GAM Task 10-023 Model Run Report

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EXECUTIVE SUMMARY:

We ran the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer from 2009 to 2060 to estimate the future condition of the aquifer under three different scenarios. In each of these scenarios, pumping in the Ogallala aquifer in the northern portion of Groundwater Management Area 2 results in approximately 50 percent of the estimated 2008 volume of water in the aquifer remaining in 2060. In the southern portion of Groundwater Management Area 2, pumping in the Ogallala Aquifer in the three scenarios approximates a specified rate of water level decline. In the first two scenarios, pumping within Groundwater Management Area 2 is taken from previously completed groundwater availability model runs. In the third scenario, pumping was determined iteratively to achieve, to the extent possible, the specified future condition of the aquifer. Results are compared to previously completed groundwater availability model runs and are reported by county, groundwater conservation district, and groundwater management area for each aquifer.

PURPOSE OF MODEL RUNS:

The three model runs contained in this report were performed using the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer to evaluate and determine the compatibility of different potential desired future conditions for selected aquifers located in the northern and southern portions of Groundwater Management Area 2.

DESCRIPTION OF MODEL RUNS:

The counties comprising the northern and southern portions of Groundwater Management Area 2 are shown in Figure 1. In the northern portion of Groundwater Management Area 2, the pumping specified in each of the three scenarios achieves approximately 50 percent of the 2008 volume of water in the Ogallala Aquifer remaining in 2060. In the southern portion of Groundwater Management Area 2, pumping in scenarios 1 and 2 in this report is taken from the two scenarios presented in Groundwater Availability Model Run 08-85 (Smith and others, 2009). In Scenario 3, pumping in the Ogallala Aquifer in the southern portion of Groundwater Management Area 2 was determined iteratively to achieve, to the extent possible, the 5- or 10-year average water level declines reported in Smith and others (2009).

Though the pumping specified in the model for the Edwards-Trinity (High Plains) Aquifer was not adjusted among the three scenarios presented here, results are reported for this aquifer to show the affect on this aquifer of the different pumping scenarios for the overlying Ogallala Aquifer.

METHODS:

We used the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer to complete the predictive simulations described in this report. This groundwater availability model is based on the U.S. Geological Survey’s MODFLOW 2000 groundwater modeling code (Harbaugh and others, 2000).

The pumping assigned within and outside of Groundwater Management Area 2 for each of the scenarios is described in the Pumping section below. Note that we converted the MODFLOW Multi-Node Well package to the MODFLOW Well package for the predictive simulations presented here. This was done to allow pumping to be adjusted in the Ogallala Aquifer without changing the pumping in the underlying Edwards-Trinity (High Plains) Aquifer. In essence, the model simulations are identical using either the MODFLOW Multi-Node Well package or the Well package through the historical-calibration portion of the model (1930 to 2000) as well as during the interim period prior to the beginning of the predictive simulation (2001 to 2008). The location of the converted multi-node wells is shown in the model update report (Blandford and others, 2008), but is primarily limited to Gaines and Dawson counties.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer are described below:

- We used version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. This model is an expansion on and update to the previously developed groundwater availability model for the southern portion of the Ogallala Aquifer described in Blandford and others (2003). See Blandford and others (2008) and Blandford and others (2003) for assumptions and limitations of the groundwater availability model.

- The model includes four layers representing the southern portion of the Ogallala and Edwards-Trinity (High Plains) aquifers. The units comprising the Edwards-Trinity (High Plains) Aquifer (primarily Edwards, Comanche Peak, and Antlers Sand formations) are separated from the overlying Ogallala Aquifer by a layer of Cretaceous shale, where present.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the Ogallala Aquifer in 2000 is 33 feet. The mean absolute error for the Edwards-Trinity (High Plains) Aquifer in 1997 is 25 feet (Blandford and others, 2008). This represents 1.8 and 3.0 percent of the hydraulic head drop across the model area for each aquifer, respectively.

- We used Groundwater Vistas version 5.36 Build 10 (Environmental Simulations, Inc., 2007) as the interface run model simulations.

- Cells were assigned to individual counties and groundwater conservation districts as shown in the September 14, 2009 version of the model grid for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer.

- The recharge used for the model run represents average recharge as described in Blandford and others (2003).

Pumping

The pumping for each of the three scenarios described here was either extracted from a previous groundwater availability model run or was determined through an iterative process to achieve a specific future condition of the aquifer. The changes to the existing pumping were made using the same methods as described in Groundwater Availability Model Run (GAM Run) 09-023 (Oliver, 2010a). Briefly, where a decrease in pumping was required to achieve a specific desired future condition, the pumping value for each cell in the area was decreased by a uniform factor, preserving the original pumping distribution. Where an increase in pumping was required, pumping was uniformly increased over all model cells in the area that contained pumping during the last year of the historical-calibration portion of the model. This process was repeated until the decline in the aquifer matched the specified desired future condition.

Table 1 contains a summary of the pumping sources in each area of the model for each scenario. Figure 2 shows this same information in map-form. For Groundwater Management Area 1, pumping in each of the three scenarios was calculated to match a 50 percent decline over the area as a whole over 50 years. This is consistent with the desired future conditions of the aquifer adopted by Groundwater Management Area 1.

For the northern portion of Groundwater Management Area 2, pumping in scenarios 1 and 2 was taken from GAM Run 09-023 (Oliver, 2010a). In GAM Run 09-023, this pumping achieved 50 percent of the 2008 volume of water in the Ogallala Aquifer remaining in 2060. However, due to changes in pumping outside of these counties, this level of pumping may not result in exactly 50 percent remaining as it did in GAM Run 09-023 (for example, Lynn and Hockley counties). For this reason, Scenario 3 contains pumping that has been adjusted slightly to achieve 50 percent of the 2008 volume of water in the Ogallala Aquifer remaining in 2060 in each county.

For the counties making up the southern portion of Groundwater Management Area 2 (see Figure 1), pumping for Scenario 1 was taken from the 5- or 10-year average decline scenario of GAM Run 08-85 (Smith and others, 2009). The average water-level decline for all counties in Groundwater Management Area 2 for this scenario was 0.675 feet per year. The two exceptions are Howard and Martin counties. Since these counties achieved an average increase in water levels during the 5-year period of 2003 to 2007, pumping was held constant here at the level for the last year of the historical-calibration portion of the model (2000). In Scenario 2 in the southern portion of Groundwater Management Area 2, the same assumptions were made for Howard and Martin counties as in Scenario 1. Elsewhere, pumping was taken from the weighted 1-foot average decline scenario of GAM Run 08-85. For Scenario 3, pumping was adjusted to achieve, to the extent possible, the 5- or 10-year average declines reported in GAM Run 08-85 (excluding Howard and Martin counties). Note that in Yoakum County the rate of pumping was held at the level in Scenario 1 during Scenario 3 because the annual rate of decline could not be maintained through 2060. In all scenarios, pumping in Andrews and Borden counties was held constant at the level during the last year of the historical-calibration period since these were not assessed in GAM Run 08-85.

In Groundwater Management Area 6, pumping was determined iteratively to match a 50 percent decline in each county over the 52 year period from 2009 to 2060. This is consistent with the decline in the Ogallala in the neighboring counties in Groundwater Management Area 2.

In Groundwater Management Area 7, pumping for scenarios 1 and 2 was taken from GAM Run 09-027 (Oliver, 2010b). In GAM Run 09-027, this level of pumping achieved a 50 percent decline in the volume of water in the Ogallala Aquifer between 2009 and 2060 in each county. However, as described above, this level of pumping may not achieve that exact decline due to changes in pumping outside of these counties. In Scenario 3, pumping in Groundwater Management Area 7 was adjusted to achieve a 50 percent decline in the volume water in the Ogallala Aquifer in each county over the 52 year predictive period.

In New Mexico, pumping was held constant at the level for the last year of the historical-calibration portion of the model. In the underlying Edwards-Trinity (High Plains) Aquifer, pumping was set to the same level as the last year of the interim period (2008), which is between the end of the historical-calibration period (2000) and the beginning of the predictive simulation (2009). As mentioned above, the modified MODFLOW Well package imitates the results that would be achieved if the original MODFLOW Multi-Node Well and Well packages were used and held constant from the end of the historical-calibration period through the interim period of 2001 to 2008. However, due to the nature of the Multi-Node package, pumping from the Edwards-Trinity (High Plains) Aquifer adjusts through time with changing water levels in the Edwards-Trinity (High Plains) and Ogallala aquifers. For this reason pumping from the last year of the interim period was used instead of pumping from the last year of the historical-calibration portion of the model through the predictive simulation.

