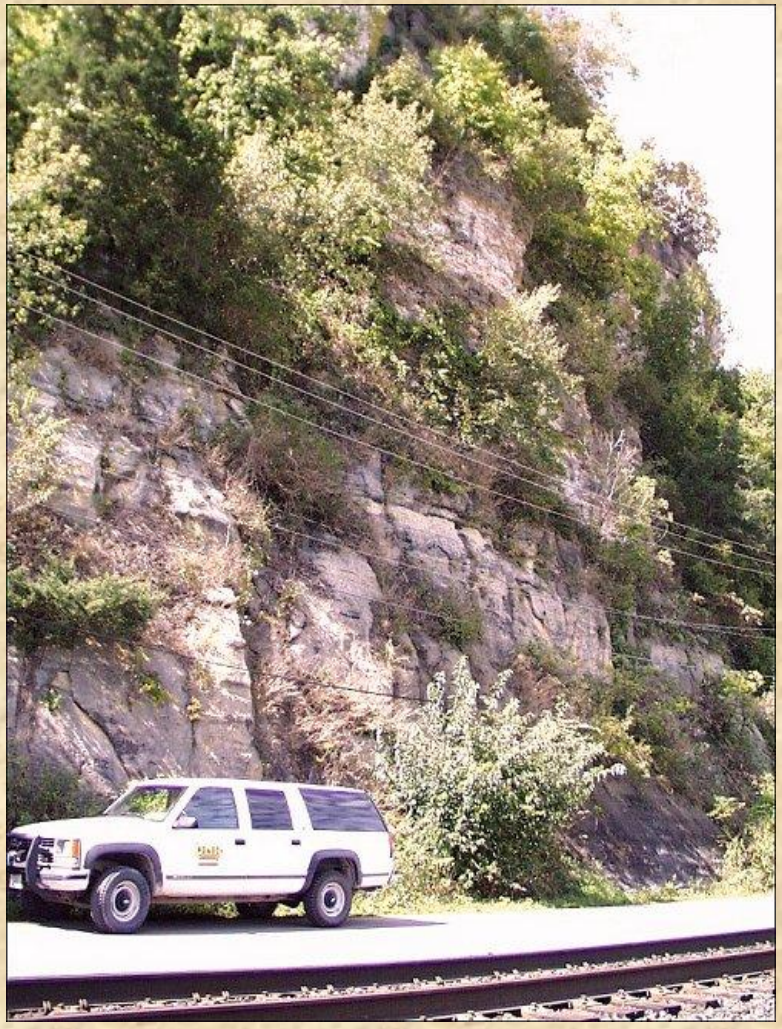
Iowa's Jordan Aquifer: Current Status and Future Conditions

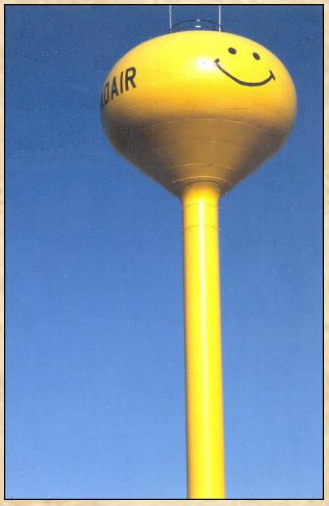
Bob Libra
State Geologist of Iowa
Iowa DNR – Geological Survey

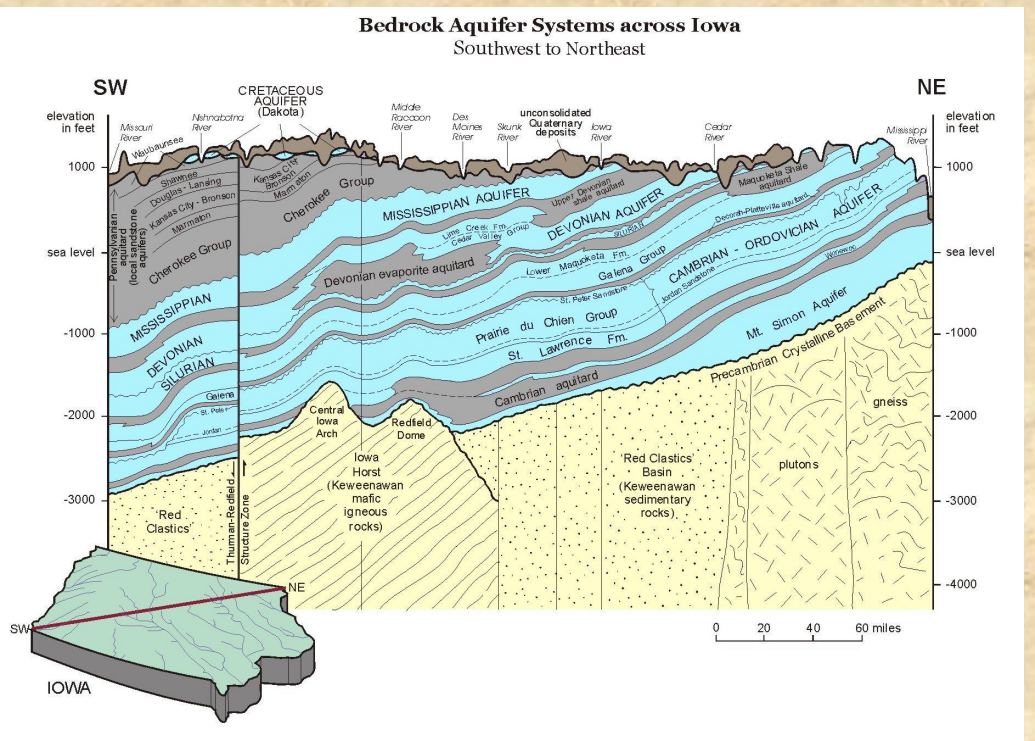


Cambrian, Jordan Sandstone
McGregor, Clayton Co.

Managing our Water Resources

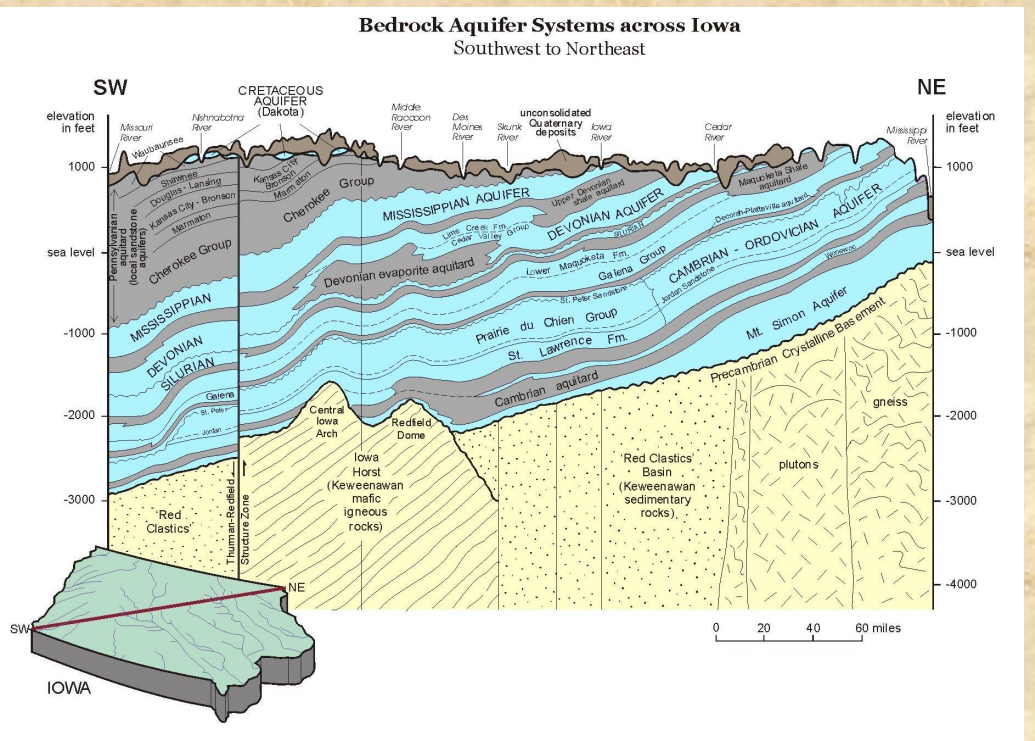
- What Are Our Water Resources?
- How Much Water Do We Have?
- How Much Water Do We – Will We - Use?
- Is it Sustainable for the Long Term?

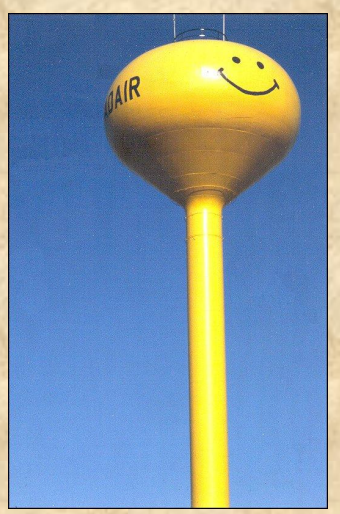




Need for a Water Resource Management Program

- Characterization of our Major Aquifers and Watersheds out of date.
- Energy - Related Water Impacts
- Climate Change and Water Impacts
- Allocation and Planning Beyond One Permit at a Time.





Water Management-A Comprehensive Program

- **Updated Assessment of Current Demand:**
  -- Last Major Use Assessments, by Aquifer and Watershed, in 1995.

- **Resume and Enhance Groundwater Level Monitoring:**
  -- Regional Aquifer Trends and Local Hotspots.

- **Add and Maintain Additional Stream Gages:**
  -- Gages needed for accurate surface water allocation, reservoir studies.

- **Updated Assessments of Aquifers—Geologic and Hydrologic Properties:**
  -- Last Major Efforts in the 1960's – 1980's.

- **Upgraded Assessment Techniques:**
  -- Need to Utilize Modern Modeling and Predictive Analysis.

- **More Thorough Hydrogeologic Reviews of Permits:**
  -- Well/Stream Interference and Sustainability Questions. Assistance in Drought and Conservation Planning for Water Supplies.

- **Update the State Water Plan—The Road Map for Water Use:**
  -- Last update in 1985. Do our rules, regs, policies need reworking?

Water Resource Management for Long-Term Sustainability

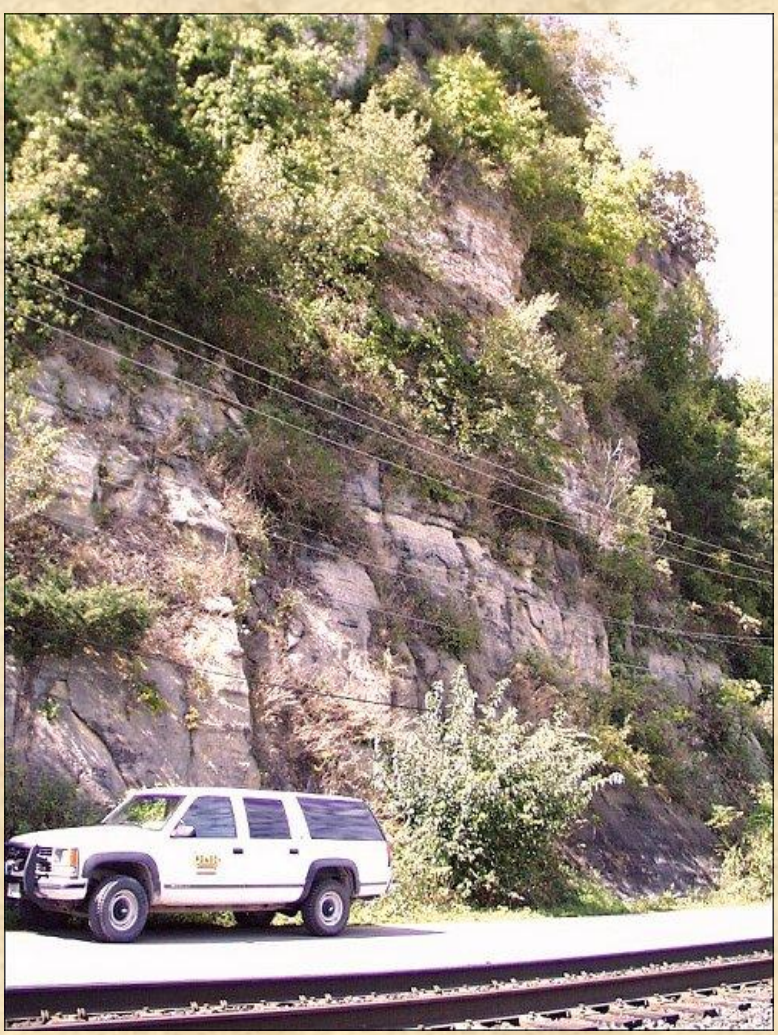
Original Water Resource Management Program Proposal -- $1.65 M annually
DNR Strategy -- $2M for FY10

Legislative Appropriation --$480K FY08 ($495K FY's 09 and 10)
Water Allocation Permit Fees – up to $500K annually

Main Activities

- Developed aquifer characterization methodology.
- Data Mining – Characterization of Dakota Sandstone and Jordan Aquifers.
- Predictive Models developed for Dakota and Jordan Aquifers.

What is the Jordan Aquifer?



