

Effects of the 2000-2005 Drought on Groundwater Levels in Nebraska

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Purposes

1. Review the nature of drought on the northern Great Plains
2. Document groundwater-level changes associated with the recent drought in Nebraska
3. Identify regions that may be particularly vulnerable to hydrological drought
4. Offer insights into the consequences of long-term drought in Nebraska and some adjacent areas

Drought Types

Meteorological or *Climatological* – Departure from normal precipitation over some period of time

Agricultural – Lack of soil moisture to meet the needs of a particular crop at a particular time

Hydrological - Deficiencies in surface and subsurface water supplies

Socioeconomic - Occurs when physical water shortages start to affect the health, well-being, and quality of life of the people

Drought on the Northern Great Plains

- Recurrent phenomenon in North America
- Tends to be most persistent in the central to northern Great Plains
- Numerous long-term (>100 yrs) droughts within the past 15,000 years

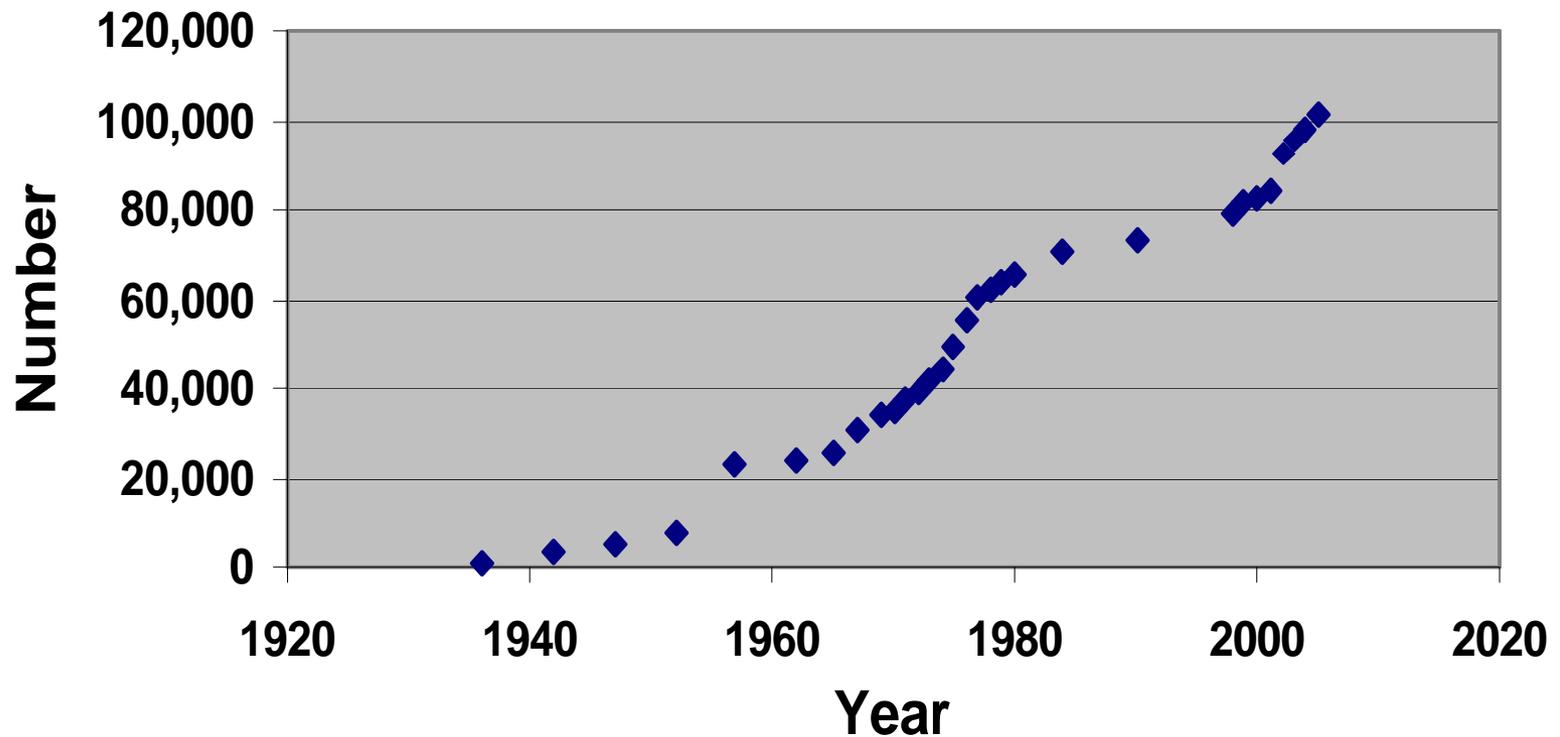
*References available from authors



Current Drought (2000-2005)

- Estimated losses in 2002 = **\$10-\$20** billion
- Nebraska - **\$1.2** billion (agricultural)
- Increase in irrigation well installation
 - Montana (2005) - **largest** number of groundwater appropriations for irrigation in nearly two decades
 - Wyoming (2001-2005) – **largest** 5-year period of irrigation well registration since 1970's
 - Colorado (2000-2004) – **largest** 5-year period of irrigation well registration since 1970's
 - Nebraska (2002) – **Record** number of irrigation wells registered