RESULTS:

Table 2 below contains a summary of the total amount of pumping in Groundwater Management Area 2 from the Ogallala Aquifer by decade for various groundwater availability model runs. These include the 5- or 10-year average decline scenario from GAM Run 08-85 (Smith and others, 2009), the weighted 1-foot per year average decline scenario from GAM Run 08-85, the 50-percent reduction scenario in each county from GAM Run 09-023 (Oliver, 2010a), and the three scenarios documented in this report. Note that no results are presented for GAM Run 08-85 in 2060 because the model simulations only extended to 2056. In both the previous model runs and the runs presented here, the pumping output from the model decreases through time. This is due to cells going inactive. A cell goes inactive when the water level in the cell drops below the base of the aquifer. In this situation pumping can no longer occur.

In Table 2 the weighted 1-foot per year average decline scenario from GAM Run 08-85 contains the highest amount of pumping in 2010. GAM Run 09-023, with the lowest level of pumping in 2010 at approximately 2,175,000 acre-feet per year, contains the highest amount of pumping in 2060 at 1,431,000 acre-feet per year.

The model runs presented in this report follow a similar trend as the model runs completed previously in the relationship between the initial level of pumping and the rate of decline in the amount that is pumped. For example, the run with the highest level of pumping in 2010 (Scenario 2) contains the lowest level of pumping in 2060. Alternatively, the run with the lowest level of pumping in 2010 (Scenario 1) contains the highest level of pumping in 2060.

Note that a direct correlation should not be made between the total pumping in Groundwater Management Area 2 for the two scenarios in GAM Run 08-85 and the other model runs shown in Table 2. The first reason for this is that the initial volume of water in the Ogallala Aquifer was more precisely assessed (based on water level measurements for 2008) for GAM Run 09-023 and the three scenarios documented in this report than was done for GAM Run 08-85. This assessment led to the use of a correction factor (an 8.7 percent reduction) for pumping output from the model that was not applied in GAM Run 08-85. See GAM Run 09-023 for more information on the initial volume calculation and the correction factor applied to the pumping. The second reason is that GAM Run 08-85 was based on the first, single-layer version of the model documented Blandford and others (2003). The most recent version of the model, documented in Blandford and others (2008), was updated to account for the interaction of the Ogallala Aquifer with the Edwards-Trinity (High plains) Aquifer.

Finally, in the two scenarios documented in GAM Run 08-85, pumping during the predictive period was only applied to those counties with a specified average annual change in water levels (see Table 1 in GAM Run 08-85). A significant effect of this is that the pumping totals for GAM Run 08-85 shown in Table 2 do not include pumping for the counties without specified rates of decline. Within Groundwater Management Area 2 this includes Andrews, Borden, Swisher, and Briscoe counties. For GAM Run 09-023 and the three scenarios documented in this report, these four counties collectively contain between 163,000 and 211,000 acre-feet per year of pumping in 2010. By 2060, these same counties account for between 85,000 and 117,000 acre-feet per year of the total amount of pumping. The omission of pumping in GAM Run 08-85 from those areas not shown in Table 1 of that report may also have affected results in neighboring counties due to changes in the magnitude of lateral flow from one area to another. Though the effect of this has not been directly assessed, it is unlikely to have been large because lateral flow constitutes a much smaller portion of the water budget for the Ogallala Aquifer than recharge from precipitation and pumping. See Appendix C of Oliver (2010a) for examples of full water budget information for the Ogallala Aquifer by county, groundwater conservation district, and groundwater management area.

Tables 3, 4 and 5 below show the results for Scenario 1 for the Ogallala Aquifer, the Edwards-Trinity (High Plains) Aquifer, and the combined Ogallala and Edwards-Trinity (High Plains) aquifers, respectively. These results are shown by decade and are divided by county, groundwater conservation district, and groundwater management area. Note that the results by groundwater conservation district are for the districts as a whole and are not limited to Groundwater Management Area 2. Each of the tables contains the pumping output from the model and the average drawdown within each area. Additionally, Table 3 contains information on the percent of the estimated 2008 volume of water in the Ogallala Aquifer that is remaining through time. Tables 6 through 8 and 9 through 11 show the corresponding results for scenarios 2 and 3, respectively.

It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary (for example, a county) is assigned to one side of the boundary based on the location of the centroid of the model cell.

REFERENCES AND ASSOCIATED MODEL RUNS:

Blandford, T.N., Blazer, D.J., Calhoun, K.C., Dutton, A.R., Naing, T., Reedy, R.C., and Scanlon, B.R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico—Numerical simulations through 2050: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 158 p.

Blandford, T.N., Kuchanur, M., Standen, A., Ruggiero, R., Calhoun, K.C., Kirby, P., and Shah, G., 2008, Groundwater availability model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 176 p.

Environmental Simulations, Inc., 2007, Guide to using Groundwater Vistas Version 5, 381 p.

Harbaugh, A.W., Banta, E.R., Hill, M.C., McDonald, M.G., 2000, MODFLOW-2000, The U.S. Geological Survey modular ground-water model-User guide to modularization concepts and the groundwater-water flow process: U.S. Geological Survey, Open-File Report 00-92.

Oliver, W., 2010a, GAM run 09-023: Texas Water Development Board, GAM Run 09-023 Report, 30 p.

Oliver, W., 2010b, GAM run 09-027: Texas Water Development Board, GAM Run 09-027 Report, 22 p.

Smith, R., Aschenbach, E., Wade, S., 2009, GAM Run 08-85: Texas Water Development Board, GAM Run 08-85 Report, 42 p.

