GAM Run 05-23

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June 11, 2005

REQUESTOR:

Mr. Neil Hudgins on behalf of the Coastal Bend Groundwater Conservation District and the Coastal Plains Groundwater Conservation District.

DESCRIPTION OF REQUEST:

Mr. Hudgins requested maps of water levels and water-level changes for Matagorda and Wharton counties to supplement the water budget data he requested from GAM Run 05-03. The requested maps are for Matagorda and Wharton counties for 1988, 1992, and the the predictive period (2005 through 2012). Additionally, Mr. Hudgins requested calculation of the total freshwater in storage in the Gulf Coast aquifer in the respective counties.

METHODS:

We used the historic and predictive models for the Groundwater Availability Model (GAM) for the central part of the Gulf Coast aquifer (Waterstone and Parsons, 2003; Chowdhury and others, 2004) to determine the water levels for Matagorda and Wharton counties. The historic model simulates groundwater flow through the central part of the Gulf Coast aquifer during the period 1980 through 2000. We extracted water levels from the GAM for zones representing Matagorda and Wharton counties for 1988, 1992, and the predictive period (2005 through 2012). The water levels reported for 1988 are the average water levels for that year. Similarly, the water levels for the predictive period are the average for the years 2005 through 2012. We calculated water-level changes for the respective counties relative to 1980 water levels, water levels at the beginning of the simulation.

We assumed that the total freshwater in storage for the unconfined Chicot aquifer is the product of the saturated thickness and specific yield where the saturated thickness is the difference between the water-level elevation and the elevation of the aquifer base. For the confined aquifers (the Evangeline aquifer, Burkeville confining unit, and Jasper aquifer), we assumed storage to be the product of the total aquifer thickness and specific yield.

PARAMETERS AND ASSUMPTIONS:

- See Chowdhury and others (2004) for assumptions and limitations of the GAM. The root mean squared errors for this model is 21 feet, 46 feet, and 36 feet for the steady-state, 1989, and 1999, respectively. This error will have more of an effect on model results where the aquifer is thin. In addition, the model assumes that pumping in the Evangeline aquifer only occurs in the upper part of the Evangeline aquifer (Chowdhury and others, 2004).

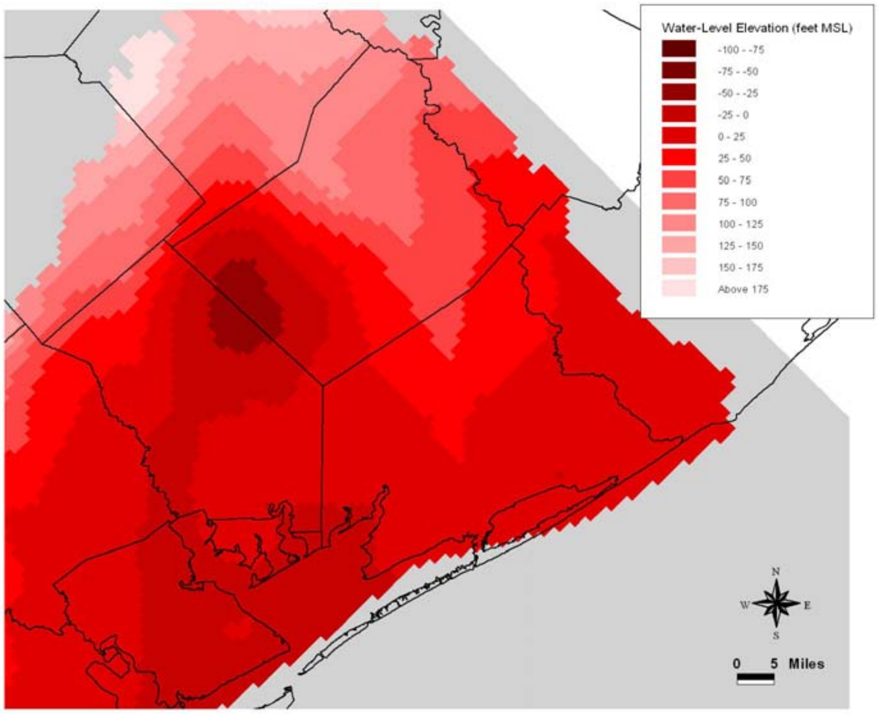
- Assumed uniform specific yield values of 0.05, 0.1, 0.005, and 0.05 in the Chicot aquifer, Evangeline aquifer, Burkeville confining unit, and Jasper aquifer, respectively.
- We used the same assumptions listed in GAM run 05-03 for the predictive simulation pumpage and recharge.

RESULTS:

The water-level elevation maps from the GAM indicate that groundwater generally flows towards the southeast in Matagorda and Wharton counties (Figures 1 through 12). In 1988, there is a cone of depression in the Chicot and Evangeline aquifers that is centered in western Wharton County. This cone of depression is less apparent in 1992 and not apparent in the underlying Burkeville confining unit and Jasper aquifer. The cone of depression is the product of pumping from the Chicot and Evangeline aquifers. The higher water levels in 1992 are due to less pumping during 1992, the wettest year in the 1980 through 2000 transient simulation.

Water-level changes indicate on average higher water levels in the Chicot and Evangeline aquifers and lower water levels in the Burkeville confining unit and Jasper aquifer for 1988, 1992, and the predictive period relative to 1980 water levels. In Matagorda County, water-level changes range from -12 to 10 feet in the Chicot aquifer, 0 to 23 feet in the Evangeline aquifer, and -11 to -1 feet in the Burkeville confining unit. In Wharton County, water-level changes range from -12 to 45 feet in the Chicot aquifer, -4 to 39 feet in the Evangeline aquifer, -19 to 8 feet in the Burkeville confining unit, and -44 to -5 feet in the Jasper aquifer.

Table 1 shows estimates of freshwater storage in the respective aquifers in Matagorda and Wharton counties. These estimates are a function of assumed specific yield and variation of the saturated thickness for each model layer. Saturated thickness only varies with water-level fluctuations in unconfined aquifers. Consequently, freshwater storage only varies in the Chicot aquifer from 43,900,000 to 44,000,000 acre-feet in Matagorda County and from 24,000,000 to 24,200,000 acre-feet in Wharton County. In Matagorda County, freshwater storage is 65,400,000 acre-feet, 656,000 acre-feet, and 8,500,000 acre-feet in the Evangeline aquifer, Burkeville confining unit, and Jasper aquifer, respectively. In Wharton County, freshwater storage is 89,300,000 acre-feet, 2,500,000 acre-feet, and 22,400,000 acre-feet in the Evangeline aquifer, Burkeville confining unit, and Jasper aquifer, respectively.



