwater Discharge (%)

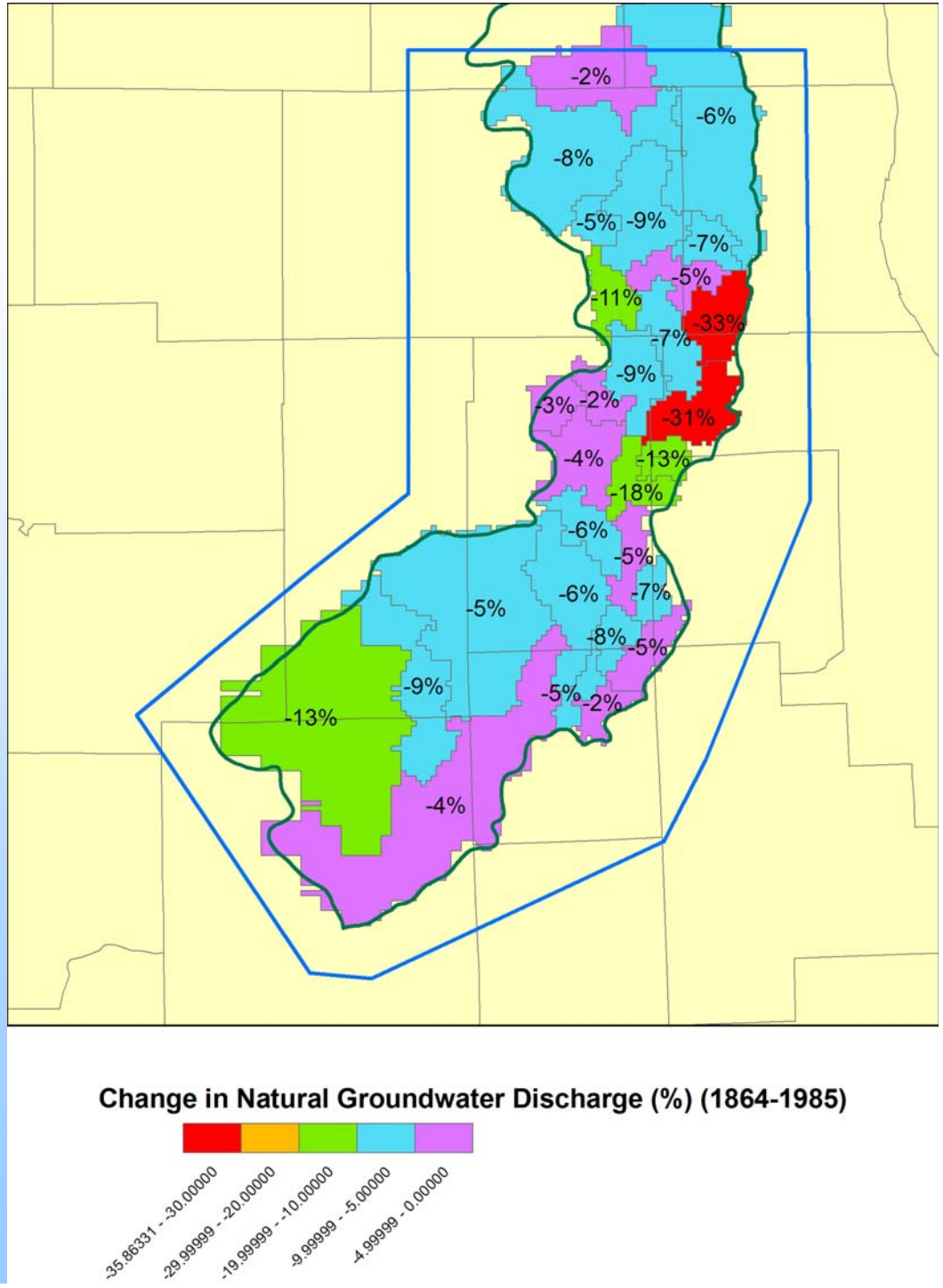
Predevelopment (1864) to 2003



From Meyer *et al*., 2009. *Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County And Northeastern Illinois*

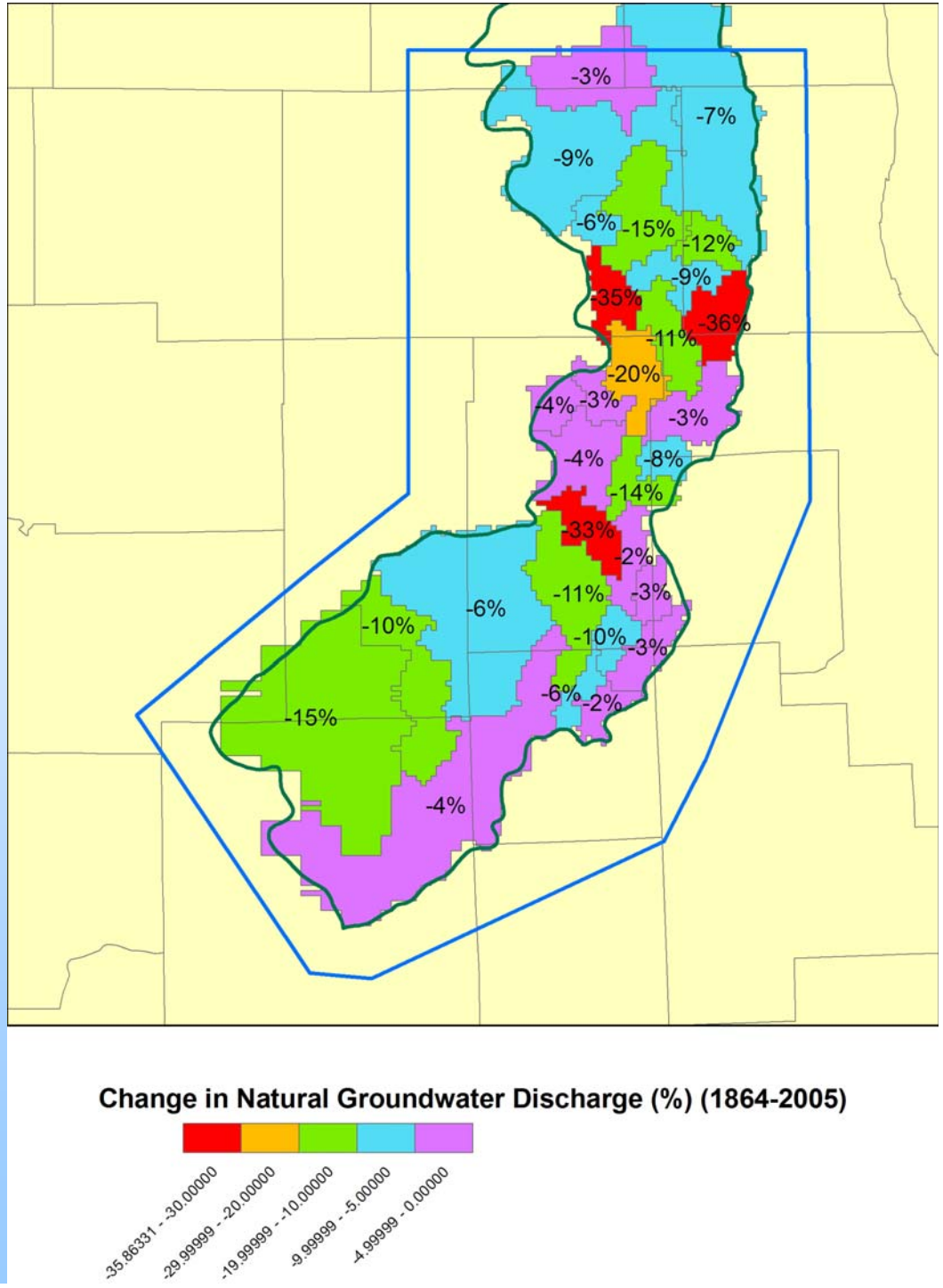
Change in Natural Groundwater Discharge (%)

Predevelopment (1864) to 1985



Change in Natural Groundwater Discharge (%)

Predevelopment (1864) to 2005

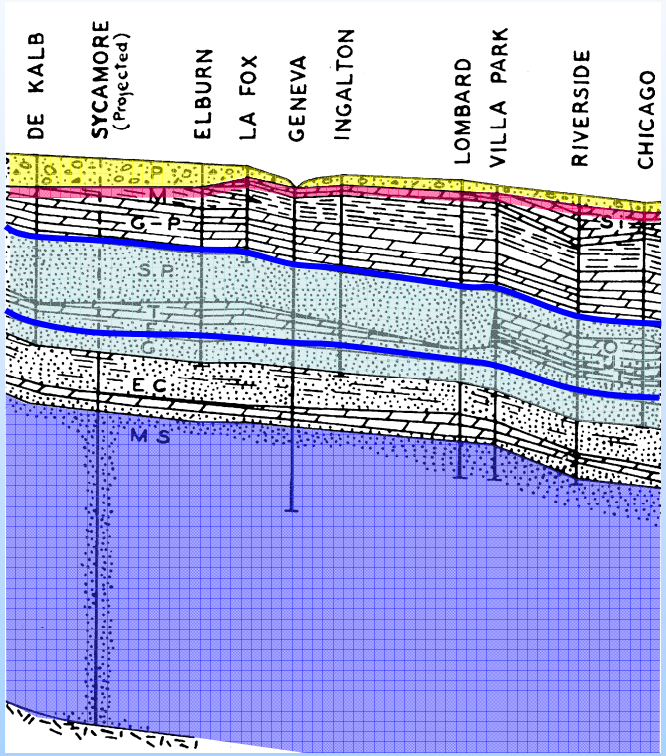


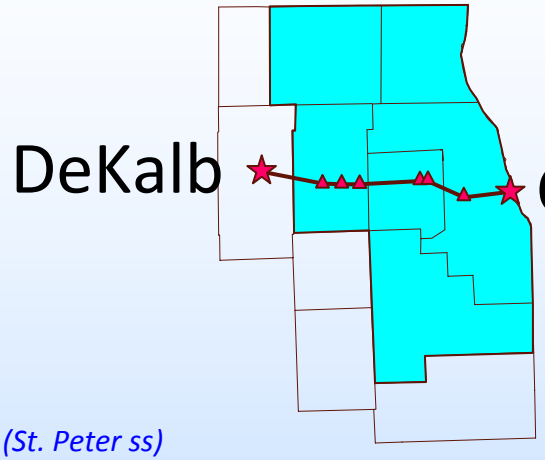
“Old” Conclusions (December 2008)

- Regional groundwater flow model results have been produced for the 3 basic demand scenarios
- Results for shallow sand/gravel aquifers within the Fox River Basin were presented - cones of depression are evident in major pumping centers – some Carpentersville wells apparently went dry in the Baseline and MRI scenarios
- Stream flow impacts have not been examined yet – stream flow may be contributing significantly to sand/gravel wells
- Results for Ironton-Galesville were presented and some future demand scenarios show significant impacts, esp. in areas near Aurora and Joliet
- **Model results suggest future demands can largely be met only *if* the impacts are deemed acceptable**
- There is time to make model improvements and plan alternatives, but not time to waste

