Appendix L

Water Supply Estimation
for
Water Management Strategy
for
Canadian River Municipal Water Authority
Llano Estacado Water Planning Region
CRMWA-Member Cities
and
Water Level Trends in Observation Wells near
CRMWA-Member Cities
Hale, Hockley, Lubbock, Lynn,
Terry, and Dawson
Counties

Purpose: The development of the CRMWA Water Management Strategy consisted of identifying and evaluating potential water management strategies using groundwater from the Ogallala aquifer located in Region O for CRMWA-member cities of Region O (Plainview, Brownfield, Lamesa, Levelland, O'Donnell, Slaton, and Tahoka) that are presently being supplied from the CRMWA pipeline sources (Lake Meredith and Roberts County groundwater). The projected water demands of the member cities for which this water management strategy is a potential supply source are approximately 4,700 acft/yr for Plainview north of Lubbock and approximately 11,000 acft/yr for the remaining members located west of Lubbock, and south of Lubbock (Table 4.4-68).

Method: The approach used to locate potential sources of water to meet the projected needs of the CRMWA-member cities of Region O was based upon an analysis of saturated thickness and historical trends in groundwater levels, using available aquifer saturated thickness maps and groundwater levels of the Ogallala aquifer near the CRMWA member cities (Appendix L).[1] 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 Dawson, Hale, Hockley, Lubbock, Lynn, and Terry Counties. The steps included:

a. estimating the base of the Ogallala aquifer, the 1995 water level and 1995 saturated thickness of the aquifer near each well field (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);
b. compiling measured groundwater levels for each long-term monitoring well in the three counties for the period 1990 to 2009;
c. calculating the recent (1998-2009) trend in groundwater levels at each of the monitoring wells in the vicinity of each member city;
d. calculating an adjustment to the 1998 to 2009 trend for use in projecting water levels from 2009 to 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

[1] McReynolds, D., 1996, Hydrologic Atlas for (Dawson, Hale, Hockley, Lubbock, Lynn, and Terry) Counties, Texas, High Plains Underground Water Conservation District No. 1.

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 well field 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 well field 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 well field for each decade from 2010 through 2060 using the projected groundwater levels and the estimated base of the aquifer elevations at the well fields; 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 monitoring wells in the six-county area for the period 1998 to 2009 provides estimates of the recent trend in groundwater levels (See hydrographs at end of Appendix L). An example of a 1998 to 2009 groundwater level hydrograph and trend for a monitor well number 1152703 in Hale County shows that average annual water level decline at monitor well number 1152703 for the period 1998 through 2009 is about 2.96 feet per year (The slope of the water level curve for well number 1152703 is minus 2.963; Figure L-1). Of the nine

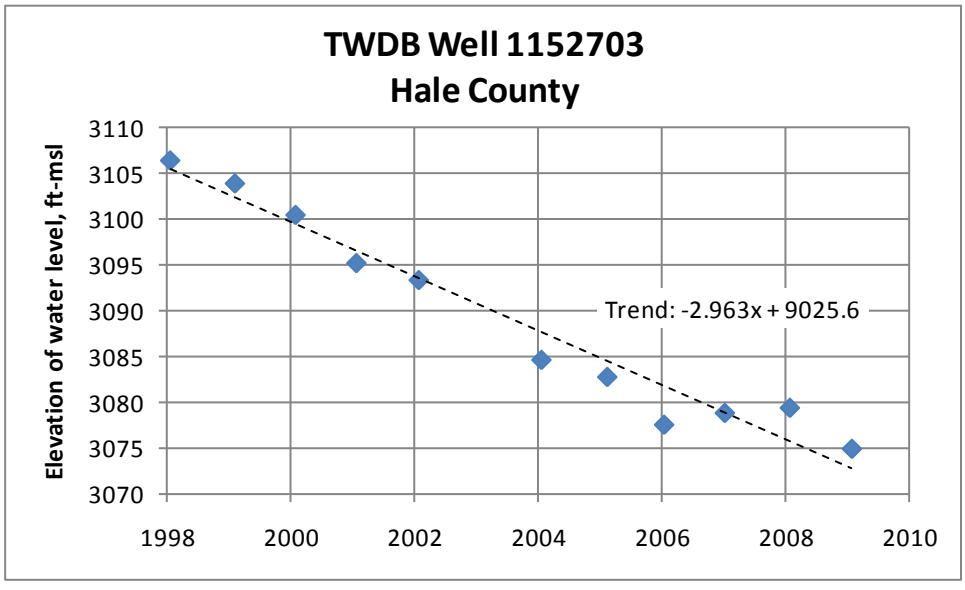


Figure L-1: Groundwater Hydrograph for Hale County

Hale County monitor wells considered for this analysis, the average annual water level decline for the period of 1998 through 2009 was calculated at 1.91 feet per year (See Hale County hydrographs near end of Appendix L).

In the case of Hockley County, water level measurements were obtained and graphed for four monitor wells. Average annual water level decline for these four wells was 0.50 feet per year for the 1998 through 2009 period (See Hockley County hydrographs near end of Appendix L). Average annual decline for four monitor wells in Lubbock County for the period 1998 through 2009 was calculated at 1.41 feet per year; average annual rise for five monitor wells in Lynn County for the 1998 through 2009 period was 0.45 feet per year (all the Lynn County monitor wells considered showed water level rises for the 1998—2009 period); average annual decline for three monitor wells in Terry County for the 1998 through 2009 period was 0.74 feet per year; while average annual decline for four monitor wells in Dawson County for the 1998 through 2009 period was 1.38 feet per year (See hydrographs near end of Appendix L).