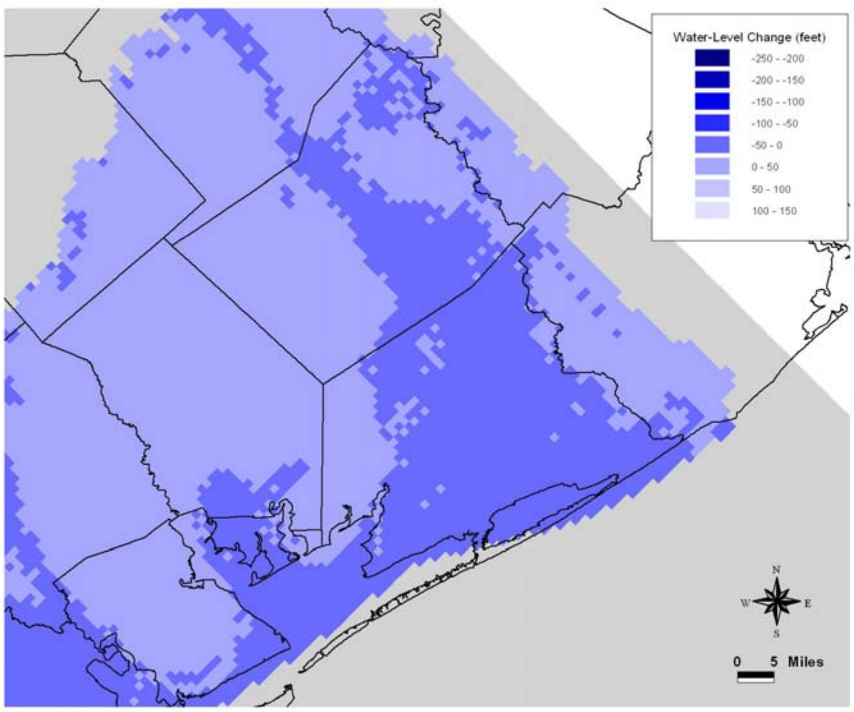


Figure 1. Average water-level elevations for 1988 in the Chicot aquifer and average water-level changes relative to 1980 water levels.

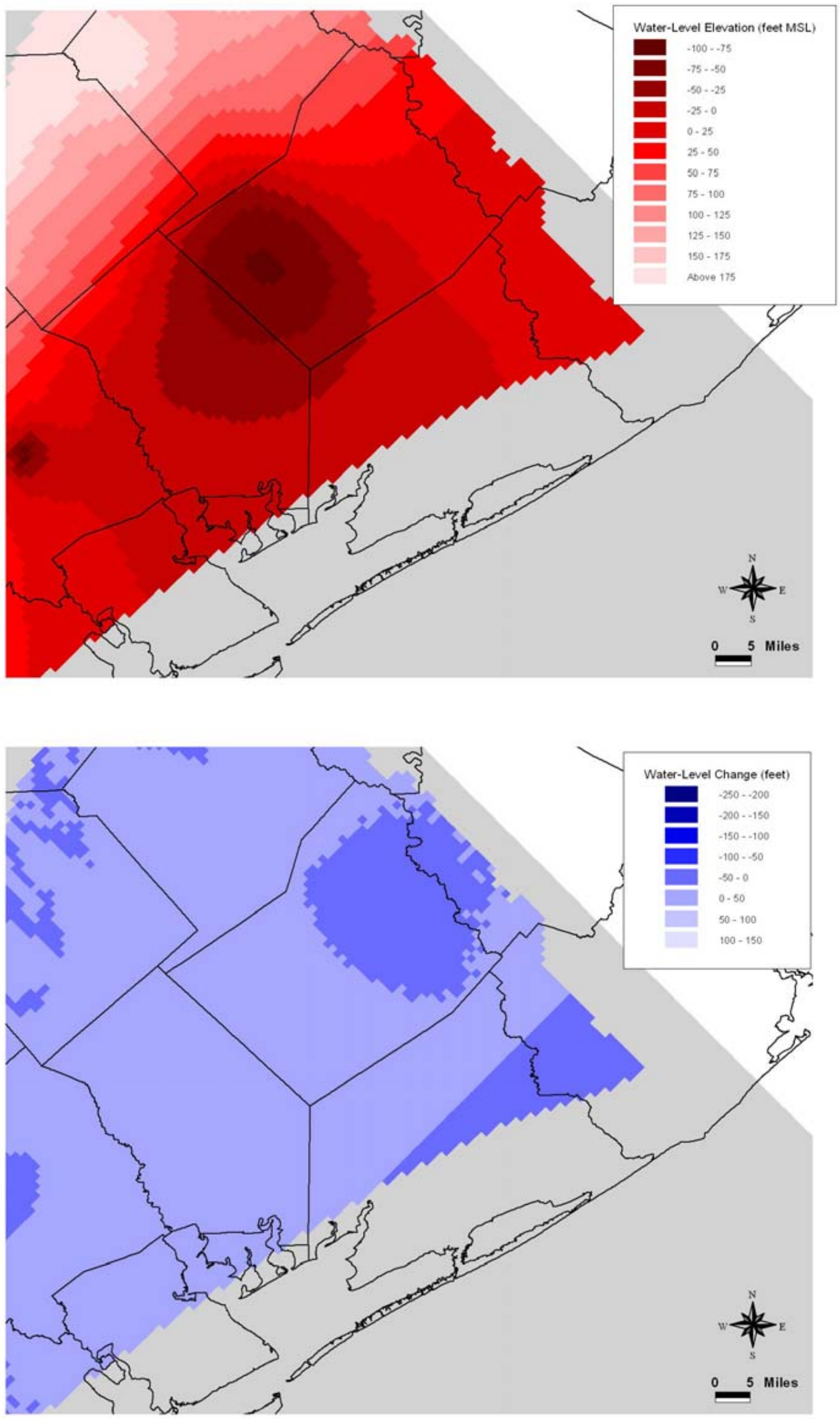


Figure 2. Average water-level elevations for 1988 in the Evangeline aquifer and average water-level changes relative to 1980 water levels.

