GAM run 05-13_revised

by Richard Smith, P.G.

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
May 17, 2005

REQUESTOR:

Mr. Stefan Schuster with Freese and Nichols, Inc. on behalf of the Panhandle Regional Water Planning Group

DESCRIPTION OF REQUEST:

Mr. Schuster requested that we run the Groundwater Availability Model for the northern part of the Ogallala aquifer for the period 1950 to 2060 and provide maps of saturated thicknesses for 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, and 2060. He requested that the maps for 2000 to 2060 be based on the groundwater demands he provided to us that were from the Panhandle Regional Water Planning Group for their 2006 regional water plan (Region A demands).

METHODS:

We used the Groundwater Availability Model (GAM) for the northern part of the Ogallala aquifer (Dutton and others, 2001; Dutton, 2004). For the historical simulation (1950 to 1999), we used pumpage as included in the GAM. For the predictive simulation (2000 to 2060) we used pumpage based on Region A demands. We proportionally adjusted predictive pumping in the GAM by category in each county to equal Region A demands. The predictive run in the original GAM only extends to 2050. To get to 2060, we took the adjusted pumping for 2050, proportionally adjusted this pumping by category in each county to equal Region A demands for 2060, and then linearly interpolated between 2050 and 2060. Since the original model was designed to end in 2050, we extended all other model parameters to 2060.

Once we ran the GAM, we calculated saturated thickness by subtracting the bottom elevation of the Ogallala aquifer as included in the GAM from the GAM calculated water levels. We contoured this saturated thickness data on a cell-by-cell basis in PMWIN 5.3 instead of using Surfer8© to create maps.

PARAMETERS AND ASSUMPTIONS:

- See Dutton and others (2001) and Dutton (2004) for assumptions and limitations of the GAM. Root mean squared error for this model is 53 feet. This error will have more of an effect on model results where the aquifer is thin.
- Recharge represents average conditions for the predictive period.

- Used a specific yield unique to each cell in the model instead of assuming a uniform 0.15 specific yield across the aquifer (GAM Run 05-13 dated April 5, 2005).

RESULTS:

Figures 1 through 12 show GAM historic and predicted saturated thicknesses. Note that the white areas in these figures represent inactive cells. As the predictive run progresses, more white appears in the GAM. These white areas represent parts of the GAM that are going dry because the aquifer can not continue to support the pumping. In the GAM, once a part of the model goes dry, it stays dry, and the pumping is "shut off." Cells adjacent to the dry cells with no pumping will still experience recharge and lateral inflow. This can result in water levels rising in nearby areas once the pumping in the area has stopped. This also results in less pumping in the model because the pumping has been stopped in these areas. In reality, the aquifer will probably not go dry because pumping will become uneconomical before the aquifer goes dry in any particular area. However, the GAM is suggesting that these areas may experience water supply problems sometime in the next 50 years. These figures have been revised from GAM Run 05-13 based on unique specific yield values for each cell instead of the average of 0.15 used earlier and using PMWIN 5.3 for creating the maps which did a better job of representing dry cells in the figures.

REFERENCES:

Dutton, A., 2004, Adjustments of parameters to improve the calibration of the Og-N model of the Ogallala aquifer, Panhandle Water Planning Area: prepared for Freese and Nichols, Inc. and the Panhandle Regional Water Planning Group by the Bureau of Economic Geology, The University of Texas at Austin, 9 p.

Dutton, A., Reedy, R., and Mace, R., 2001, Saturated thickness of the Ogallala aquifer in the Panhandle Water Planning Area – Simulation of 2000 through 2050 Withdrawal Projections: prepared for the Panhandle Water Planning Group by the Bureau of Economic Geology, The University of Texas at Austin, 54 p.