The procedure selected for estimating the declining trend in quantities of groundwater in storage 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 storage 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 L-2. For purposes of this analysis, the historical trend computed for 1998-2009 was used for 1995-2010.

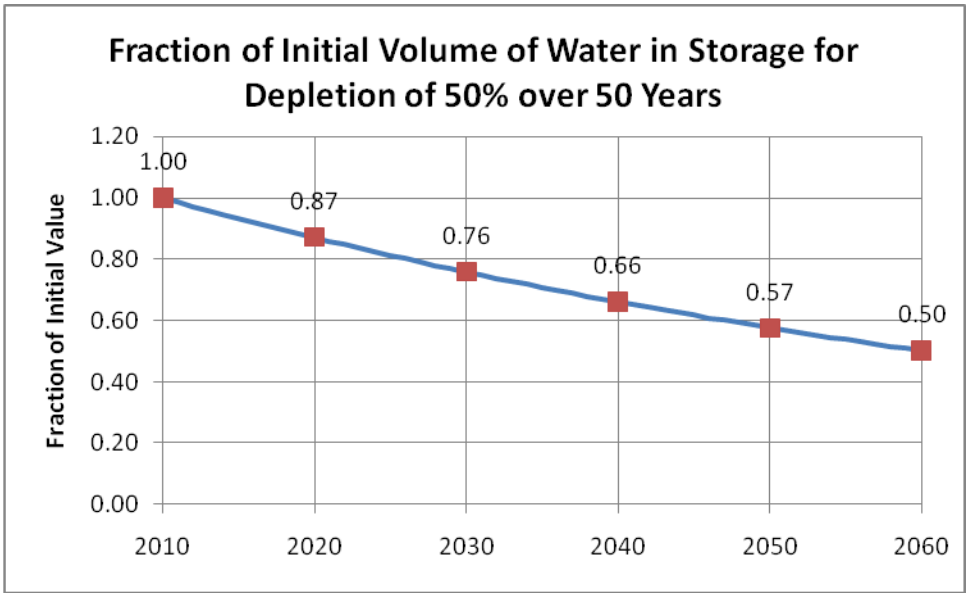
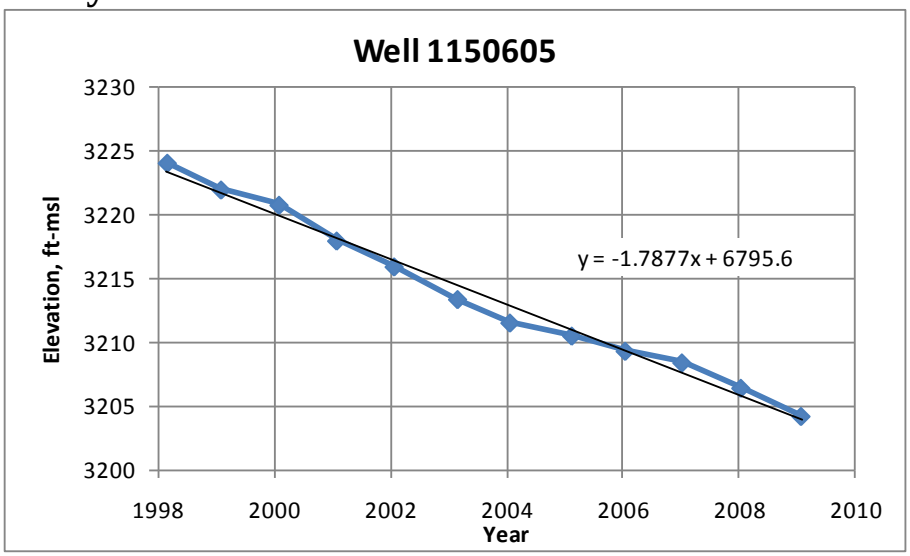


Figure L-2: Fraction of Water in Storage in 50 Years

Three potential well field sites were identified and evaluated. Water from either, or all of these sites could be routed to the existing CRMWA pipeline and become available for distribution to the CRMWA-member cities of Region O.

The analysis shows that there is sufficient groundwater at the three potential well fields to meet the projected demands for Plainview (Well Field 1 with a yield 4,635 acft/yr in 2040, declining to 4,488 acft/yr in 2060) and, for the remaining cities (Well Field 2 with 10,957 acft/yr yield in 2040, projected to decline to 10,649 acft/yr in 2060).