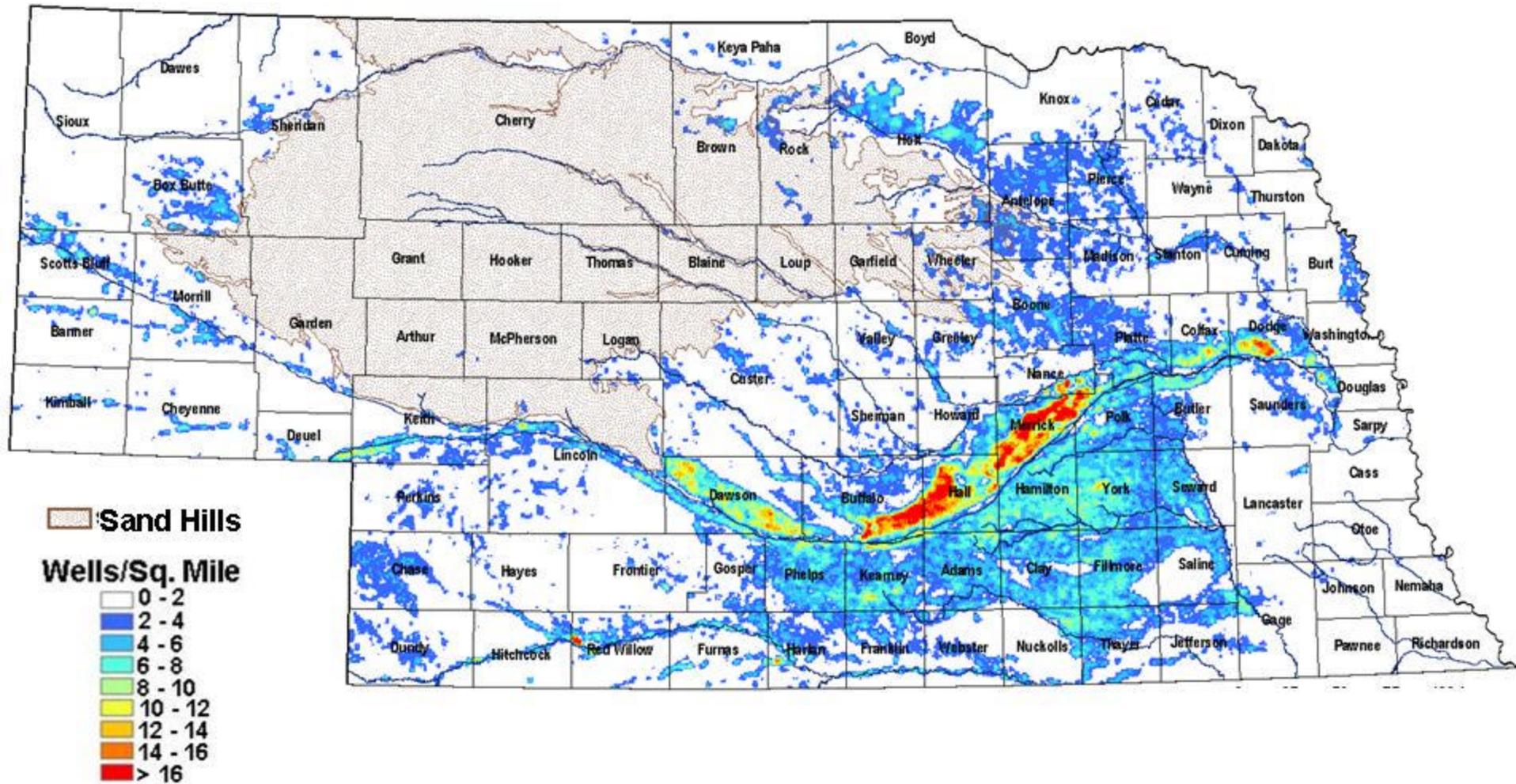
Registered Irrigation Wells in Nebraska



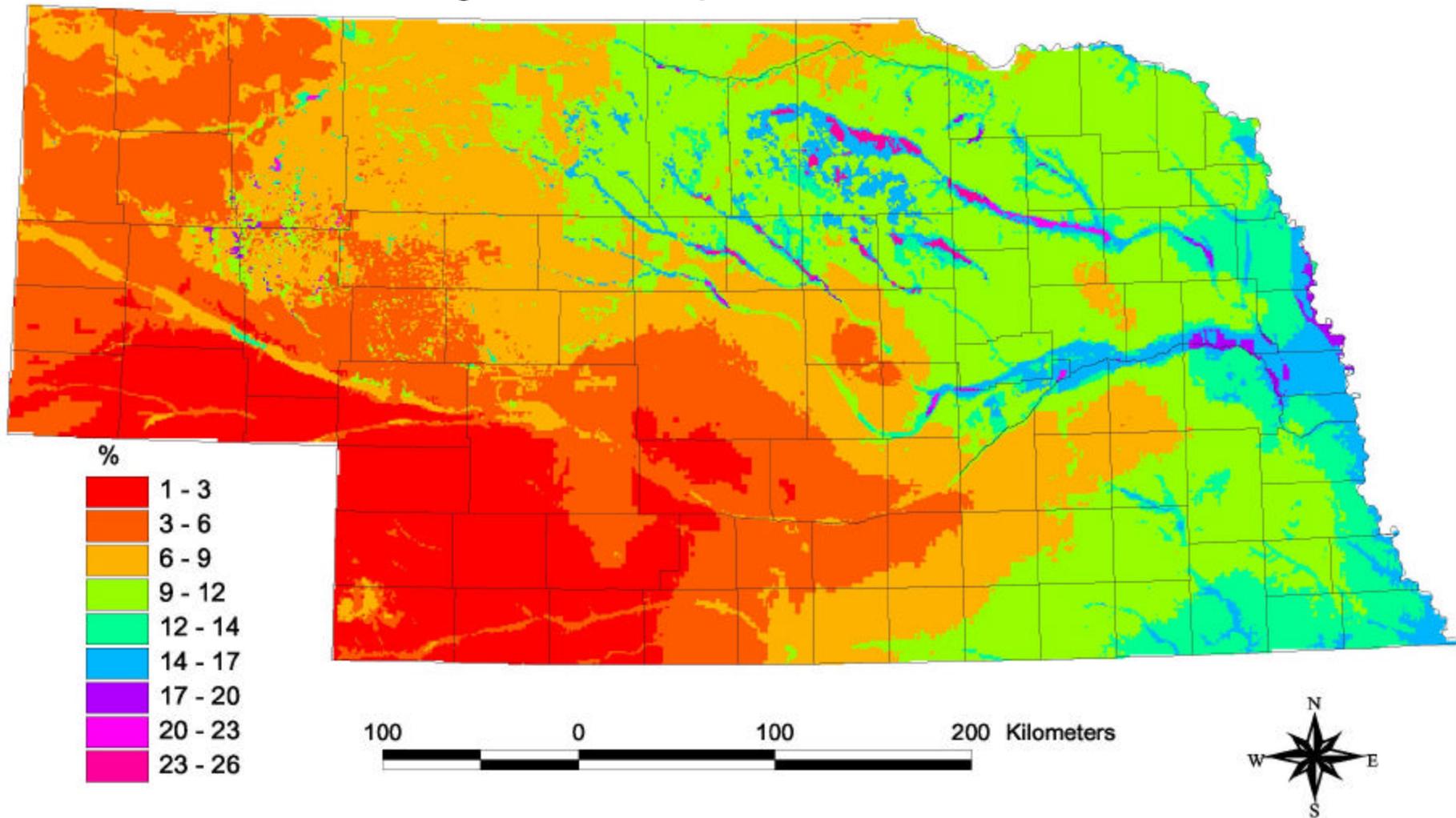
Total = 101,546 (1/06/06)

2000-2005 = 19,068 new wells, 23% Increase

Density of Registered Irrigation Wells in Nebraska, August 2005



Estimated Mean Annual Total Recharge Rates as Percentage of Precipitation (Szilagyi et al 2005)