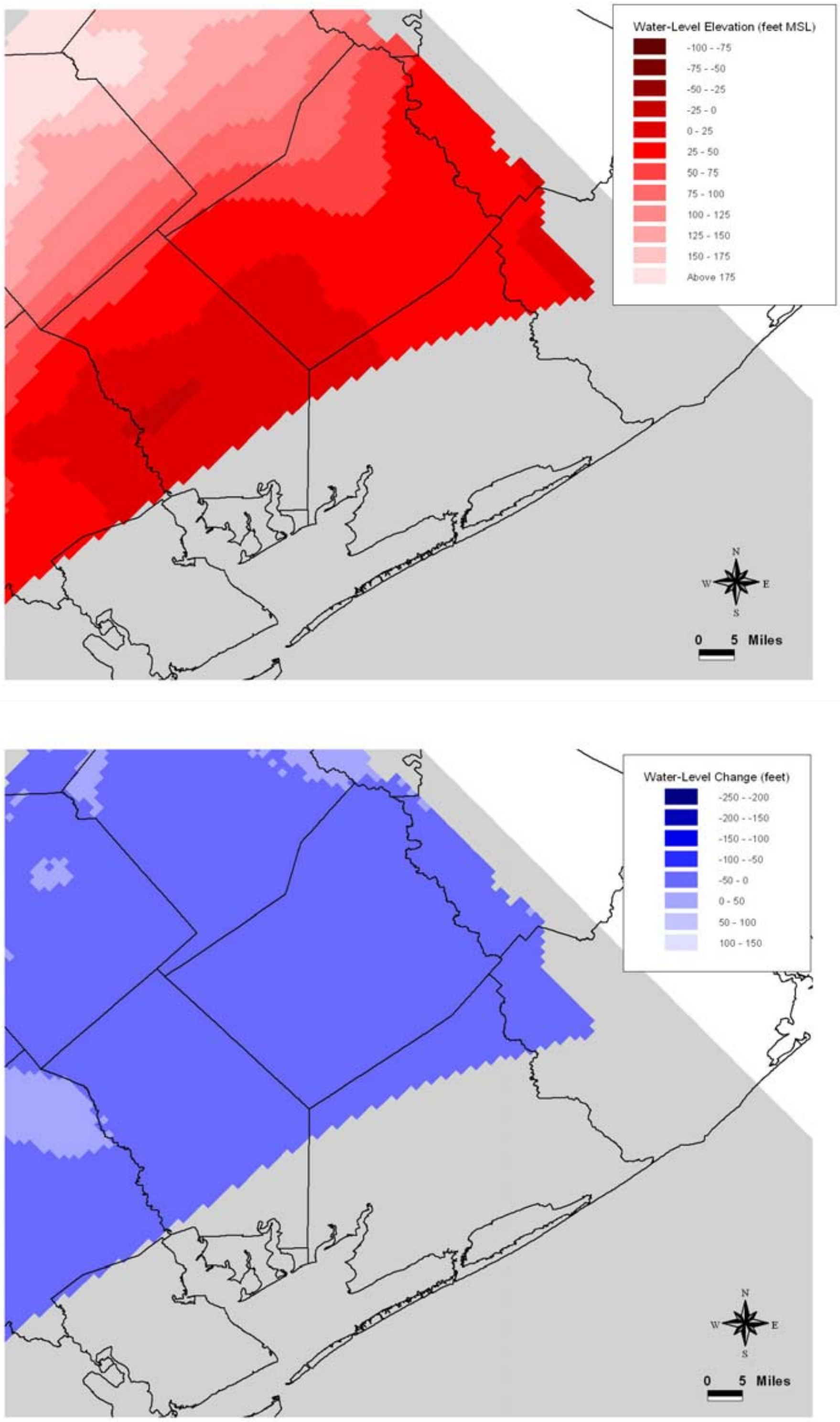


Figure 3. Average water-level elevations for 1988 in the Burkeville confining unit and average water-level changes relative to 1980 water levels.

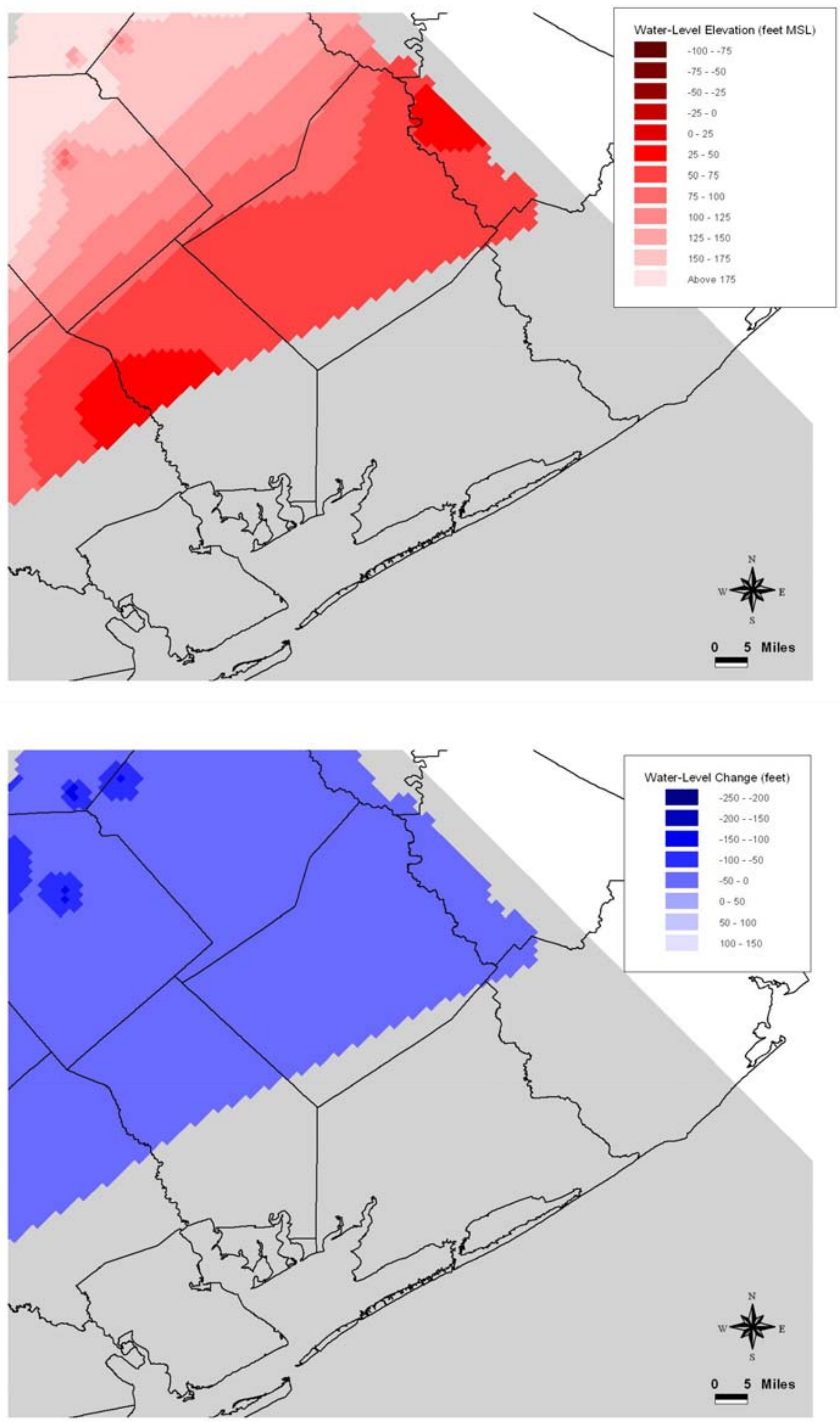


Figure 4. Average water-level elevations for 1988 in the Jasper aquifer and average water-level changes relative to 1980 water levels.