Hale County


Well 1150605
Elevation, ft-msl
3230
3225
3220
3215
3210
3205
3200
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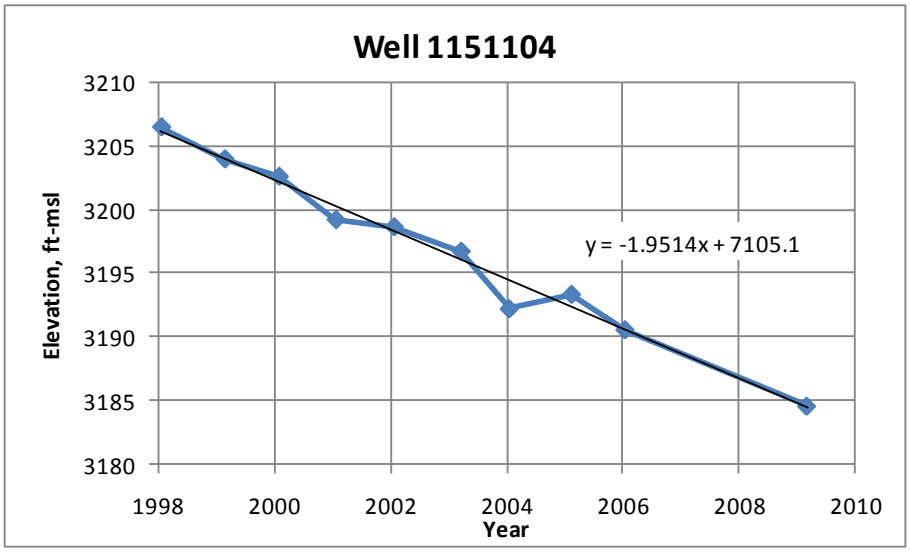
1998
2000
2002
2004
2006
2008
2010
Year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Elevation, ft-msl
3210
3205
3200
3195
3190
3185
3180
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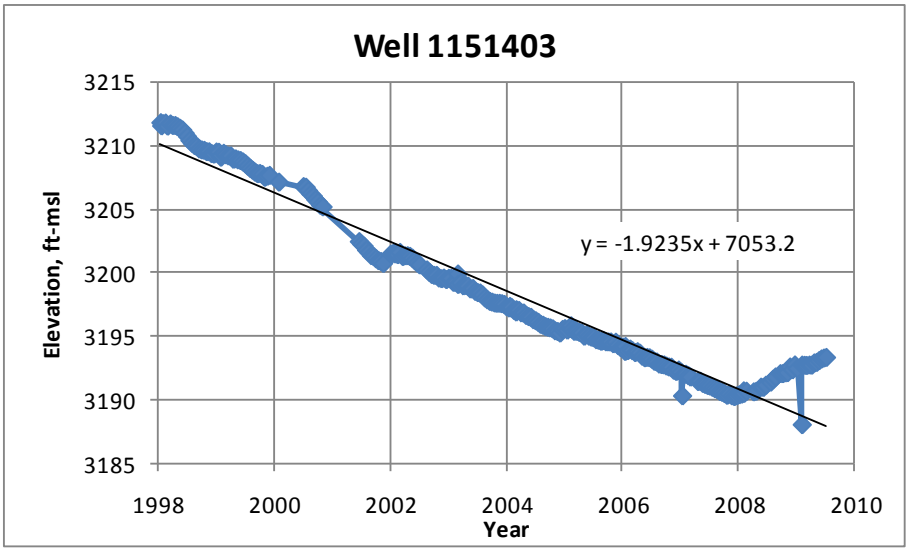
1998
2000
2002
2004
2006
2008
2010
Year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3215
3210
3205
3200
3195
3190
3185
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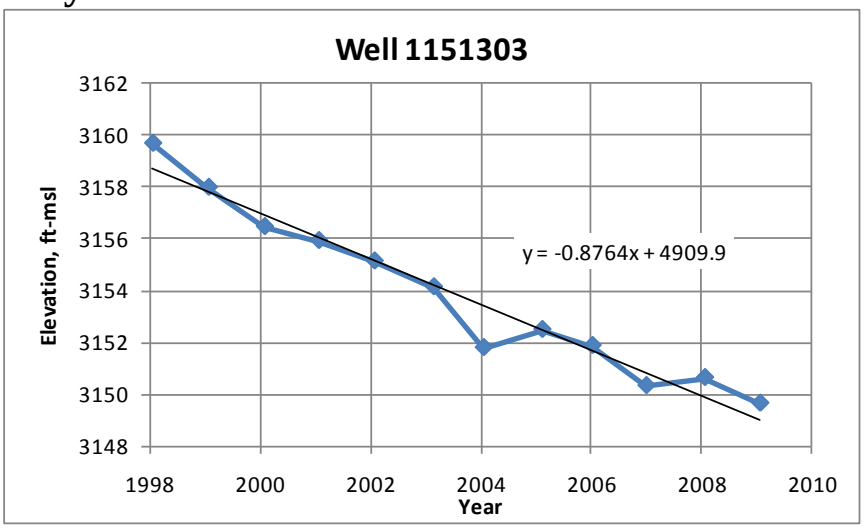
1998
2000
2002
2004
2006
2008
2010
Year