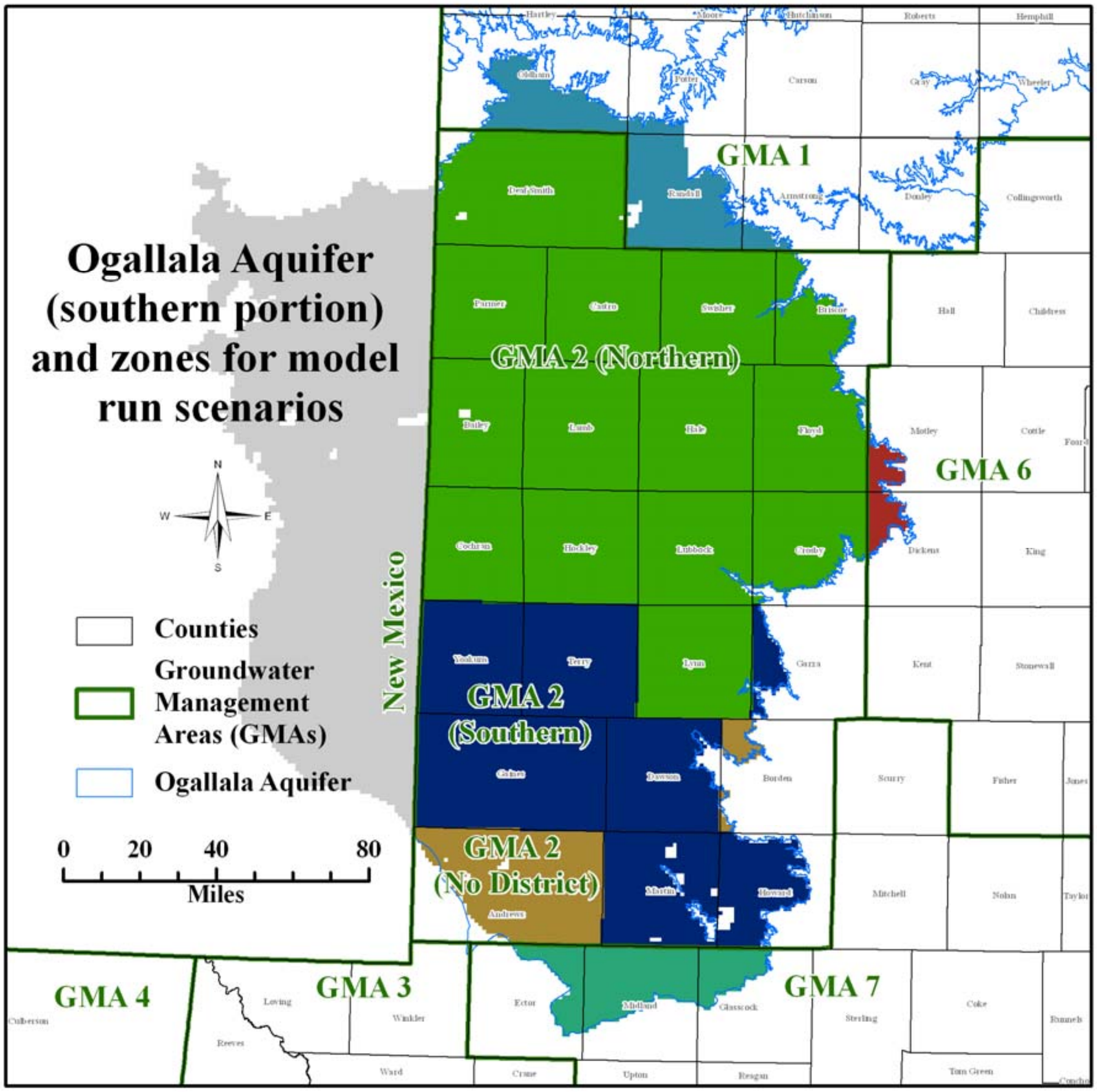

Figure 1. Map showing the zones in the groundwater availability model that contain different pumping sources.

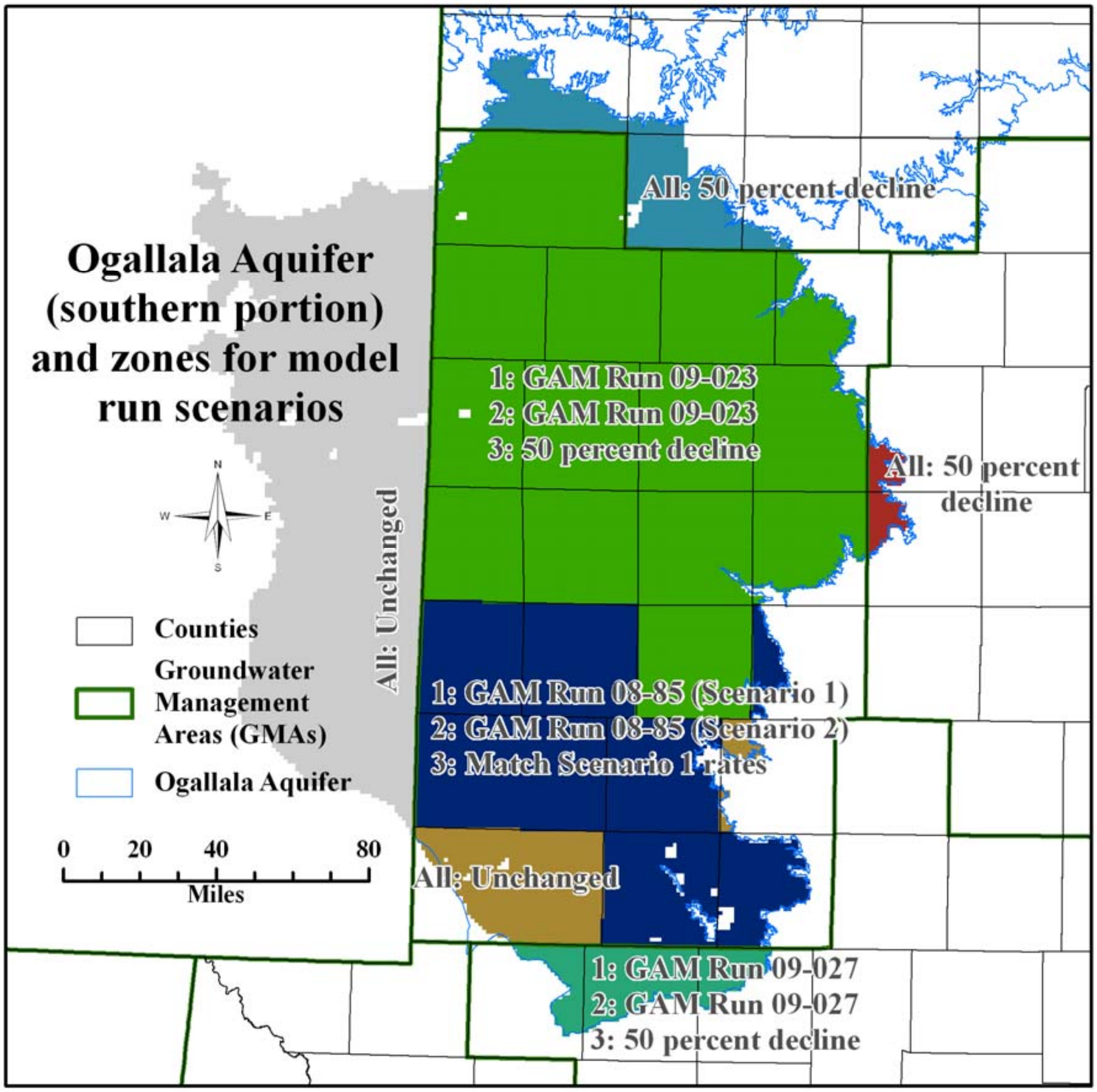

Figure 2. Map showing the zones in the groundwater availability model and the pumping sources for the three model run scenarios.

Table 1. Sources of pumping for each zone of the model shown in figures 1 and 2 for each scenario.

	Scenario 1	Scenario 2	Scenario 3
Groundwater Management Area 1	Calculated to match 50 percent decline over 50 years		
Northern portion of Groundwater Management Area 2	GAM Run 09-023 (Oliver, 2010a)		Calculated to match 50 percent decline in each county over 52 years
Southern portion of Groundwater Management Area 2	Average decline scenario from GAM Run 08-85 (Smith and others, 2009)	Weighted 1-foot average decline scenario from GAM Run 08-85	Calculated to match requested decline rates for average decline scenario in GAM Run 08-85
Andrews and Bordon counties within Groundwater Management Area 2	Held constant at the level during the last year of the historical-calibration period in the model		
Groundwater Management Area 6	Calculated to match 50 percent decline in each county over 52 years		
Groundwater Management Area 7	GAM Run 09-027 (Oliver, 2010b)		Calculated to match 50 percent decline in each county over 52 years
New Mexico	Held constant at the level during the last year of the historical-calibration period in the model		

Table 2. Comparison of the total pumping from Groundwater Management Area 2 by decade for various groundwater availability model runs (GAM Runs). All pumping is in acre-feet per year.

	2010	2020	2030	2040	2050	2060
GAM Run 08-85* (10-year average decline)	2,212,348	2,155,597	2,051,227	1,878,120	1,703,365	-
GAM Run 08-85* (weighted 1-foot average decline)	2,842,757	2,698,639	2,392,243	2,038,359	1,674,069	-
GAM Run 09-023	2,175,279	2,011,192	1,869,880	1,724,743	1,567,632	1,430,799
T10-023 Scenario 1	2,221,924	2,077,823	1,936,375	1,764,889	1,567,305	1,374,361
T10-023 Scenario 2	2,451,937	2,241,461	2,012,461	1,743,907	1,455,067	1,210,890
T10-023 Scenario 3	2,366,866	2,132,678	1,907,968	1,699,823	1,496,184	1,306,684

*Note that the model simulations reported in GAM Run 08-85 do not extend to 2060 and do not contain pumping in Andrews, Borden, Briscoe, or Swisher counties within Groundwater Management Area 2. The pumping totals for GAM Run 08-85 presented in this table, therefore, do not contain pumping for these areas. See the Results section above for more details.

Table 3. Pumping (in acre-feet per year), remaining volume, and drawdown (in feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model by decade for the Ogallala Aquifer in Scenario 1. UWCD is Underground Water Conservation District.