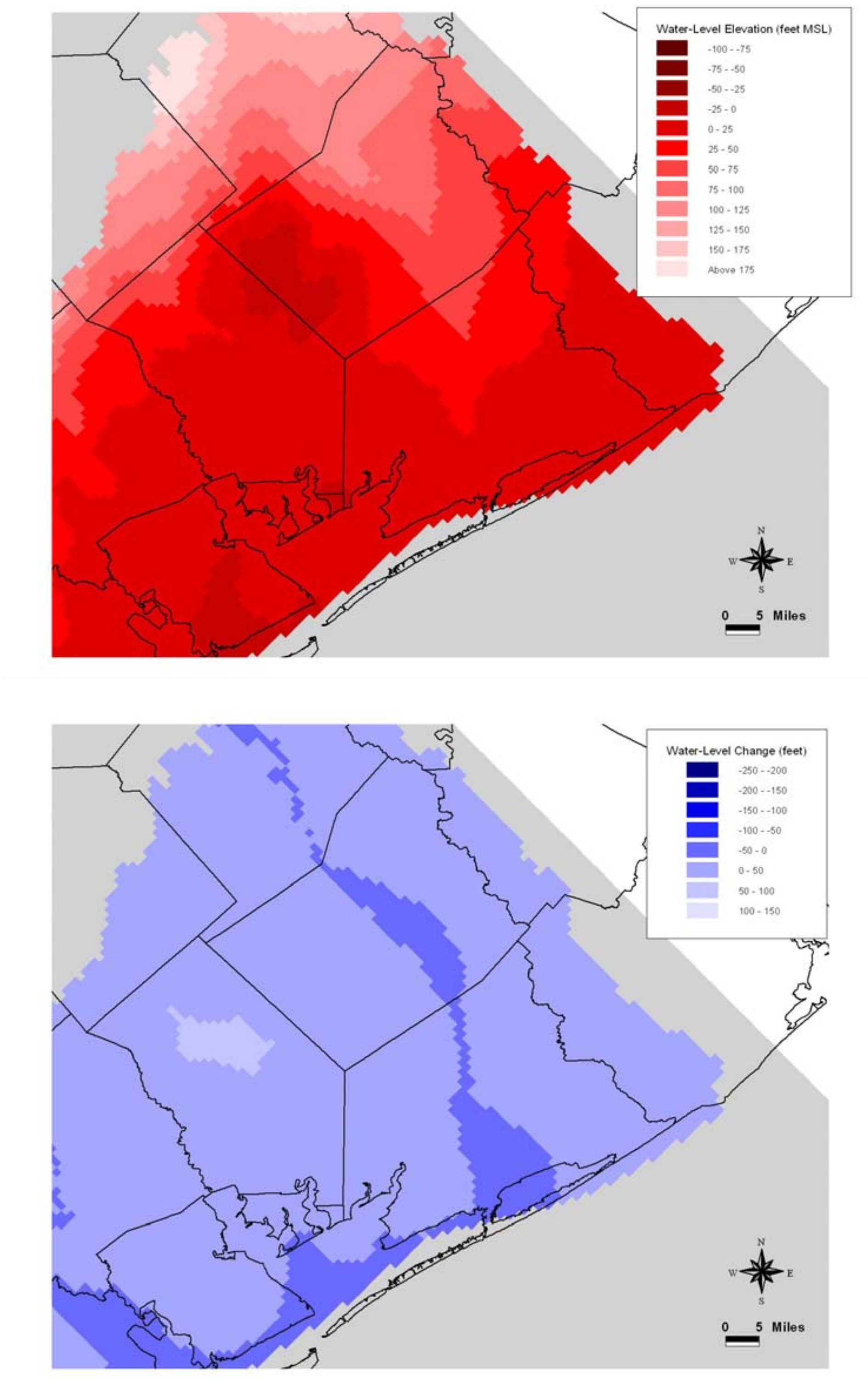


Figure 5. Chicot aquifer water-level elevations for 1992 and water-level changes relative to 1980 water levels.