Cambrian, Jordan
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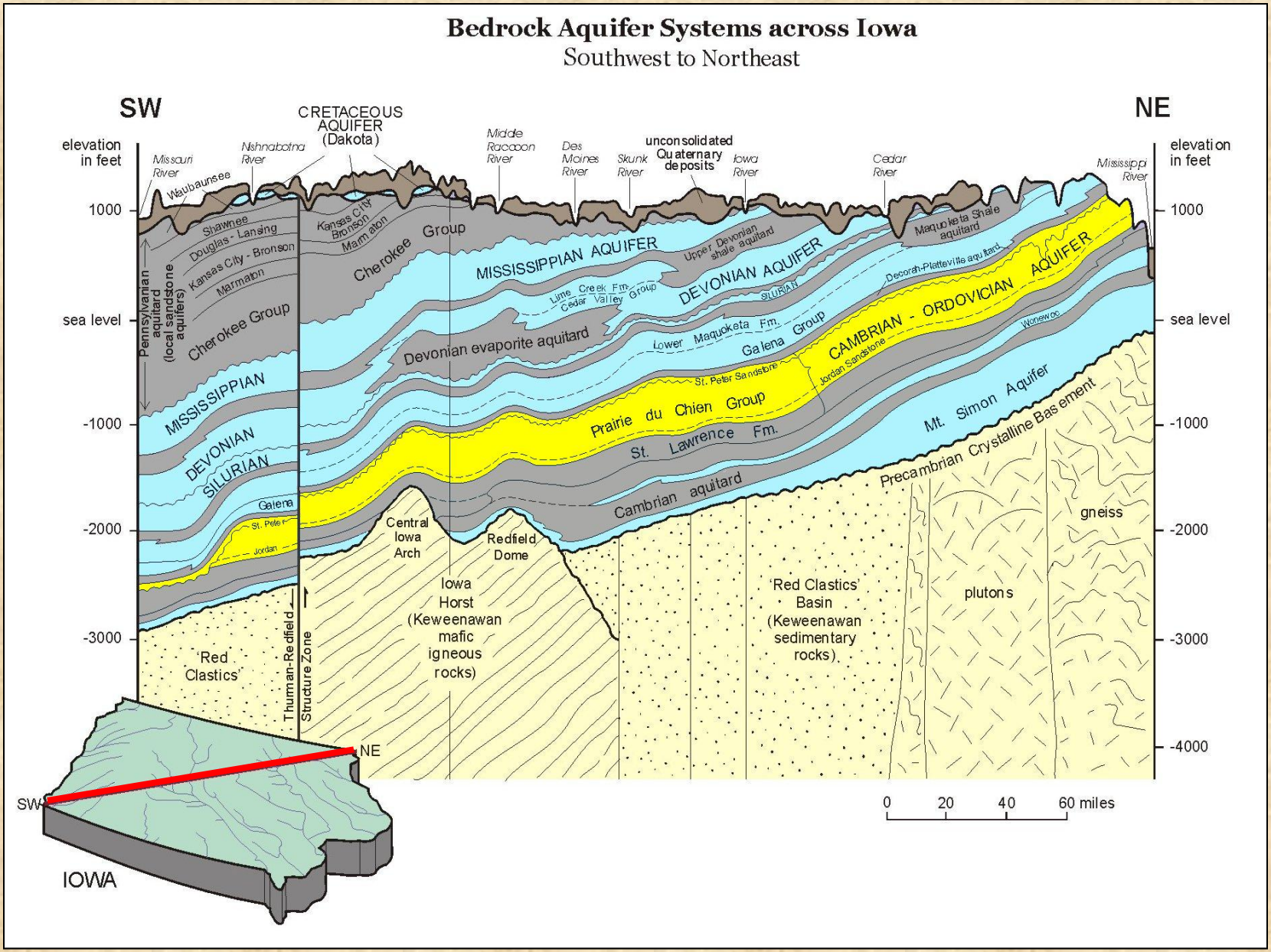
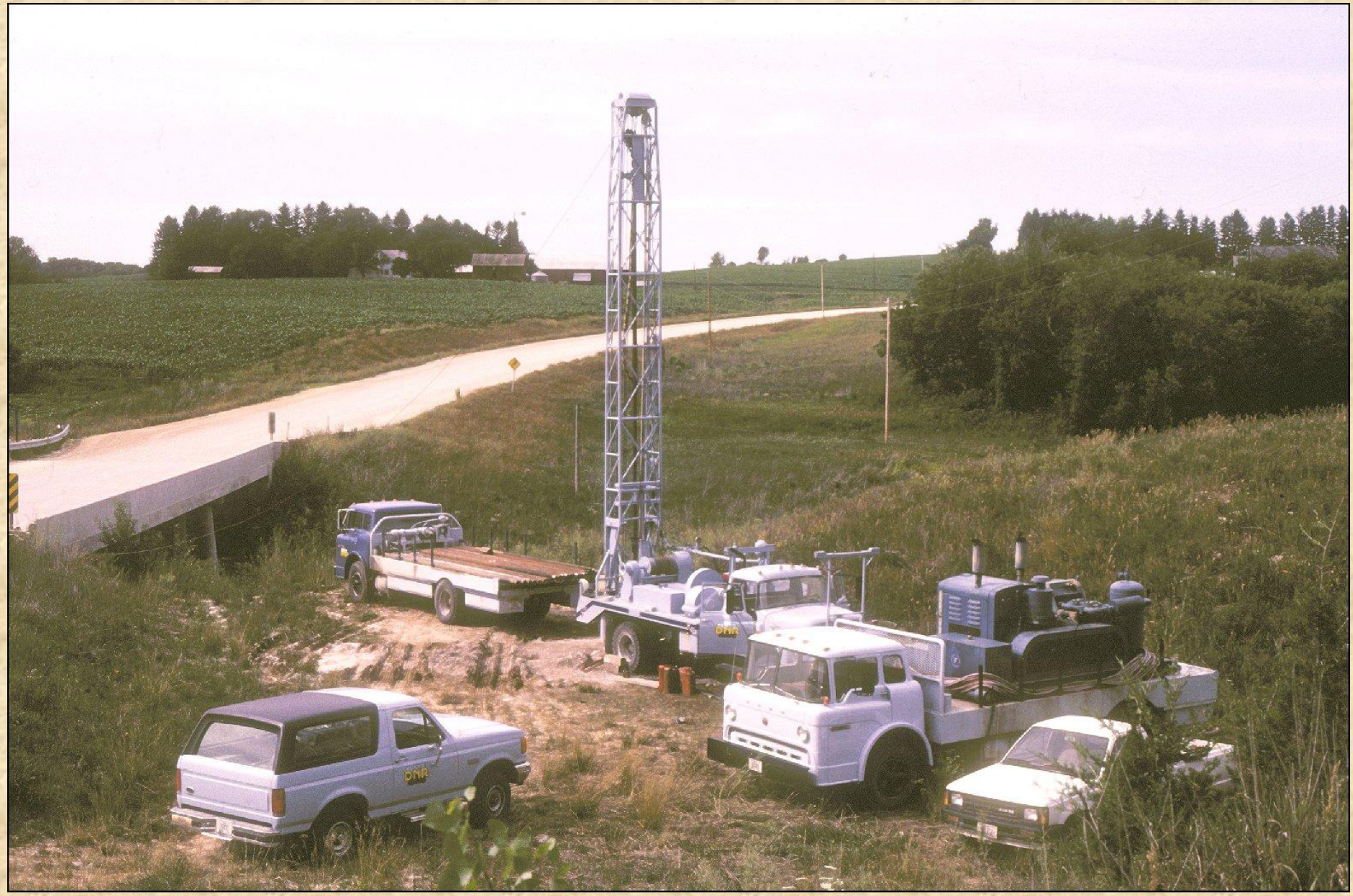
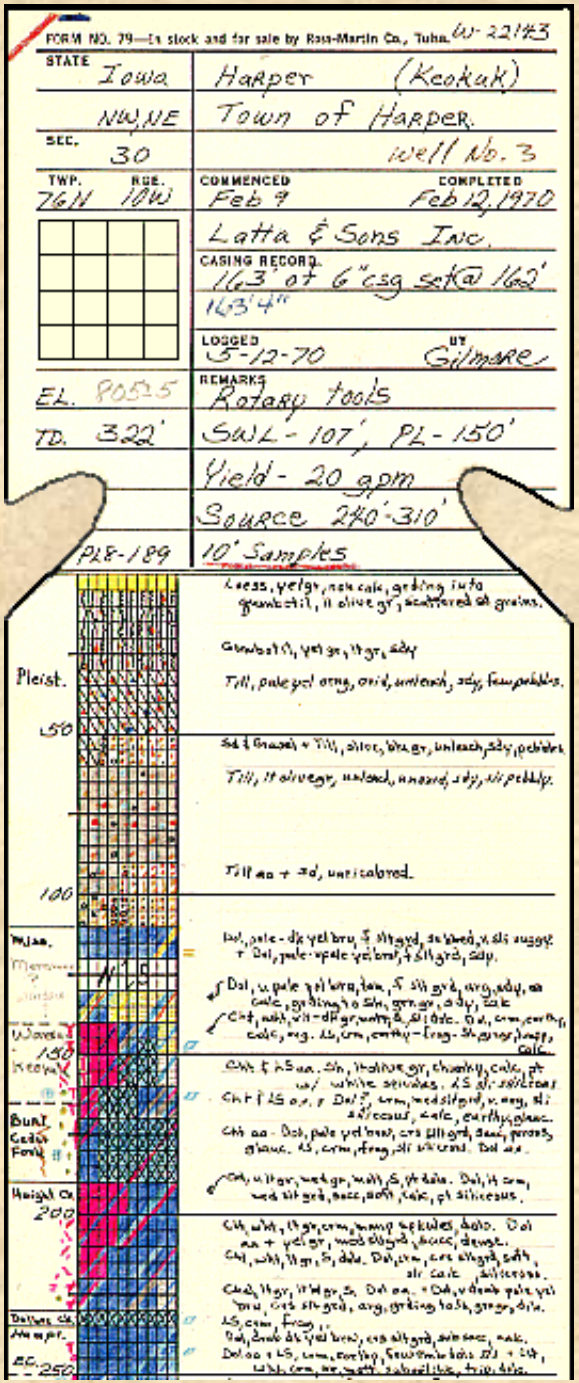