Aquifers of Northeastern Illinois

West East





Top of Ancell (St. Peter ss)

Top of Ironton-Galesville

Unconsolidated Aquifer System

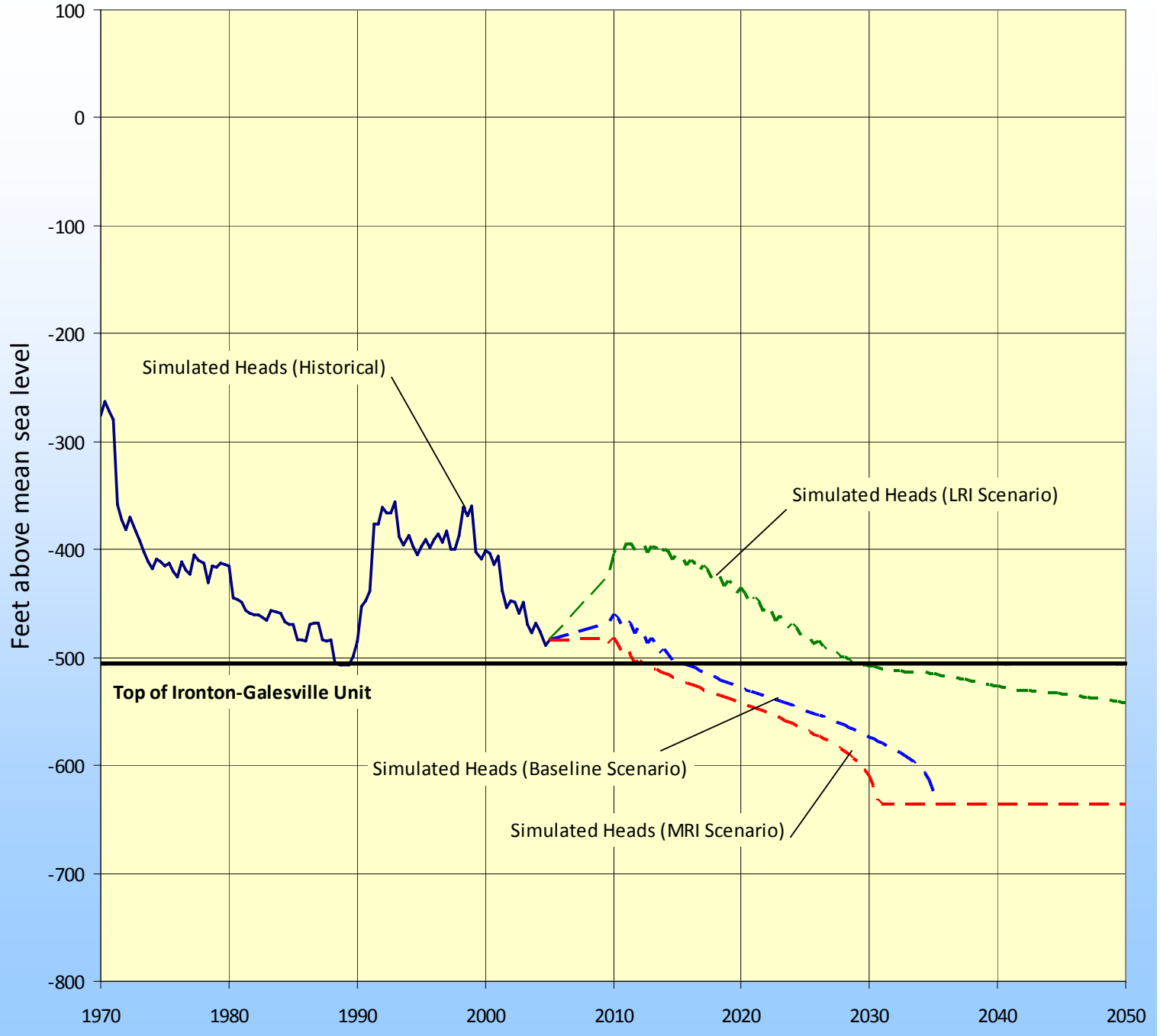
Shallow Bedrock Aquifer

Deep Bedrock Aquifer System
(Ancell and Ironton-Galesville sandstones)

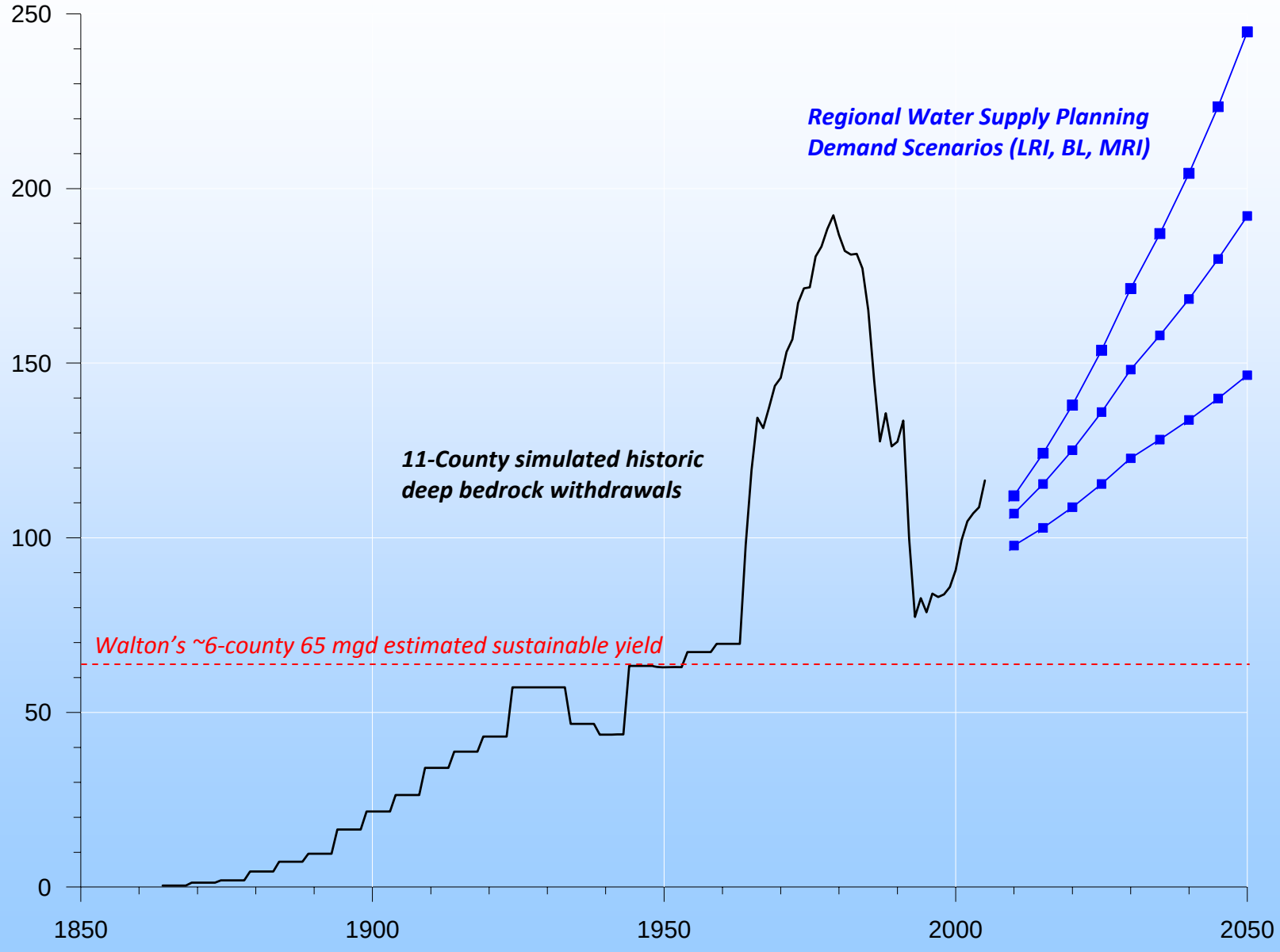
Elmhurst-Mt. Simon Aq. (saline?)

Cross-Section Modified from Bretz (1939)

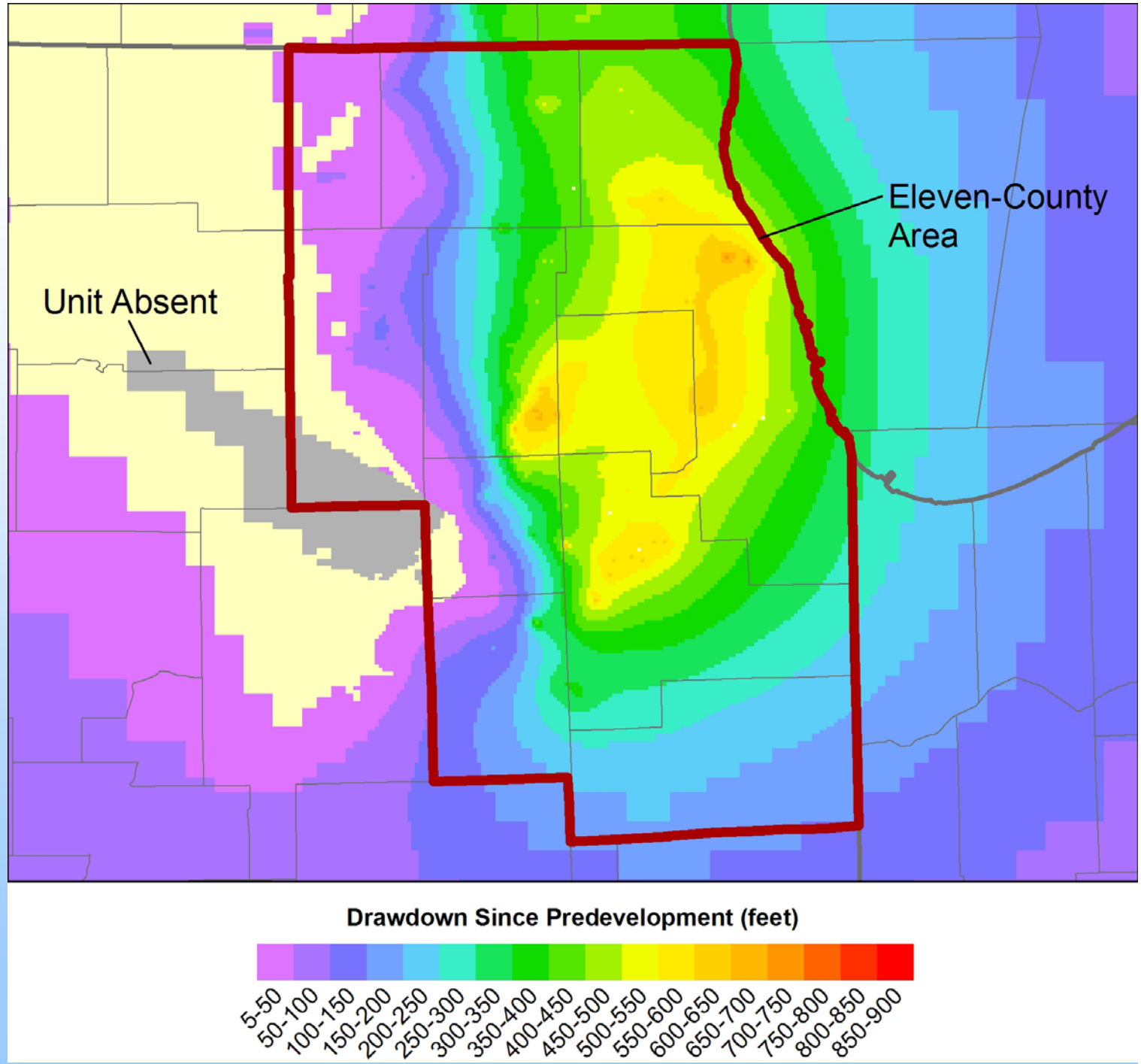
Montgomery Ironton-Galesville Unit Simulated Hydrograph