Hale County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Elevation, ft-msl
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3160
3158
3156
3154
3152
3150
3148
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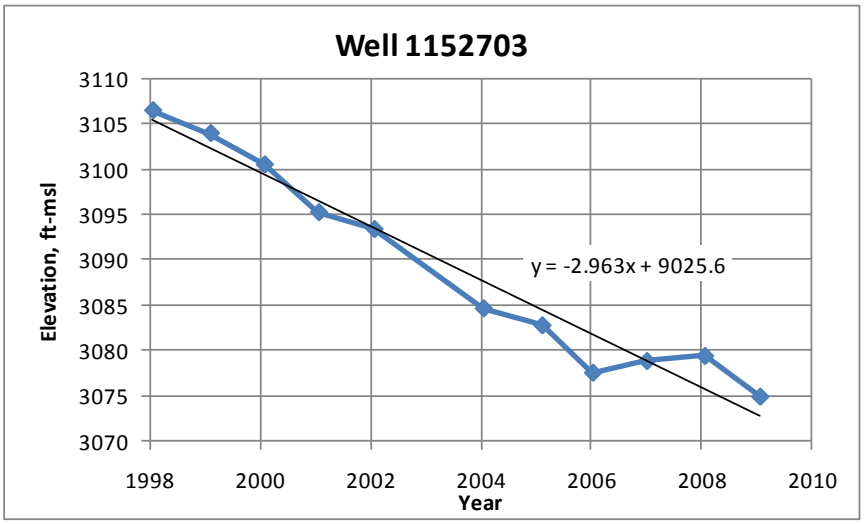
1998
2000
2002
2004
2006
2008
2010
Year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Elevation, ft-msl
3110
3105
3100
3095
3090
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3080
3075
3070
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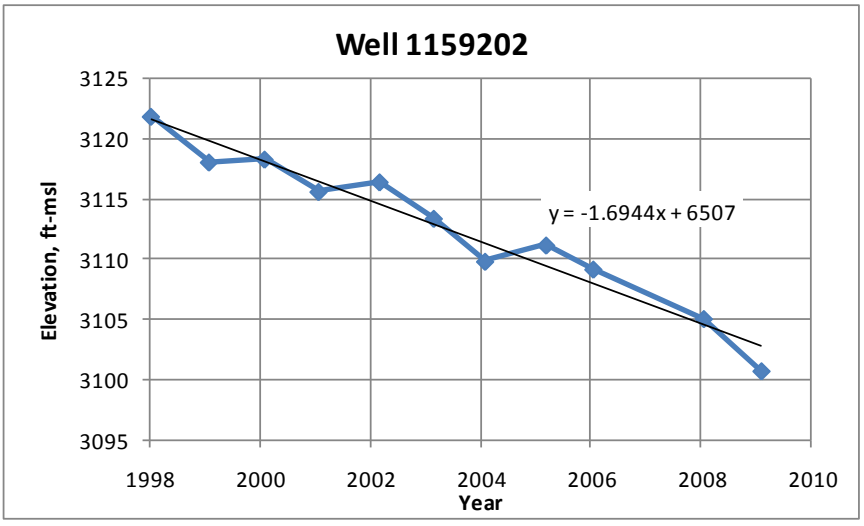
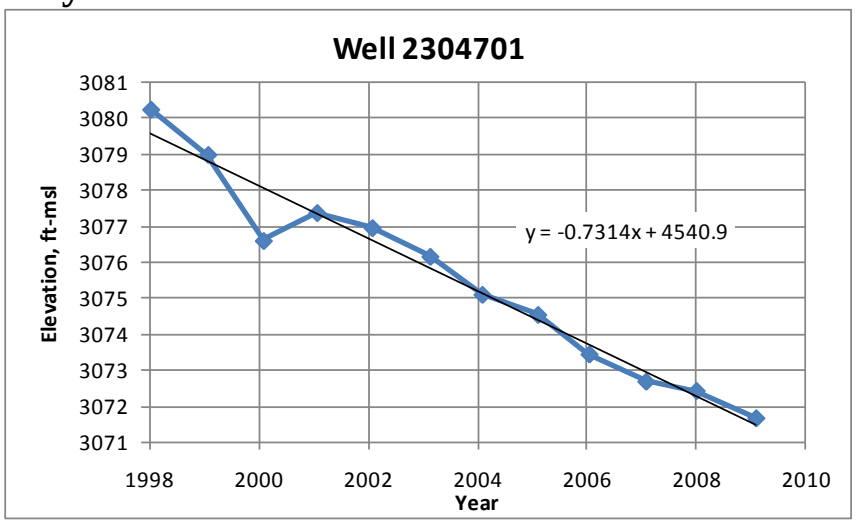
1998
2000
2002
2004
2006
2008
2010
Year


Well 1159202
Elevation, ft-msl
3125
3120
3115
3110
3105
3100
3095
y = -1.6944x + 6507
1998
2000
2002
2004
2006
2008
2010
Year