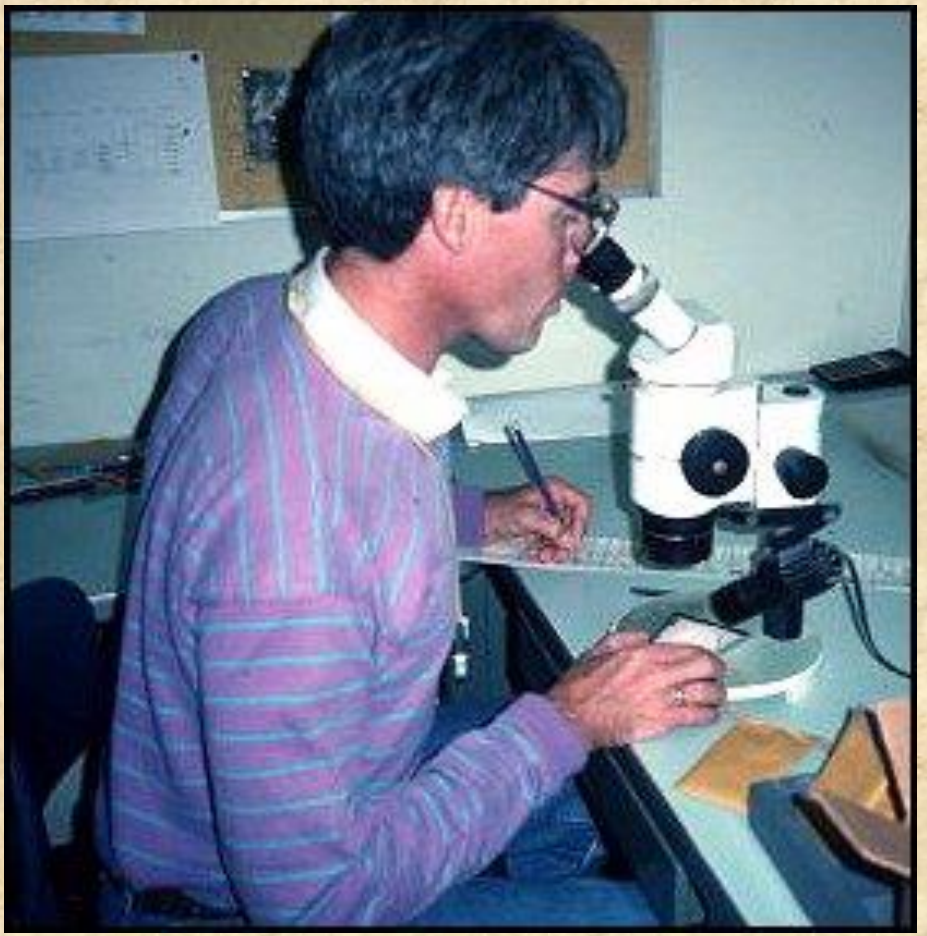

DNR
DNR

4
C3
C2

BLUE M

Analysis and Interpretation

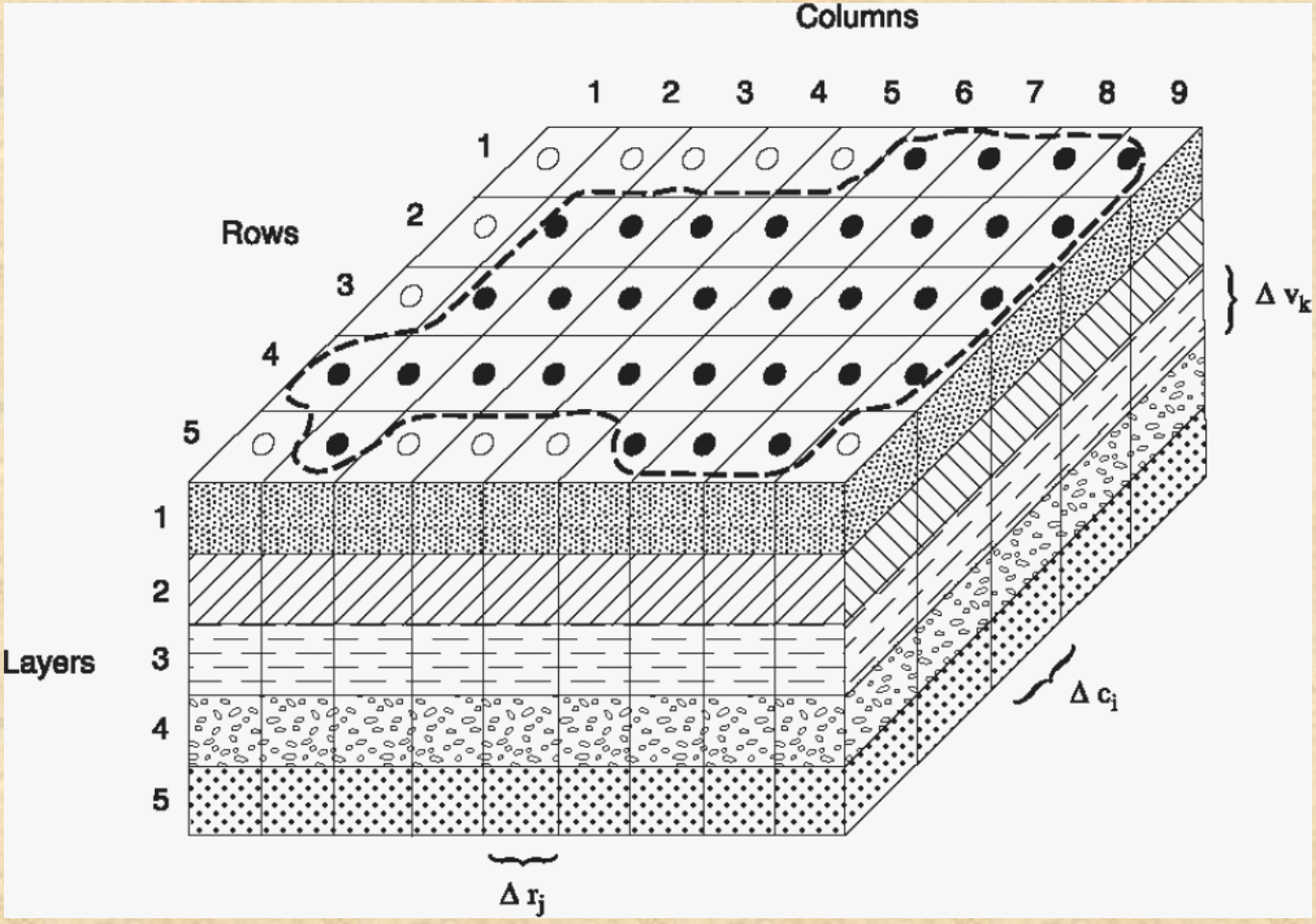




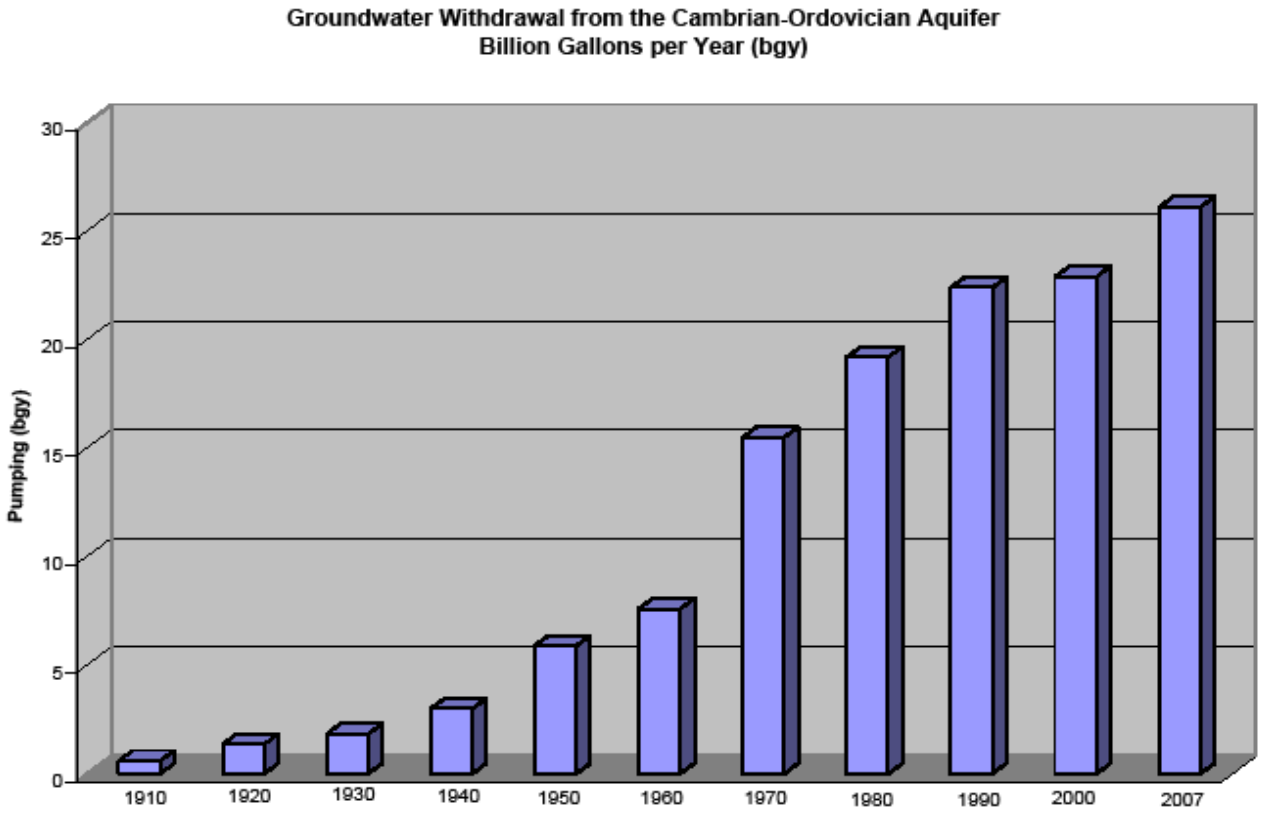
Water Withdrawals, Aquifer Tests, GW Quality Data….

Locations, Analysis, Specific Sources

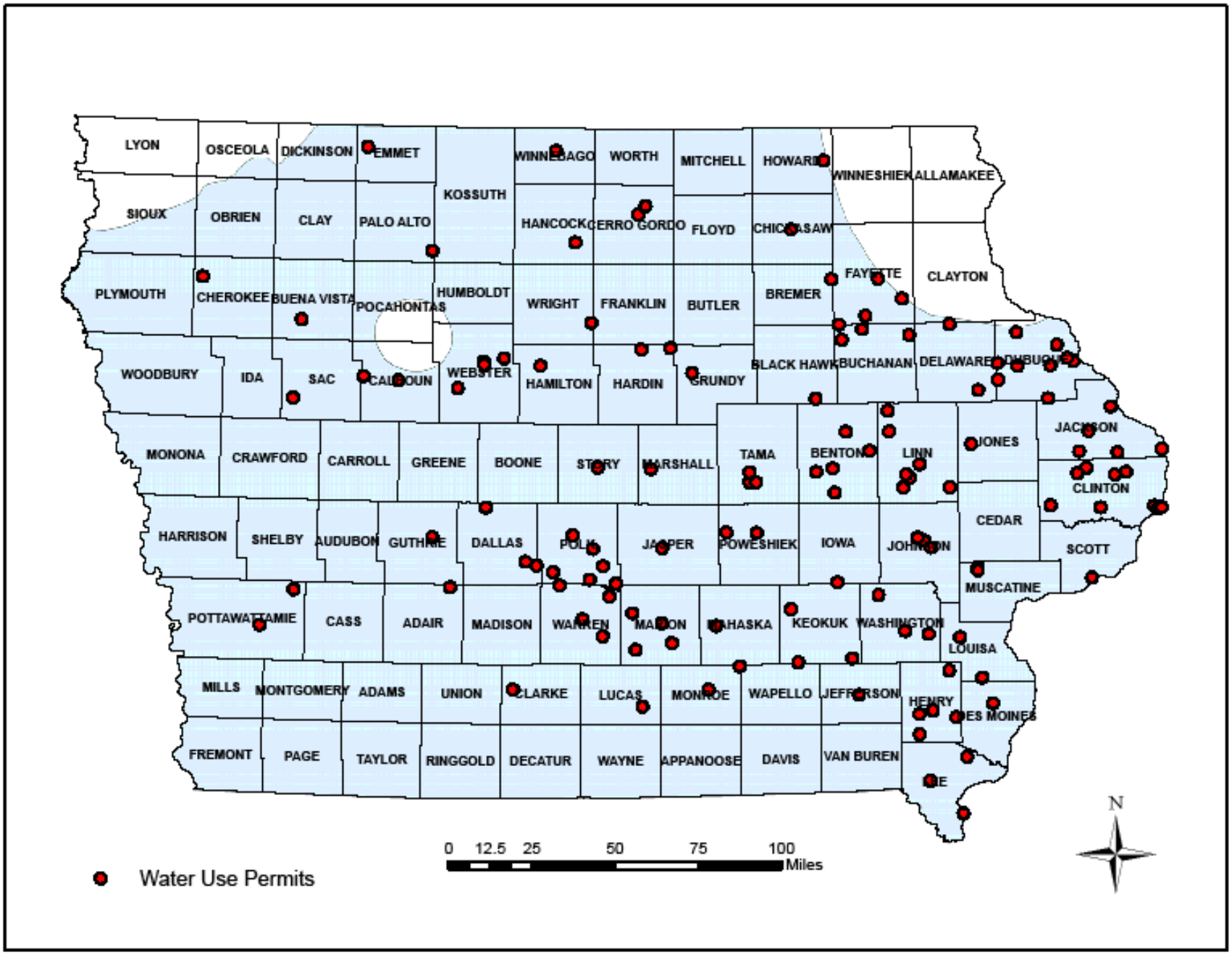
Geology, Aquifer Properties, Groundwater Elevations, Recharge, Pumping History…….all go in here:



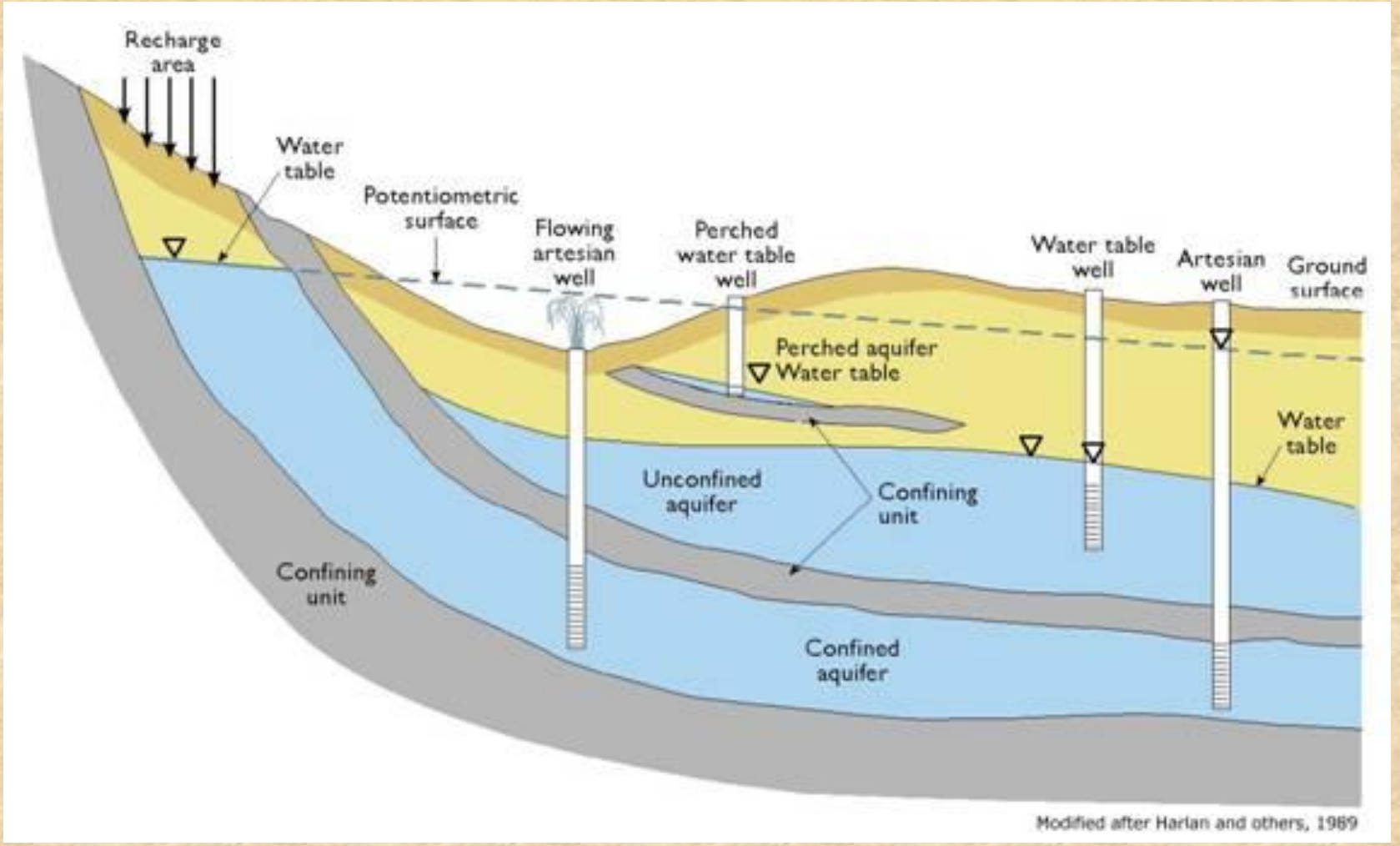
Jordan Aquifer: Long Term Use – "Memory" – Pumping History Needed
USGS Model Efforts late 70's - early 80's archived older data



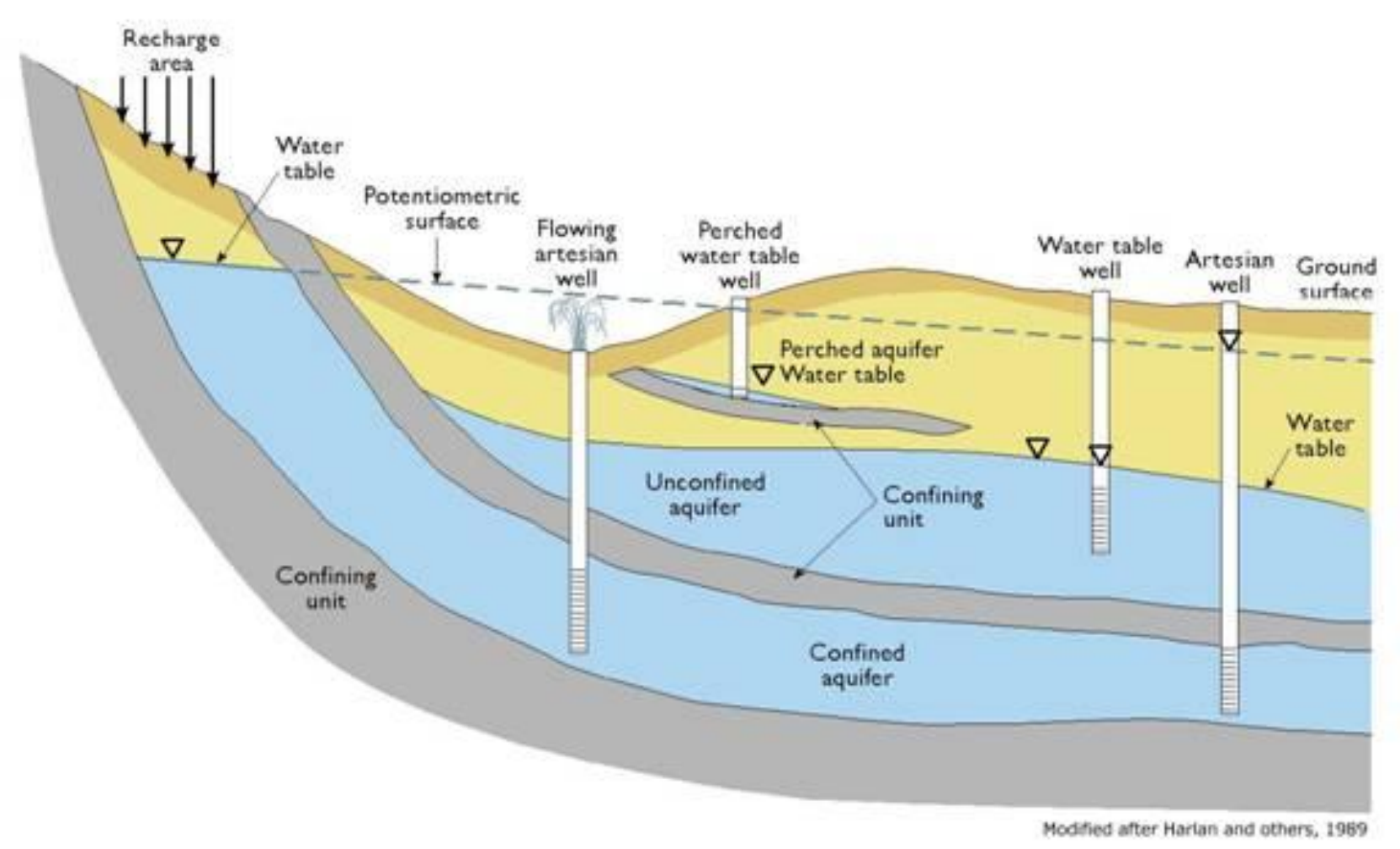
Locations of Water Use Permits for Wells tapping the Jordan Aquifer