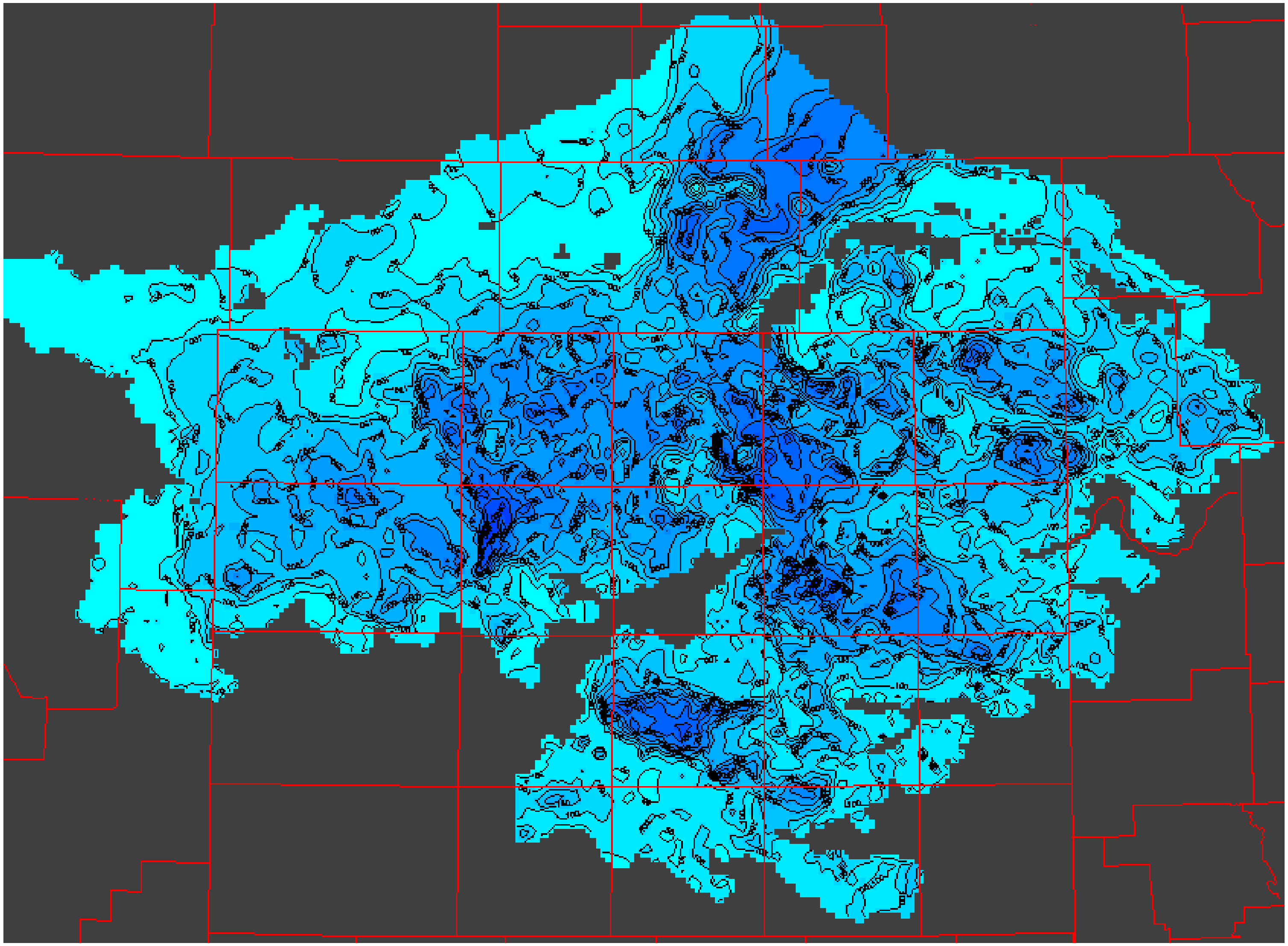

Figure 1: Saturated thickness of the northern Ogallala aquifer in 1950. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

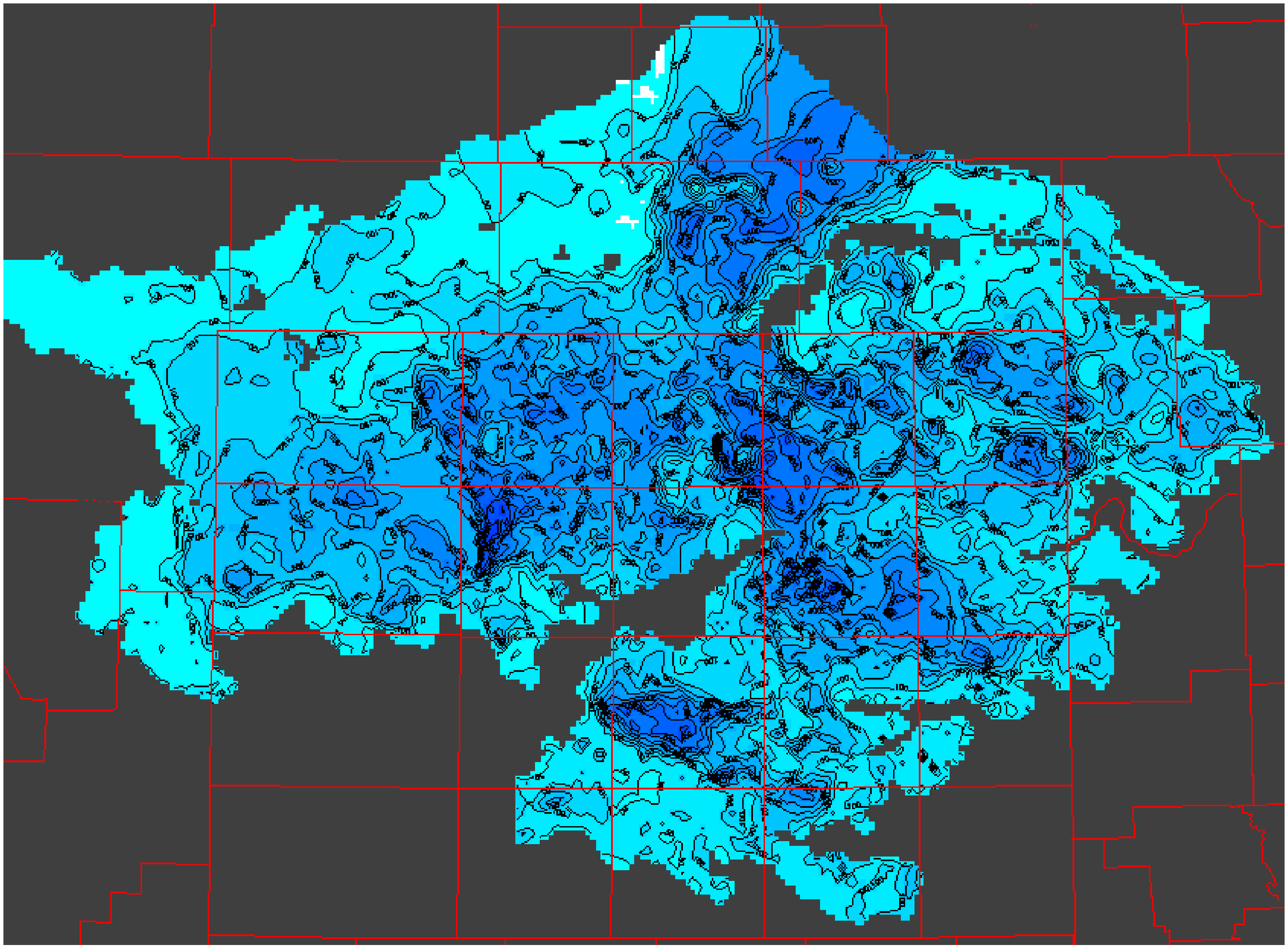

Figure 2: Saturated thickness of the northern Ogallala aquifer in 1960. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