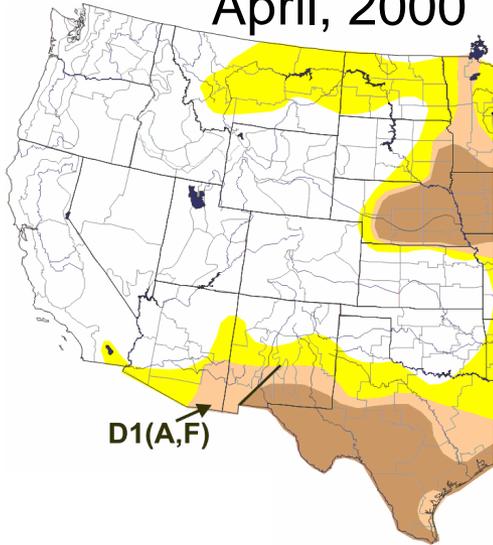
Nebraska Groundwater Facts

- **81%** of public drinking water from groundwater (100% of private water supplies)
 - only 47% nationally
- Groundwater irrigation – **7.8** billion gallons per day (2000)
- Groundwater irrigation accounts for **94%** of all groundwater withdrawals

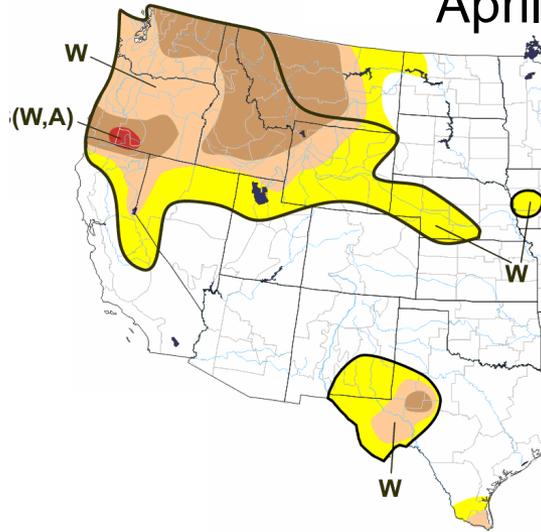
Nebraska Groundwater Facts cont.