Hale County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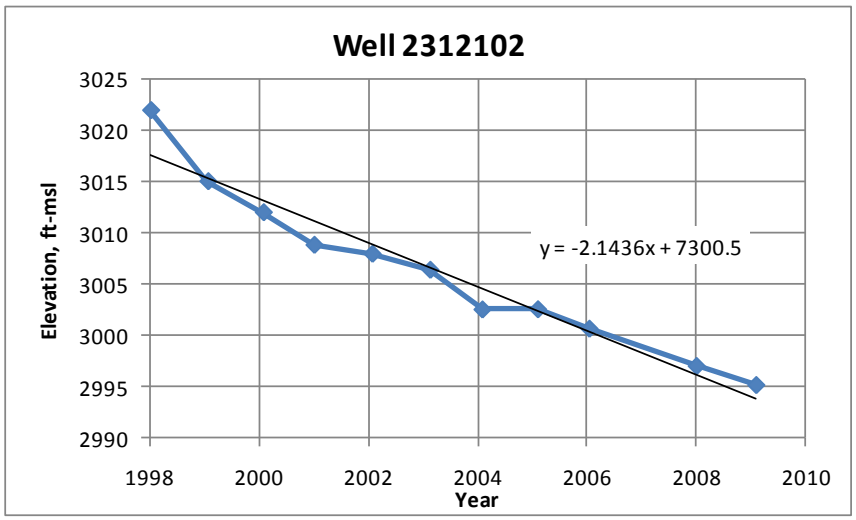
Elevation, ft-msl
3081
3080
3079
3078
3077
3076
3075
3074
3073
3072
3071
y = -0.7314x + 4540.9
1998
2000
2002
2004
2006
2008
2010
Year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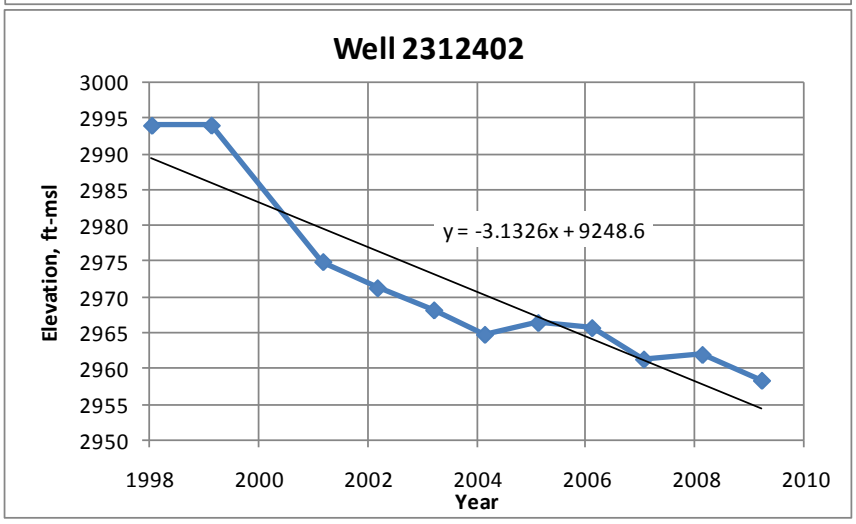
Elevation, ft-msl
3025
3020
3015
3010
3005
3000
2995
2990
y = -2.1436x + 7300.5
1998
2000
2002
2004
2006
2008
2010
Year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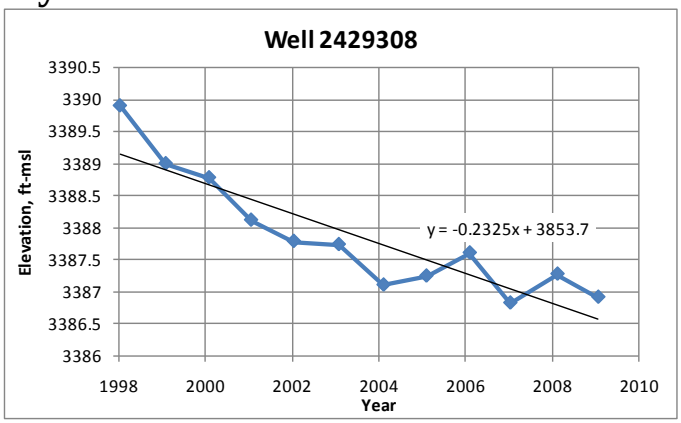
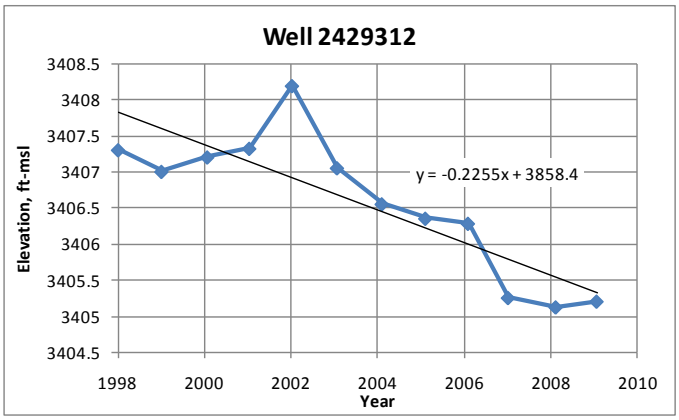
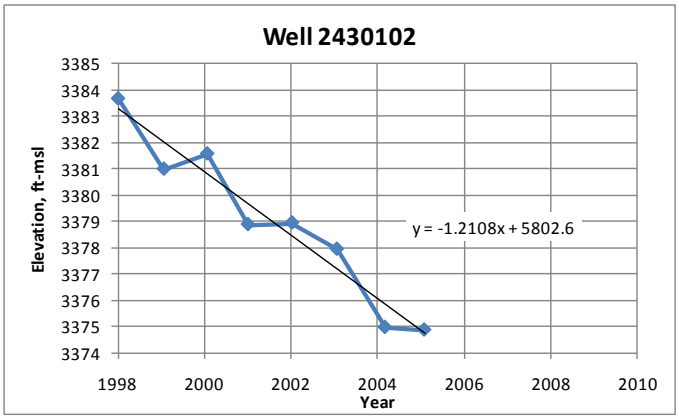
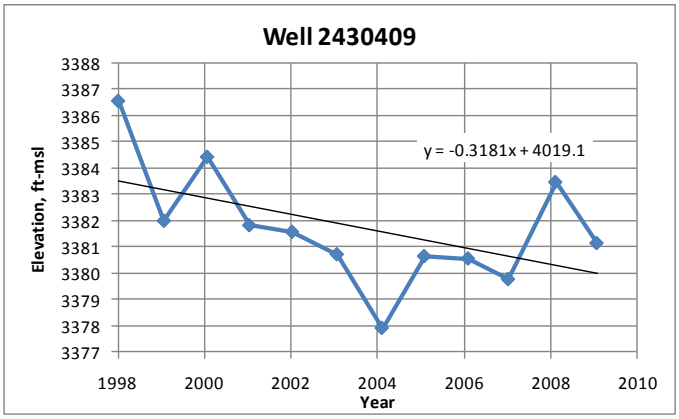
Elevation, ft-msl
3000
2995
2990
2985
2980
2975
2970
2965
2960
2955
2950
y = -3.1326x + 9248.6
1998
2000
2002
2004
2006
2008
2010
Year