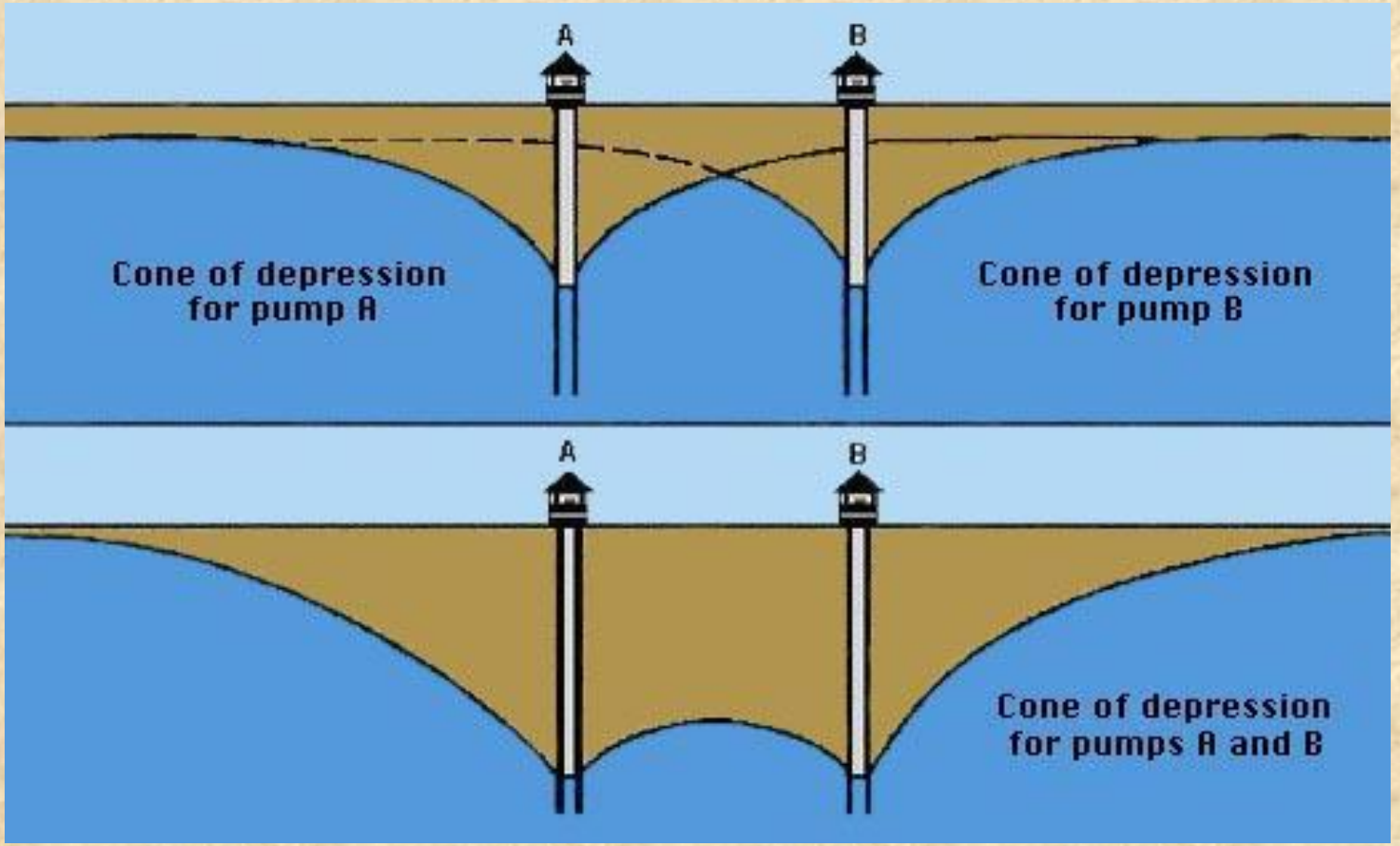
The Jordan is a "Confined Aquifer"



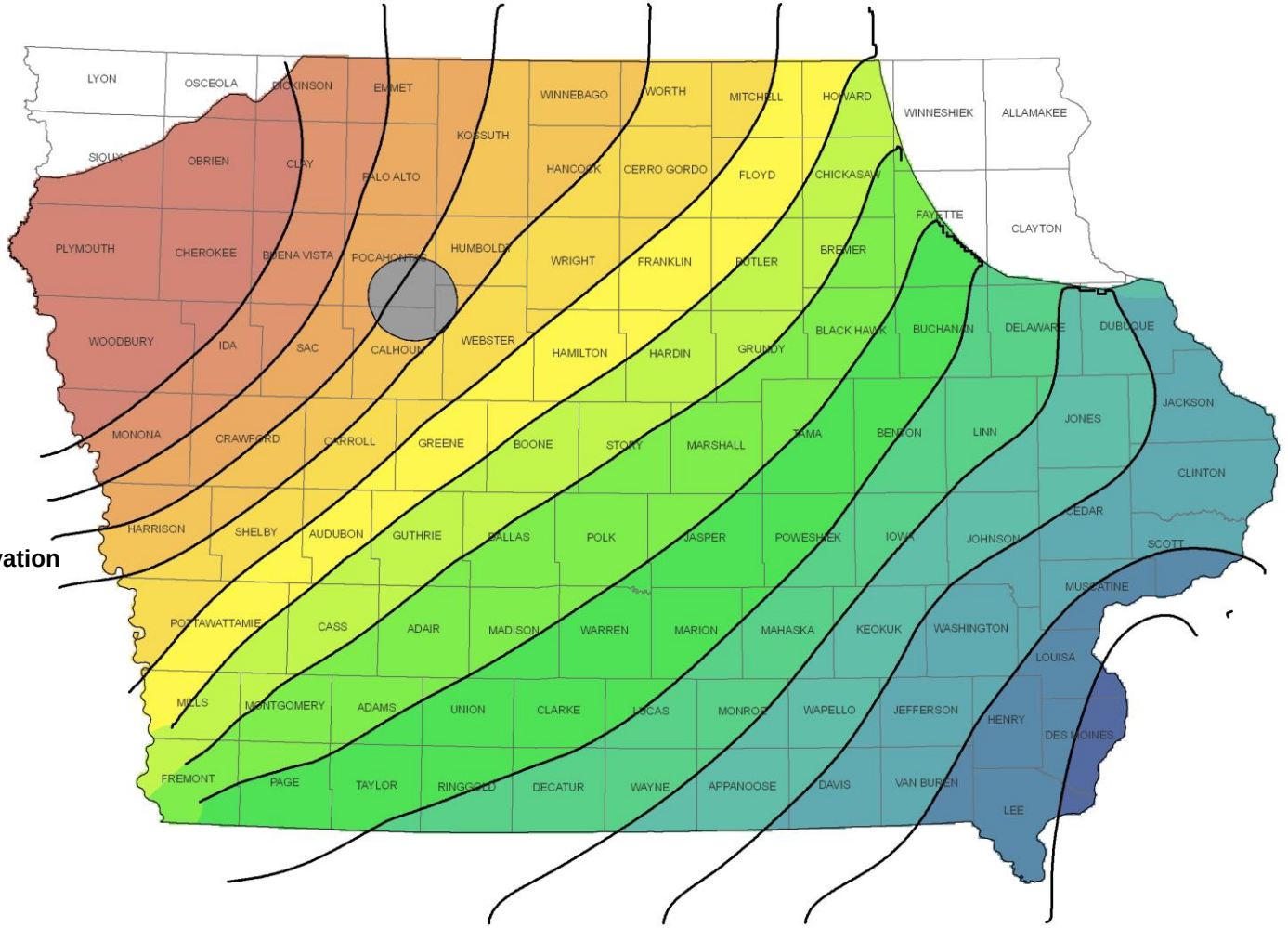
What has occurred since we started using the Aquifer?



Pumping results in lowering or "drawdown" of the pressure surface.



Pre-Development



Groundwater Elevation

- <500 ft
- 500-550 ft
- 550-600 ft
- 600-650 ft
- 650-700 ft
- 700-750 ft
- 750-800 ft
- 800-850 ft
- 850-900 ft
- 900-950 ft
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- 1050-1100 ft
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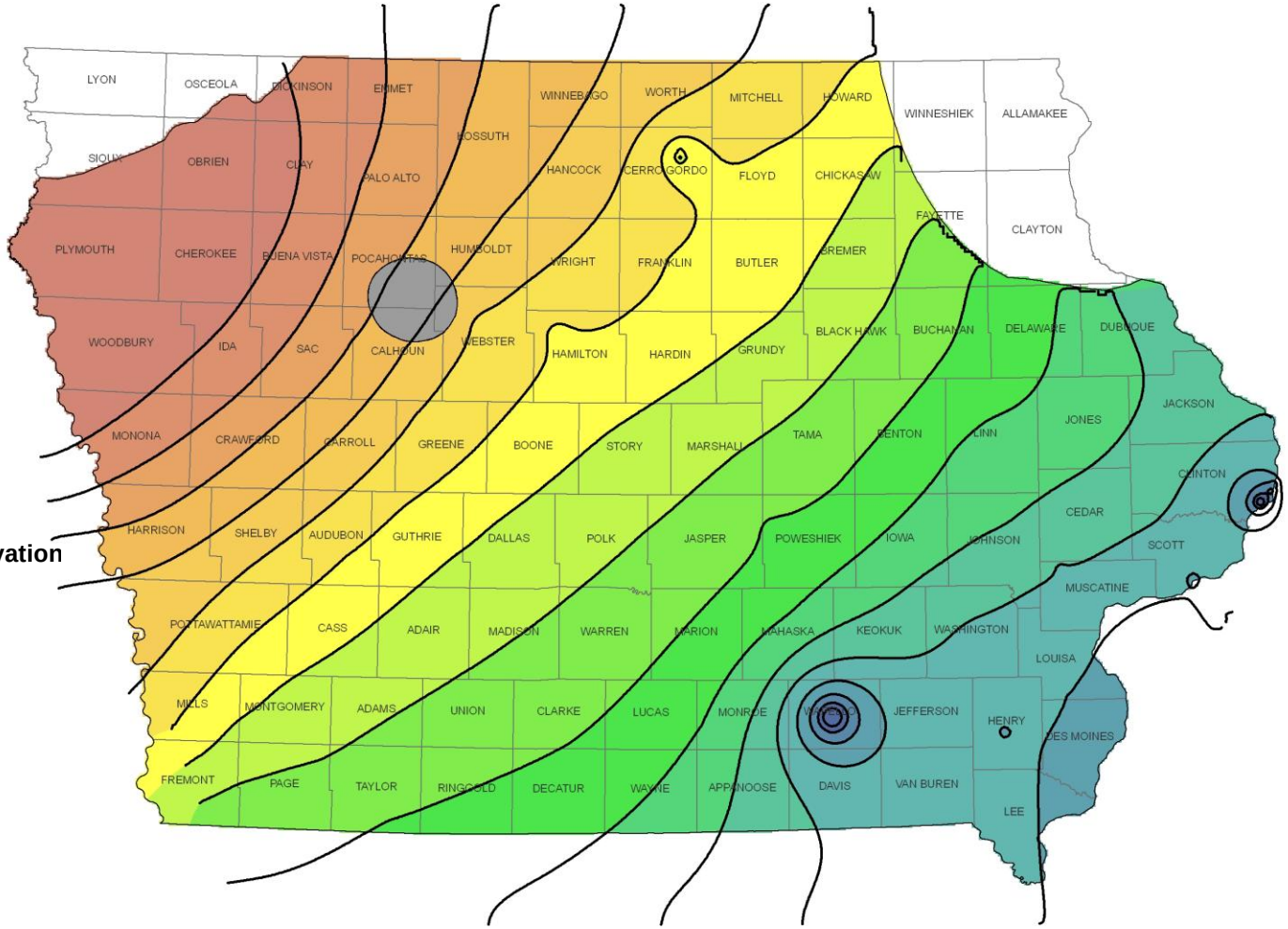
- 1150-1200 ft
- >1200 ft

1960



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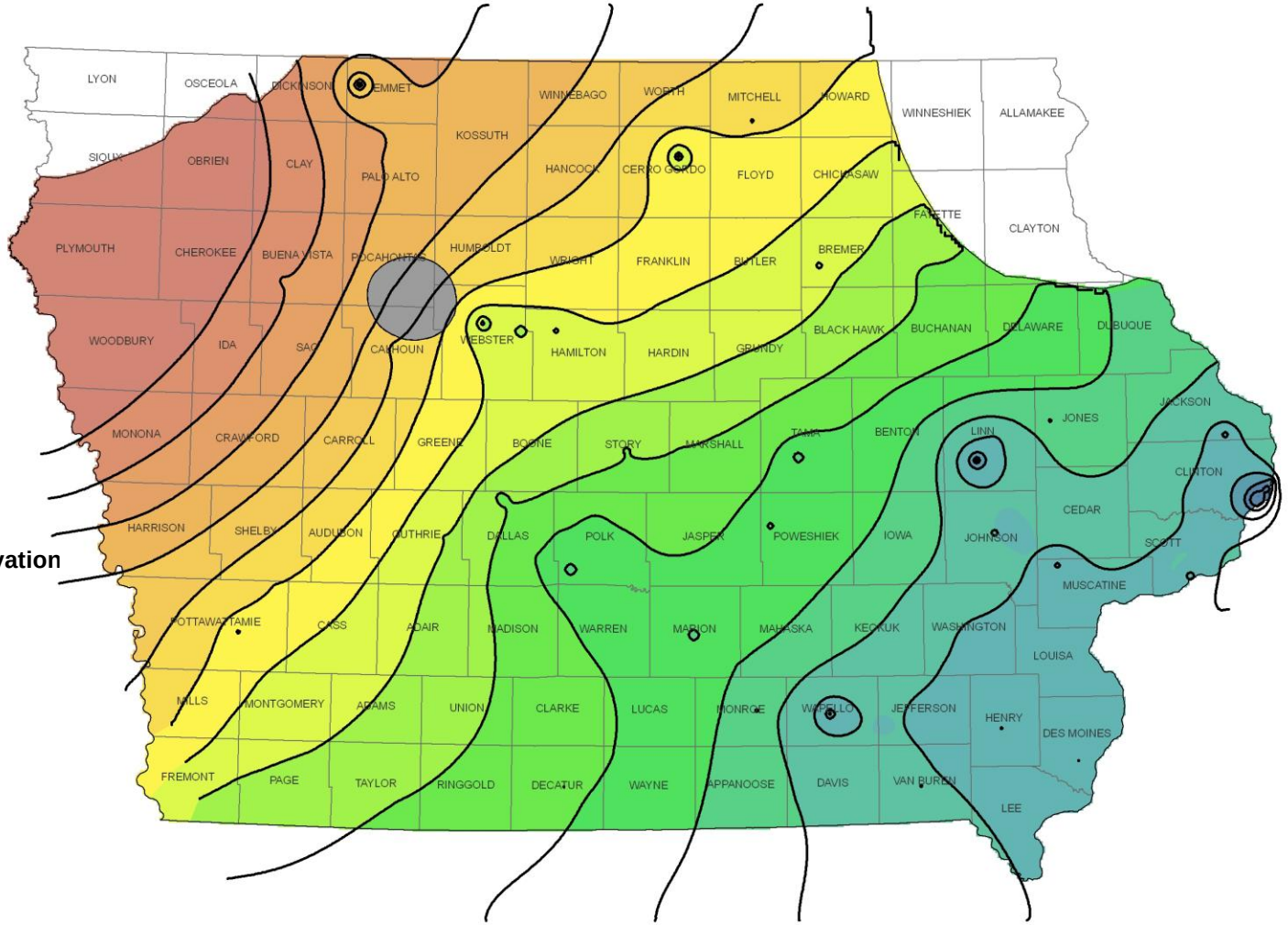
1990