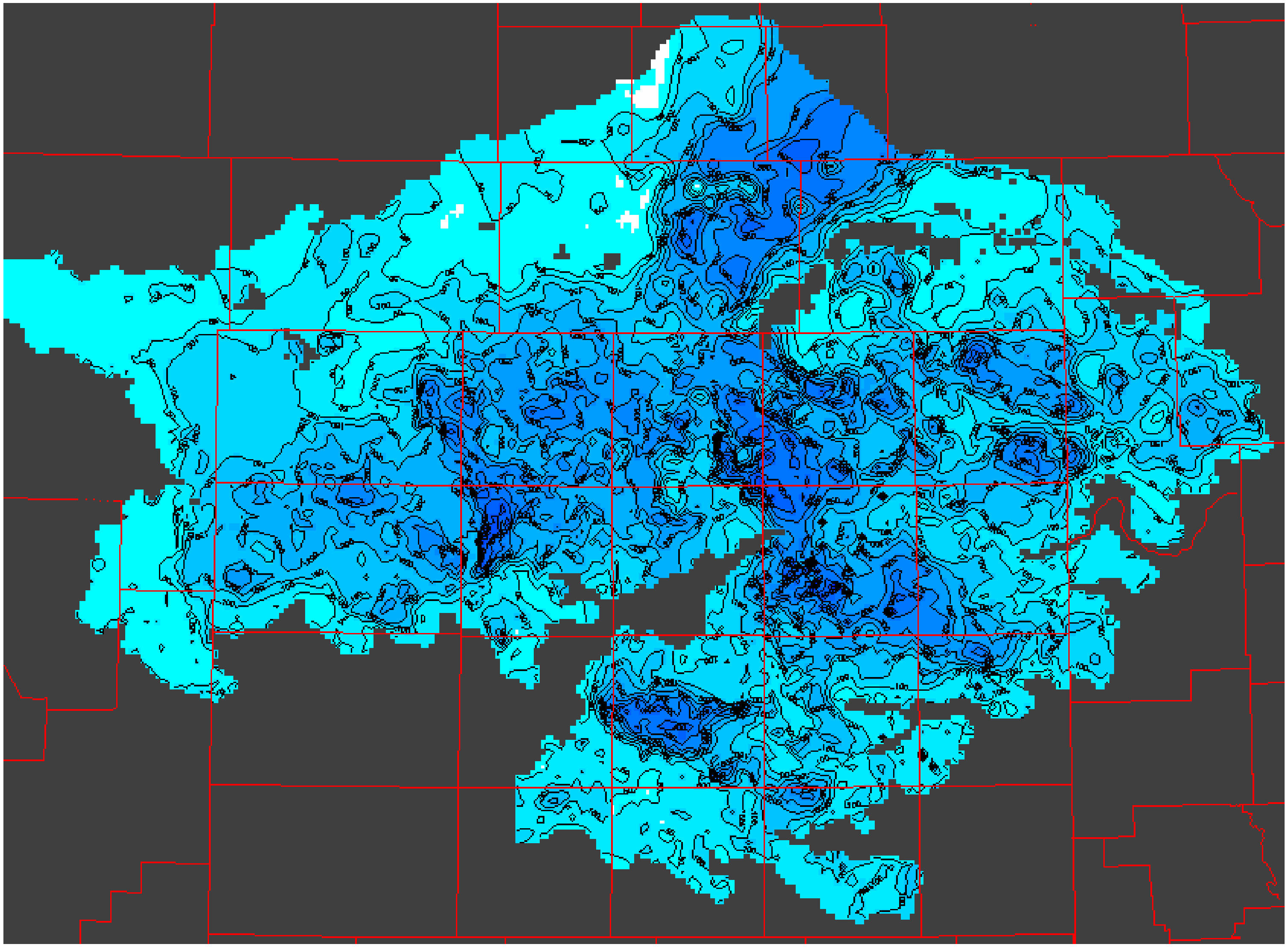

Figure 3: Saturated thickness of the northern Ogallala aquifer in 1970. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

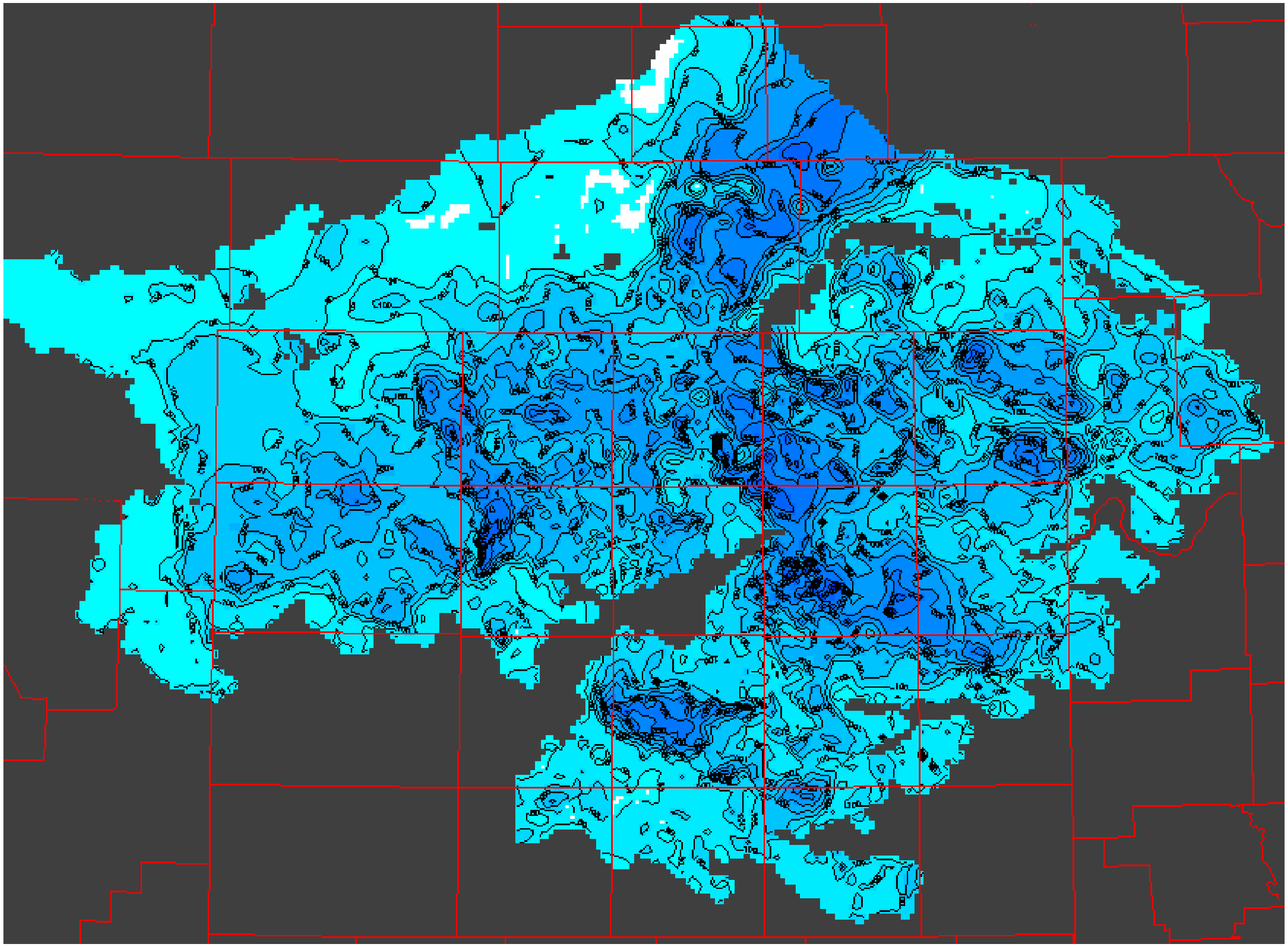

Figure 4: Saturated thickness of the northern Ogallala aquifer in 1980. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