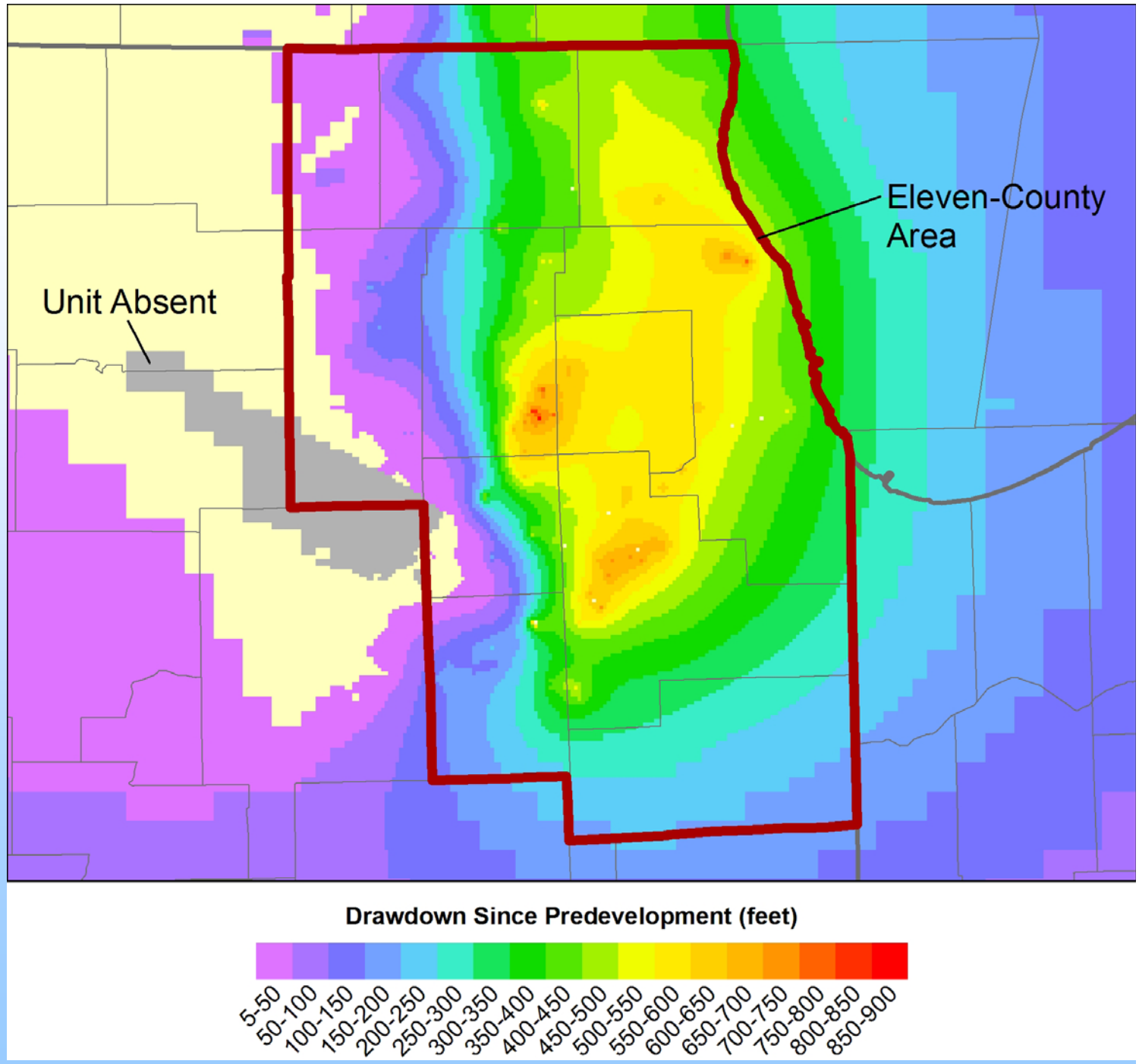
11-County Simulated Deep Bedrock Withdrawals