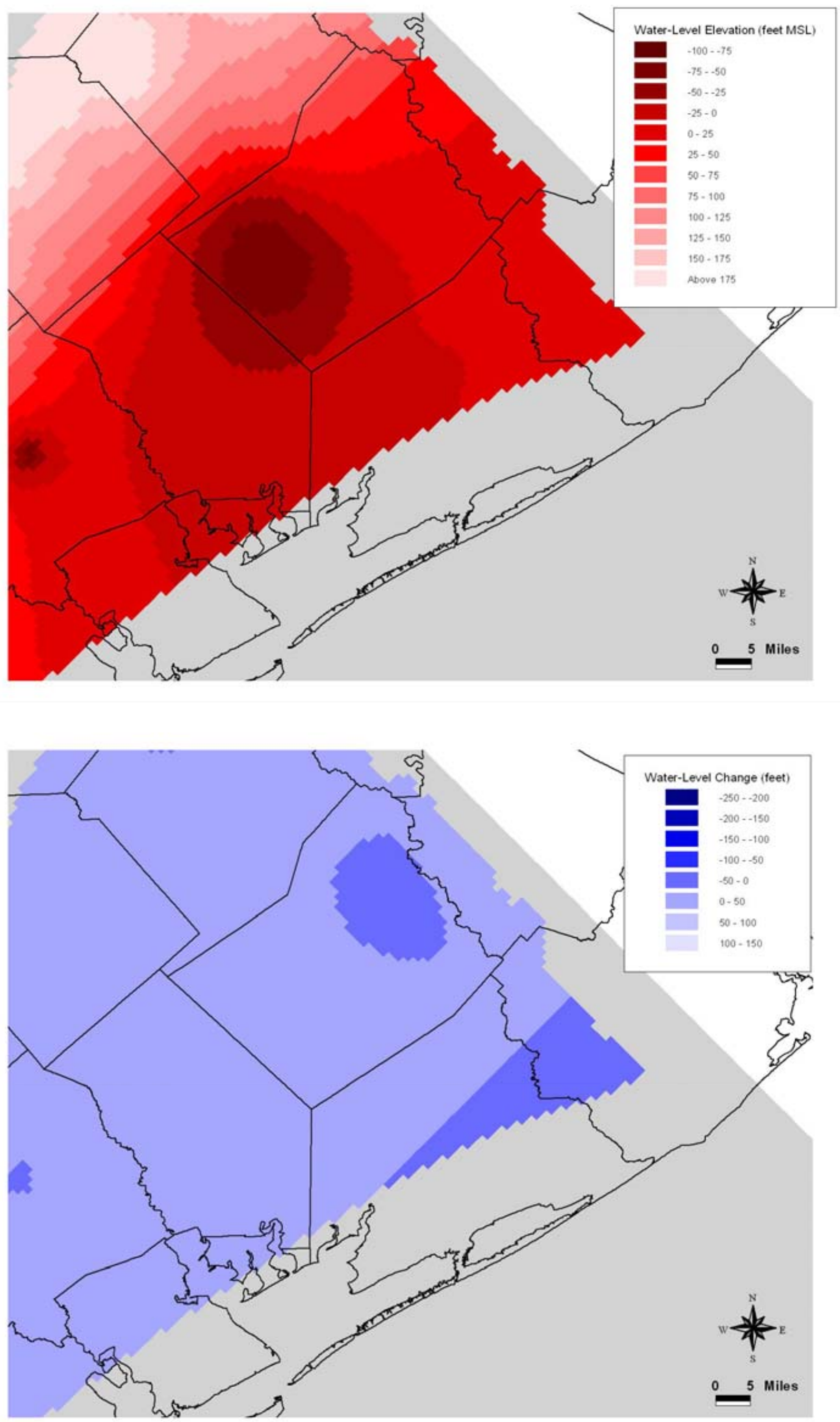


Figure 6. Evangeline aquifer water-level elevations for 1992 and water-level changes relative to 1980 water levels.

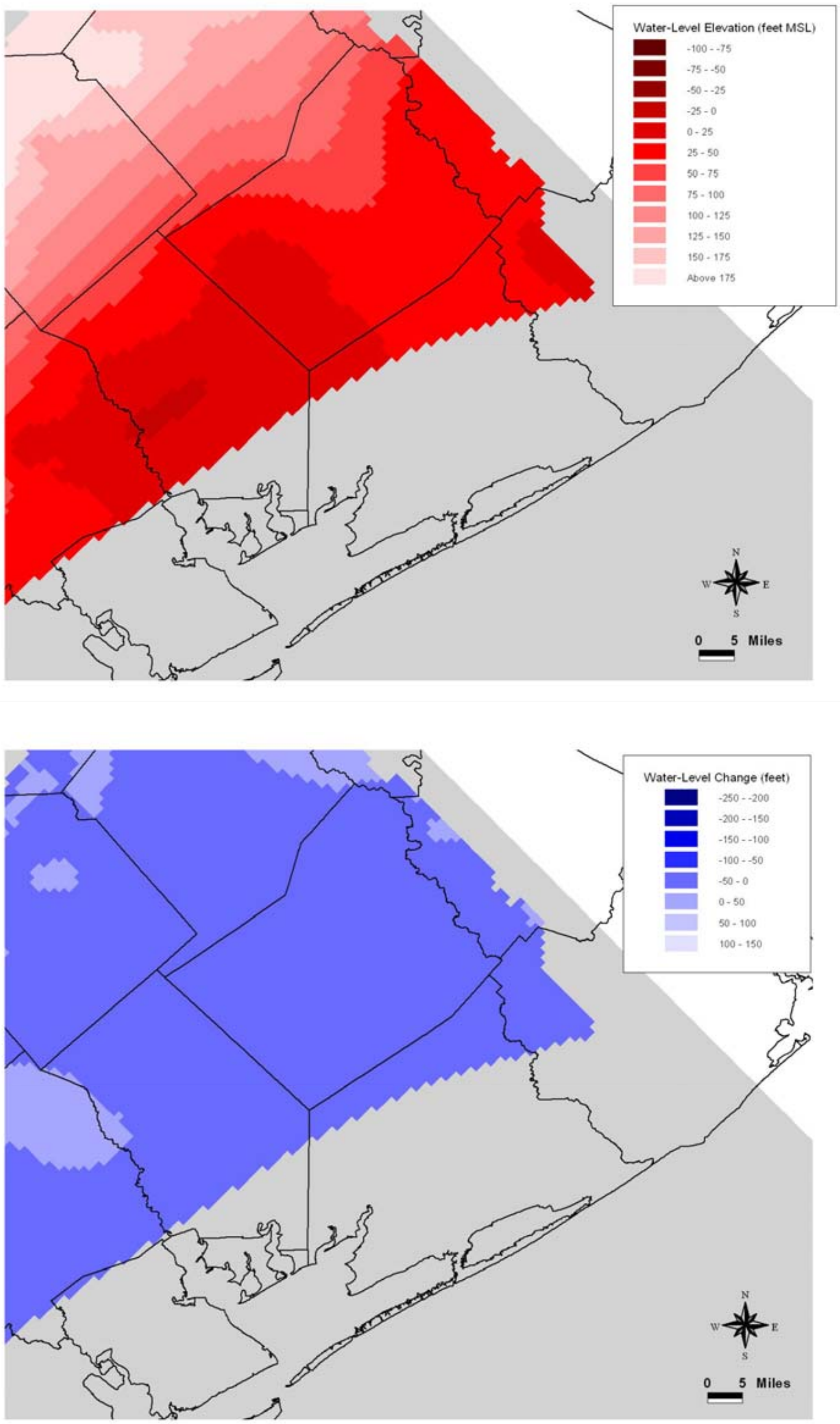


Figure 7. Burkeville confining unit water-level elevations for 1992 and water-level changes relative to 1980 water levels.