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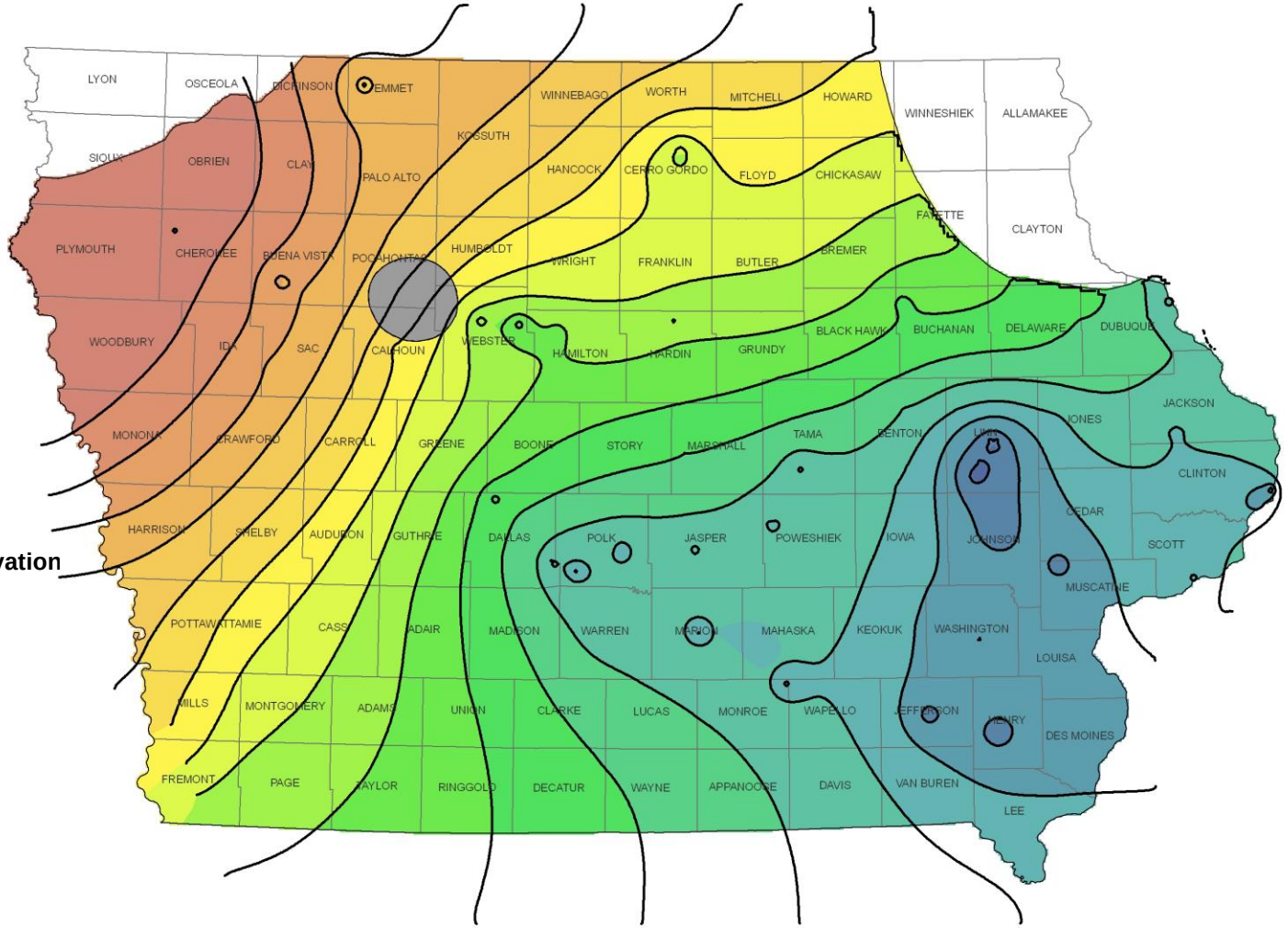
2007



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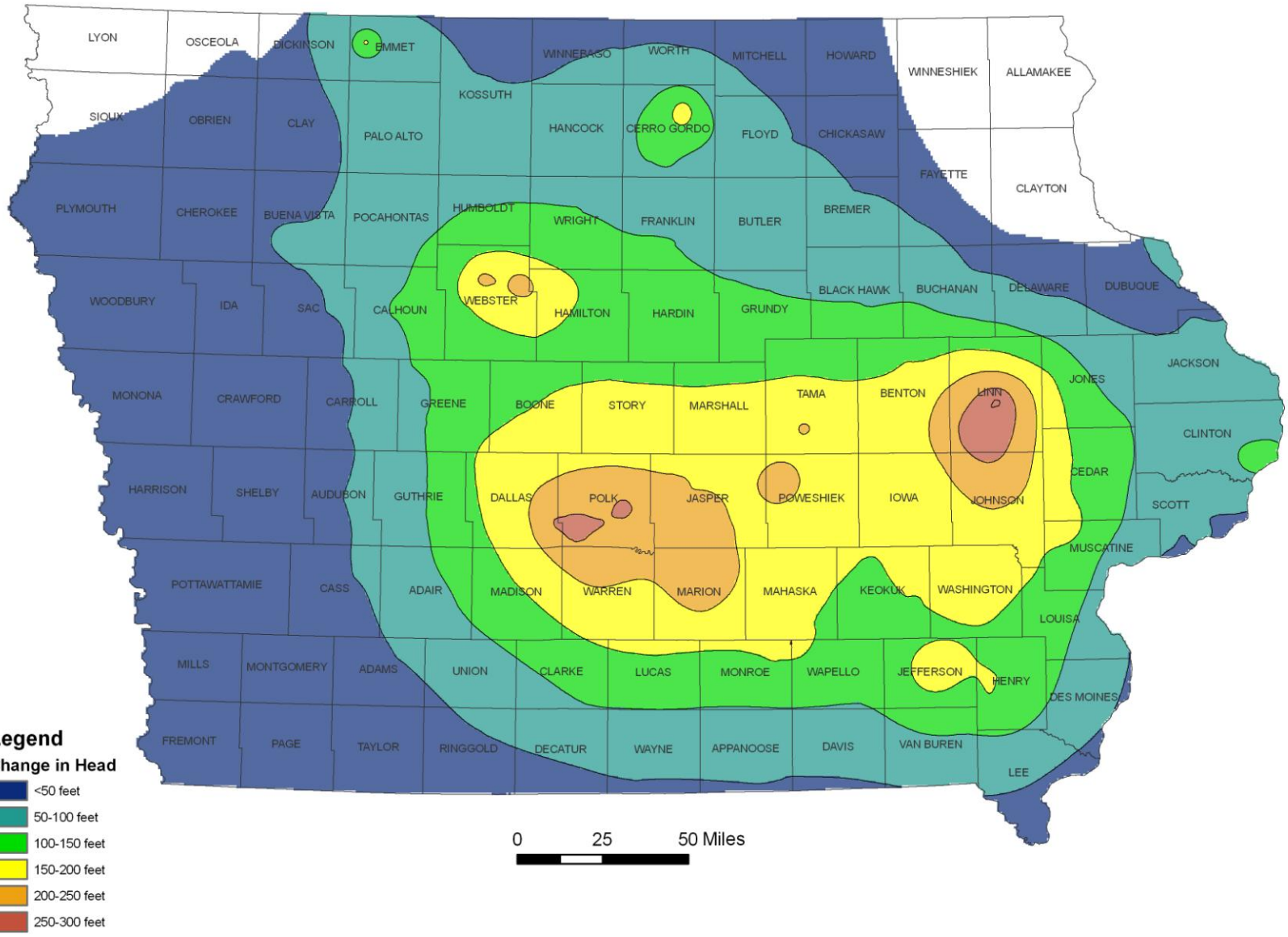
Change in Head (Drawdown) from Pre-Development to 2008

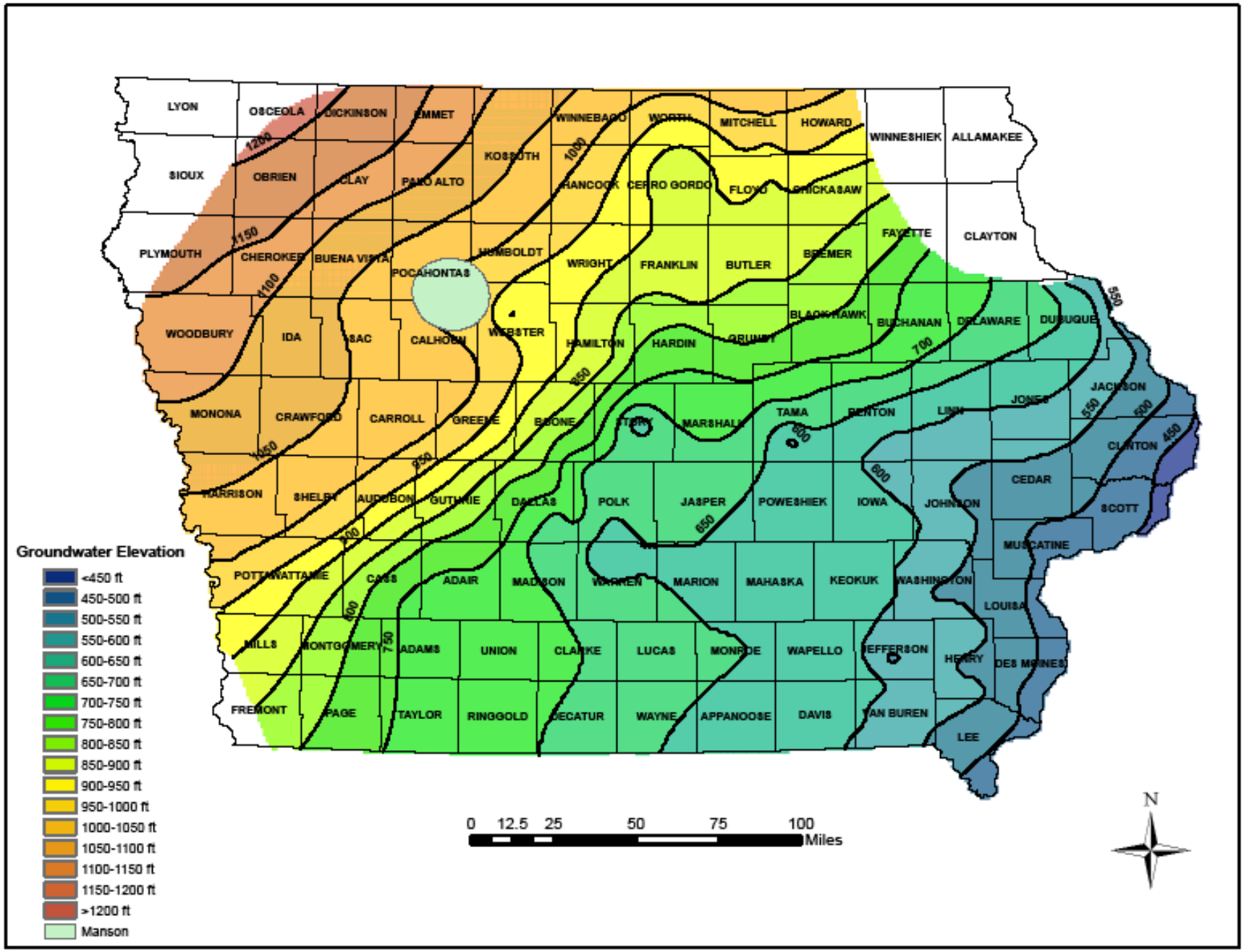


Sustainability Criteria:

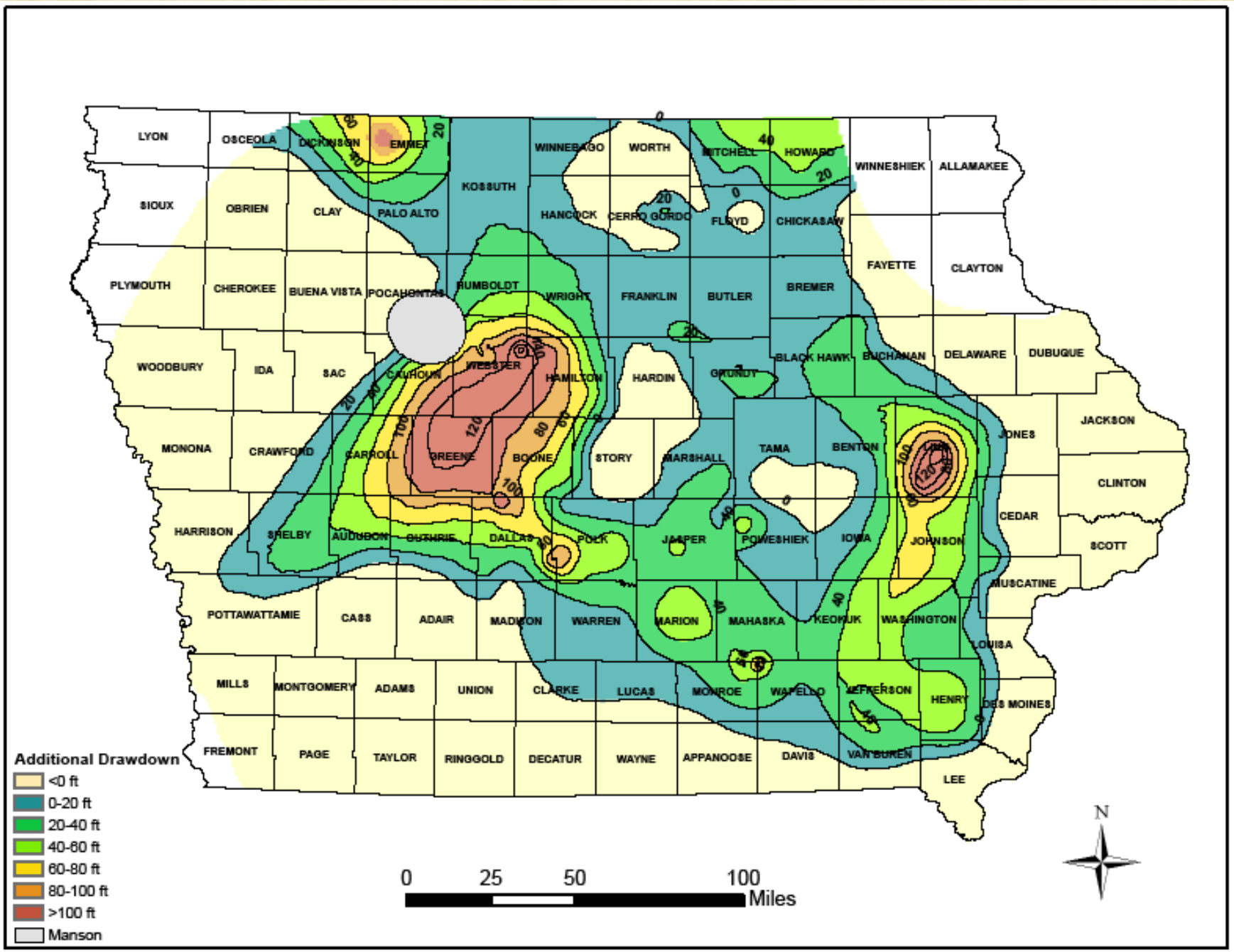
IAC 567 Chapter 52.4(3)c.