2025 Drawdown Ancell Unit Baseline Scenario

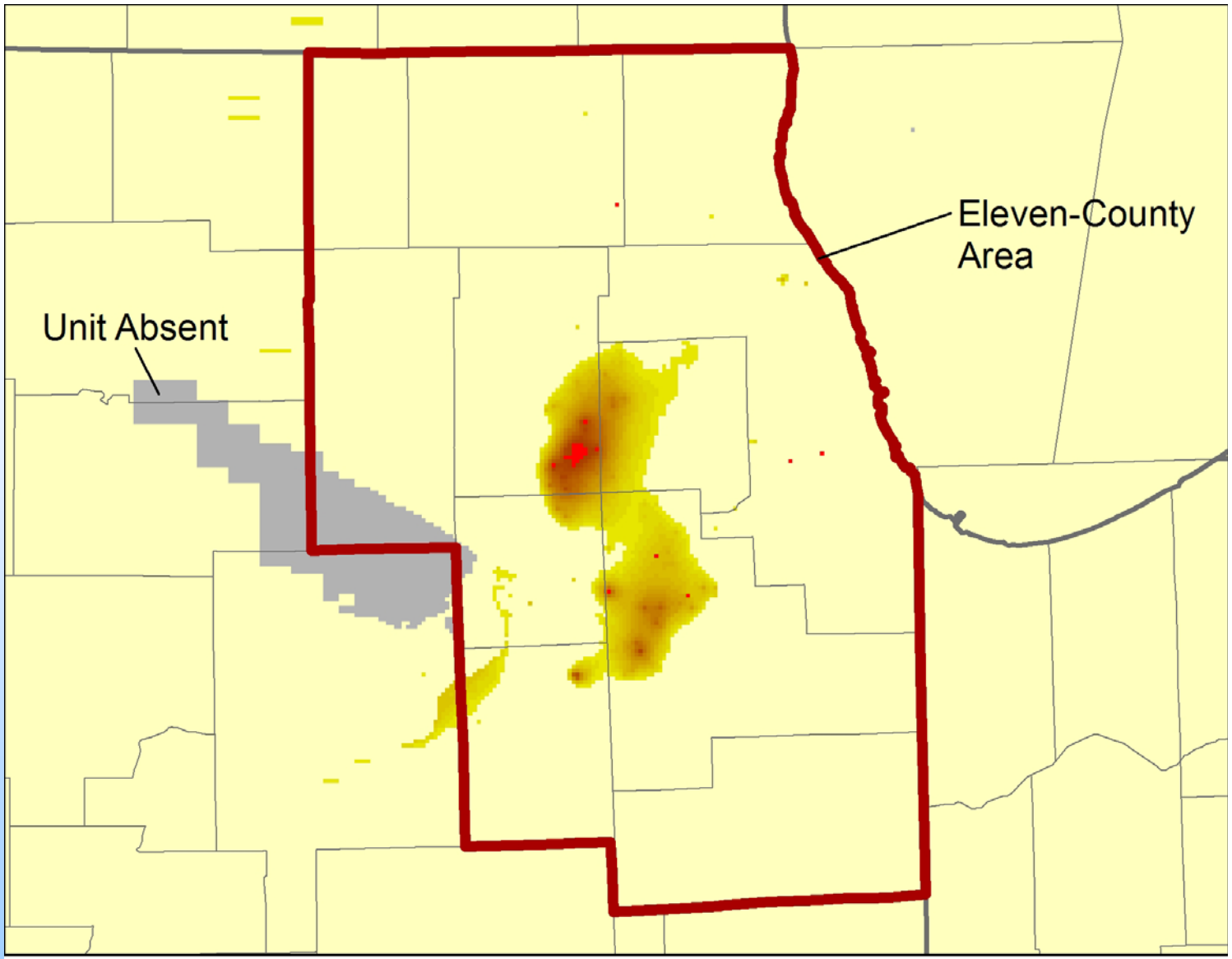


2050 Drawdown Ancell Unit Baseline Scenario

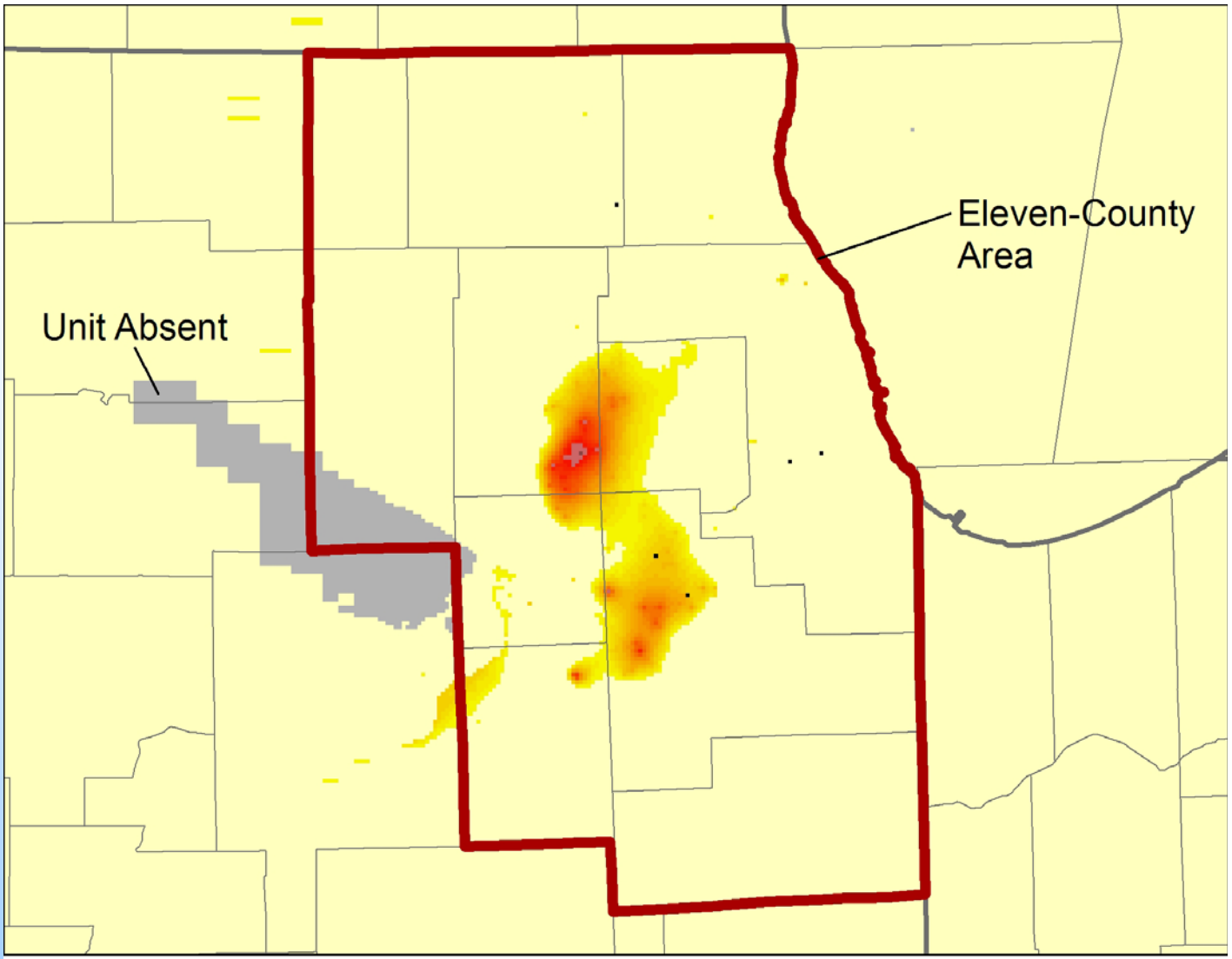


2025 Available Head Above the Ancell Unit

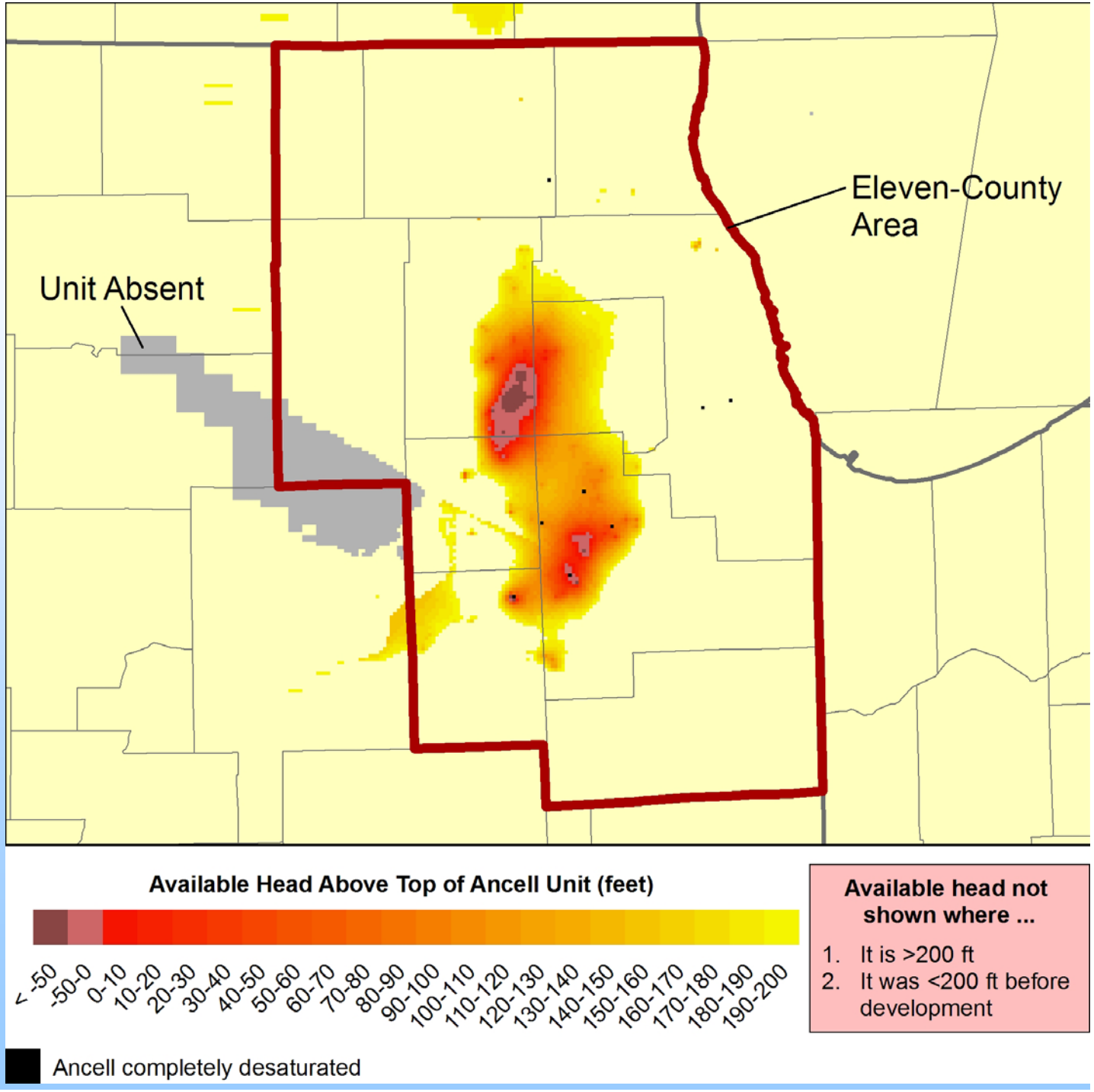
Baseline Scenario



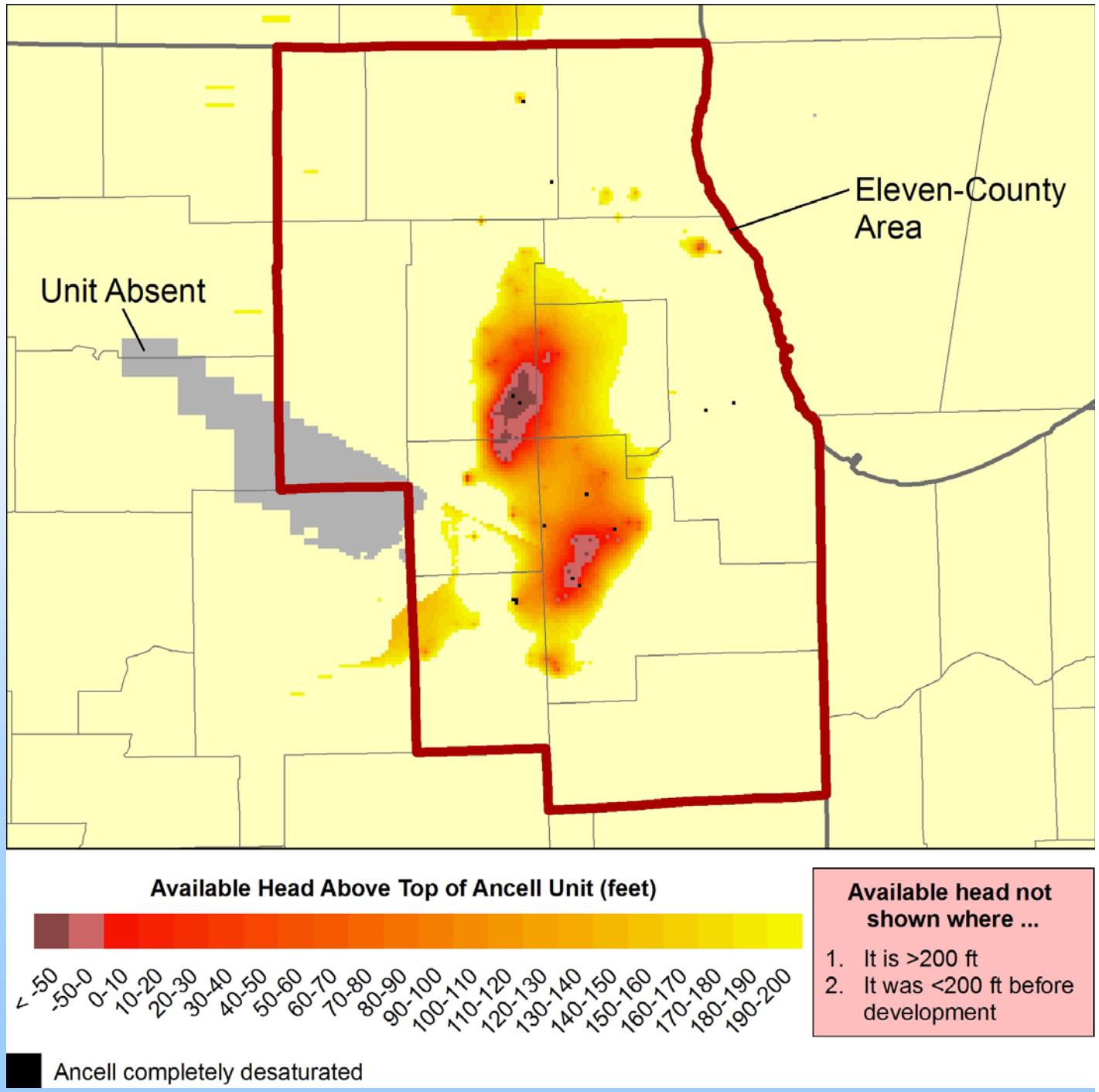
2025 Available Head Above the Ancell Unit Baseline Scenario