Scenario 1:	Pumping reduced by 8.7 percent correction factor						Percent volume remaining						Average drawdown					
Ogallala Aquifer	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County																		
Andrews	17,639	15,646	13,718	12,054	10,572	8,797	99	96	94	91	88	86	0	2	3	4	5	5
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	98	87	76	66	56	46	2	13	23	32	42	52
Bailey	63,086	41,340	34,937	30,093	24,048	21,429	96	82	71	62	55	50	1	6	10	13	15	17
Borden	398	398	398	398	398	398	101	104	104	103	102	102	-1	-2	-2	-1	-1	0
Briscoe	33,629	26,464	19,728	14,226	13,043	11,938	97	82	71	63	56	50	2	9	15	19	23	28
Castro	127,426	127,306	126,511	125,819	123,284	118,002	98	88	78	69	59	50	2	11	20	29	38	46
Cochran	48,346	36,663	33,642	30,696	28,085	25,372	97	85	75	66	57	50	1	6	11	15	18	22
Crosby	135,582	135,399	135,399	135,399	135,399	135,399	98	88	79	69	59	50	3	19	35	51	67	83
Dawson	171,559	171,193	165,709	158,163	145,993	119,450	97	80	64	50	36	24	3	19	34	50	65	79
Deaf Smith	129,744	118,728	106,838	97,043	80,372	65,913	97	86	75	65	57	50	1	8	14	20	24	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	98	88	78	69	59	50	2	14	25	36	47	57
Ector	8,665	8,026	7,730	7,171	7,135	6,727	98	88	78	69	61	52	1	5	9	13	17	21
Floyd	155,716	150,092	146,069	139,063	130,113	124,898	98	87	77	67	58	50	3	18	33	47	61	75
Gaines	262,385	224,000	191,414	161,746	133,601	103,960	95	73	55	40	28	19	4	20	35	49	63	77
Garza	17,859	17,732	17,641	17,641	17,537	17,381	98	89	80	71	62	54	2	9	17	25	32	40
Glasscock	21,773	21,322	20,875	20,089	17,398	15,197	98	87	78	68	60	53	2	14	26	37	47	58
Hale	130,611	129,806	128,007	126,003	120,127	112,250	98	88	78	68	59	50	2	10	19	28	37	45
Hockley	96,973	93,816	89,259	85,148	77,610	67,042	98	87	76	67	57	49	1	9	15	22	27	32
Howard	4,435	4,429	4,425	4,381	4,381	4,350	100	99	98	97	96	94	0	0	1	1	2	3
Lamb	147,672	137,607	125,457	111,501	95,689	85,184	97	85	75	65	57	50	2	11	20	27	33	38
Lubbock	124,773	120,231	115,282	108,636	100,702	90,781	98	87	77	67	58	50	2	10	19	27	34	40
Lynn	105,723	105,456	104,657	101,804	93,960	85,207	98	87	76	66	57	49	1	8	15	22	27	32
Martin	7,690	7,690	7,669	7,634	7,634	7,621	100	100	99	98	97	96	0	0	1	2	3	4
Midland	39,227	38,388	36,824	34,623	32,995	31,696	98	87	78	68	60	52	2	9	16	23	30	37
Motley	9,936	9,936	9,936	9,936	9,936	9,576	98	88	79	69	59	50	2	13	24	35	45	56
Oldham	19,236	16,416	15,640	14,911	13,530	12,691	98	90	82	75	68	62	1	6	10	15	19	23
Parmer	68,909	63,430	56,590	52,156	45,626	40,986	97	86	75	65	57	50	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	96	78	66	59	53	47	3	13	19	22	27	31
Randall	72,963	70,740	69,626	64,546	59,098	49,709	97	85	73	61	51	42	2	10	18	25	32	38
Swisher	111,506	107,605	101,015	84,830	73,860	64,309	98	86	75	65	57	50	2	11	20	27	34	39
Terry	159,965	158,682	153,428	128,354	92,681	59,403	96	75	55	36	22	12	2	15	27	38	49	60
Yoakum	100,298	84,107	58,583	32,102	12,592	4,293	92	57	30	13	4	1	2	14	25	37	48	58

Table 3. Continued.

Scenario 1: Ogallala Aquifer	Pumping reduced by 8.7 percent correction factor 2010	2020	2030	2040	2050	2060	Percent volume remaining 2010	2020	2030	2040	2050	2060	Average drawdown 2010	2020	2030	2040	2050	2060
District																		
Garza County UWCD	17,859	17,732	17,641	17,641	17,537	17,381	98	89	80	71	62	54	2	9	17	25	32	40
Glasscock GCD	21,773	21,322	20,875	20,089	17,398	15,197	98	87	78	68	60	53	2	14	26	37	47	58
High Plains UWCD No. 1	1,381,614	1,303,274	1,244,003	1,179,433	1,087,154	996,494	98	86	75	65	56	47	2	11	20	29	37	44
Llano Estacado UWCD	262,385	224,000	191,414	161,746	133,601	103,960	95	73	55	40	28	19	4	20	35	49	63	77
Mesa UWCD	171,559	171,193	165,709	158,163	145,993	119,450	97	80	64	50	36	24	3	19	34	50	65	79
Panhandle GCD	370	370	370	370	370	370	98	93	89	84	80	77	1	4	7	10	12	14
Permian Basin UWCD	12,049	12,043	12,017	11,938	11,938	11,894	100	99	99	98	97	95	0	0	1	2	2	3
Sandy Land UWCD	100,298	84,107	58,583	32,102	12,592	4,293	92	57	30	13	4	1	2	14	25	37	48	58
South Plains UWCD	160,601	159,318	154,064	128,991	93,317	60,039	96	75	56	37	23	13	2	15	26	38	49	59
Management Area																		
Out-of-State	76,546	65,120	55,688	48,697	43,015	39,677	100	98	97	95	95	94	0	1	1	1	1	2
GMA 1	106,789	99,630	96,158	89,526	82,639	72,054	98	86	75	66	56	48	2	9	16	22	28	34
GMA 2	2,221,924	2,077,823	1,936,375	1,764,889	1,567,305	1,374,361	97	86	75	65	56	48	2	10	18	26	32	38
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	98	88	79	69	59	50	2	13	24	35	46	57
GMA 7	69,665	67,737	65,429	61,883	57,529	53,620	98	87	78	68	60	52	2	9	17	24	31	37

Table 4. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Edwards-Trinity (High Plains) Aquifer in Scenario 1. UWCD is Underground Water Conservation District.

Scenario 1: Edwards-Trinity (High Plains) Aquifer	**Pumping**						**Average drawdown**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County												
Bailey	279	279	279	279	279	279	0	1	2	4	4	5
Borden	106	106	106	106	106	106	0	1	1	2	3	4
Cochran	263	263	263	263	263	263	-1	0	3	6	9	11
Dawson	1,103	1,103	1,103	1,103	1,103	1,101	3	18	33	46	57	66
Floyd	1,216	1,216	1,216	1,213	1,200	1,182	3	16	29	41	52	62
Gaines	85,129	46,841	31,478	23,394	16,262	12,902	5	27	43	56	64	70
Garza	18	18	18	18	18	18	1	8	14	21	28	34
Hale	3,523	3,523	3,523	3,523	3,523	3,419	1	8	15	22	29	36
Hockley	96	96	96	96	96	96	1	6	13	19	24	28
Lamb	164	164	164	164	164	164	0	1	1	2	3	3
Lubbock	689	689	689	689	689	689	1	8	14	19	24	29
Lynn	230	230	230	230	230	230	0	7	14	21	27	32
Terry	982	982	945	945	945	945	1	10	20	29	36	40
Yoakum	2,532	1,893	1,757	1,642	1,642	1,524	1	7	12	15	17	18
District												
Garza County UWCD	18	18	18	18	18	18	1	8	14	21	28	34
High Plains UWCD No. 1	6,415	6,415	6,415	6,412	6,399	6,277	1	5	11	17	21	26
Llano Estacado UWCD	85,129	46,841	31,478	23,394	16,262	12,902	5	27	43	56	64	70
Mesa UWCD	1,103	1,103	1,103	1,103	1,103	1,101	3	18	33	46	57	66
Sandy Land UWCD	2,532	1,893	1,757	1,642	1,642	1,524	1	7	12	15	17	18
South Plains UWCD	982	982	945	945	945	945	1	10	20	29	36	40
Management Area												
Out-of-State	1	1	1	1	1	1	0	1	2	2	2	3
GMA 2	96,331	57,404	41,868	33,665	26,521	22,919	1	8	15	21	26	30

Table 5. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Ogallala and Edwards-Trinity (High Plains) aquifers in Scenario 1. UWCD is Underground Water Conservation District.