Hockley County

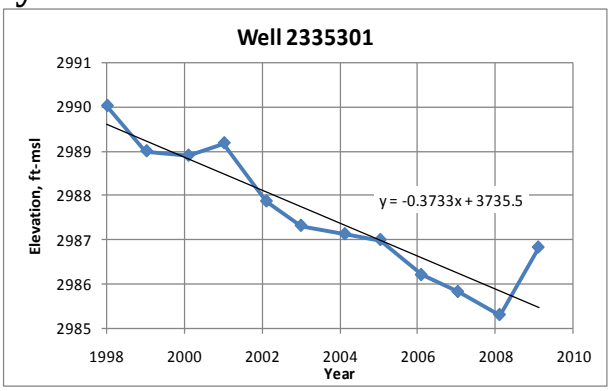


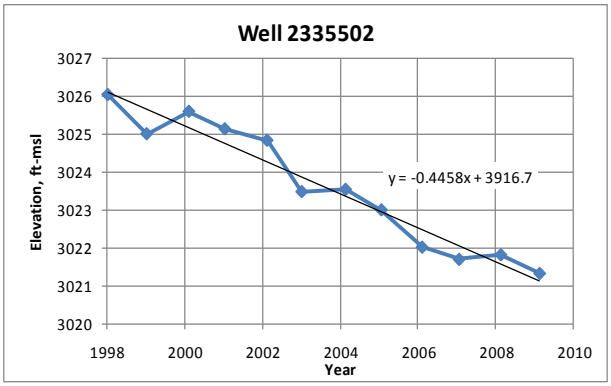


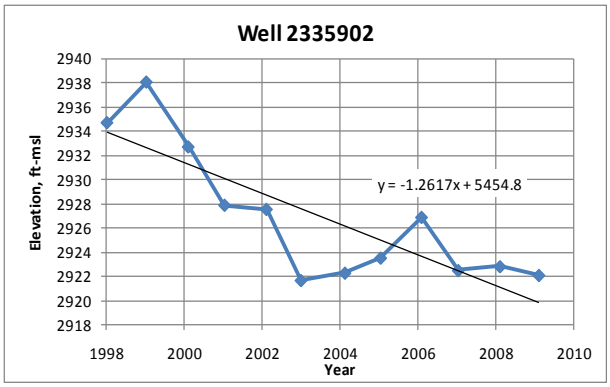


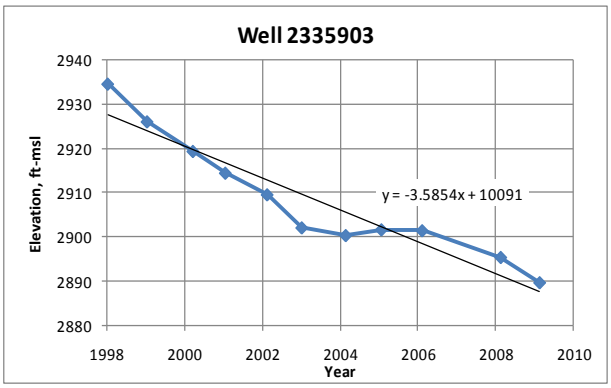


Lubbock County

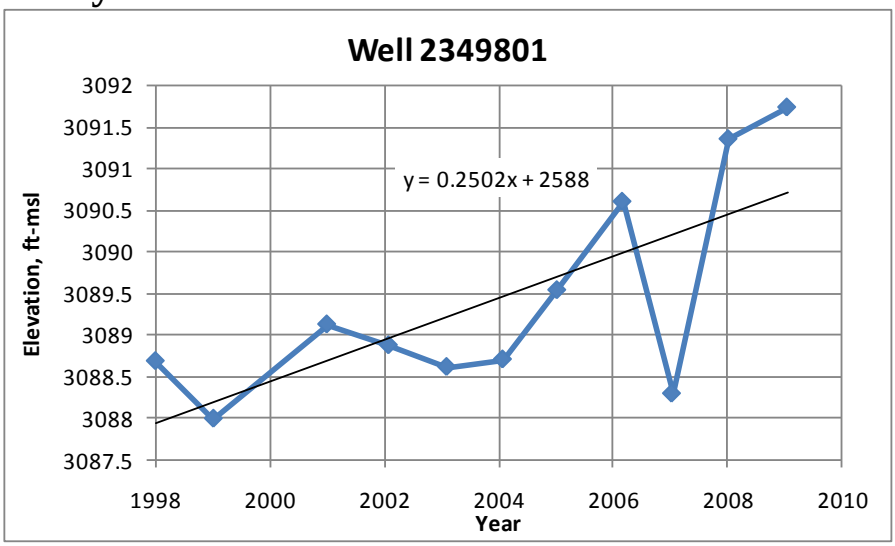








Lynn County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3091
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3089.5
3089