- Irrigated agriculture provides **2x** net income than dryland agriculture (normal precip)
- Irrigated agriculture provides **2.5x** net income than dryland agriculture (drought, 2003)

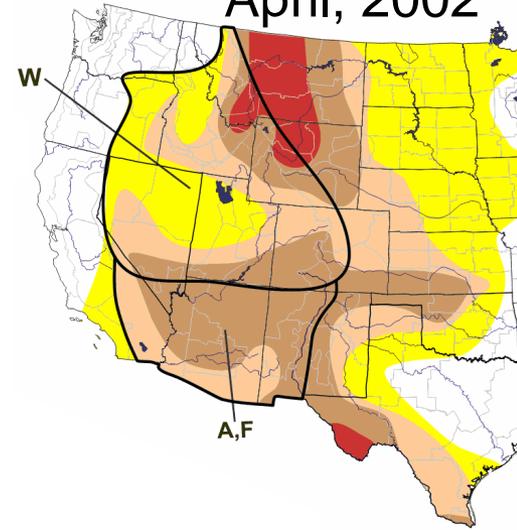
April, 2000



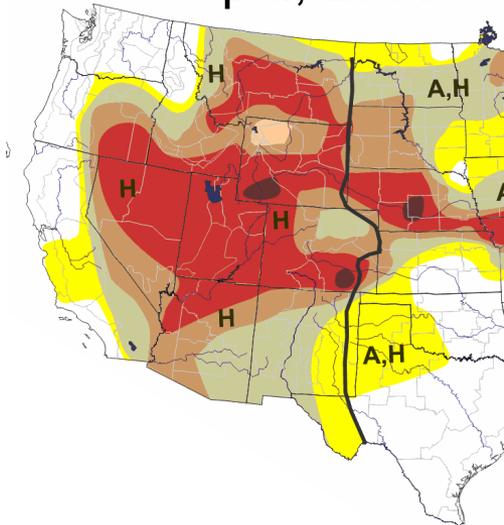
April, 2001