Scenario 1: Ogallala and Edwards-Trinity (High Plains) Aquifers	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Andrews	17,639	15,646	13,718	12,054	10,572	8,797	0	2	3	4	5	5
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	2	13	23	32	42	52
Bailey	63,365	41,619	35,215	30,371	24,327	21,708	1	3	6	8	8	10
Borden	504	504	504	504	504	504	0	0	1	2	2	3
Briscoe	33,629	26,464	19,728	14,226	13,043	11,938	2	9	15	19	23	28
Castro	127,426	127,306	126,511	125,819	123,284	118,002	2	11	20	29	38	46
Cochran	48,609	36,926	33,906	30,960	28,348	25,635	0	1	5	8	11	13
Crosby	135,582	135,399	135,399	135,399	135,399	135,399	3	19	35	51	67	83
Dawson	172,663	172,296	166,812	159,266	147,096	120,551	3	19	34	48	61	71
Deaf Smith	129,744	118,728	106,838	97,043	80,372	65,913	1	8	14	20	24	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	2	14	25	36	47	57
Ector	8,665	8,026	7,730	7,171	7,135	6,727	1	5	9	13	17	21
Floyd	156,932	151,308	147,284	140,276	131,312	126,080	3	17	31	45	57	69
Gaines	347,515	270,841	222,892	185,139	149,864	116,862	5	24	39	53	64	72
Garza	17,877	17,750	17,659	17,659	17,555	17,399	1	8	16	23	30	37
Glasscock	21,773	21,322	20,875	20,089	17,398	15,197	2	14	26	37	47	58
Hale	134,135	133,329	131,530	129,526	123,651	115,669	2	10	18	27	35	43
Hockley	97,069	93,912	89,355	85,244	77,706	67,138	1	7	13	19	25	29
Howard	4,435	4,429	4,425	4,381	4,381	4,350	0	0	1	1	2	3
Lamb	147,836	137,771	125,621	111,665	95,853	85,348	1	7	12	16	19	21
Lubbock	125,462	120,921	115,972	109,325	101,392	91,470	1	9	15	22	27	32
Lynn	105,953	105,686	104,887	102,034	94,190	85,437	1	7	14	21	27	32
Martin	7,690	7,690	7,669	7,634	7,634	7,621	0	0	1	2	3	4
Midland	39,227	38,388	36,824	34,623	32,995	31,696	2	9	16	23	30	37
Motley	9,936	9,936	9,936	9,936	9,936	9,576	2	13	24	35	45	56
Oldham	19,236	16,416	15,640	14,911	13,530	12,691	1	6	10	15	19	23
Parmer	68,909	63,430	56,590	52,156	45,626	40,986	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	3	13	19	22	27	31
Randall	72,963	70,740	69,626	64,546	59,098	49,709	2	10	18	25	32	38
Swisher	111,506	107,605	101,015	84,830	73,860	64,309	2	11	20	27	34	39
Terry	160,946	159,664	154,373	129,299	93,626	60,347	2	11	22	31	38	43
Yoakum	102,830	86,000	60,340	33,744	14,233	5,818	1	8	14	17	18	19

Table 5. Continued.

Scenario 1: Ogallala and Edwards-Trinity (High Plains) Aquifers	**Pumping**						**Average drawdown**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
District												
Garza County UWCD	17,877	17,750	17,659	17,659	17,555	17,399	1	8	16	23	30	37
Glasscock GCD	21,773	21,322	20,875	20,089	17,398	15,197	2	14	26	37	47	58
High Plains UWCD No. 1	1,388,029	1,309,689	1,250,417	1,185,845	1,093,553	1,002,770	1	8	15	22	28	34
Llano Estacado UWCD	347,515	270,841	222,892	185,139	149,864	116,862	5	24	39	53	64	72
Mesa UWCD	172,663	172,296	166,812	159,266	147,096	120,551	3	19	34	48	61	71
Panhandle GCD	370	370	370	370	370	370	1	4	7	10	12	14
Permian Basin UWCD	12,049	12,043	12,017	11,938	11,938	11,894	0	0	1	2	2	3
Sandy Land UWCD	102,830	86,000	60,340	33,744	14,233	5,818	1	8	14	17	18	19
South Plains UWCD	161,582	160,300	155,009	129,935	94,262	60,984	2	11	22	31	38	42
Management Area												
Out-of-State	76,547	65,121	55,689	48,698	43,016	39,678	0	1	1	2	2	2
GMA 1	106,789	99,630	96,158	89,526	82,639	72,054	2	9	16	22	28	34
GMA 2	2,318,256	2,135,226	1,978,243	1,798,555	1,593,826	1,397,279	1	9	17	23	29	33
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	2	13	24	35	46	57
GMA 7	69,665	67,737	65,429	61,883	57,529	53,620	2	9	17	24	31	37

Table 6. Pumping (in acre-feet per year), remaining volume, and drawdown (in feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model by decade for the Ogallala Aquifer in Scenario 2. UWCD is Underground Water Conservation District.

Scenario 2:	**Pumping reduced by 8.7 percent correction ractor**						**Percent volume remaining**						**Average drawdown**					
Ogallala Aquifer	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County																		
Andrews	17,639	15,135	13,718	12,054	10,572	8,079	99	96	93	90	87	85	0	2	3	4	5	6
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	98	87	76	66	56	46	2	13	23	32	42	52
Bailey	63,086	41,315	34,937	30,093	24,048	21,429	96	82	71	62	55	50	1	6	10	13	15	17
Borden	398	398	398	398	398	398	101	102	102	101	100	100	-1	-1	-1	0	0	1
Briscoe	33,629	26,464	19,728	14,226	13,082	11,938	97	82	71	63	56	50	2	9	15	19	23	28
Castro	127,426	127,306	126,511	125,819	123,284	118,002	98	88	78	69	59	50	2	11	20	29	38	46
Cochran	48,346	36,209	33,642	30,696	28,264	25,372	97	85	75	66	57	50	1	6	11	15	18	22
Crosby	135,582	135,399	135,399	135,399	135,399	135,399	98	88	79	69	59	50	3	19	35	51	67	83
Dawson	226,777	223,172	207,547	178,367	107,946	51,990	95	71	49	30	15	8	5	28	50	72	91	104
Deaf Smith	129,744	118,133	106,838	97,043	81,080	65,913	97	86	75	65	57	50	1	8	14	20	25	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	98	88	78	69	59	50	2	14	25	36	47	57
Ector	8,665	8,026	7,730	7,171	7,135	6,727	98	88	78	69	61	52	1	5	9	13	17	21
Floyd	155,716	150,092	146,069	139,063	130,454	124,898	98	87	77	67	58	50	3	18	33	47	61	75
Gaines	353,065	281,111	223,440	165,602	103,410	55,452	93	63	41	24	12	6	5	28	49	70	89	106
Garza	22,551	22,390	22,265	22,127	21,197	18,624	97	84	71	58	46	35	2	14	25	36	47	57
Glasscock	21,773	21,322	20,875	20,089	17,398	15,197	98	87	78	68	60	53	2	14	26	37	48	58
Hale	130,611	129,806	128,007	126,003	120,127	112,250	98	88	78	68	59	50	2	10	19	28	37	45
Hockley	96,973	93,370	89,259	85,148	77,288	67,042	98	87	76	66	57	49	1	9	15	22	28	32
Howard	4,653	4,647	4,617	4,595	4,585	4,563	100	99	98	96	95	94	0	1	1	2	2	3
Lamb	147,672	137,293	125,457	111,501	95,984	85,184	97	85	75	65	57	50	2	11	20	27	33	38
Lubbock	124,773	119,976	115,282	108,636	101,028	90,781	98	87	77	67	58	50	2	10	19	27	34	40
Lynn	105,723	105,456	104,657	101,804	94,100	84,618	98	87	76	66	56	48	1	9	16	22	28	33
Martin	8,062	8,062	8,040	8,003	8,003	7,990	100	99	98	97	96	94	0	1	1	3	4	5
Midland	39,227	38,309	36,824	34,623	33,222	31,696	98	87	78	68	60	51	2	9	16	23	30	37
Motley	9,936	9,936	9,936	9,936	9,936	9,576	98	88	79	69	59	50	2	13	24	35	45	56
Oldham	19,236	16,416	15,640	14,911	13,568	12,691	98	90	82	75	68	62	1	6	10	15	19	23
Parmer	68,909	63,072	56,590	52,156	45,954	40,986	97	86	75	65	57	50	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	96	78	66	59	53	47	3	13	19	22	27	31
Randall	72,963	70,696	69,626	64,546	59,098	49,709	97	85	73	61	51	42	2	10	18	25	32	38
Swisher	111,506	107,419	101,015	84,830	74,196	64,309	98	86	75	65	57	50	2	11	20	27	34	39
Terry	205,663	201,359	166,155	98,664	52,608	15,393	94	64	36	17	6	2	4	21	38	55	70	81
Yoakum	133,433	93,875	42,890	11,679	2,059	283	89	41	13	3	0	0	3	20	37	54	63	10