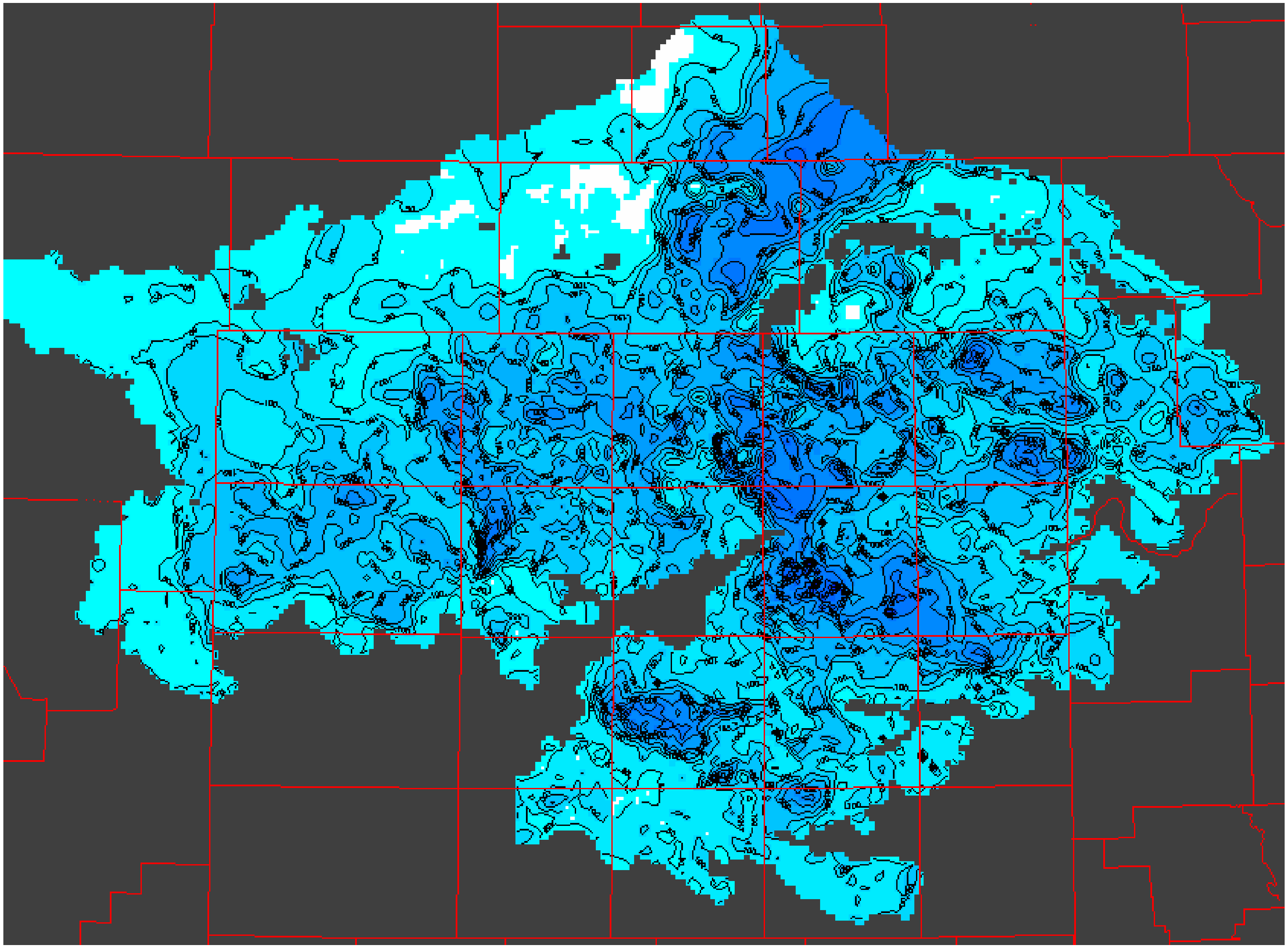

Figure 5: Saturated thickness of the northern Ogallala aquifer in 1990. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