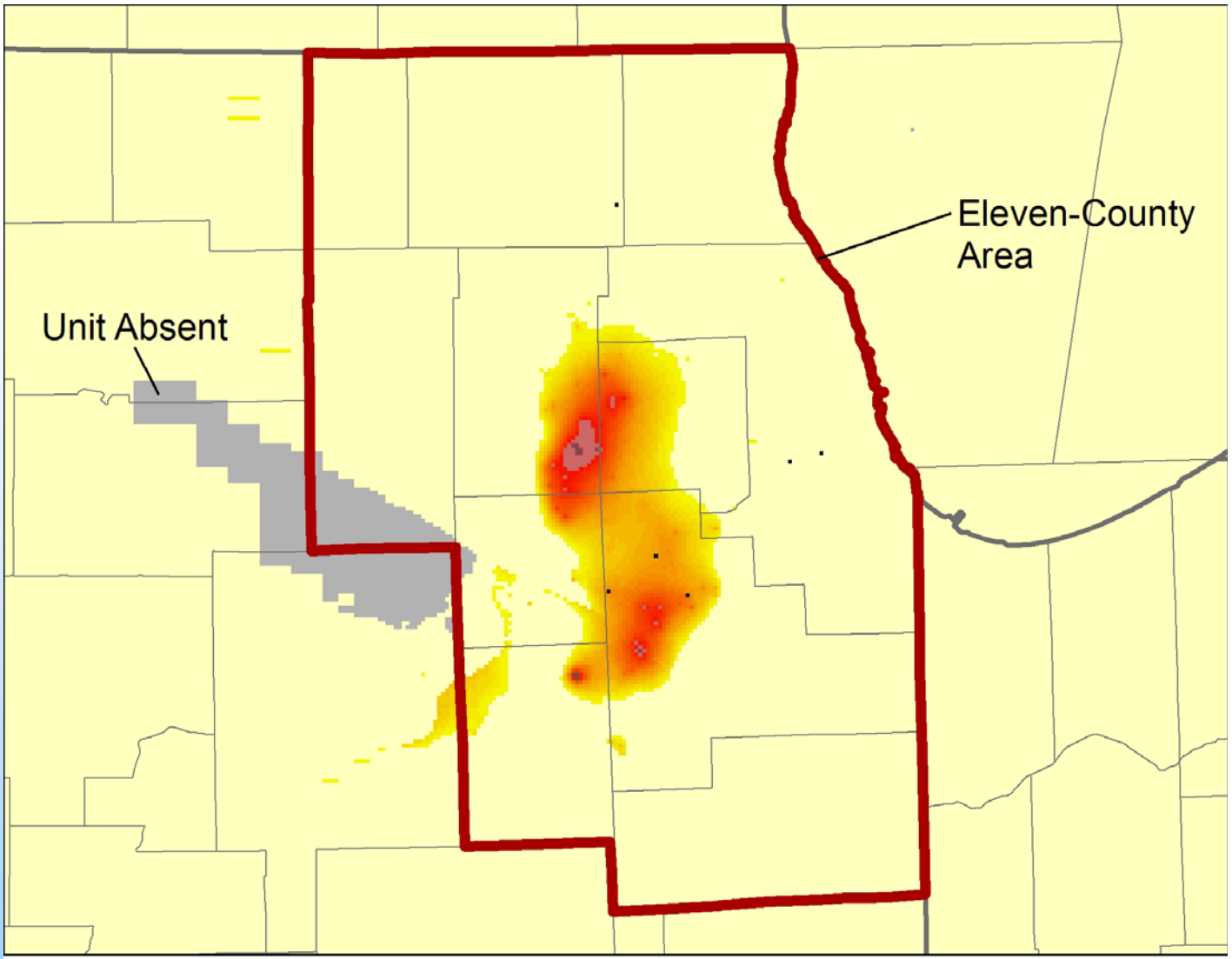
2050 Available Head Above the Ancell Unit Baseline Scenario