Table 6. Continued.

Scenario 2:	Pumping reduced by 8.7 percent correction ractor						Percent volume remaining						Average drawdown					
Ogallala Aquifer	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
District																		
Garza County UWCD	22,551	22,390	22,265	22,127	21,197	18,624	97	84	71	58	46	35	2	14	25	36	47	57
Glasscock GCD	21,773	21,322	20,875	20,089	17,398	15,197	98	87	78	68	60	53	2	14	26	37	48	58
High Plains UWCD No. 1	1,381,614	1,300,826	1,244,003	1,179,433	1,089,149	995,905	98	86	75	65	56	47	2	11	20	29	37	44
Llano Estacado UWCD	353,065	281,111	223,440	165,602	103,410	55,452	93	63	41	24	12	6	5	28	49	70	89	106
Mesa UWCD	226,777	223,172	207,547	178,367	107,946	51,990	95	71	49	30	15	8	5	28	50	72	91	104
Panhandle GCD	370	370	370	370	370	370	98	93	89	84	80	77	1	4	7	10	12	14
Permian Basin UWCD	12,629	12,623	12,570	12,512	12,502	12,466	100	99	98	97	95	94	0	1	1	2	3	4
Sandy Land UWCD	133,433	93,875	42,890	11,679	2,059	283	89	41	13	3	0	0	3	20	37	54	63	10
South Plains UWCD	206,300	201,995	166,791	99,300	53,244	16,029	94	65	38	18	8	3	4	21	38	53	67	72
Management Area																		
Out-of-State	76,546	65,044	55,688	48,572	43,017	39,786	100	98	97	95	95	94	0	1	1	1	1	2
GMA 1	106,789	99,586	96,158	89,526	82,676	72,054	98	86	75	66	56	48	2	9	16	22	28	34
GMA 2	2,451,937	2,241,461	2,012,461	1,743,907	1,455,067	1,210,890	97	84	72	61	53	46	2	12	20	28	32	36
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	98	88	79	69	59	50	2	13	24	35	46	57
GMA 7	69,665	67,657	65,429	61,883	57,756	53,620	98	87	78	68	60	52	2	9	17	24	31	37

Table 7. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Edwards-Trinity (High Plains) Aquifer in Scenario 2. UWCD is Underground Water Conservation District.

Scenario 2: Edwards-Trinity (High Plains) Aquifer	Pumping 2010	2020	2030	2040	2050	2060	Average drawdown 2010	2020	2030	2040	2050	2060
County												
Bailey	279	279	279	279	279	279	0	1	2	4	4	5
Borden	106	106	106	106	106	106	0	1	2	3	4	4
Cochran	263	263	263	263	263	263	-1	0	3	6	9	11
Dawson	1,103	1,103	1,103	1,103	1,101	1,096	4	26	45	60	66	64
Floyd	1,216	1,216	1,216	1,213	1,200	1,182	3	16	29	41	52	62
Gaines	85,129	45,952	29,729	21,141	15,051	11,428	7	34	53	64	70	73
Garza	18	18	18	18	18	18	2	12	21	31	41	49
Hale	3,523	3,523	3,523	3,523	3,523	3,419	1	8	16	22	29	36
Hockley	96	96	96	96	96	96	1	7	13	19	25	29
Lamb	164	164	164	164	164	164	0	1	1	2	3	3
Lubbock	689	689	689	689	689	689	1	8	14	20	25	29
Lynn	230	230	230	230	230	230	0	7	15	23	29	33
Terry	982	982	945	945	945	945	2	13	26	35	40	43
Yoakum	2,532	1,893	1,757	1,642	1,638	1,524	1	9	14	16	18	18
District												
Garza County UWCD	18	18	18	18	18	18	2	12	21	31	41	49
High Plains UWCD No. 1	6,415	6,415	6,415	6,412	6,399	6,277	1	6	12	17	22	26
Llano Estacado UWCD	85,129	45,952	29,729	21,141	15,051	11,428	7	34	53	64	70	73
Mesa UWCD	1,103	1,103	1,103	1,103	1,101	1,096	4	26	45	60	66	64
Sandy Land UWCD	2,532	1,893	1,757	1,642	1,638	1,524	1	9	14	16	18	18
South Plains UWCD	982	982	945	945	945	945	2	13	26	35	40	42
Management Area												
Out-of-State	1	1	1	1	1	1	0	1	2	2	2	3
GMA 2	96,331	56,514	40,119	31,412	25,304	21,440	1	10	18	24	28	31

Table 8. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Ogallala and Edwards-Trinity (High Plains) aquifers in Scenario 2. UWCD is Underground Water Conservation District.

Scenario 2: Ogallala and Edwards-Trinity (High Plains) Aquifers	**Pumping**						**Average drawdown**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County												
Andrews	17,639	15,135	13,718	12,054	10,572	8,079	0	2	3	4	5	6
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	2	13	23	32	42	52
Bailey	63,365	41,593	35,215	30,371	24,327	21,708	1	3	6	8	8	10
Borden	504	504	504	504	504	504	0	0	1	2	3	4
Briscoe	33,629	26,464	19,728	14,226	13,082	11,938	2	9	15	19	23	28
Castro	127,426	127,306	126,511	125,819	123,284	118,002	2	11	20	29	38	46
Cochran	48,609	36,472	33,906	30,960	28,527	25,635	0	1	5	8	11	13
Crosby	135,582	135,399	135,399	135,399	135,399	135,399	3	19	35	51	67	83
Dawson	227,881	224,275	208,650	179,470	109,047	53,085	4	27	47	65	74	71
Deaf Smith	129,744	118,133	106,838	97,043	81,080	65,913	1	8	14	20	25	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	2	14	25	36	47	57
Ector	8,665	8,026	7,730	7,171	7,135	6,727	1	5	9	13	17	21
Floyd	156,932	151,308	147,284	140,276	131,653	126,080	3	17	31	45	57	69
Gaines	438,194	327,063	253,170	186,743	118,461	66,880	6	31	51	67	76	80
Garza	22,569	22,408	22,283	22,145	21,215	18,642	2	13	23	33	43	52
Glasscock	21,773	21,322	20,875	20,089	17,398	15,197	2	14	26	37	48	58
Hale	134,135	133,329	131,530	129,526	123,651	115,669	2	10	18	27	35	43
Hockley	97,069	93,466	89,355	85,244	77,384	67,138	1	7	14	20	25	29
Howard	4,653	4,647	4,617	4,595	4,585	4,563	0	1	1	2	2	3
Lamb	147,836	137,457	125,621	111,665	96,148	85,348	1	7	12	16	19	21
Lubbock	125,462	120,665	115,972	109,325	101,717	91,470	1	9	15	22	28	32
Lynn	105,953	105,686	104,887	102,034	94,330	84,848	1	8	15	23	28	33
Martin	8,062	8,062	8,040	8,003	8,003	7,990	0	1	1	3	4	5
Midland	39,227	38,309	36,824	34,623	33,222	31,696	2	9	16	23	30	37
Motley	9,936	9,936	9,936	9,936	9,936	9,576	2	13	24	35	45	56
Oldham	19,236	16,416	15,640	14,911	13,568	12,691	1	6	10	15	19	23
Parmer	68,909	63,072	56,590	52,156	45,954	40,986	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	3	13	19	22	27	31
Randall	72,963	70,696	69,626	64,546	59,098	49,709	2	10	18	25	32	38
Swisher	111,506	107,419	101,015	84,830	74,196	64,309	2	11	20	27	34	39
Terry	206,645	202,341	167,100	99,609	53,553	16,337	2	15	29	38	43	44
Yoakum	135,965	95,768	44,647	13,321	3,697	1,808	2	11	16	17	18	18

Table 8. Continued.