Two hundred (200) foot limit on the decline of groundwater piezometric levels. The maximum collective long-term decline in groundwater piezometric levels in the Cambrian Jordan Sandstone Aquifer in any high use area will not be permitted to exceed 200 feet from the 1977 baseline as determined from available records of the department's Iowa Geological Survey (IGS).

Horick and Steinhilber 1978 Potentiometric surface



Drawdown from Horick and Steinhilber (1978) Compared to 2007 Simulated

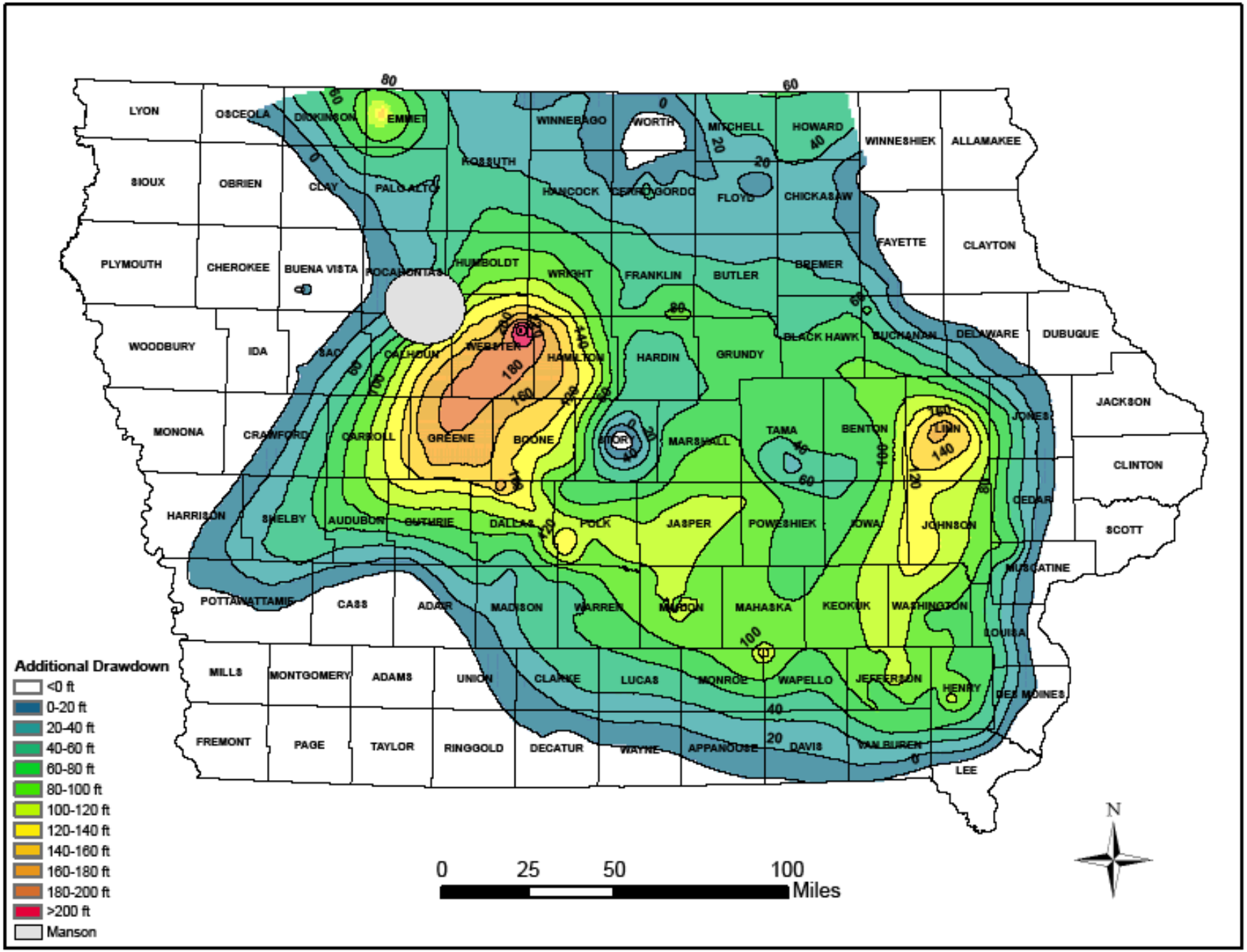


Predictive Simulations

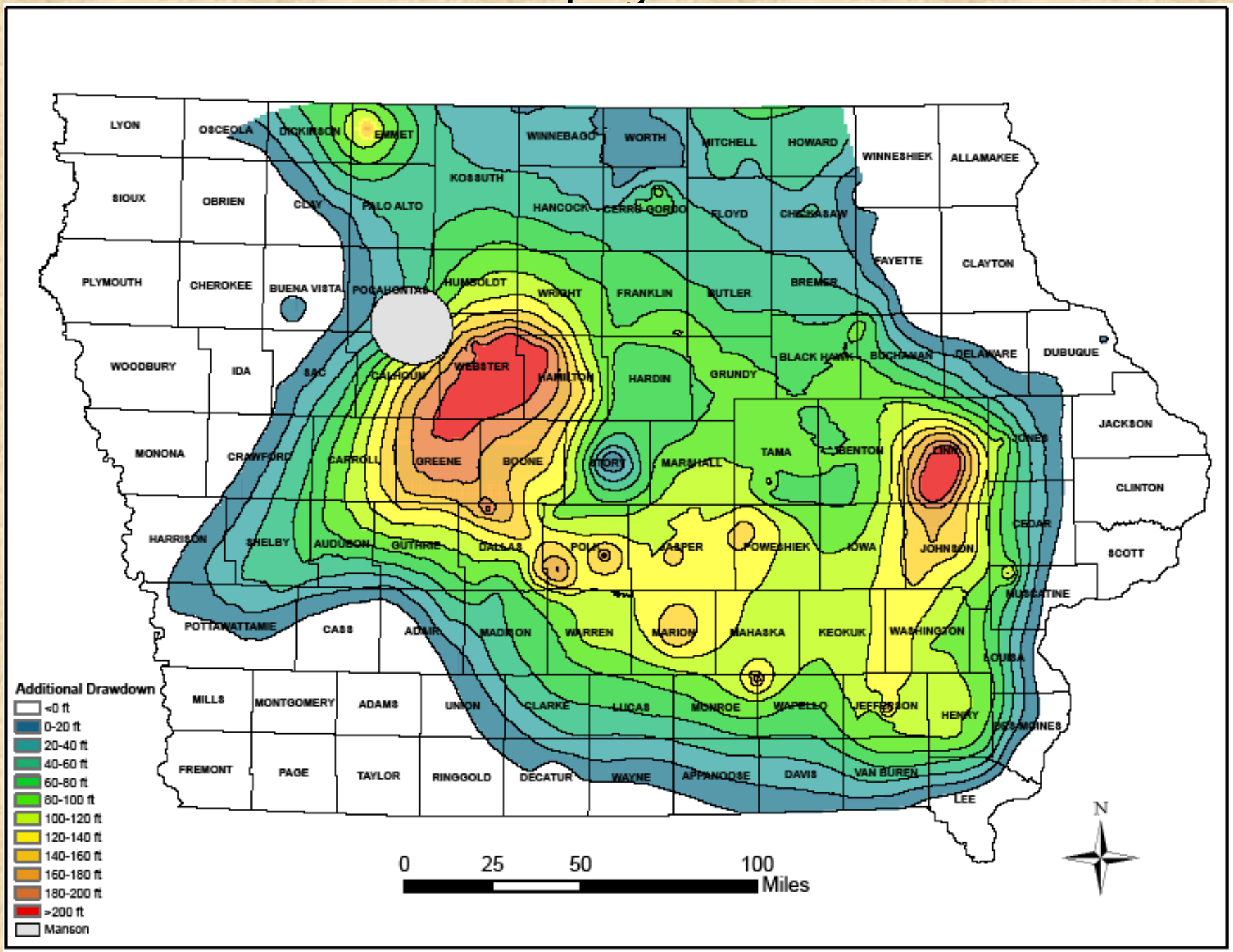
Drawdown based on Horick and Steinhilber (1978) potentiometric map