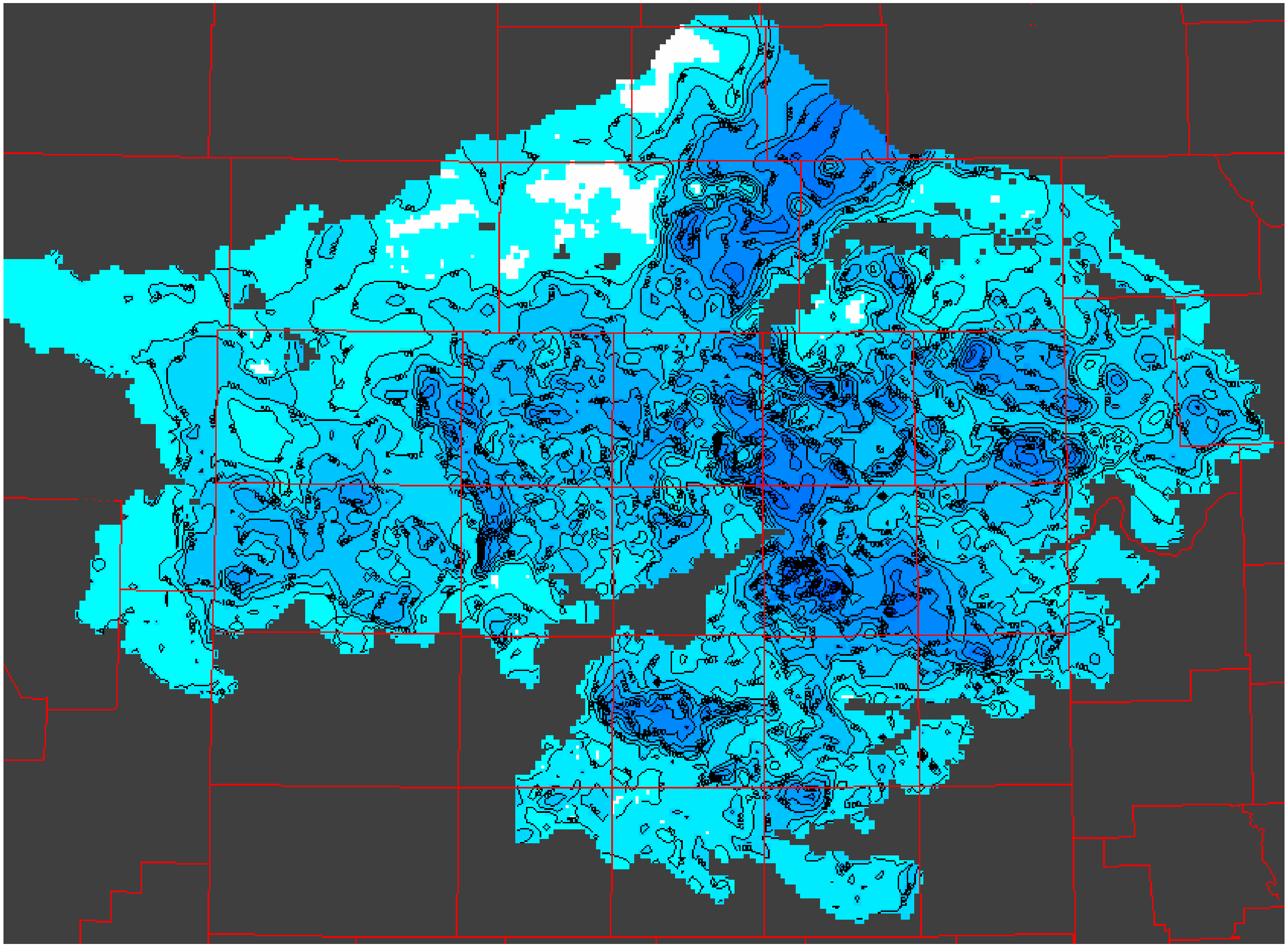

Figure 6: Saturated thickness of the northern Ogallala aquifer in 2000. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

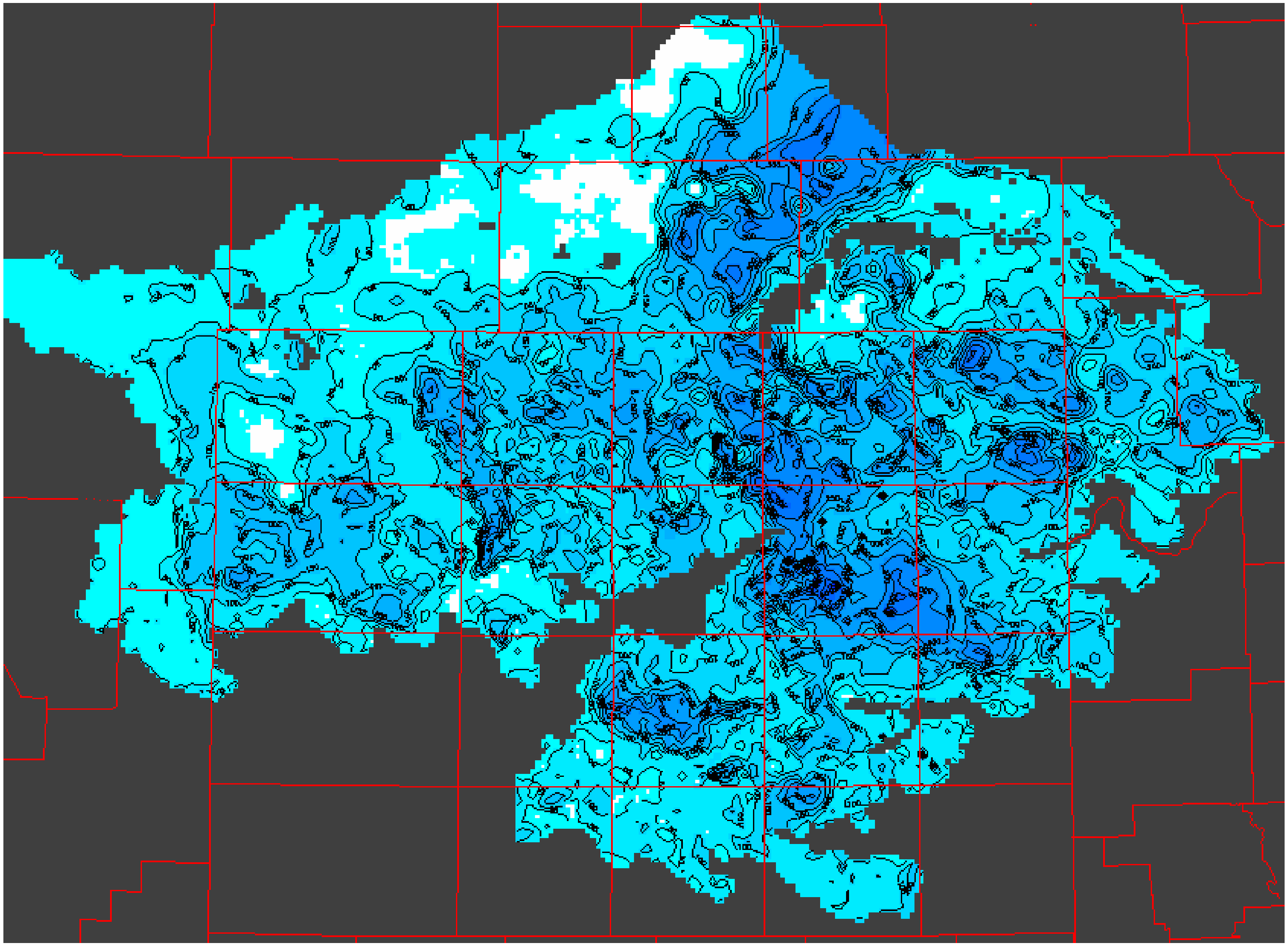

Figure 7: Saturated thickness of the northern Ogallala aquifer in 2010. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