2050 Available Head Above the Ancell Unit MRI Scenario

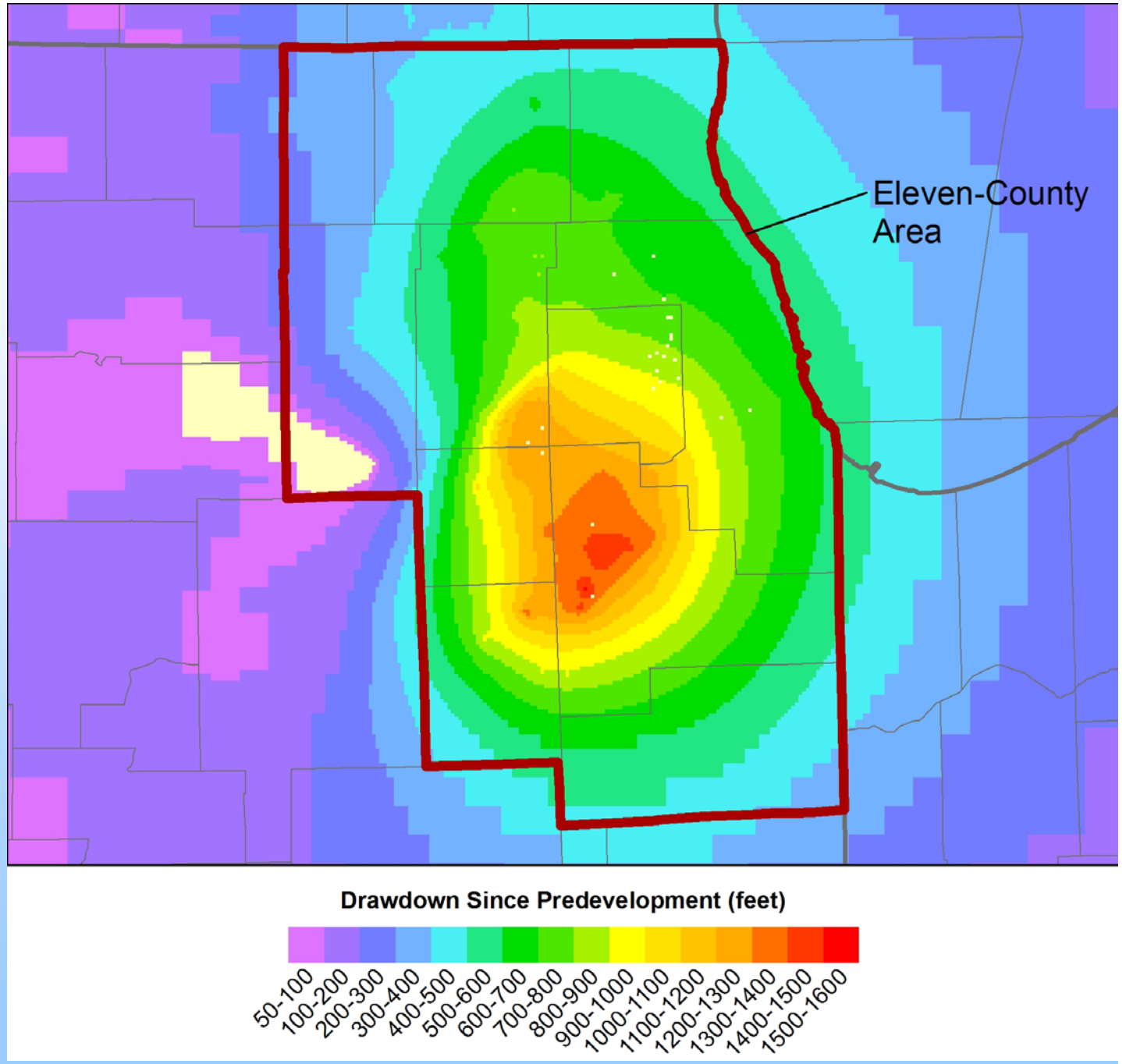


2050 Available Head Above the Ancell Unit LRI Scenario

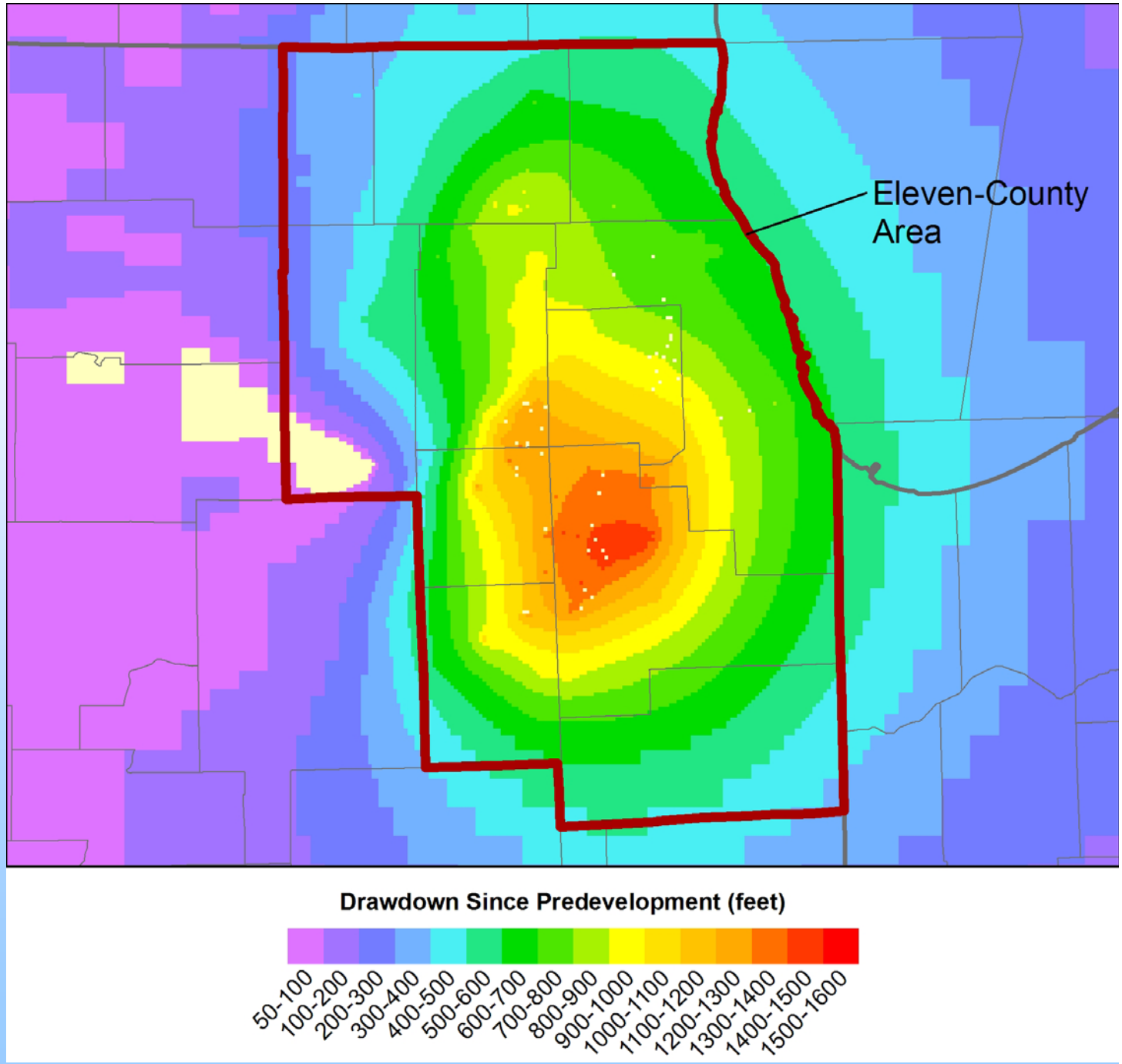


Montgomery Ancell Unit Simulated Hydrograph

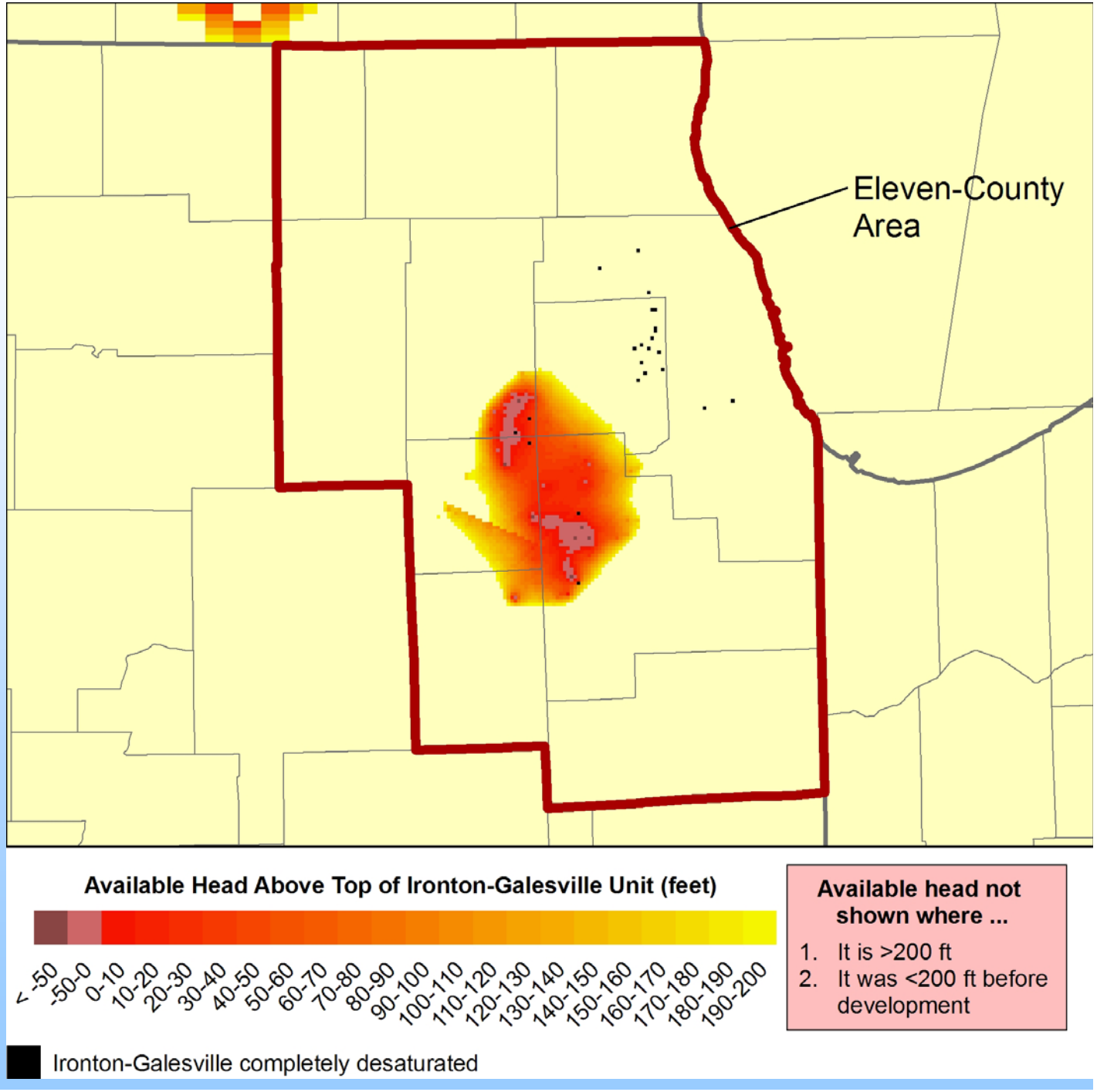
Drawdown in the Ironton-Galesville Unit 2025 Baseline Scenario



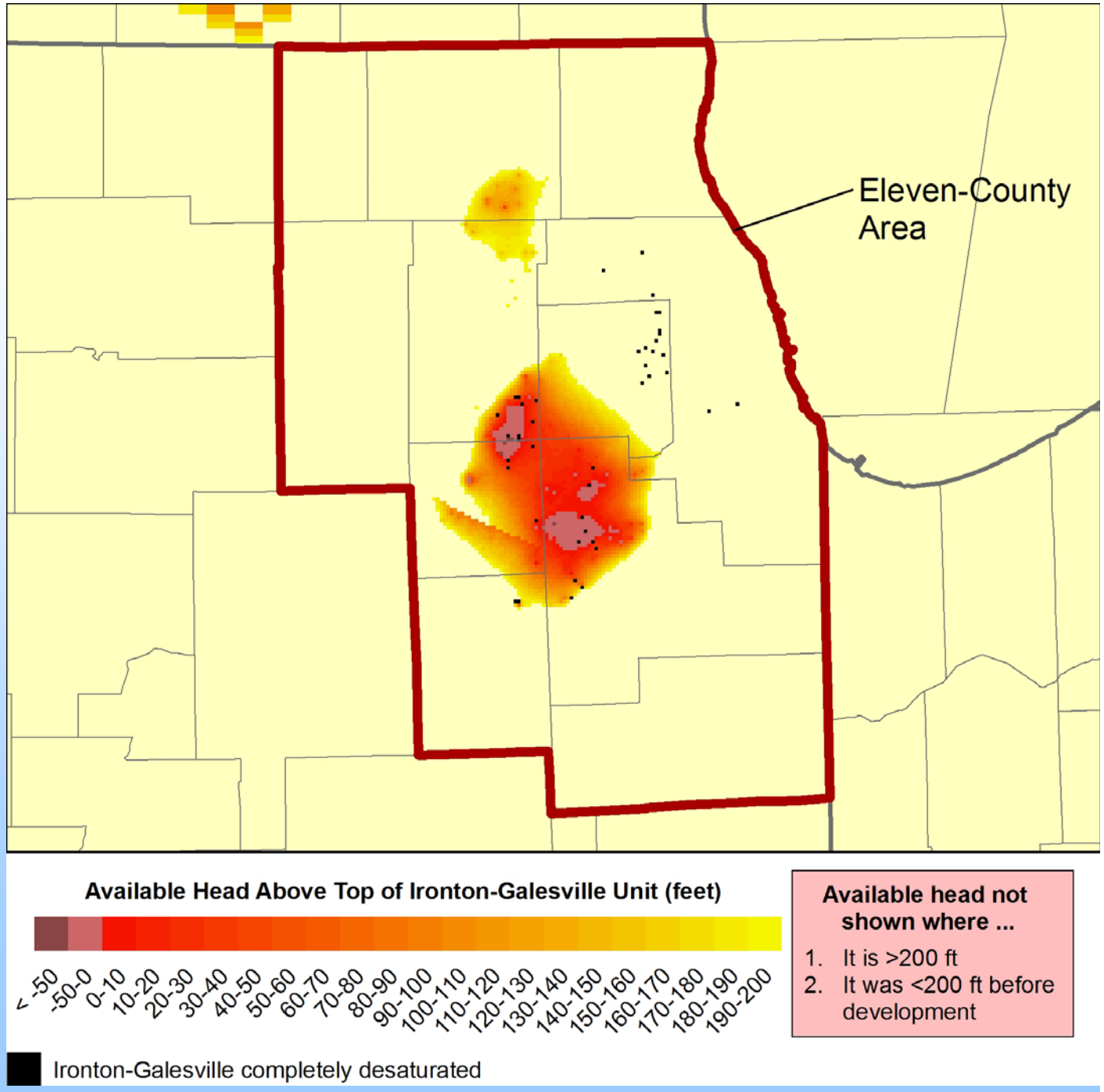
Drawdown in the Ironton-Galesville Unit 2050 Baseline Scenario



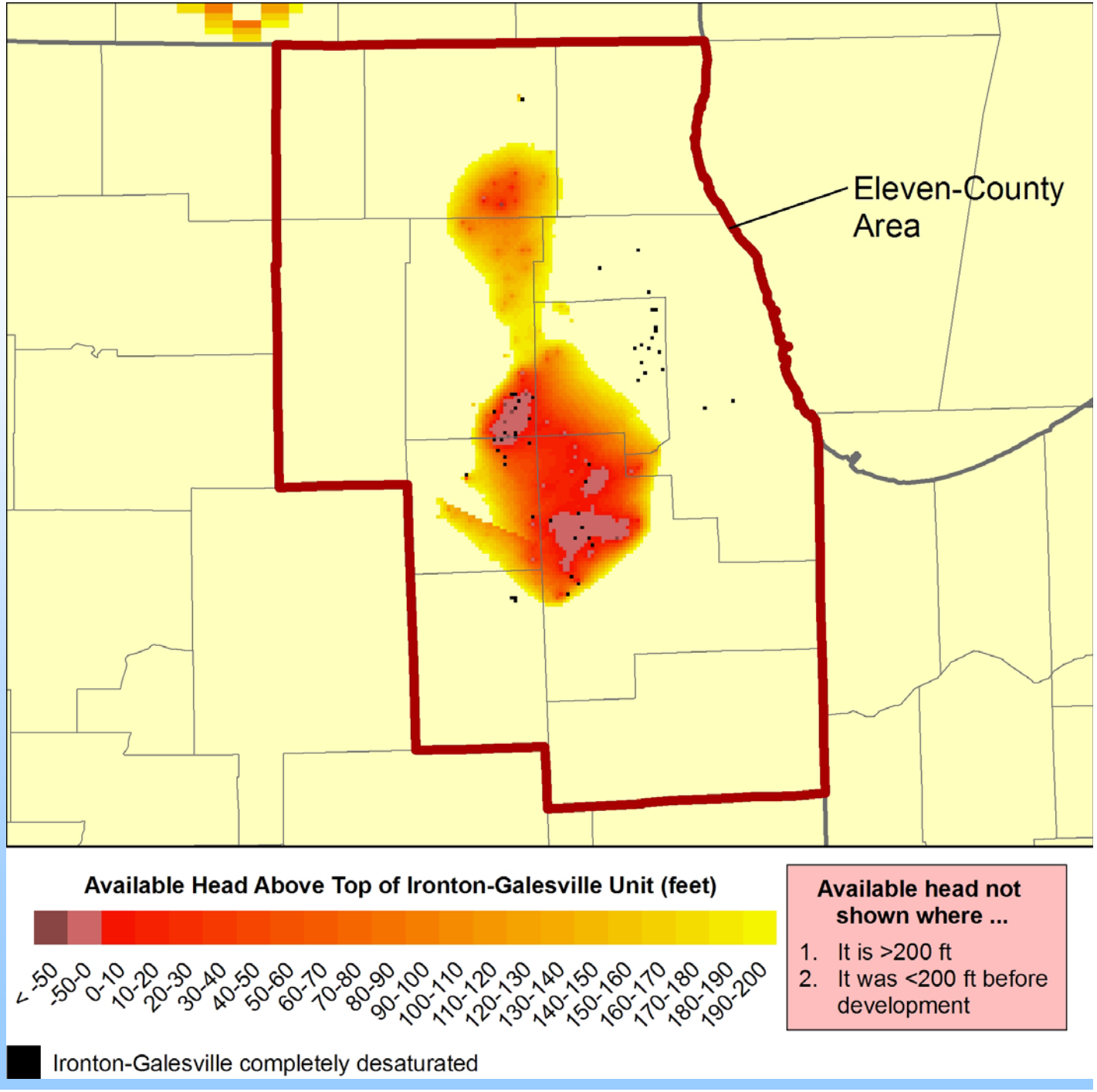
2025 Available Head Above the I-G Unit Baseline Scenario