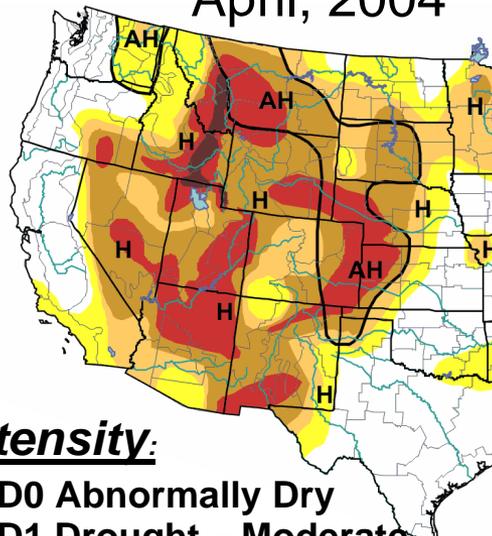
April, 2002



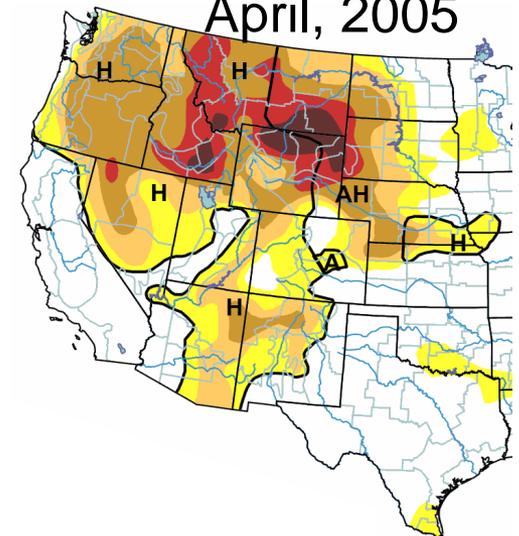
April, 2003



April, 2004



April, 2005

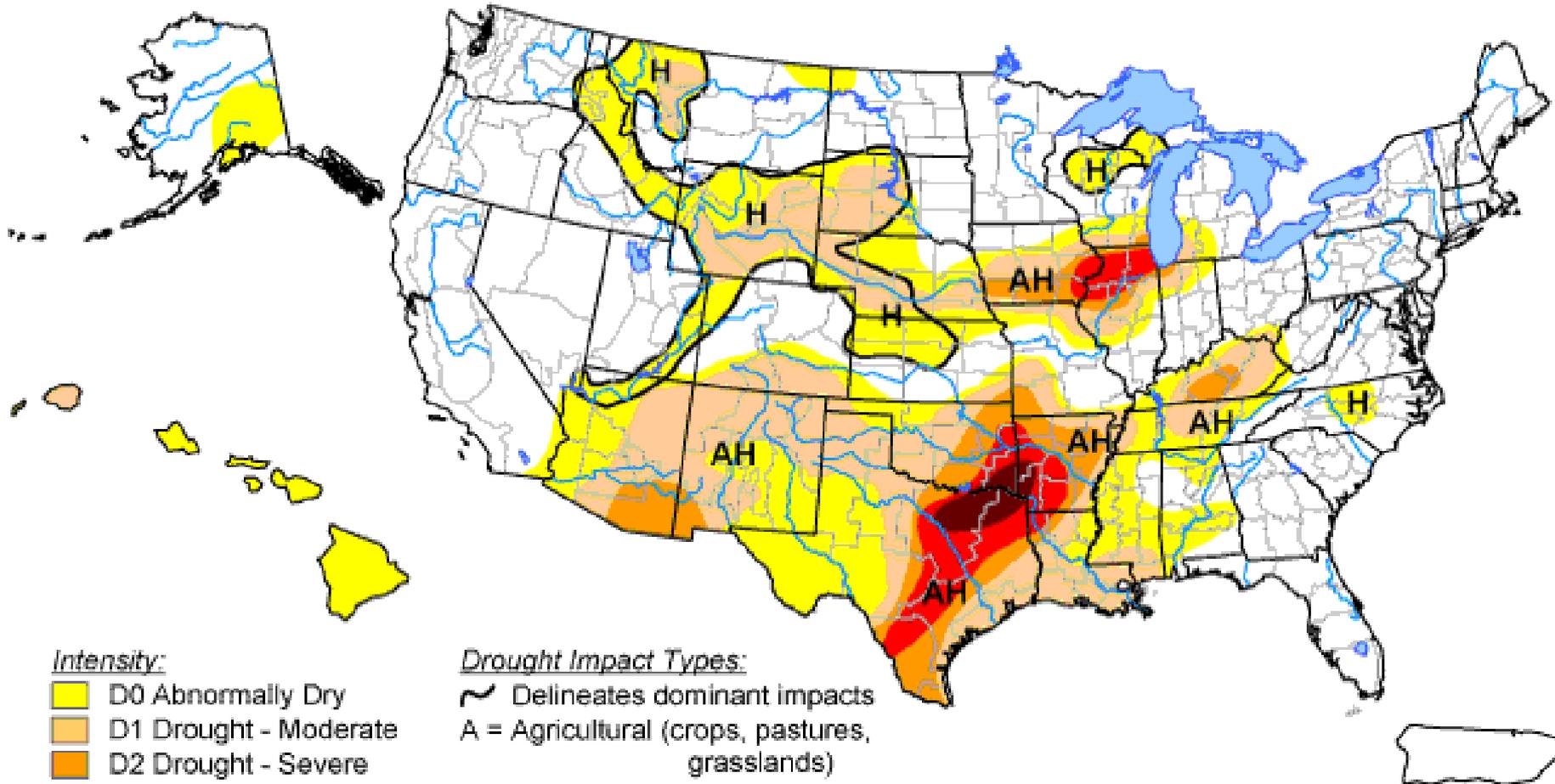


Intensity:

-  D0 Abnormally Dry
-  D1 Drought – Moderate
-  D2 Drought – Severe
-  D3 Drought – Extreme
-  D4 Drought – Exceptional

