GAM Run 07-32

by Andrew C. A. Donnelly, P.G.
Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
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EXECUTIVE SUMMARY:

We ran the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer for a 71-year simulation, which consisted of 21 years of historic conditions followed by a 50-year predictive time period. Average recharge conditions were used for the first 44 years of the predictive portion of the simulation, followed by a six-year drought-of-record. The same baseline pumpage approved by the members of Groundwater Management Area 7 for use in GAM Run 07-03 (Donnelly, 2007) was used in this simulation.

Results of this model run indicated that water levels after 50 years of baseline pumpage stayed within 25 feet of water levels at the end of 2000 with one exception. An area of extreme drawdown (up to 500 feet) centered in Glasscock and Reagan counties in the Trinity Aquifer was predicted by the model at the end of fifty years. Research into the model performance during the calibration time period indicates that the model is not simulating the response of the aquifer to pumpage in this area appropriately. Because properties for this layer are consistent across the entire model area, it is recommended that the use of this model to evaluate desired future conditions in this layer be done with care.

REQUESTOR:

Ms. Caroline Runge from the Menard County Underground Water Conservation District (on behalf of Groundwater Management Area 7).

DESCRIPTION OF REQUEST:

Ms. Runge asked for a baseline model run using the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. This baseline model run would be a 71-year simulation, with the first 21 years being the historic portion of the simulation followed by a 50-year predictive time period. Average recharge conditions were used for the first 44 years of the predictive portion of the simulation, followed by the drought-of-record at the end of the predictive time period. Each year of the predictive portion of the simulation would use a specified baseline pumpage approved by members of Groundwater Management Area 7.

METHODS:

Initial streamflows were averaged for the 1961 to 1990 time period. These averages were then used for each year of the 50-year predictive portion of the model simulation along with the baseline pumpage. Recharge was also averaged for the 1961 to 1990 time period. Average recharge was used for the first 44 years of the predictive portion of the model run. The final six years of the predictive portion of the run used drought-of-record recharge, representing recharge for the years 1951 to 1956. Resulting water levels and drawdowns were then evaluated and are described in the Results section below.

PARAMETERS AND ASSUMPTIONS:

The groundwater availability model for the Edwards-Trinity (Plateau) Aquifer was used for this model run. The parameters and assumptions for this model are described below:

- We are using version 1.0 of the groundwater availability model of the Edwards-Trinity (Plateau) Aquifer, which includes the Pecos Valley Aquifer (formerly known as the Cenozoic Pecos Alluvium Aquifer). See Anaya and Jones (2004) for assumptions and limitations of the model.

- The root mean squared error (a measure of the difference between simulated and actual water levels during model calibration) in the entire Edwards-Trinity (Plateau) and Pecos Valley (formerly the Cenozoic Pecos Alluvium) groundwater availability model for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2004).

- The model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2). The Pecos Valley Aquifer is included in Layer 1 of the model.

- The model run was 71 years in length. The first 21 years were the historic calibration-verification portion of the simulation, followed by a 50-year predictive period.

- Pumpage for each year of the predictive portion of the model run was based the baseline pumpage requested by members of Groundwater Management Area 7, and is the same pumpage used in the previous baseline GAM Run (GAM Run 07-03). A description of how the baseline pumpage data set was assembled is included in the GAM07-03 report (Donnelly, 2007).

- The groundwater availability model simulates discharge to springs and seeps mostly along the northern and eastern margins of the aquifer. Spring and seep parameters used in the model are from the calibrated model.

- Recharge was distributed in the groundwater availability model based on a percent of annual precipitation and aquifer outcrop (surface geology).

- The groundwater availability model simulates the interaction between the aquifer(s) and major streams and rivers flowing in the region. Flow both from the stream to the aquifer and from the aquifer to the stream is allowed, and the direction of flow is determined by the water levels in the aquifer and the surface water elevation of the stream during each stress period in the simulation. The stream parameters, including streambed conductance and initial flow values, used in the model are from the calibrated model.

- The groundwater availability model uses general head boundary cells to simulate cross-formational groundwater flow between the Edwards-Trinity (Plateau) and Pecos Valley aquifers and adjacent aquifers, including the Ogallala, Dockum, Edwards (Balcones Fault Zone), and Llano Uplift area aquifers. Parameters assigned to the general head boundary cells such as aquifer conductance and water levels were from the calibrated model.

RESULTS:

Included in the results are estimates of the water budgets after running the model for 50 years. The components of the water budget are described below.

- Wells—water produced from wells in each aquifer. This component is always shown as "Outflow" from the water budget, because all wells included in the model produce (rather than inject) water. Wells are modeled using the MODFLOW Well package.

- Springs and seeps—water that drains from an aquifer to seeps and springs along the margins of the aquifer. This component is always shown as "Outflow", or discharge, from the water budget. Springs and seeps are modeled using the MODFLOW Drain package.

- Recharge—simulates areally distributed recharge due to precipitation falling on the outcrop areas of aquifers. Recharge is always shown as "Inflow" into the water budget. Recharge is modeled using the MODFLOW Recharge package.

- Vertical Leakage (Upward or Downward)—describes the vertical flow, or leakage, between two aquifers. This flow is controlled by the water levels in each aquifer and aquifer properties of each aquifer that define the amount of leakage that can occur. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer.