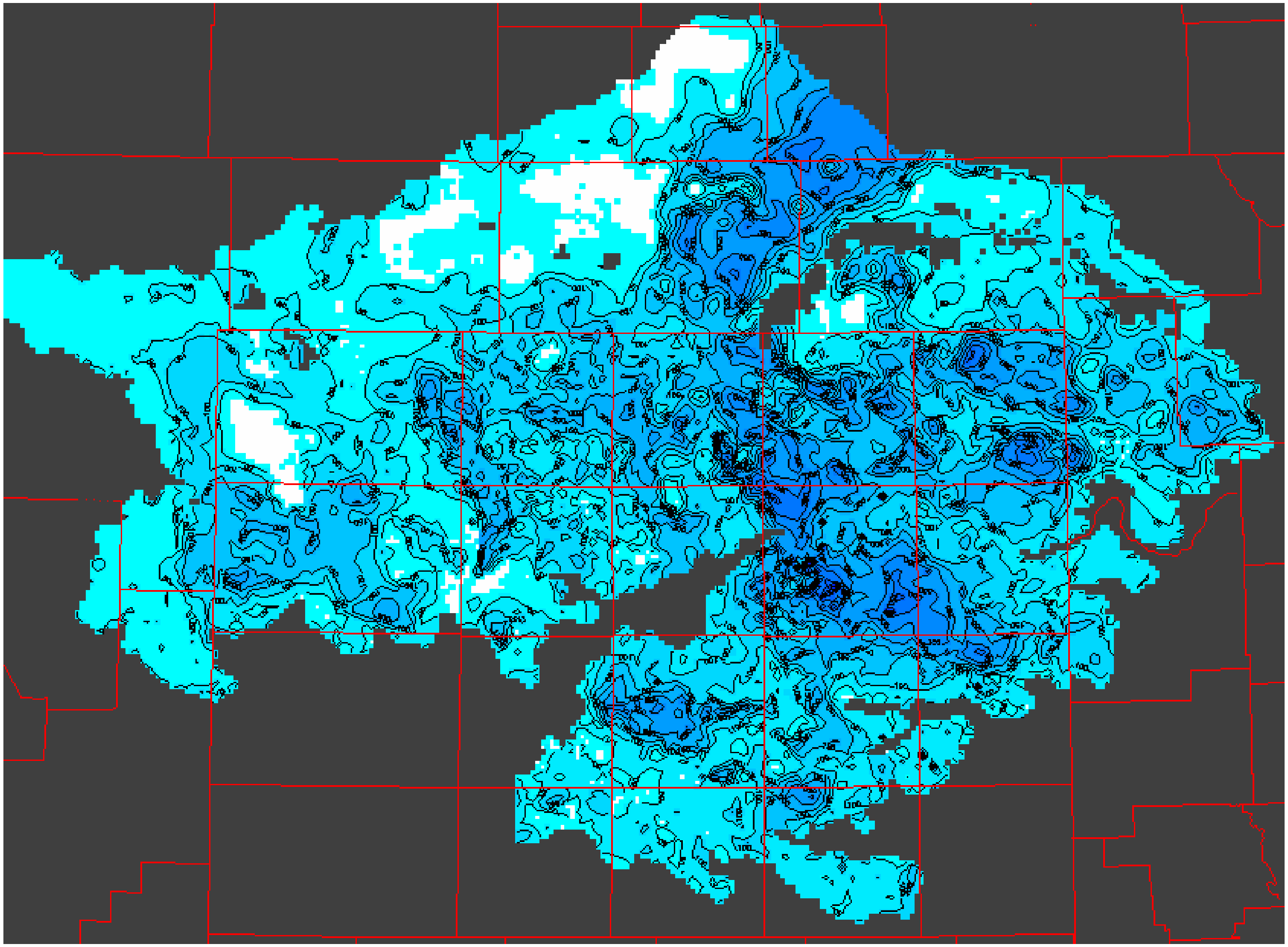

Figure 8: Saturated thickness of the northern Ogallala aquifer in 2020. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

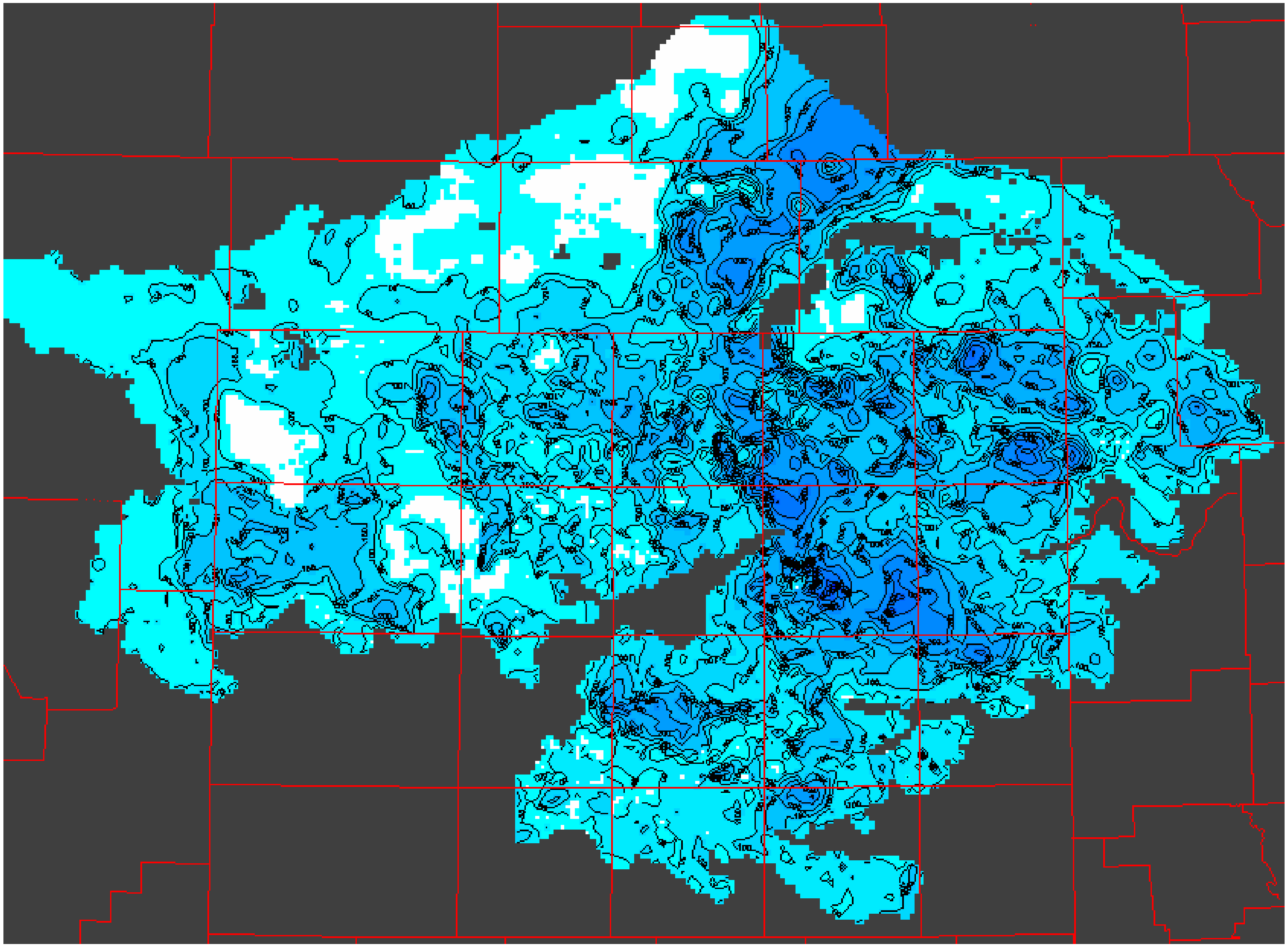

Figure 9: Saturated thickness of the northern Ogallala aquifer in 2030. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