U.S. Drought Monitor

January 17, 2006
Valid 7 a.m. EST



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

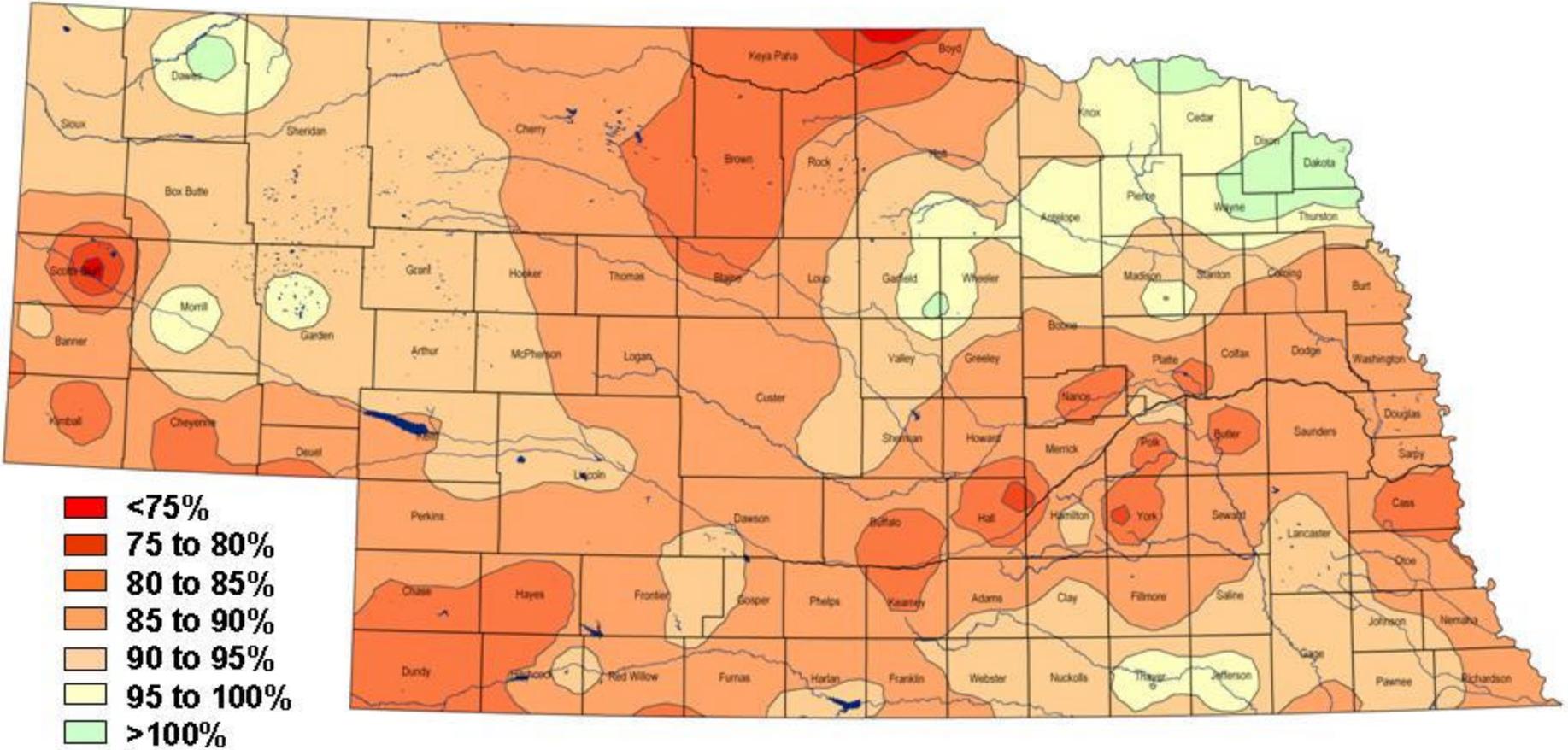
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>

