Appendix K

Water Supply Estimation
for
Water Management Strategy
for
Confined Animal Feeding Enterprises
for
Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer Counties

Purpose: The development of the CAFO water management strategy consisted of identifying those CAFOs that are projected to experience a water need (shortage) during the 2010 through 2060 planning period and developing a potential water management strategy to meet the projected need using groundwater from the Ogallala Aquifer within the county where the shortage is projected to occur.

Methods: The initial approach in determining which, if any, of the CAFOs would be expected to experience a water shortage was to utilize the Groundwater Availability Model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico. The intent was to use this model, called the E-T (HP) GAM, to simulate projected 2000-2060 groundwater pumpage and recharge to provide information on areas where the saturated thickness could not producing wells.[1] It was intended to use a comparison of the model's saturated thickness map with a map showing the locations of the CAFOs in order to identify water supplies for individual CAFOs for the purpose of estimating whether or not supplies at the respective locations would be adequate to meet projected water needs. However, a review of the model's calibration shows dry cells underlying large areas of Bailey, Parmer and Deaf Smith Counties; i.e.; the model calculated groundwater levels below the base of the aquifer. Since these results are inconsistent with the knowledge that few, if any, wells used by CAFOs in these counties were dry in 2009, the planned approach could not be used, and an alternative approach, as described below, was selected.

The selected alternative approach in determining which CAFOs, if any, would be expected to experience a shortage and when it would occur is based upon an analysis of historical and trends in groundwater levels and saturated thickness of the Ogallala at each CAFO.

[1] "Groundwater Availability Model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico," Blanford, T. Neil, P.G. Muthu Kuchanur, PhD, Allan Standen, P.G., Robert Ruggiero, P.G., Kenneth C. Calhoun, Paul Kirby, and Gopika Sha, Daniel B. Stephens & Assocoates, Inc. Texas Water Development Board, Austin, Texas, December 2008.

The primary data and information used included maps of the base of the Ogallala aquifer and recent measurements of groundwater levels in monitoring wells of Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer Counties where CAFOs are located. The steps included:

a. estimating the base of the Ogallala aquifer, the 1995 water level and 1995 saturated thickness of the aquifer at each CAFO location (available aquifer saturated thickness maps for these counties were prepared based upon 1995 water levels and is the beginning point for projecting future water levels and quantities of water in storage);[2]
b. compiling measured groundwater levels for each long-term monitor well in the six counties for the period 1990- 2009;
c. calculating the recent (1998-2009) trend in groundwater levels at each of the monitor wells in the vicinity of each CAFO;
d. calculating an adjustment to the 1998-2009 trend for use in projecting water levels from 2009-2060 (As water levels and saturation thicknesses decline, it is projected that well yields and quantities pumped will also decline, resulting in a slowing of the declining trends in water levels at the monitor wells. The adjustment factor selected for use here is to level out projected declining trends to result in projected saturated thickness in 50 years that is 50 percent of estimated saturated thickness in 2010.);
e. estimating the groundwater level trend at each CAFO that considers the historical trend and the adjustment for declining water levels described in item d, above;
f. calculating the projected groundwater level at each CAFO for each decade from 2010 through 2060 by using the estimated 1995 water levels and trends in groundwater level declines;
g. calculating the saturated thickness at each CAFO for each decade from 2010 through 2060 using the projected groundwater levels and the estimated base of the aquifer elevations at the CAFOs; and
h. determining if a moderate to high capacity well could continue to operate during each decade on the basis of saturated thickness.

A study of groundwater level hydrographs for the long-term monitor wells in the 6 county area indicates that the period 1998-2009 provides representative estimates of the recent trend in groundwater levels. An example of a 1998-2009 groundwater level hydrograph and trend for a monitor well in Castro County is shown in Figure K-1.

[2] McReynolds, D., 1996, Hydrologic Atlas for (Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer) Counties, Texas, High Plains Underground Water Conservation District No. 1.