2009-2029

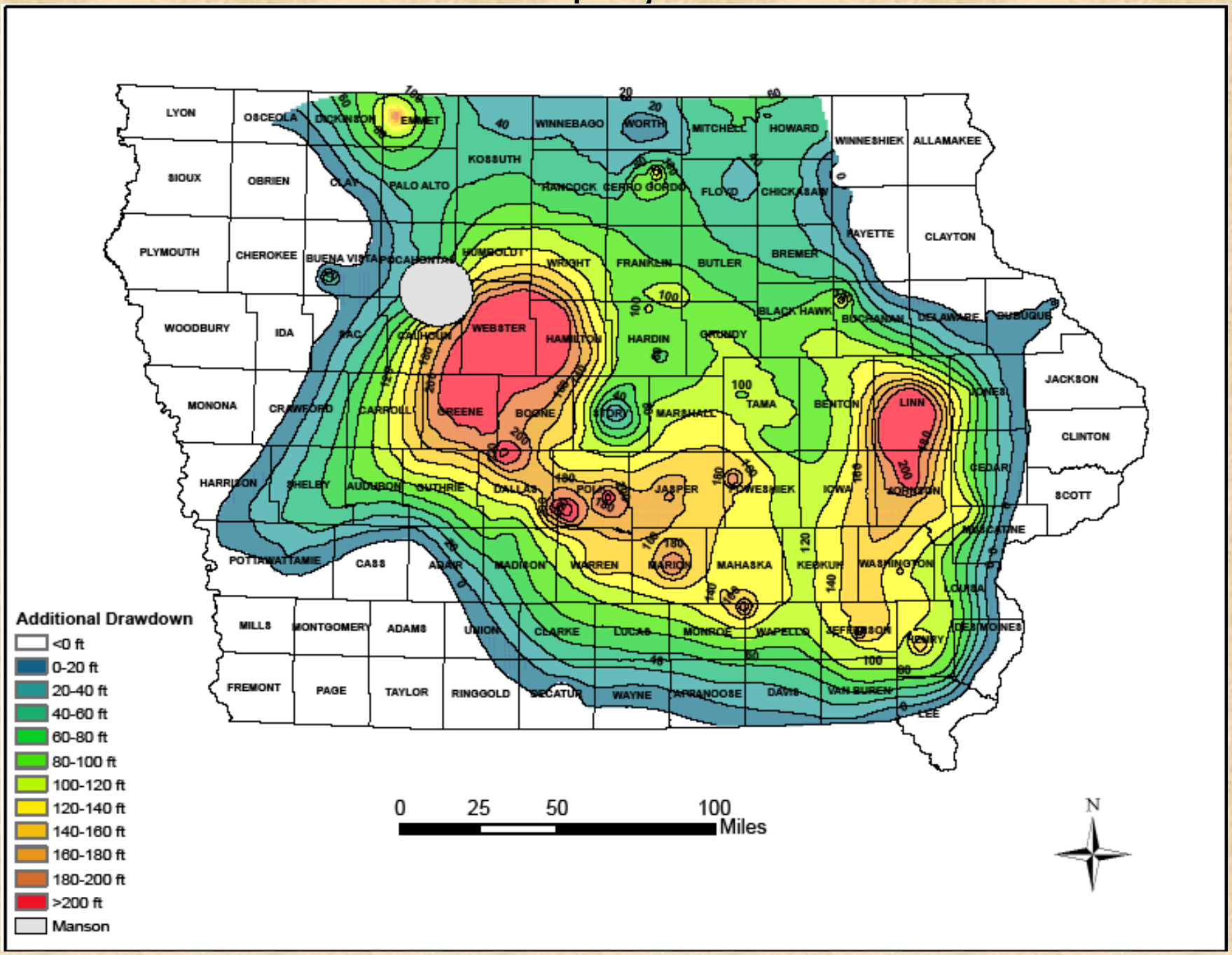
Constant Pumping rates 2009-2029



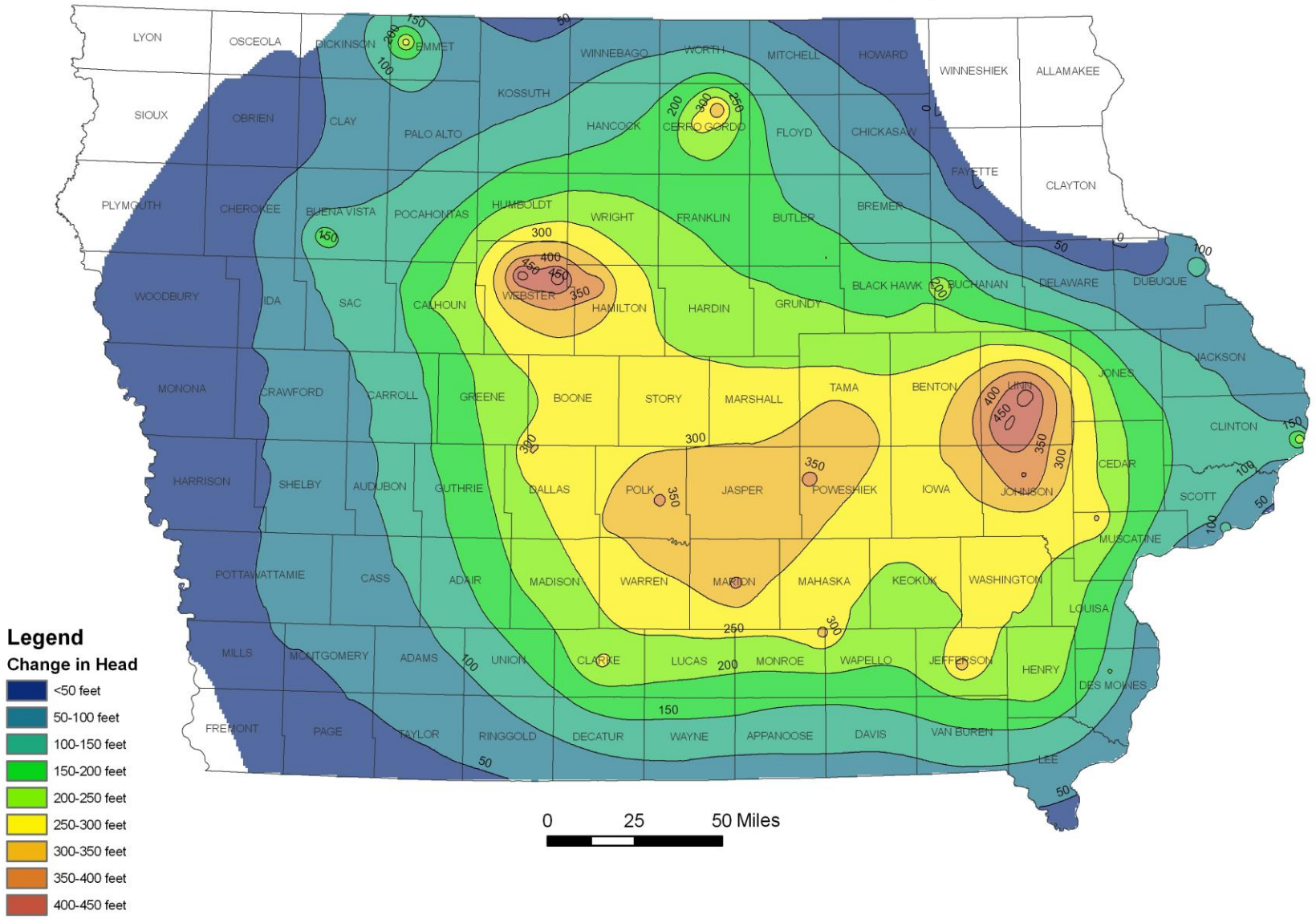
25% Increase in Pumping Rates 2009-2029



50% Increase in Pumping Rates 2009-2029



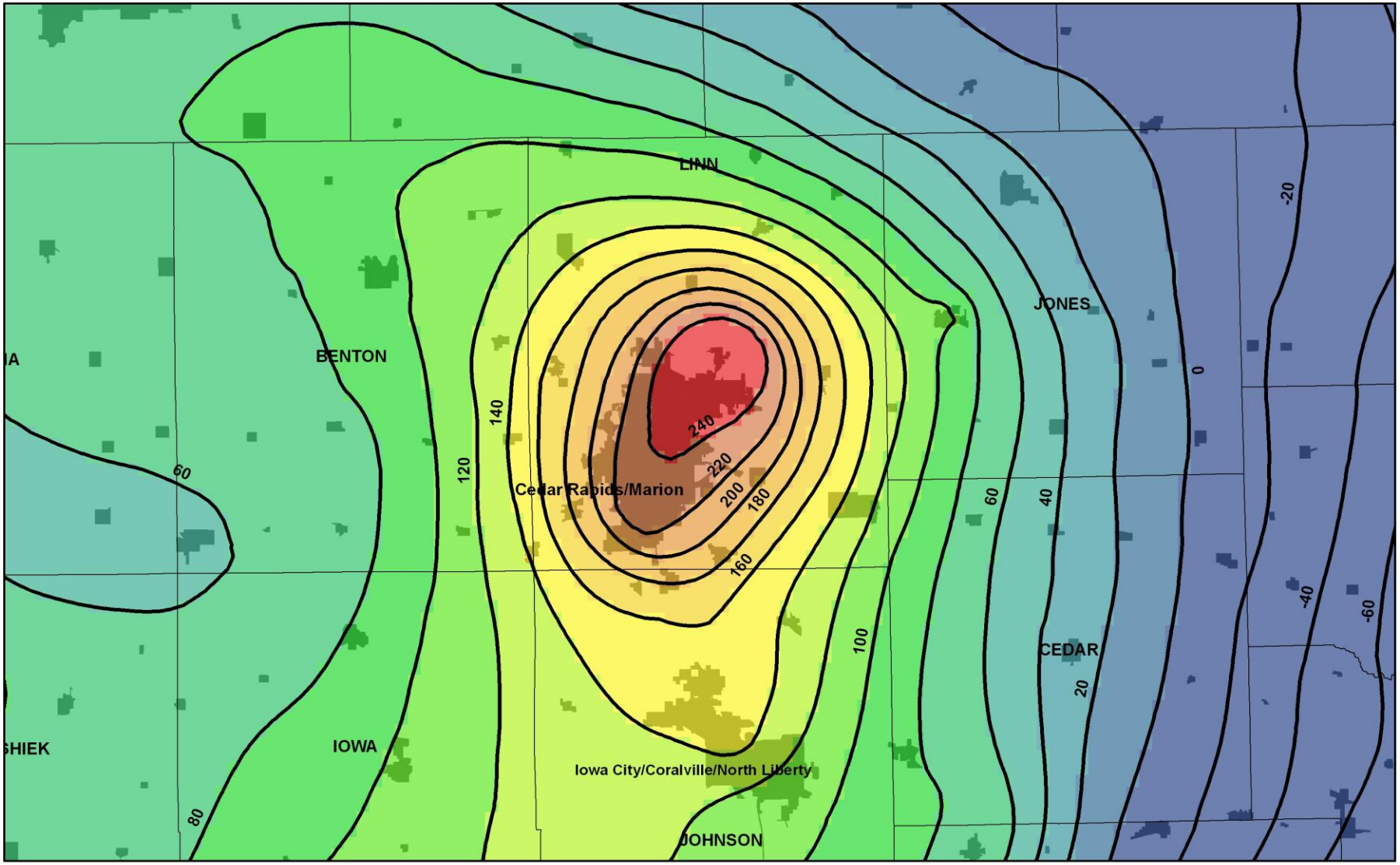
Change in Head (Drawdown) from Pre-Development to 2029 (50% increase in water usage)



Modeling Needs Projections of Future / Planned Use

Example: City of Marion

Predicted Drawdown in 2029 Using Horick (1978) as a Baseline
Pumping Rates Based on City's 30 year Water Plan



Sustainability Criteria:

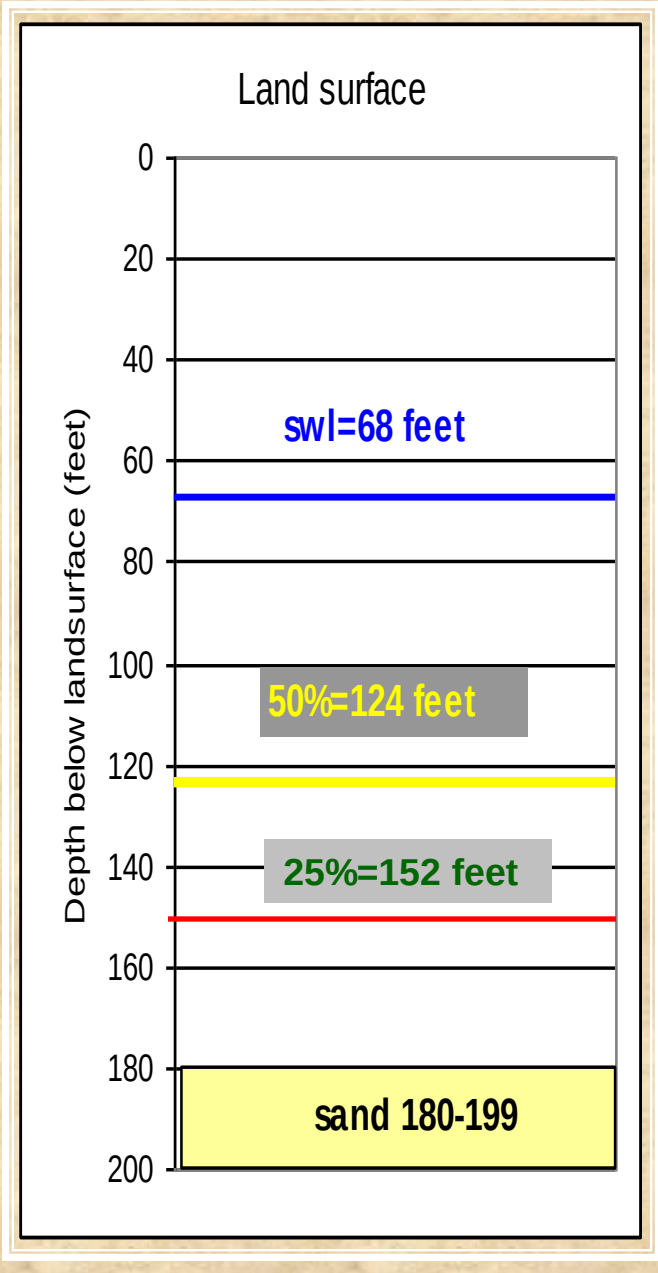
--One allowable drawdown for the entire Aquifer (i.e., 200 feet from 1977?)

--Percent of original "Pressure Head"?

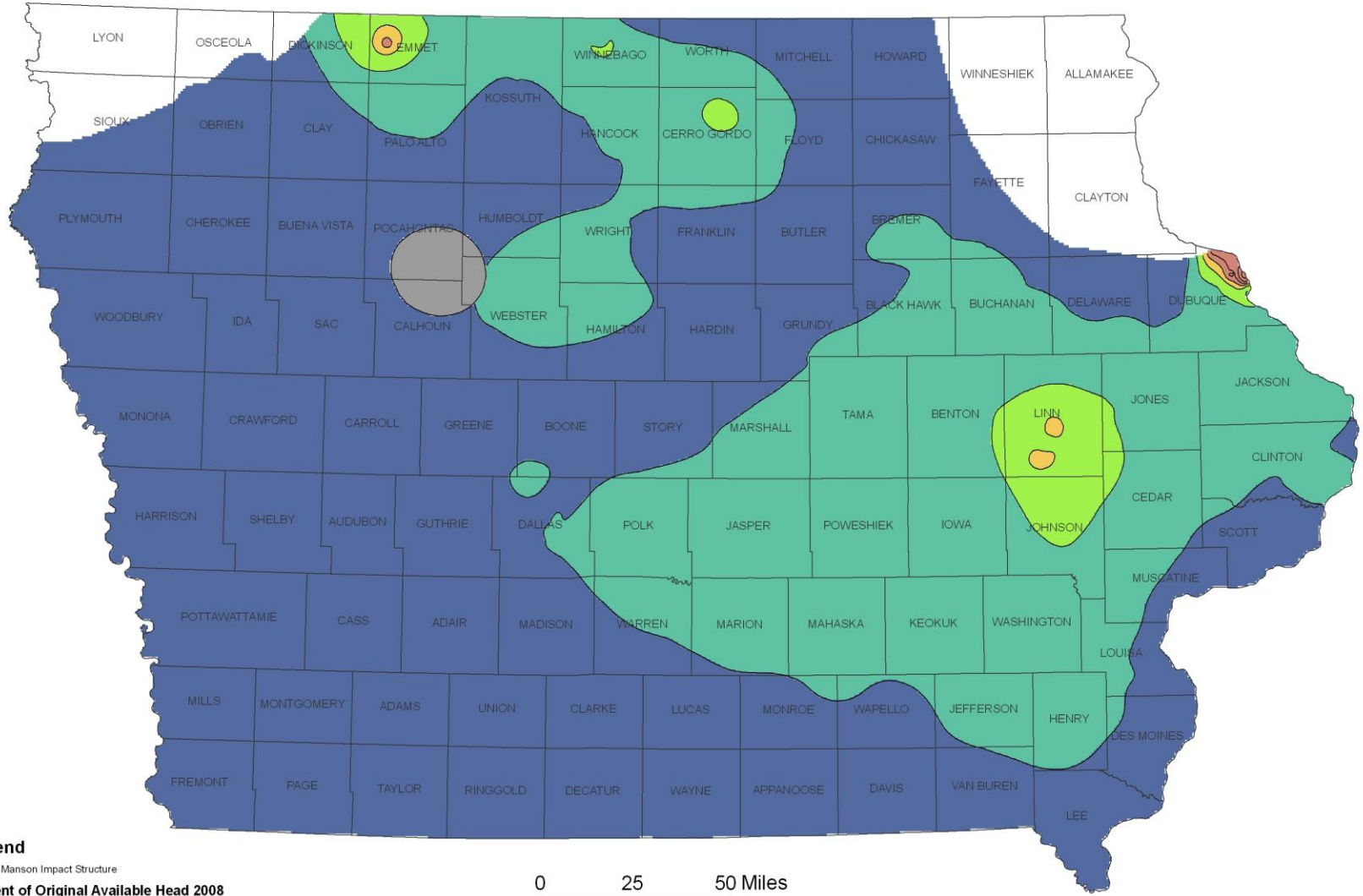
--MN DNR uses Pressure (Available) Head approach. At 50% loss, submit a plan to assure Available Head will not fall below 25% of original.

--MN DNR applies this at the well, not in a mapped zone around it.

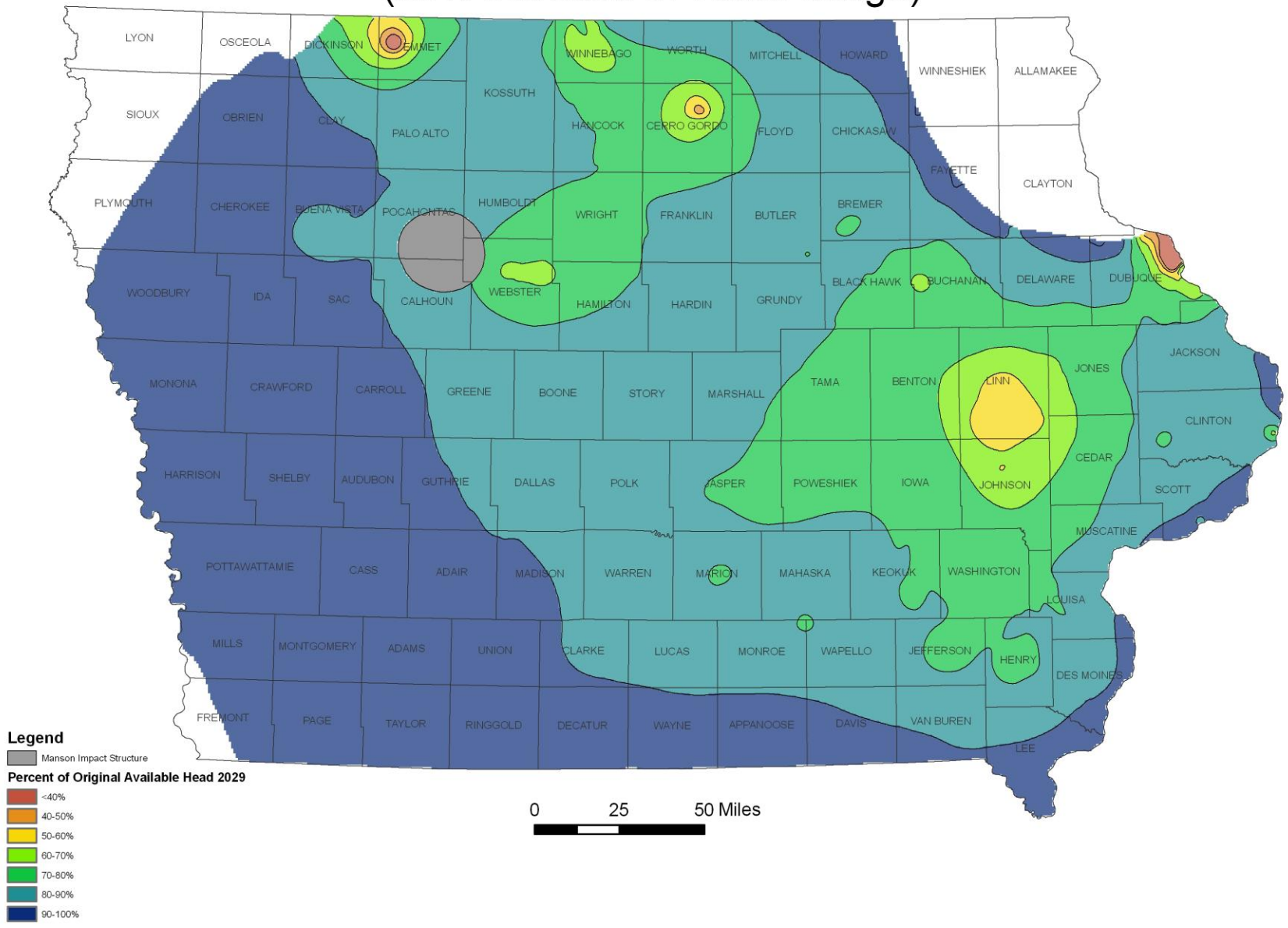
Pressure Head



Percent of Original Available Head 2008



Percent of Original Available Head 2029
(50% increase in Water usage)