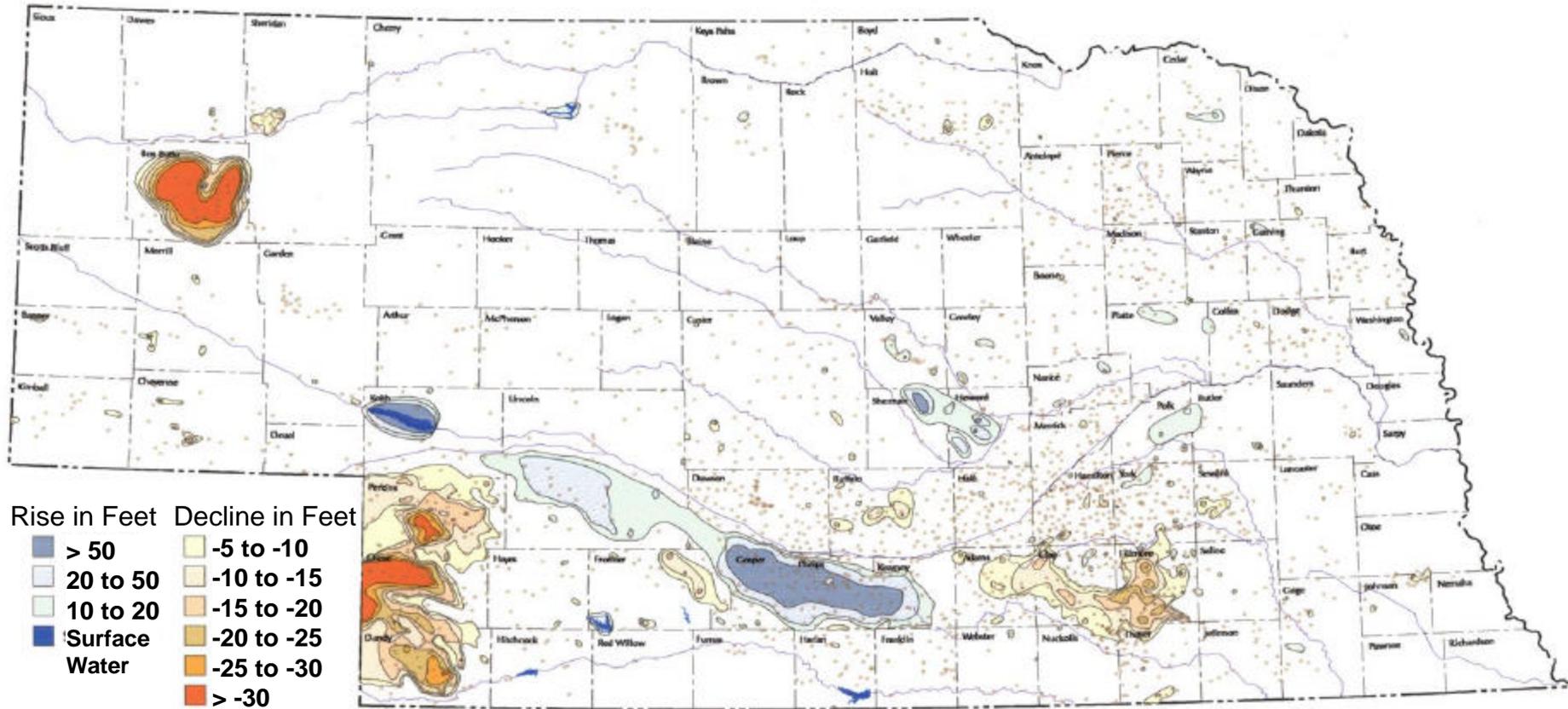


Released Thursday, January 19, 2006
Author: Mark Svoboda and Brian Fuchs, NDMC

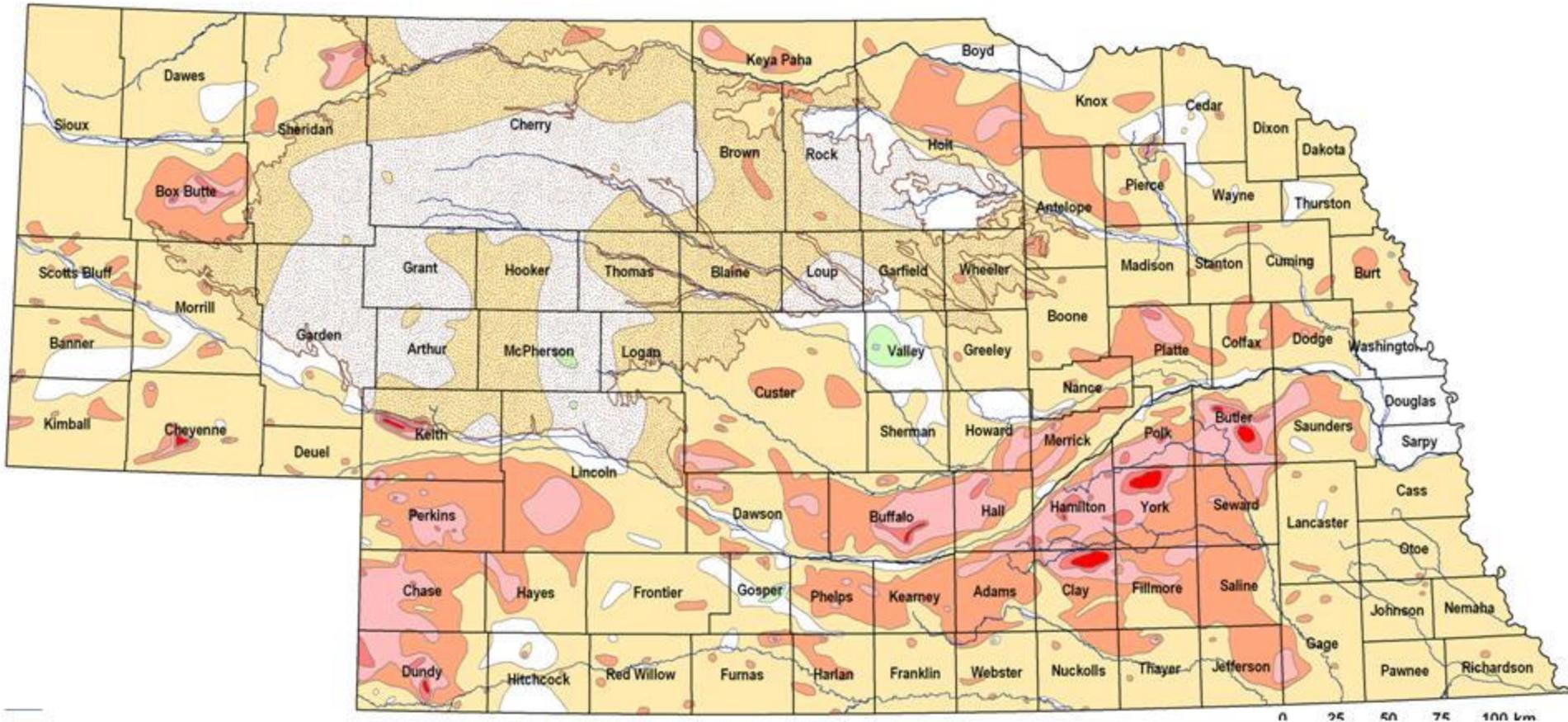
Percent of Normal Precipitation, January 2000 to January 2005