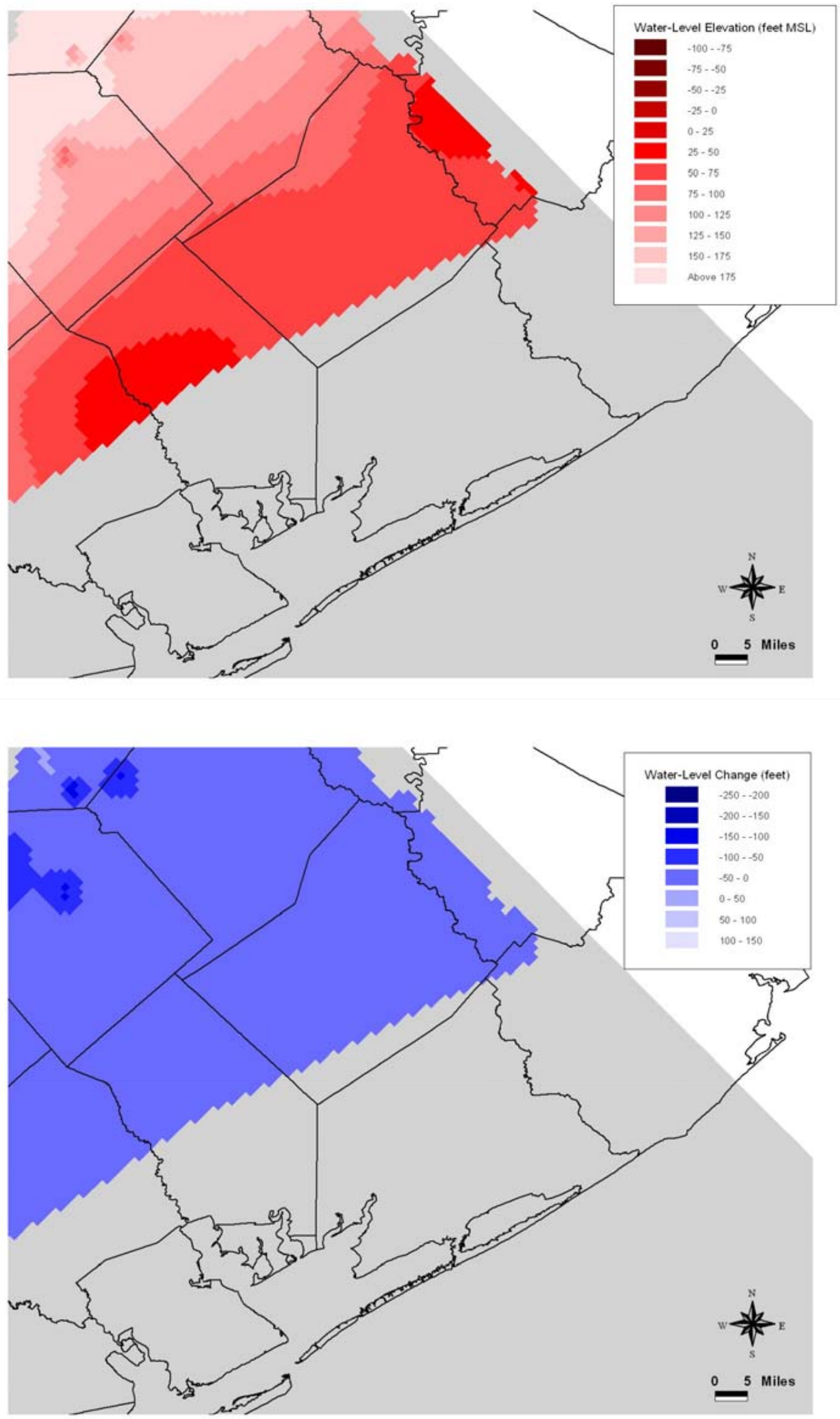


Figure 8. Jasper aquifer water-level elevations for 1992 and water-level changes relative to 1980 water levels.

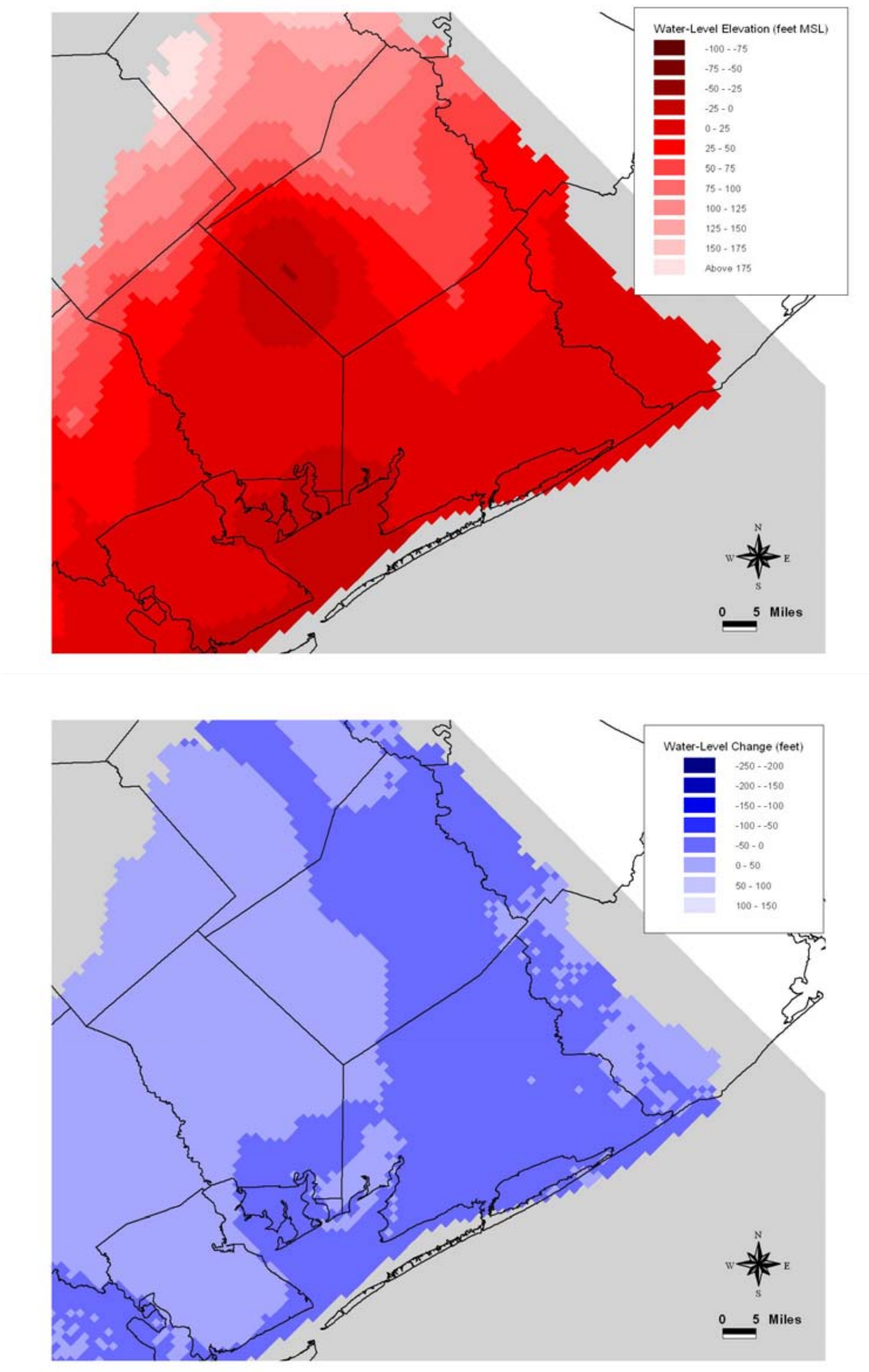


Figure 9. Average water-level elevations for the predictive period 2005 through 2012 in the Chicot aquifer and average water-level changes relative to 1980 water levels.