Scenario 2: Ogallala and Edwards-Trinity (High Plains) Aquifers	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
District												
Garza County UWCD	22,569	22,408	22,283	22,145	21,215	18,642	2	13	23	33	43	52
Glasscock GCD	21,773	21,322	20,875	20,089	17,398	15,197	2	14	26	37	48	58
High Plains UWCD No. 1	1,388,029	1,307,241	1,250,417	1,185,845	1,095,548	1,002,181	1	8	16	23	29	34
Llano Estacado UWCD	438,194	327,063	253,170	186,743	118,461	66,880	6	31	51	67	76	80
Mesa UWCD	227,881	224,275	208,650	179,470	109,047	53,085	4	27	47	65	74	71
Panhandle GCD	370	370	370	370	370	370	1	4	7	10	12	14
Permian Basin UWCD	12,629	12,623	12,570	12,512	12,502	12,466	0	1	1	2	3	4
Sandy Land UWCD	135,965	95,768	44,647	13,321	3,697	1,808	2	11	16	17	18	18
South Plains UWCD	207,281	202,977	167,736	100,245	54,189	16,973	2	15	28	37	42	43
Management Area												
Out-of-State	76,547	65,045	55,689	48,573	43,018	39,787	0	1	1	2	2	2
GMA 1	106,789	99,586	96,158	89,526	82,676	72,054	2	9	16	22	28	34
GMA 2	2,548,268	2,297,975	2,052,580	1,775,319	1,480,371	1,232,330	2	11	19	26	30	33
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	2	13	24	35	46	57
GMA 7	69,665	67,657	65,429	61,883	57,756	53,620	2	9	17	24	31	37

Table 9. Pumping (in acre-feet per year), remaining volume, and drawdown (in feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model by decade for the Ogallala Aquifer in Scenario 3. UWCD is Underground Water Conservation District.

Scenario 3:	Pumping reduced by 8.7 percent correction factor						Percent volume remaining						Average drawdown					
Ogallala Aquifer	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County																		
Andrews	17,639	15,135	13,718	12,054	10,057	7,418	99	96	93	90	87	85	0	2	3	4	5	6
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	98	87	76	66	56	46	2	13	23	32	42	52
Bailey	62,538	41,283	34,907	30,064	24,021	21,429	96	82	71	62	56	50	1	6	10	13	15	17
Borden	398	398	398	398	398	398	101	103	103	102	101	101	-1	-2	-1	-1	0	0
Briscoe	33,622	26,457	19,722	14,220	13,037	11,933	97	82	71	63	56	50	2	9	15	19	23	28
Castro	127,422	127,302	126,508	125,815	123,281	117,998	98	88	78	69	59	50	2	11	20	29	38	46
Cochran	48,345	36,208	33,641	30,696	28,084	25,371	97	85	75	66	57	50	1	6	11	15	18	22
Crosby	134,863	134,682	134,682	134,682	134,682	134,682	98	88	79	69	60	50	3	19	35	51	67	83
Dawson	201,610	198,109	185,882	161,615	135,454	93,779	96	76	57	40	26	16	4	23	42	58	74	87
Deaf Smith	129,167	118,165	106,868	97,057	80,382	65,931	97	86	75	65	56	50	1	8	15	20	24	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	98	88	78	69	59	50	2	14	25	36	47	57
Ector	9,024	8,382	8,075	7,508	7,470	7,050	98	87	77	68	59	50	1	5	10	14	18	22
Floyd	154,970	149,366	145,361	138,382	129,809	124,361	98	87	77	67	58	50	3	18	32	47	60	74
Gaines	350,369	240,110	175,175	130,951	97,498	71,544	93	65	46	32	23	16	5	25	41	54	66	75
Garza	19,203	19,073	18,942	18,812	18,032	17,121	98	88	78	68	58	50	2	11	19	28	35	42
Glasscock	22,776	22,304	21,835	21,012	17,749	14,945	98	87	76	66	58	50	3	15	27	39	50	61
Hale	130,622	129,816	128,017	126,013	120,137	112,259	98	88	78	68	59	50	2	10	19	28	37	45
Hockley	95,968	92,382	88,289	84,417	76,769	67,780	98	87	77	67	58	50	1	8	15	22	27	32
Howard	3,076	3,076	2,731	2,731	2,731	2,704	100	100	100	99	99	99	0	0	0	0	0	0
Lamb	147,369	137,304	125,467	111,510	95,696	85,191	97	85	75	65	57	50	2	11	20	27	33	38
Lubbock	124,519	120,044	115,348	108,699	100,762	91,073	98	87	77	67	58	50	2	10	19	27	34	40
Lynn	104,023	103,760	102,975	100,620	92,966	84,468	98	87	77	67	58	50	1	8	15	21	27	31
Martin	13,570	13,570	13,570	13,140	12,299	12,277	100	98	97	95	93	91	0	1	3	4	6	8
Midland	40,161	39,116	37,687	35,376	33,556	32,310	98	87	77	67	59	50	2	9	17	24	31	38
Motley	9,936	9,936	9,936	9,936	9,936	9,576	98	88	79	69	59	50	2	13	24	35	45	56
Oldham	19,198	16,416	15,640	14,911	13,530	12,691	98	90	82	75	68	62	1	6	10	15	19	23
Parmer	68,695	63,065	56,583	52,150	45,620	40,981	97	86	75	65	57	50	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	96	78	66	59	53	47	3	13	19	22	27	31
Randall	72,963	70,696	69,626	64,546	59,098	49,709	97	85	73	61	51	42	2	10	18	25	32	38
Swisher	110,925	107,405	101,002	84,818	73,848	64,298	98	86	75	65	57	50	2	11	20	27	34	39
Terry	205,658	196,222	134,609	87,098	53,904	33,647	94	64	40	24	14	8	4	21	35	45	53	60
Yoakum	82,297	59,745	43,575	33,882	26,717	20,040	94	68	51	38	28	21	2	9	15	20	24	27

Table 9. Continued.

Scenario 3:	Pumping reduced by 8.7 percent correction factor						Percent volume remaining						Average drawdown					
Ogallala Aquifer	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
District																		
Garza County UWCD	19,203	19,073	18,942	18,812	18,032	17,121	98	88	78	68	58	50	2	11	19	28	35	42
Glasscock GCD	22,776	22,304	21,835	21,012	17,749	14,945	98	87	76	66	58	50	3	15	27	39	50	61
High Plains UWCD No. 1	1,375,817	1,297,038	1,240,261	1,176,448	1,084,619	995,814	98	86	76	65	56	48	2	11	20	29	36	44
Llano Estacado UWCD	350,369	240,110	175,175	130,951	97,498	71,544	93	65	46	32	23	16	5	25	41	54	66	75
Mesa UWCD	201,610	198,109	185,882	161,615	135,454	93,779	96	76	57	40	26	16	4	23	42	58	74	87
Panhandle GCD	370	370	370	370	370	370	98	93	89	84	80	77	1	4	7	10	12	14
Permian Basin UWCD	16,404	16,404	16,099	15,669	14,828	14,796	100	99	97	96	94	93	0	1	2	3	4	5
Sandy Land UWCD	82,297	59,745	43,575	33,882	26,717	20,040	94	68	51	38	28	21	2	9	15	20	24	27
South Plains UWCD	206,274	196,837	135,225	87,713	54,520	34,263	94	65	41	25	16	10	4	21	34	44	52	58
Management Area																		
Out-of-State	76,367	64,788	55,688	48,572	43,177	39,786	100	98	97	95	95	94	0	1	1	1	1	2
GMA 1	106,751	99,586	96,158	89,526	82,639	72,054	98	86	75	66	56	48	2	9	16	22	28	34
GMA 2	2,366,866	2,132,678	1,907,968	1,699,823	1,496,184	1,306,684	97	85	73	64	55	48	2	11	19	26	32	37
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	98	88	79	69	59	50	2	13	24	35	46	57
GMA 7	71,962	69,802	67,597	63,896	58,775	54,304	98	87	77	67	58	50	2	10	18	25	32	38

Table 10. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Edwards-Trinity (High Plains) Aquifer in Scenario 3. UWCD is Underground Water Conservation District.