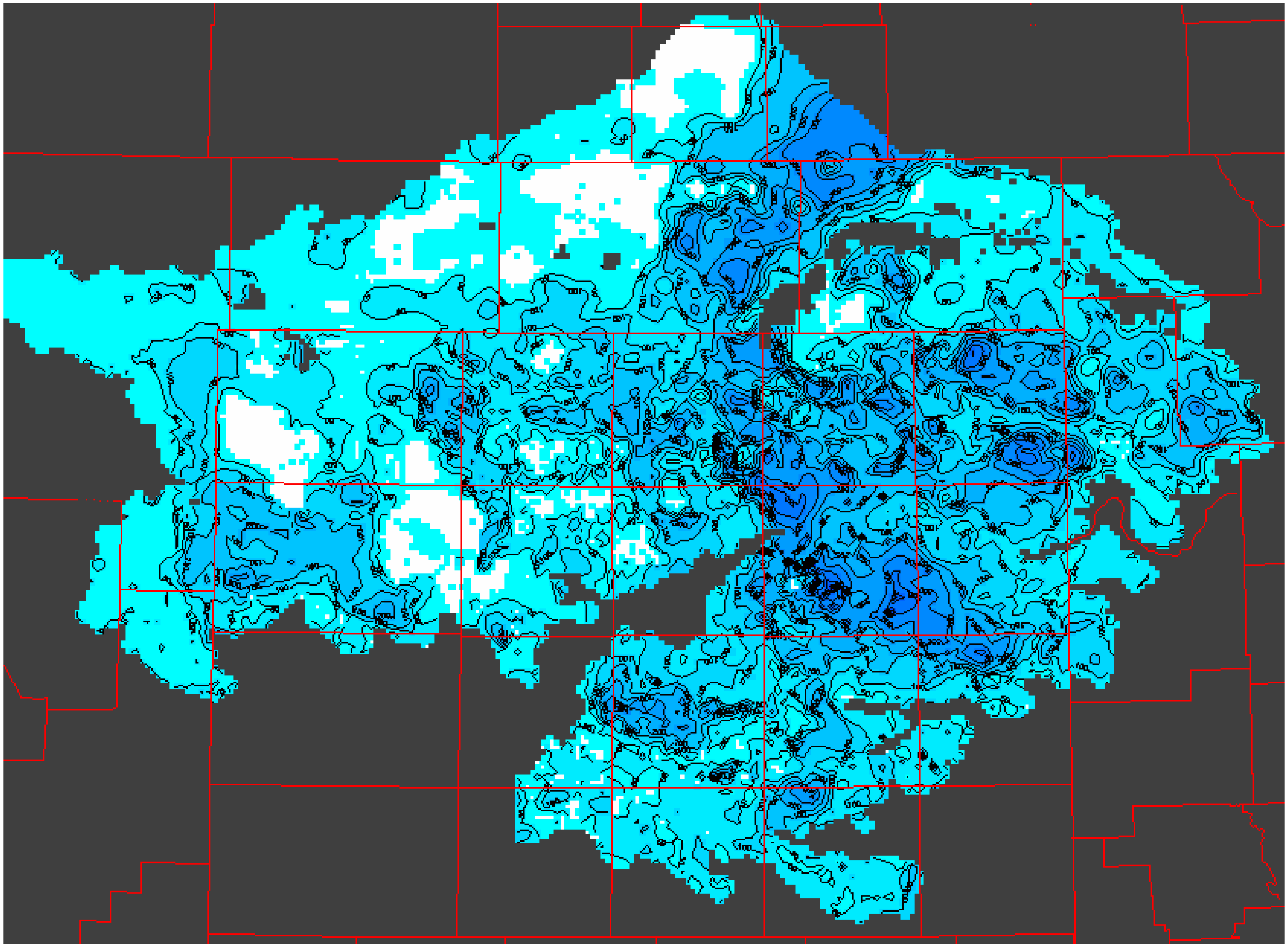

Figure 10: Saturated thickness of the northern Ogallala aquifer in 2040. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