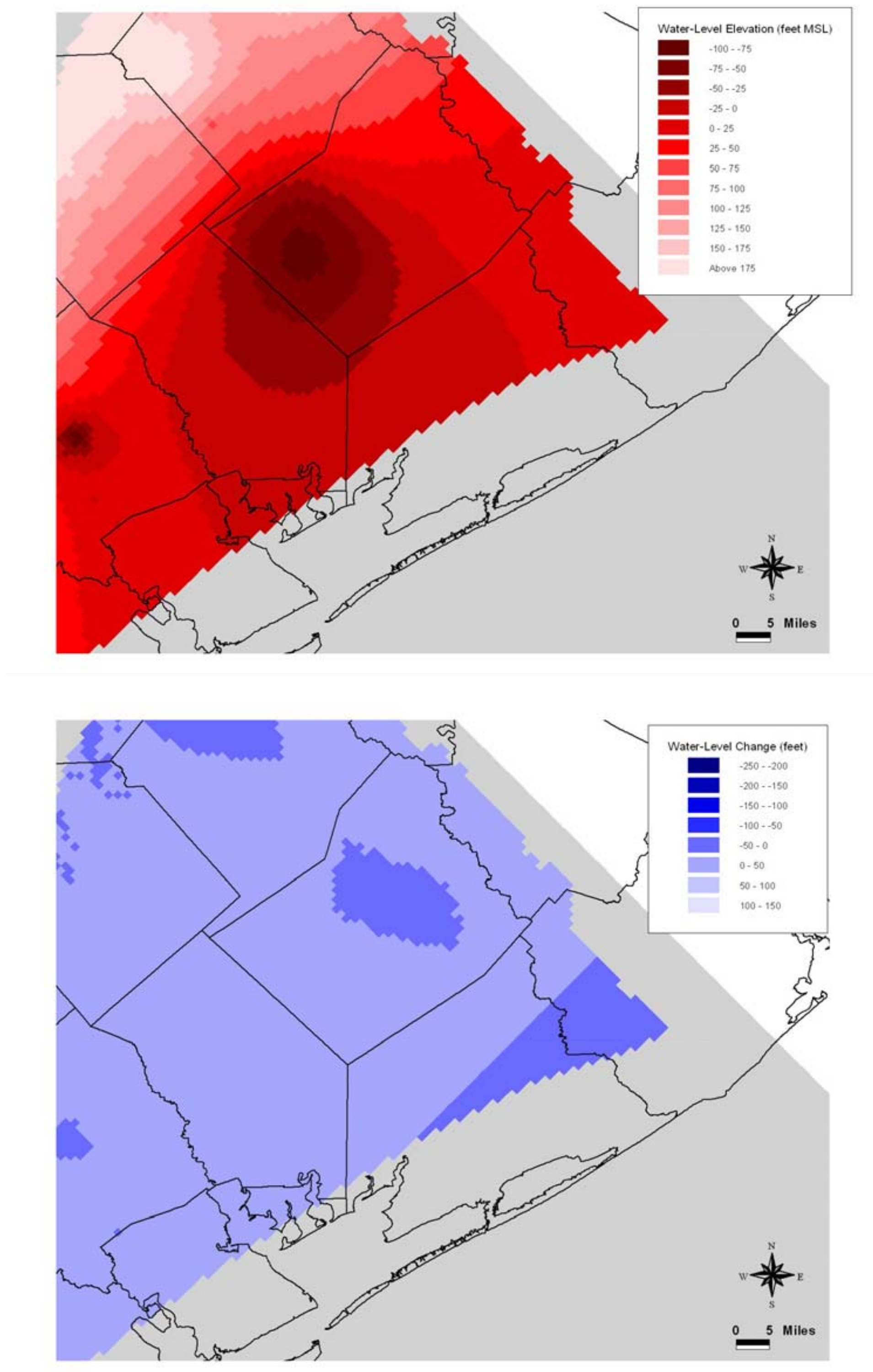


Figure 10. Average water-level elevations for the predictive period 2005 through 2012 in the Evangeline aquifer and average water-level changes relative to 1980 water levels.