Groundwater-Level Changes – Predevelopment to Spring 1998



Groundwater-Level Changes in Nebraska, Spring 2000 to Spring 2005



Rise in Feet

- 1.00 to 4.99
- > 5.00

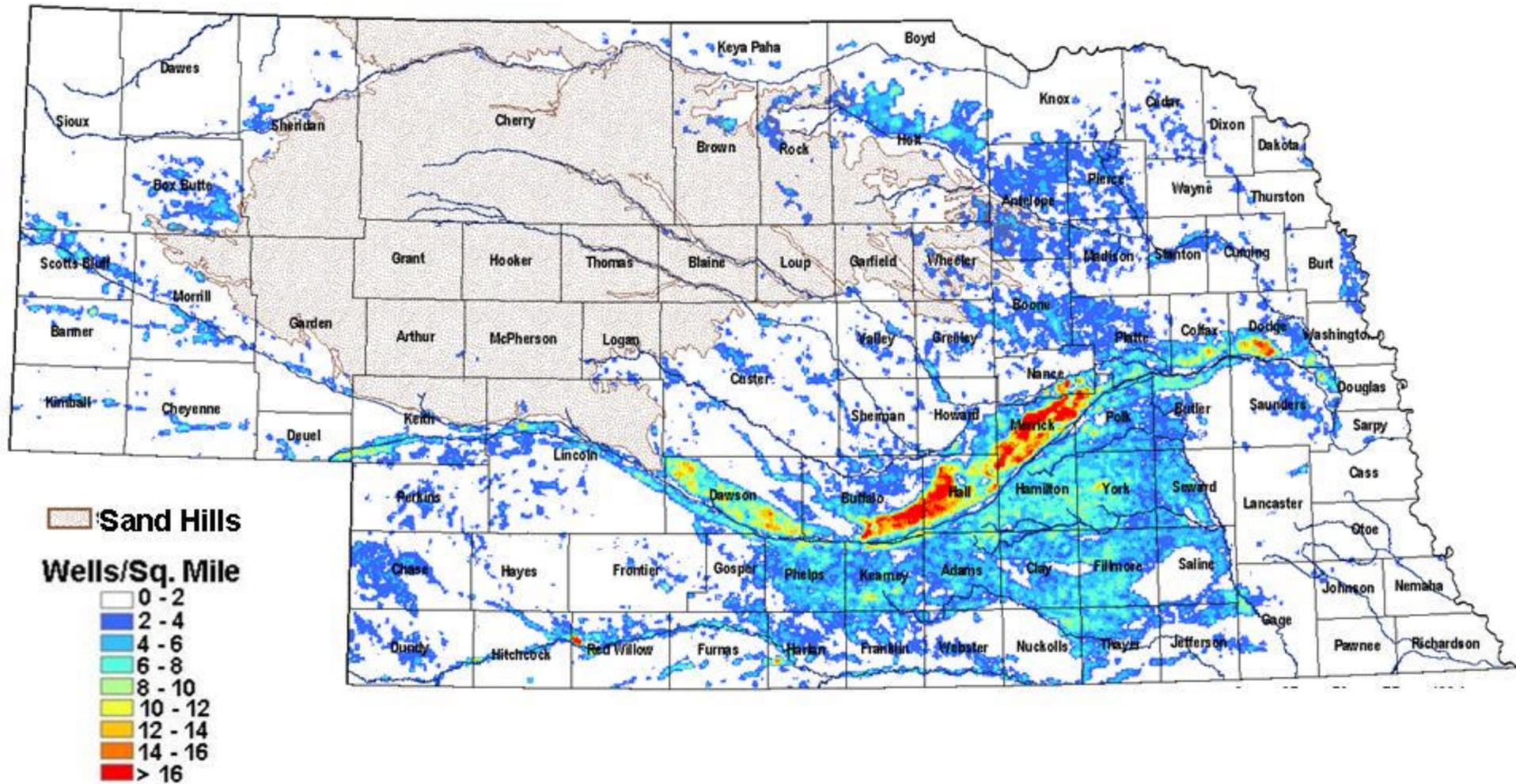
Decline in Feet

- 1.00 to -4.99
- 5.00 to -9.99
- 10.00 to -14.99
- 15.00 to 19.99
- > -20.00

- < +/- 1.00 foot change or no data
- Surface Water

0 25 50 75 100 km

Density of Registered Irrigation Wells in Nebraska, August 2005



Summary of Results

- **>90%** of state experienced below average precipitation
 - Minimum, all stations – **58%**
 - Minimum, Nebraska – **72%** (Scotts Bluff Co.)
 - Maximum, all stations – **108%** (Dakota Co.)
- Largest precipitation shortfalls in areas with lowest annual recharge rates
- Scotts Bluff Co. cumulative effect of drought **1.5** years of recharge
- Hall Co. cumulative effect of drought **1.2** year of recharge

Summary of Results, cont.

- Largest groundwater-level declines in areas with intense irrigation development
- Drought has exacerbated some already problematic areas (Box Butte Co. and other Panhandle areas, Southwestern NE, South central/Southeastern NE)

Conclusions

- Most vulnerable areas to hydrological drought are agricultural areas with high concentrations of irrigation wells.
- Recovery from the drought will be particularly difficult in areas with preexisting groundwater-level declines and low recharge rates.

Conclusions, cont.

- Longer and more intense droughts could be catastrophic.
 - Environmental and socioeconomic
 - Proximity to groundwater use is a major determinate of population change (White, 1994)
- Drought mitigation efforts on the central and northern Great Plains must consider the combined effects of area-specific reduced recharge, local geohydrology, and increased groundwater withdrawals when assessing drought vulnerability.

Water, taken in moderation, cannot hurt anybody.

--Mark Twain

Questions?

csd.unl.edu