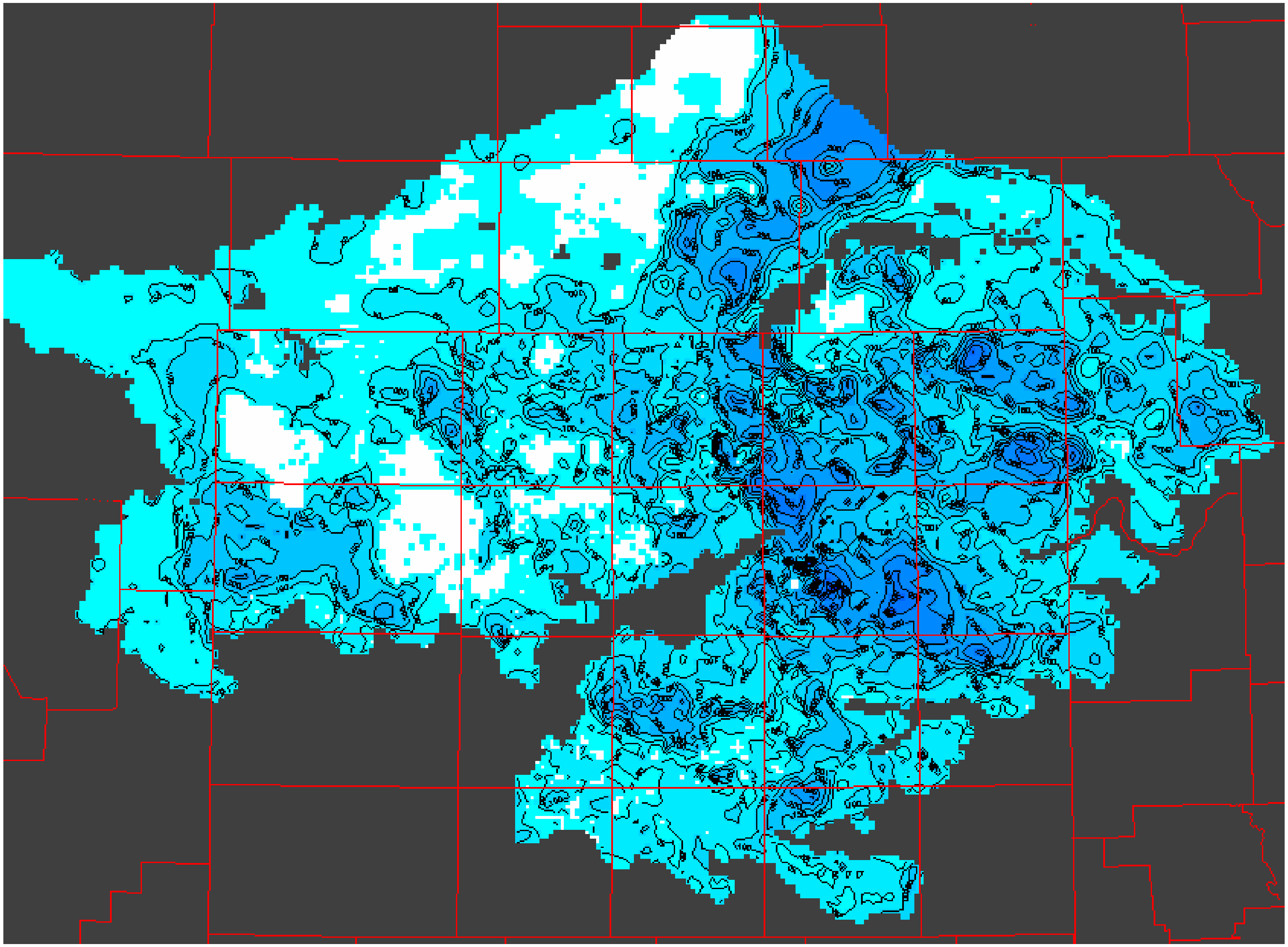

Figure 11: Saturated thickness of the northern Ogallala aquifer in 2050. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.

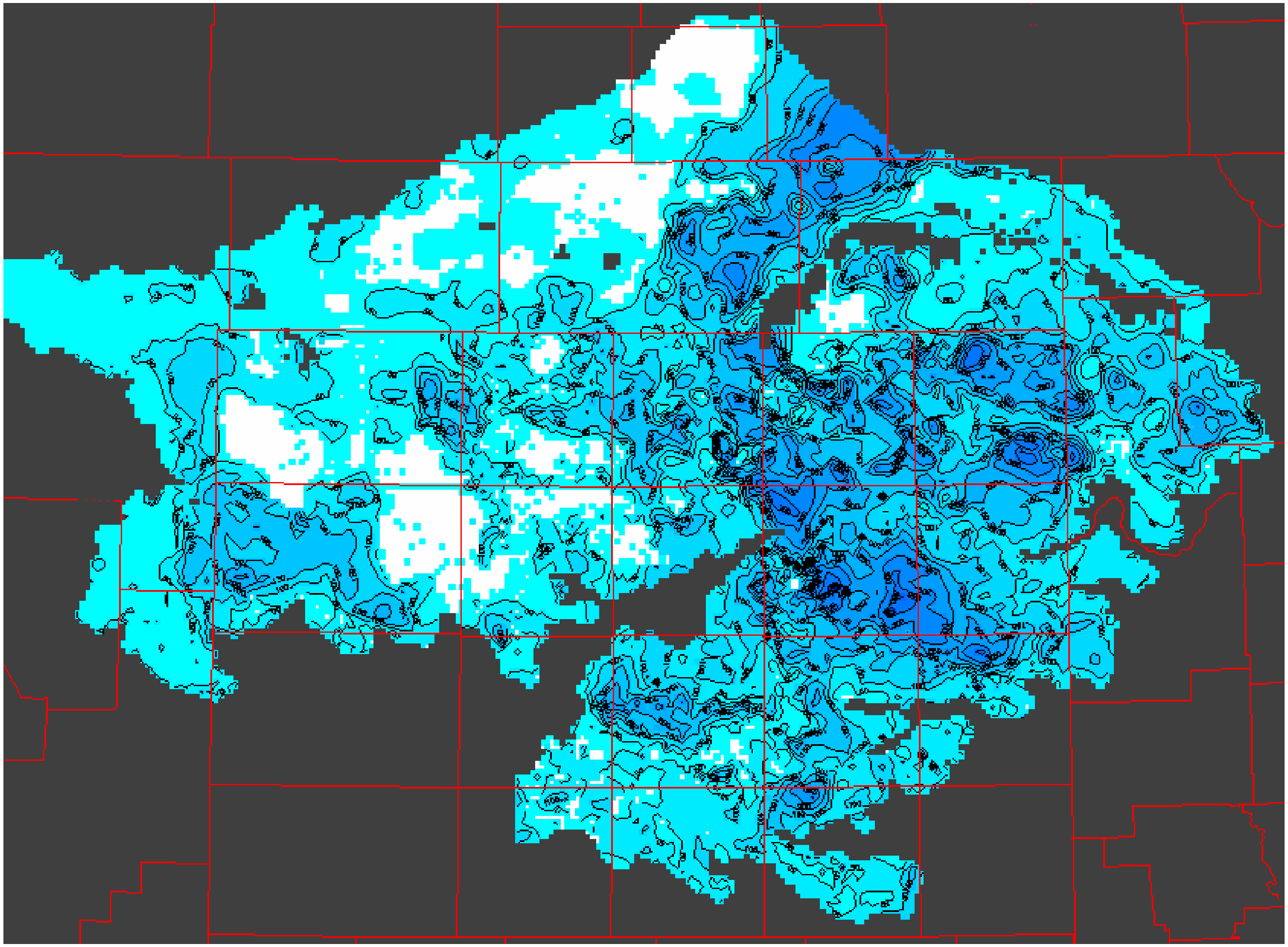

Figure 12: Saturated thickness of the northern Ogallala aquifer in 2060. North is at the top of the figure, county boundaries are in red, inactive cells are dark gray, and dry cells are white.