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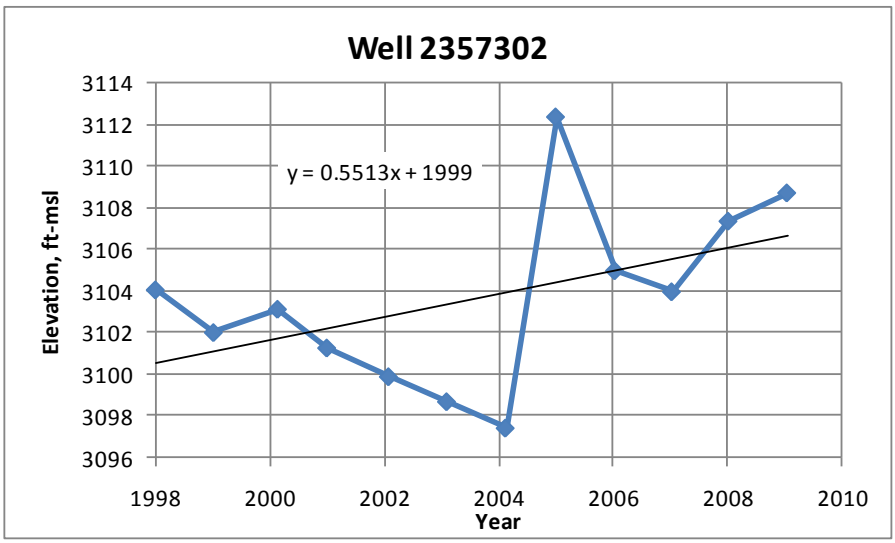
3088
3087.5
1998
2000
2002
2004
2006
2008
2010
Year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Elevation, ft-msl
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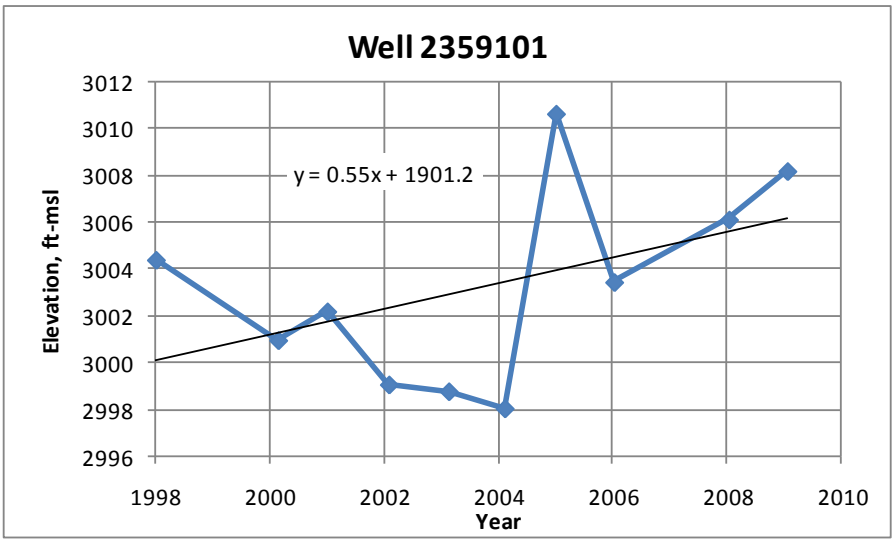
2008
2010
Year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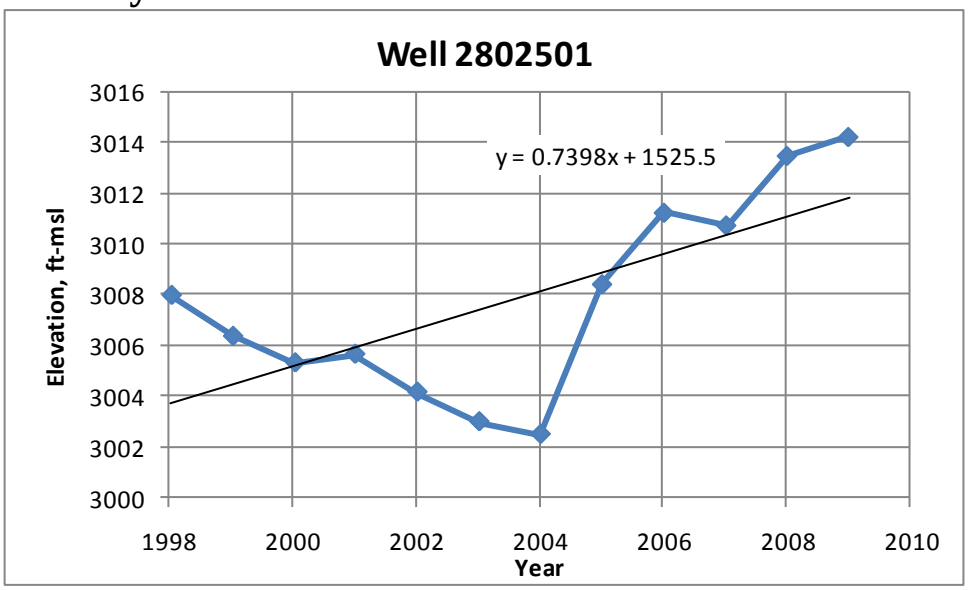
2000
2002
2004
2006
2008
2010
Year