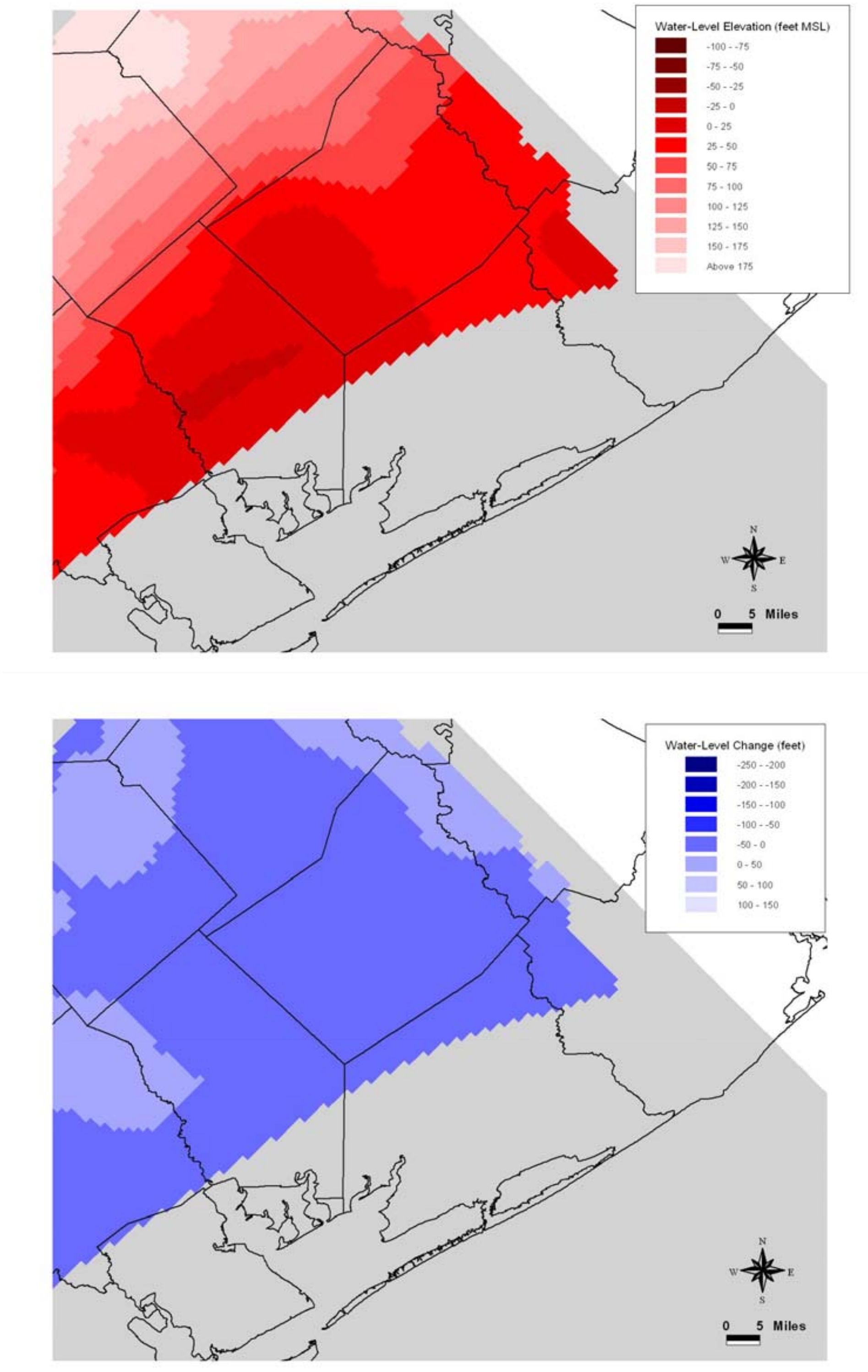


Figure 11. Average water-level elevations for the predictive period 2005 through 2012 in the Burkeville confining unit and average water-level changes relative to 1980 water levels.

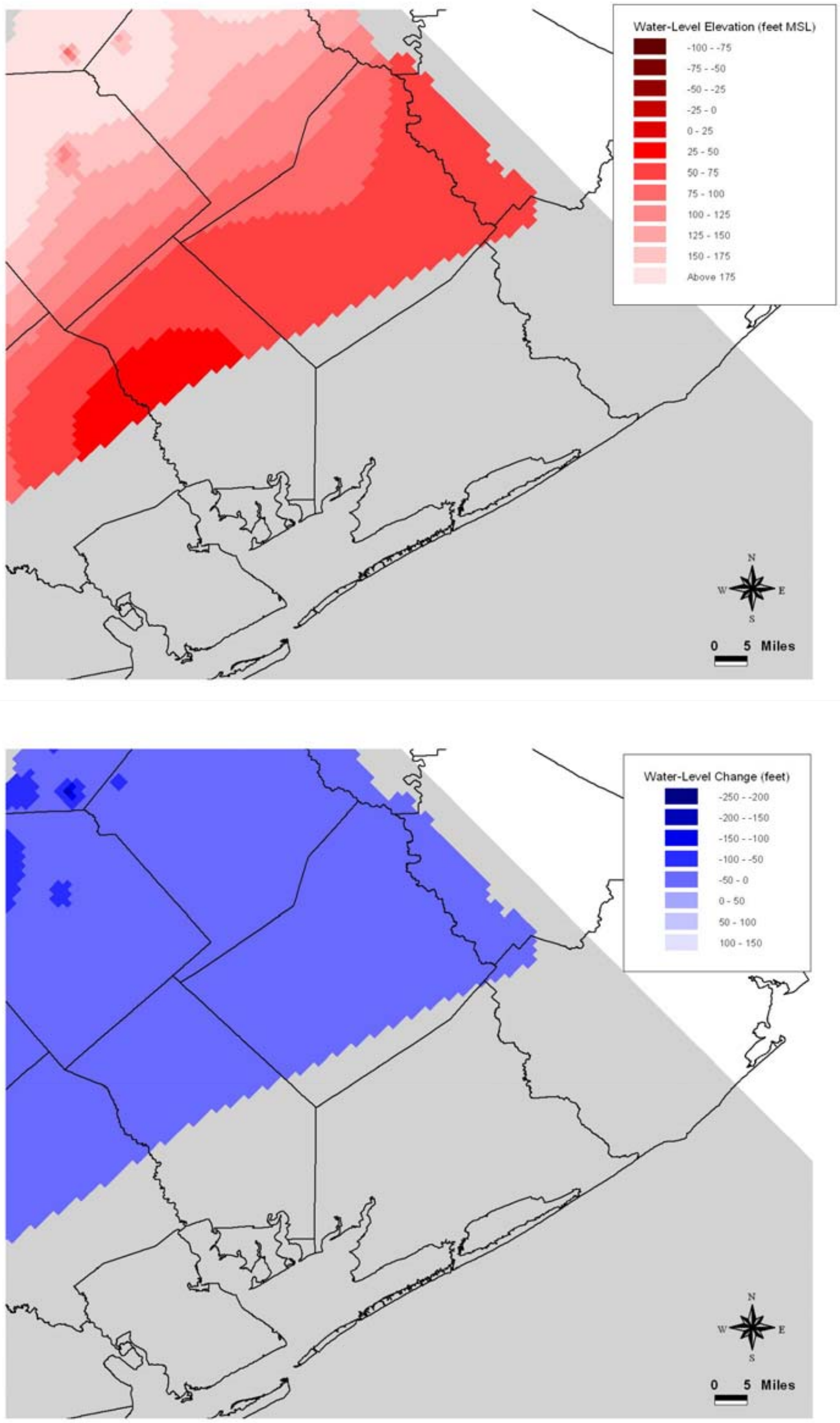


Figure 12. Average water-level elevations for the predictive period 2005 through 2012 in the Jasper aquifer and average water-level changes relative to 1980 water levels.

Table 1. Total freshwater storage estimates for Matagorda and Wharton counties, expressed in acre-feet.

County	Total Storage (acre-feet)		
	1988	1992	Predicted
Matagorda County			
Chicot aquifer	43,900,000	44,000,000	43,800,000
Evangeline aquifer	65,400,000	65,400,000	65,400,000
Burkeville confining unit	656,000	656,000	656,000
Jasper aquifer	8,500,000	8,500,000	8,500,000
Wharton County			
Chicot aquifer	24,000,000	24,200,000	24,000,000
Evangeline aquifer	89,300,000	89,300,000	89,300,000
Burkeville confining unit	2,500,000	2,500,000	2,500,000
Jasper aquifer	22,400,000	22,400,000	22,400,000

REFERENCES:

Chowdhury, A. H., Wade, S., Mace, R. E., and Ridgeway, C., 2004, Groundwater availability model of the Central Gulf Coast aquifer system: Numerical simulations through 1999: Texas Water Development Board, draft report, 108 p.

Waterstone Environmental Hydrology and Engineering, Inc., and Parsons Engineering Science, Inc., 2003, Groundwater availability of the central Gulf Coast aquifer: Numerical simulations to 2050 central Gulf Coast, Texas: prepared for the Texas Water Development Board, unpublished report, 156 p.