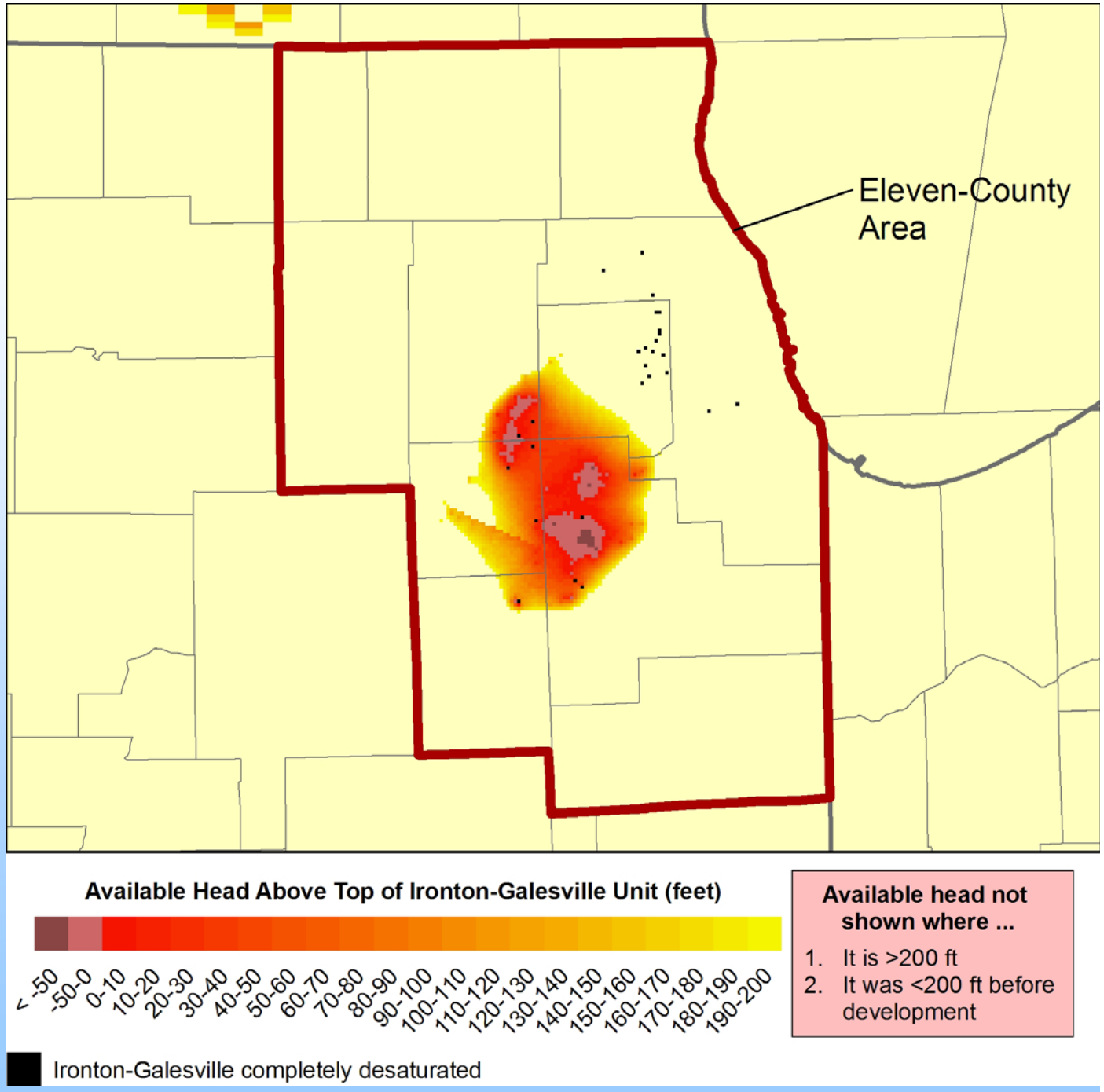
2050 Available Head Above the I-G Unit Baseline Scenario



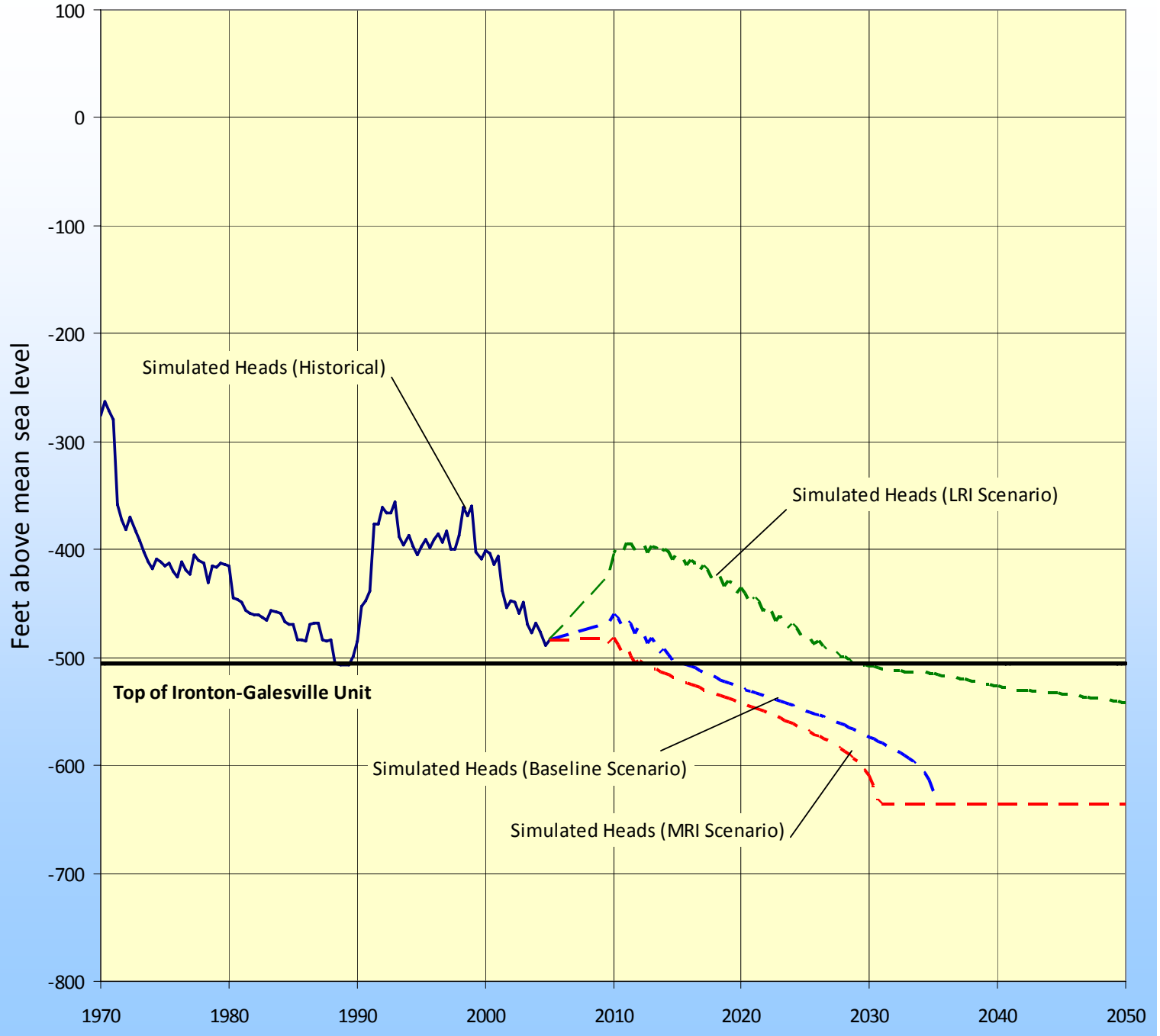
2050 Available Head Above the I-G Unit MRI Scenario



2050 Available Head Above the I-G Unit LRI Scenario



Montgomery Ironton-Galesville Unit Simulated Hydrograph



Observed vs Simulated Heads in the Deep Aquifers

1) Observed water levels in northeastern Illinois deep wells are averages of heads in all units intercepted by the open borehole of the well

2) The model simulates individual model layers, and thus, the model-simulated heads will not be the same as the actual, field-observed composite water levels

3) Model results show approximate agreement between observed water levels and model-calculated heads in the aquifers to which the wells are reported to be open

Observed vs Simulated Heads in the Deep Aquifers

4) Difference between observed composite water levels and simulated heads in intercepted aquifers may be attributable to interformational transfer of groundwater, via open boreholes, between deep aquifers

5) Effect of transfers is not simulated by the regional model

6) The transfer of water along most deep boreholes is downward 👇 from the Ancell Unit down to the Ironton-Galesville – similar to pumping from the Ancell and injecting into the I-G

7) Therefore, actual heads are likely to be lower ☹ in the Ancell and higher ☺ in the Ironton-Galesville than simulated heads

Updated Conclusions (March 2009)

- Regional groundwater flow model results continue to be analyzed for the 3 basic demand scenarios
- Stream flow impacts have been examined for historical and current conditions – stream flow appears to be contributing significantly to sand/gravel wells
- Results for Ancell & Ironton-Galesville show significant impacts, especially in areas from Aurora to Joliet
- Model results suggest the deep bedrock aquifers cannot be counted on to meet all future demand scenarios across the entire 11-county area

Remaining To-Do List for 2009

As Time Allows…

- Assess impacts on shallow bedrock aquifers
- Assess impacts of future scenarios on streamflow
- Evaluate how much demand is not being met by model cells going “dry”
- Model impacts of drought and climate change