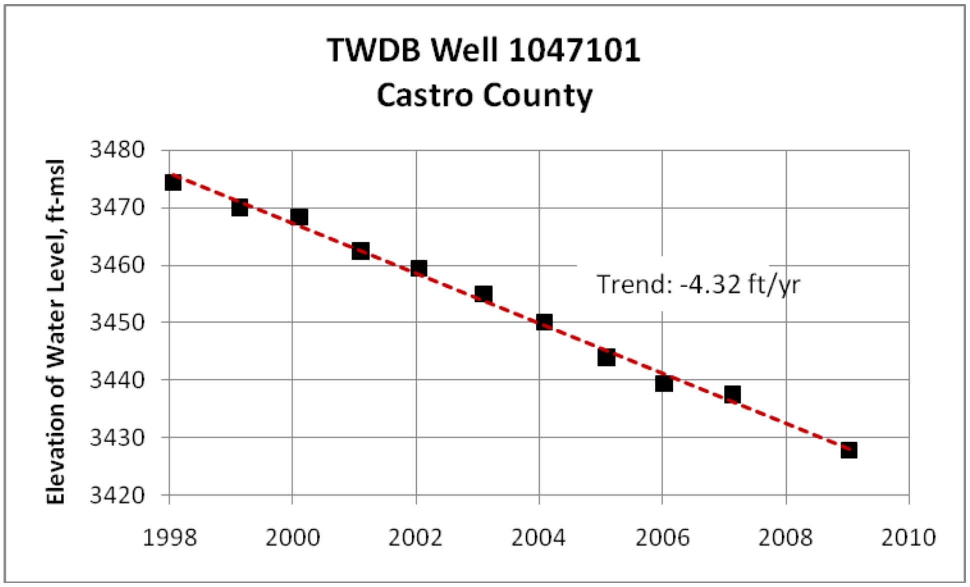

Figure K-1: Groundwater Hydrograph—Castro County

The procedure selected for estimating the declining trend in quantities of groundwater in storage in the 6 county area is based on the condition that future trends of groundwater levels in observation wells will be highly correlated with quantities of water withdrawn; i.e.; as water is withdrawn and water levels decline, for this analysis, the trends in quantities of groundwater in storage will follow the fixed percent depletion of storage each year with "50 percent of current saturated thickness remaining in 50 years." This results in a fixed annual depletion rate of 1.375 percent per year. During the early years, the quantity of depletion is greater than in the later years because of the difference in the volume of water in storage. For example, if a county has 4,000,000 acft of groundwater in storage in 2010, the depletion would be 55,000 acft; and with a remaining 2,000,000 acft in storage in 2060, the depletion would be 27,500 acft. With the assumption that groundwater level trends will follow the trend in groundwater storage, a water level declining at a rate of 4.0 ft/yr in 2010 will decline at a rate of 2.0 ft/yr in 2060. This assumption implies that groundwater pumping will decline in proportion to the amount of groundwater in storage. The fraction of the remaining water in storage within a county during this period and at the end of each decade is shown in Figure K-2. For purposes of this analysis, the historical trend computed for 1998-2009 was used for 1995-2010.

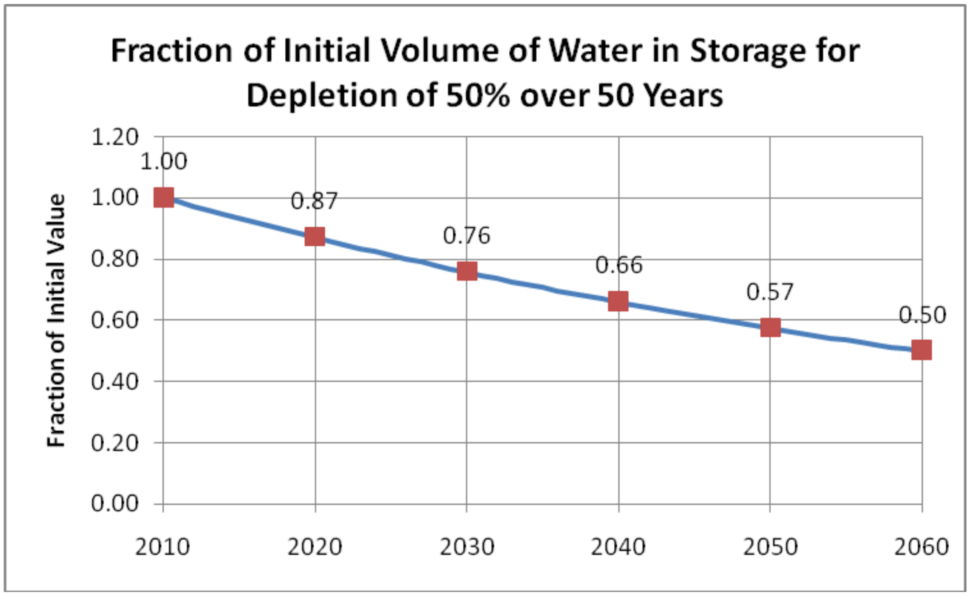

Figure K-2: Fraction of Water in Storage in 50 Years

After the trend in groundwater levels at long-term monitor wells near each CAFO was estimated, the selected approach in evaluating the potential shortage of a water supply at each CAFO was to: (1) estimate the trend of groundwater levels at the CAFO from nearby monitor wells, (2) use maps provided in Hydrologic Atlases[3] for each of the counties to estimate the (a) 1995 groundwater level and (b) base of the aquifer values, (3) calculate the saturated thickness by using the 1995 groundwater levels, trends in groundwater levels and base of the aquifer at the end of each decade, beginning in 2010, (4) assume a water shortage would exist if the saturated thickness became less than 10 ft. An example of the calculated groundwater level trend and the saturated thickness of the Ogallala Aquifer at representative feedyard in Castro County is shown in Figure K-3. This analysis shows that this feedyard would have a water shortage by 2030.