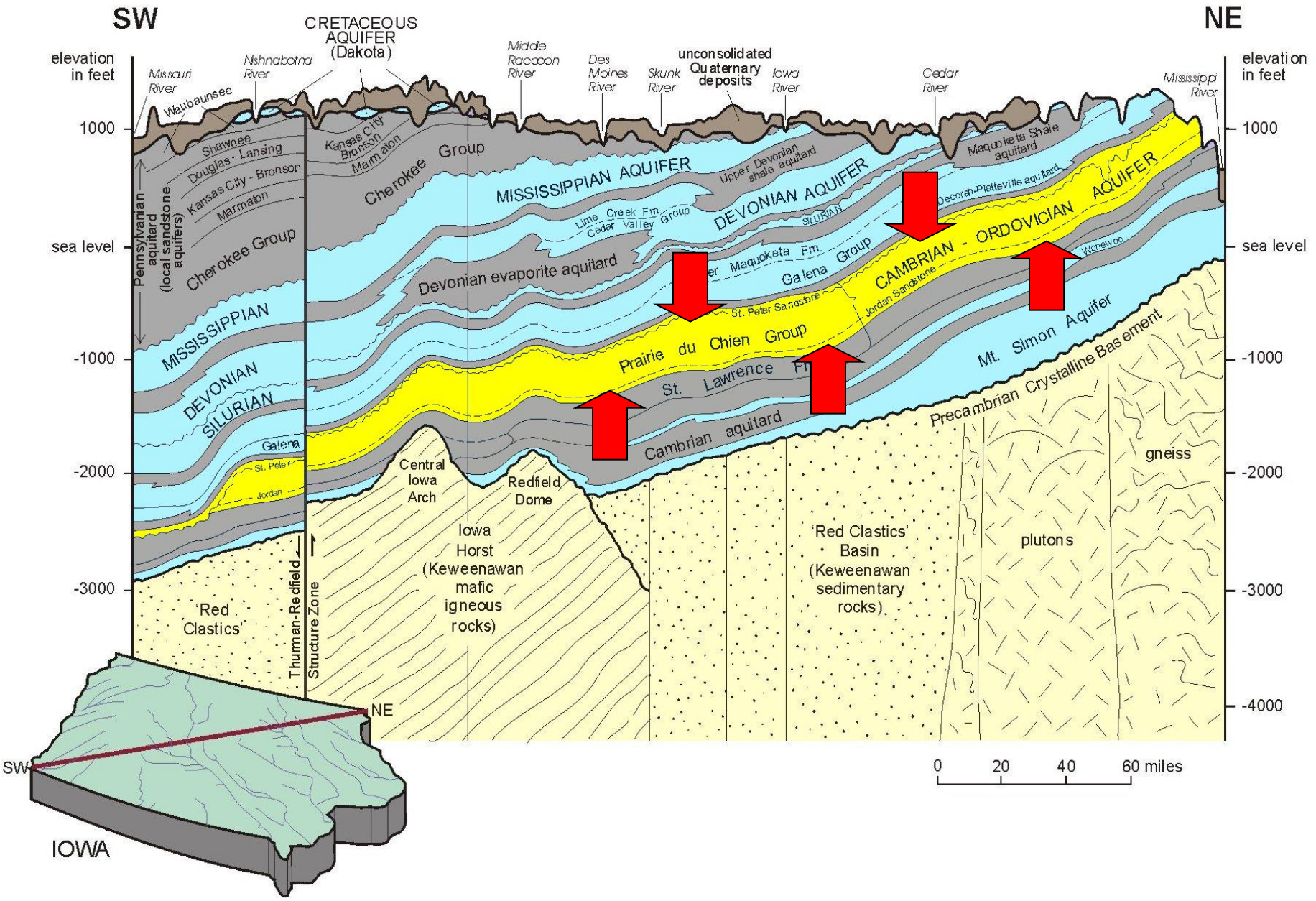


Consequences?

- **Quantity and Production Capability**: How much should be reserved for the long term?
- What do we mean by ***long term***? Life of investments? 100 years? "Forever"?
- **Pumping Costs**: Estimated increase of $25K annually for a 500 GPM well with 200 feet of additional drawdown.
- **Quality Impacts**: Vertical and Lateral GW Movement are a question of concern.

Bedrock Aquifer Systems across Iowa

Southwest to Northeast



Jordan Status – Future Conditions

- Pressure Surface – Well Levels have declined 150 ft over a broad area of Central IA, and over 250 ft locally.
- With no increase in use, Well Levels will exceed the 200 ft drawdown limit locally.
- With a 50% increase in use, Declines of over 450 ft will occur locally, about ½ of the original available head.
- Quality Impacts a concern that needs to be addressed.

Reports, Data, Model Input Files are Available on the IGWS Website at:

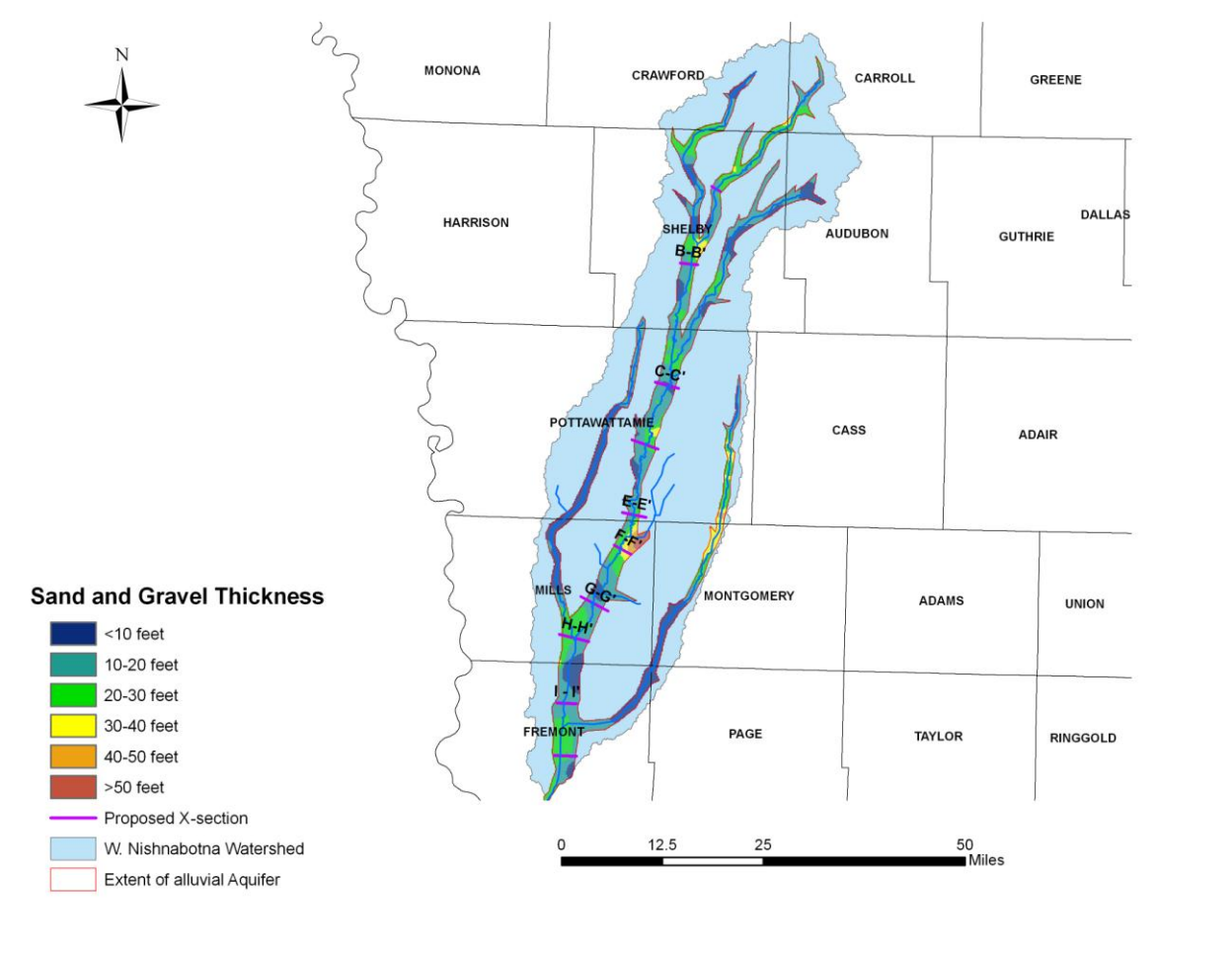
- http://www.igsb.uiowa.edu/

Additional Information on Water Quantity/Supply Issues is Available at :

- http://www.iowadnr.gov/water/quantity.html

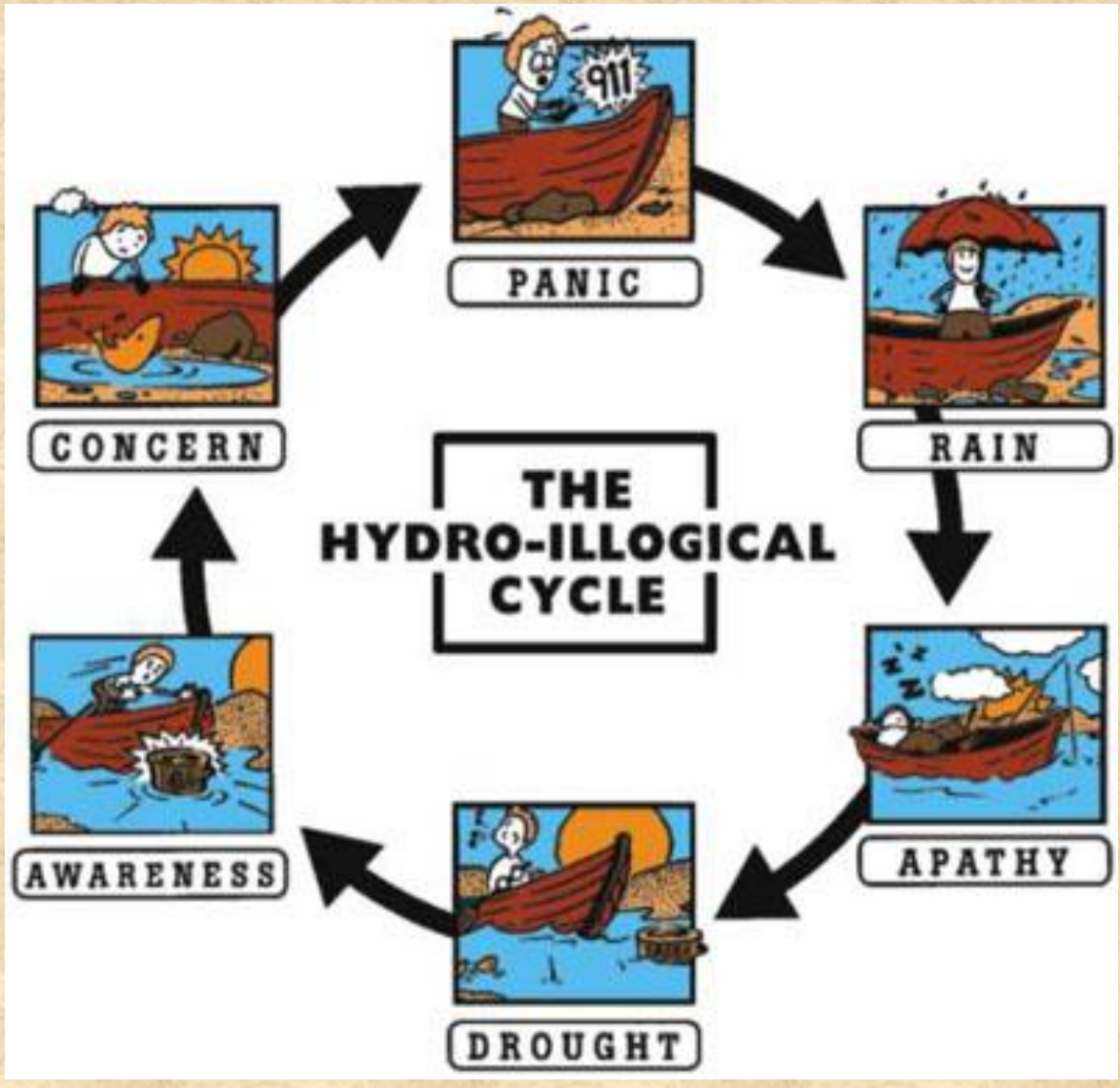
FY10: West Nishnabotna Alluvial Aquifer

- GW-SW Interactions come into play
- Drought – Climate Impacts
- Water Quality – Source Water

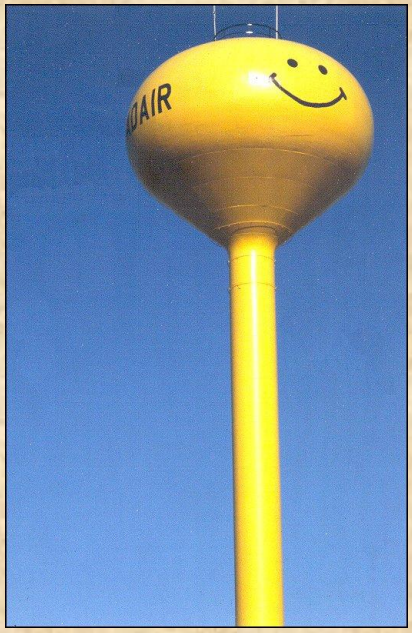


Additional Program Needs

- Expand GW level network
- Build and maintain stream gages
- Create Water Resource data-base and web applications
- Input/Refinement of Future Use Estimates
- Additional characterization support needed
  - 3D Aquifer mapping (alluvial systems)
  - Quality – Pumping relationships
  - Geologic characterization



Goal: Break the Cycle



Water Resource Sustainability:

Assuring plentiful, clean water for community, business, and ecological needs, today and into the future.

Questions?

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Mike Gannon, Hydrogeologist

DNR -- Iowa Geological Survey

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http://www.igsb.uiowa.edu/