Lynn County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2000
2002
2004
2006
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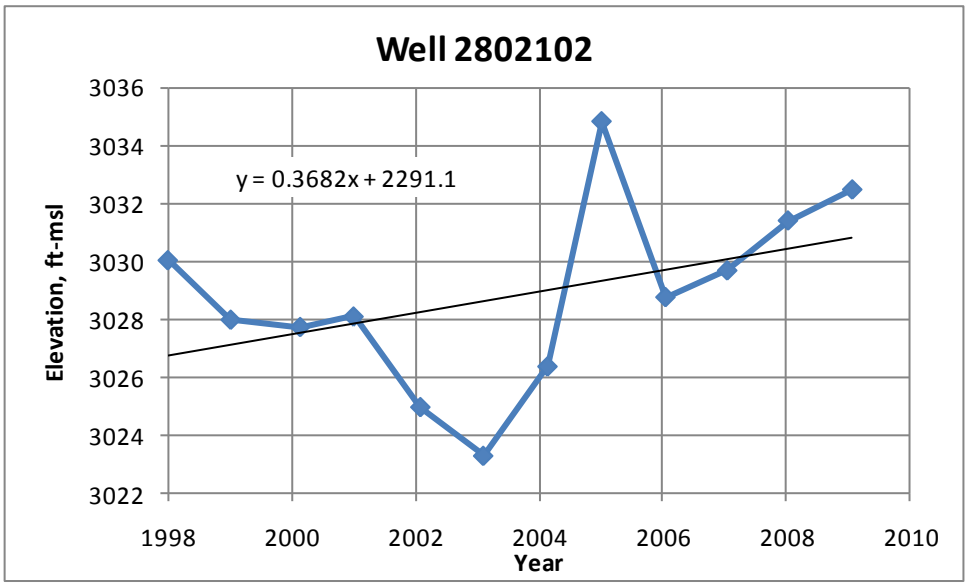
2010
Year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Elevation, ft-msl
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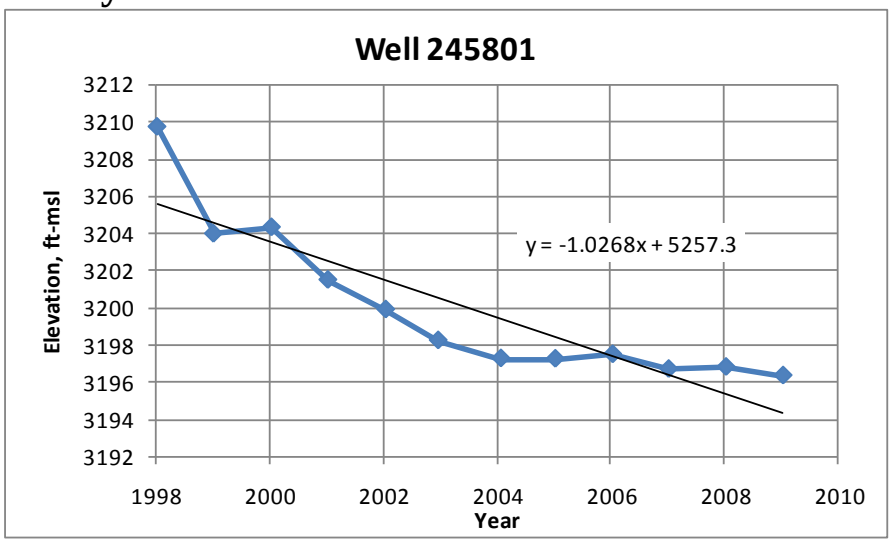
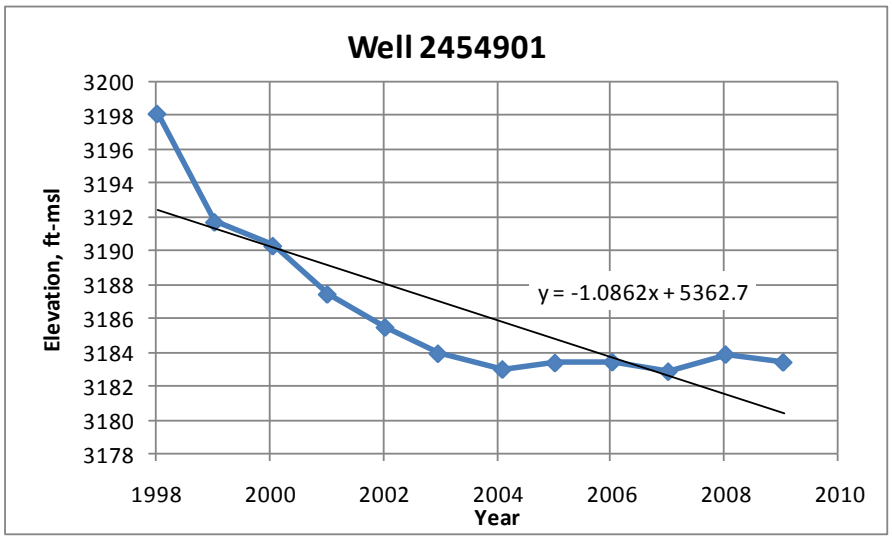
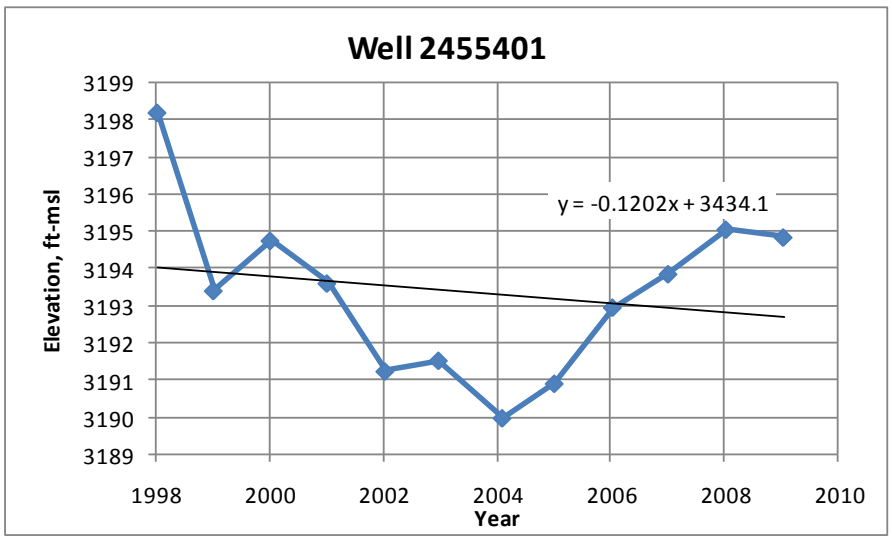
3028
3026
3024
3022
1998
2000
2002
2004
2006
2008
2010
Year

Terry County







Dawson County