[3] Ibid.

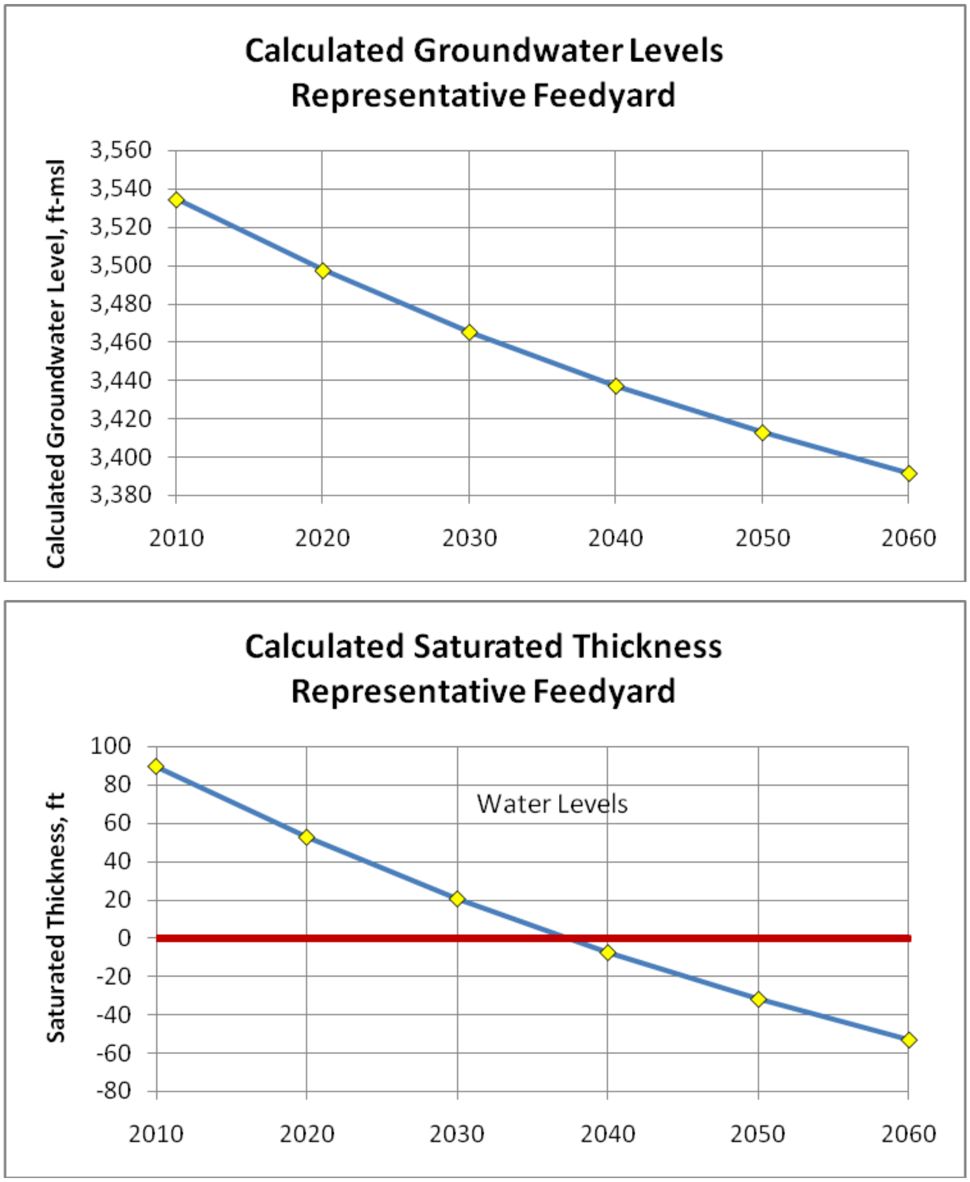

Figure K-3: Calculated Groundwater Levels and Saturated Thickness—Representative Feedyard.