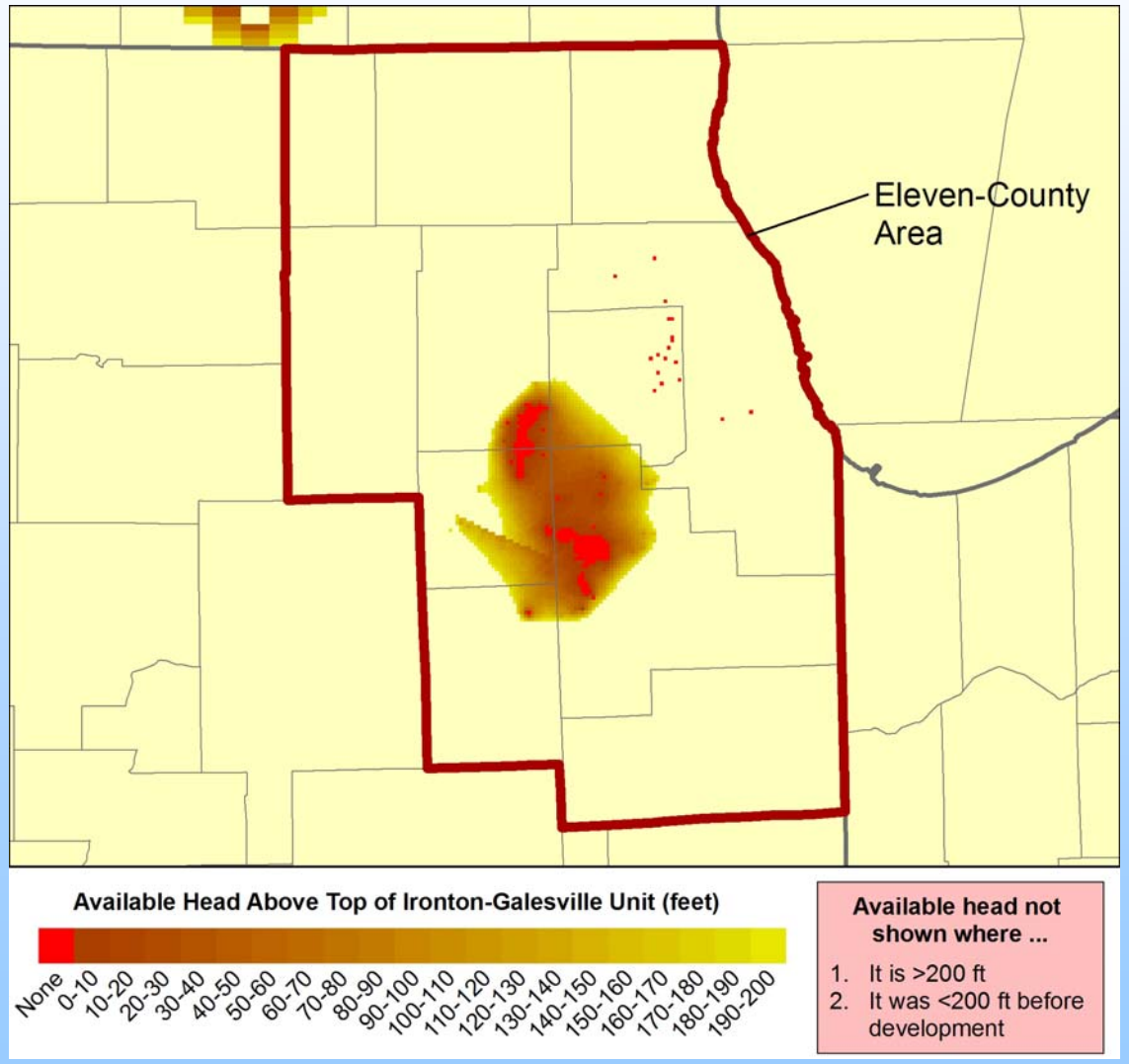
Spring is Coming!

It Really Is…

Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2025

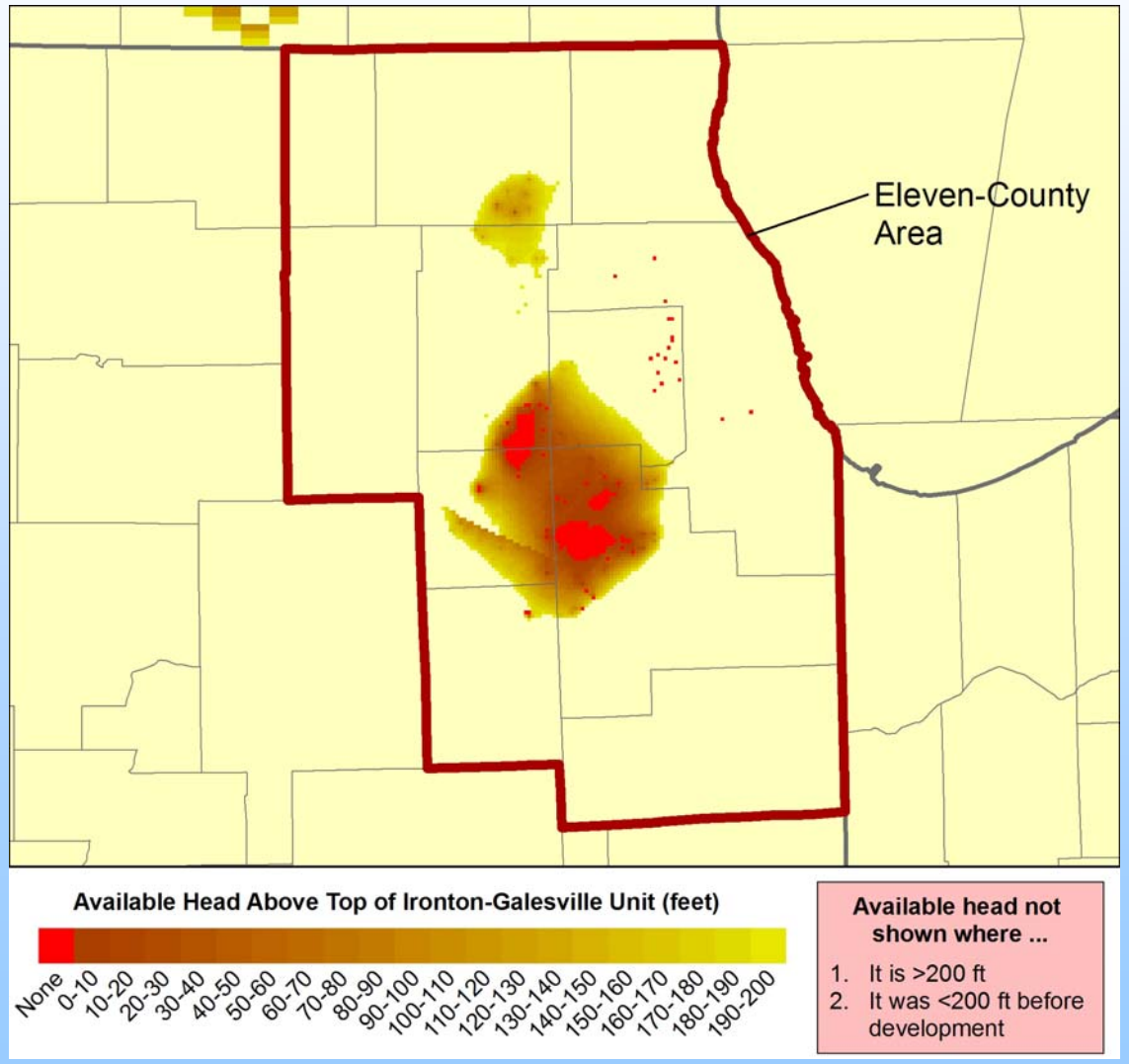
Baseline Scenario



Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2050

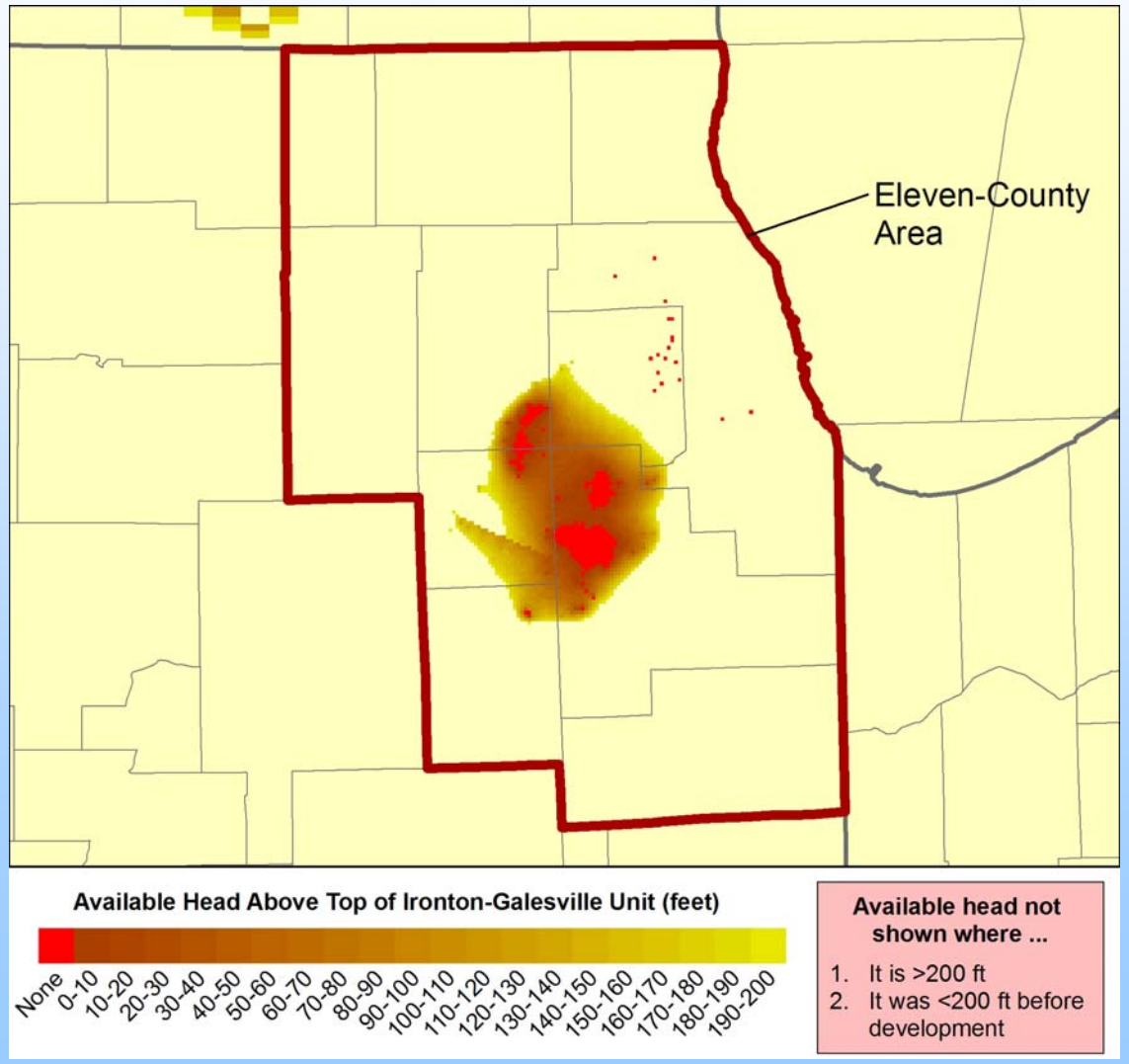
Baseline Scenario



Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2050

Less Resource-Intensive Scenario



Available Head Above Top of Ironton-Galesville

End of Summer Irrigation Season, 2050

More Resource-Intensive Scenario