Scenario 3: Edwards-Trinity (High Plains) Aquifer	**Pumping**						**Average drawdown**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
County												
Bailey	279	279	279	279	279	279	0	1	2	4	4	5
Borden	106	106	106	106	106	106	0	1	1	2	3	4
Cochran	263	263	263	263	263	263	-1	0	3	6	9	11
Dawson	1,103	1,103	1,103	1,103	1,103	1,103	3	21	37	50	60	67
Floyd	1,216	1,216	1,216	1,213	1,200	1,182	3	16	29	41	52	61
Gaines	85,058	46,202	30,316	22,998	16,524	12,904	6	28	42	53	61	67
Garza	18	18	18	18	18	18	2	10	18	26	33	40
Hale	3,523	3,523	3,523	3,523	3,523	3,419	1	8	15	22	29	36
Hockley	96	96	96	96	96	96	1	7	13	19	24	28
Lamb	164	164	164	164	164	164	0	1	1	2	3	3
Lubbock	689	689	689	689	689	689	1	8	14	20	25	29
Lynn	230	230	230	230	230	230	0	7	14	21	27	32
Terry	982	982	945	945	945	945	2	14	25	32	37	40
Yoakum	2,532	1,893	1,757	1,642	1,642	1,524	1	6	10	13	15	17
District												
Garza County UWCD	18	18	18	18	18	18	2	10	18	26	33	40
High Plains UWCD No. 1	6,415	6,415	6,415	6,412	6,399	6,277	1	5	11	17	21	25
Llano Estacado UWCD	85,058	46,202	30,316	22,998	16,524	12,904	6	28	42	53	61	67
Mesa UWCD	1,103	1,103	1,103	1,103	1,103	1,103	3	21	37	50	60	67
Sandy Land UWCD	2,532	1,893	1,757	1,642	1,642	1,524	1	6	10	13	15	17
South Plains UWCD	982	982	945	945	945	945	2	13	25	32	37	40
Management Area												
Out-of-State	1	1	1	1	1	1	0	1	1	2	2	3
GMA 2	96,260	56,765	40,706	33,269	26,782	22,923	1	9	16	22	26	30

Table 11. Pumping (acre-feet per year) and drawdown (feet) for each county, groundwater conservation district (GCD), and groundwater management area (GMA) in the model for the Ogallala and Edwards-Trinity (High Plains) aquifers in Scenario 3. UWCD is Underground Water Conservation District.

Scenario 3: Ogallala and Edwards-Trinity (High Plains) Aquifers	**Pumping**						**Average drawdown**					
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Andrews	17,639	15,135	13,718	12,054	10,057	7,418	0	2	3	4	5	6
Armstrong	8,301	8,301	8,301	8,301	8,241	8,186	2	13	23	32	42	52
Bailey	62,816	41,562	35,185	30,342	24,299	21,708	1	3	6	8	8	9
Borden	504	504	504	504	504	504	0	0	1	2	3	3
Briscoe	33,622	26,457	19,722	14,220	13,037	11,933	2	9	15	19	23	28
Castro	127,422	127,302	126,508	125,815	123,281	117,998	2	11	20	29	38	46
Cochran	48,608	36,472	33,905	30,959	28,347	25,634	0	1	5	8	11	13
Crosby	134,863	134,682	134,682	134,682	134,682	134,682	3	19	35	51	67	83
Dawson	202,713	199,212	186,985	162,718	136,557	94,882	4	22	39	54	66	74
Deaf Smith	129,167	118,165	106,868	97,057	80,382	65,931	1	8	15	20	24	28
Dickens	12,339	12,339	12,339	12,121	12,121	11,594	2	14	25	36	47	57
Ector	9,024	8,382	8,075	7,508	7,470	7,050	1	5	10	14	18	22
Floyd	156,186	150,582	146,577	139,595	131,008	125,544	3	17	31	44	57	69
Gaines	435,427	286,312	205,491	153,949	114,022	84,448	5	27	41	53	63	70
Garza	19,221	19,091	18,960	18,830	18,050	17,139	2	10	18	27	34	40
Glasscock	22,776	22,304	21,835	21,012	17,749	14,945	3	15	27	39	50	61
Hale	134,145	133,340	131,540	129,536	123,660	115,678	2	10	18	27	35	43
Hockley	96,064	92,478	88,385	84,513	76,865	67,876	1	7	13	20	25	29
Howard	3,076	3,076	2,731	2,731	2,731	2,704	0	0	0	0	0	0
Lamb	147,533	137,468	125,631	111,674	95,860	85,355	1	7	12	16	19	21
Lubbock	125,209	120,733	116,037	109,388	101,451	91,762	1	9	16	22	27	32
Lynn	104,253	103,990	103,205	100,850	93,196	84,698	1	7	14	21	27	32
Martin	13,570	13,570	13,570	13,140	12,299	12,277	0	1	3	4	6	8
Midland	40,161	39,116	37,687	35,376	33,556	32,310	2	9	17	24	31	38
Motley	9,936	9,936	9,936	9,936	9,936	9,576	2	13	24	35	45	56
Oldham	19,198	16,416	15,640	14,911	13,530	12,691	1	6	10	15	19	23
Parmer	68,695	63,065	56,583	52,150	45,620	40,981	1	6	11	15	18	21
Potter	6,290	4,173	2,591	1,769	1,769	1,468	3	13	19	22	27	31
Randall	72,963	70,696	69,626	64,546	59,098	49,709	2	10	18	25	32	38
Swisher	110,925	107,405	101,002	84,818	73,848	64,298	2	11	20	27	34	39
Terry	206,640	197,203	135,554	88,043	54,849	34,592	2	15	27	34	39	42
Yoakum	84,829	61,638	45,331	35,523	28,359	21,564	1	7	11	14	16	18

Table 11. Continued.

Scenario 3: Ogallala and Edwards-Trinity (High Plains) Aquifers	**Pumping**						**Average drawdown**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
District												
Garza County UWCD	19,221	19,091	18,960	18,830	18,050	17,139	2	10	18	27	34	40
Glasscock GCD	22,776	22,304	21,835	21,012	17,749	14,945	3	15	27	39	50	61
High Plains UWCD No. 1	1,382,231	1,303,453	1,246,676	1,182,860	1,091,017	1,002,090	1	8	15	22	28	33
Llano Estacado UWCD	435,427	286,312	205,491	153,949	114,022	84,448	5	27	41	53	63	70
Mesa UWCD	202,713	199,212	186,985	162,718	136,557	94,882	4	22	39	54	66	74
Panhandle GCD	370	370	370	370	370	370	1	4	7	10	12	14
Permian Basin UWCD	16,404	16,404	16,099	15,669	14,828	14,796	0	1	2	3	4	5
Sandy Land UWCD	84,829	61,638	45,331	35,523	28,359	21,564	1	7	11	14	16	18
South Plains UWCD	207,256	197,819	136,170	88,658	55,465	35,208	2	15	27	34	38	41
Management Area												
Out-of-State	76,368	64,789	55,689	48,573	43,178	39,787	0	1	1	2	2	2
GMA 1	106,751	99,586	96,158	89,526	82,639	72,054	2	9	16	22	28	34
GMA 2	2,463,126	2,189,443	1,948,674	1,733,092	1,522,966	1,329,607	2	10	17	24	29	33
GMA 6	22,275	22,275	22,275	22,056	22,056	21,170	2	13	24	35	46	57
GMA 7	71,962	69,802	67,597	63,896	58,775	54,304	2	10	18	25	32	38