- Storage—water stored in the aquifer. The storage component that is included in "Inflow" is water that is removed from storage in the aquifer (that is, water level declines). The storage component that is included in "Outflow" is water that is added back into storage in the aquifer (that is, water level increases). This component of the budget is often seen as water both going into and out of the aquifer because this is a regional budget, and water levels will decline in some areas (water is being removed from storage) and will rise in others (water is being added to storage).

- Lateral flow—describes lateral flow within an aquifer between a county and adjacent counties.

- Rivers and Streams—water that flows between perennial streams and rivers and an aquifer. The direction and amount of flow depends on the water level in the stream or river and the aquifer. In areas where water levels in the stream or river are above the water level in the aquifer, water flows into the aquifer and out of the stream and is shown as "Inflow" in the budget. In areas where water levels in the aquifer are above the water level in the stream or river, water flows out of the aquifer and into the stream and is shown as "Outflow" in the budget. Rivers and streams are modeled using the MODFLOW Stream package.

- Inter-aquifer Flow—The model uses general-head boundaries to simulate the movement of water between the Edwards or Trinity aquifer units and adjacent aquifers, including the Ogallala, Dockum, Edwards (Balcones Fault Zone), and Llano Uplift area aquifers.

The results of the model run are described for the individual aquifers units, the Edwards and associated limestones (Layer 1) and the undifferentiated Trinity unit (Layer 2). The Pecos Valley Aquifer is included in Layer 1.

Water levels from the end of the transient calibration portion of the model run (the end of 2000) for Layers 1 and 2 are shown in Figures 1 and 2, respectively. These figures show the starting water levels for the 50-year predictive portion of the model run.

Water levels at the end of the 50-year predictive portion of the simulation for Layers 1 and 2 are shown in Figures 3 and 4, respectively. Water levels at the end of the 50-year runs are similar to initial water levels (Figures 1 and 2), except that water levels in Layer 2 for Glasscock and Reagan counties are obviously lower at the end of the 50-year predictive portion of the run (Figure 4). Because differences between initial water levels and water levels after 50 years of pumpage are sometimes difficult to discern in these figures, maps of water level changes were made. A water level change map shows the difference between the water levels at the end of the historic portion of the model run (2000) and the water levels at the end of the 50-year predictive portion of the model run.

Water level changes over the 50-year predictive portion of the model simulation for Layers 1 and 2 are shown in Figures 5 and 6, respectively. Figure 5 indicates that water levels in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer) show mainly decreases in water levels over the 50-year predictive portion of the run ranging up to 70 feet of decline over 50 years. Very few areas in Layer 1 show water level recovery.

Figure 6 indicates that water levels in Layer 2 (Trinity) decrease throughout most of the region, mostly less than 25 feet. However a very large cone of depression centered in

Glasscock and Reagan counties that is present at the end of the historic portion of the model run (Figure 2) continues to deepen, with the model predicting up to an additional 600 feet of decline in this area over the 50-year predictive time period. Because this appeared to be a very large drawdown for a baseline run that used a constant pumpage based on historic estimated pumpage totals, the model response in this area was evaluated. It was determined that the model did not simulate the response of water levels in this area appropriately during model calibration, and in fact water level declines during the historic calibration-verification time period were much lower than the model simulated water level declines. While using the model results without consideration of this could be viewed as taking a conservative approach, the water level declines predicted by the model are so great that we recommend taking another approach to evaluate the desired future conditions in this area, especially if a "managed depletion" approach to aquifer management is being considered.

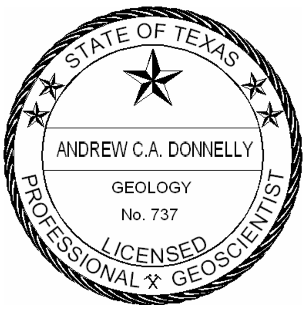
Another change in water levels that can be observed in Figure 6 is an area of increasing water levels centered in Blanco, Hays, and Kendall counties. The reason for this increase is not known at this time and will require further evaluation, but it occurs primarily outside of the Groundwater Management Area 7 boundaries. This area is also included in the groundwater availability model for the Trinity Hill Country Aquifer, which may be a better tool for evaluating aquifer conditions in this area than the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer.

Because some of the desired future conditions for the groundwater management area may be based on discharge to springs or baseflow to rivers and streams, we also evaluated the water budgets for each of these components for each county in the model area. These budgets are provided in Appendix A. The components of the water budget are divided up into "In" and "Out", representing water that is coming into and leaving from the budget. As might be expected, water from wells is only in the "Out" column, representing water that is removed from the aquifer from wells. Likewise, recharge is only found in the "In" column. Streams and rivers, however, have values in both the "In" and "Out" columns. This is because some stream reaches lose water to the aquifer, and some gain water from the aquifer depending on the water levels in the aquifer. Also included in these budgets are values for vertical leakage to overlying and underlying formations as well as lateral inflow from adjacent counties. Future model runs can be compared to these budgets to determine the impact of additional pumpage compared to this baseline run.

REFERENCES:

Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p.

Donnelly, A.C.A., 2007, GAM Run 07-03, Texas Water Development Board GAM Run Report, 49 p.



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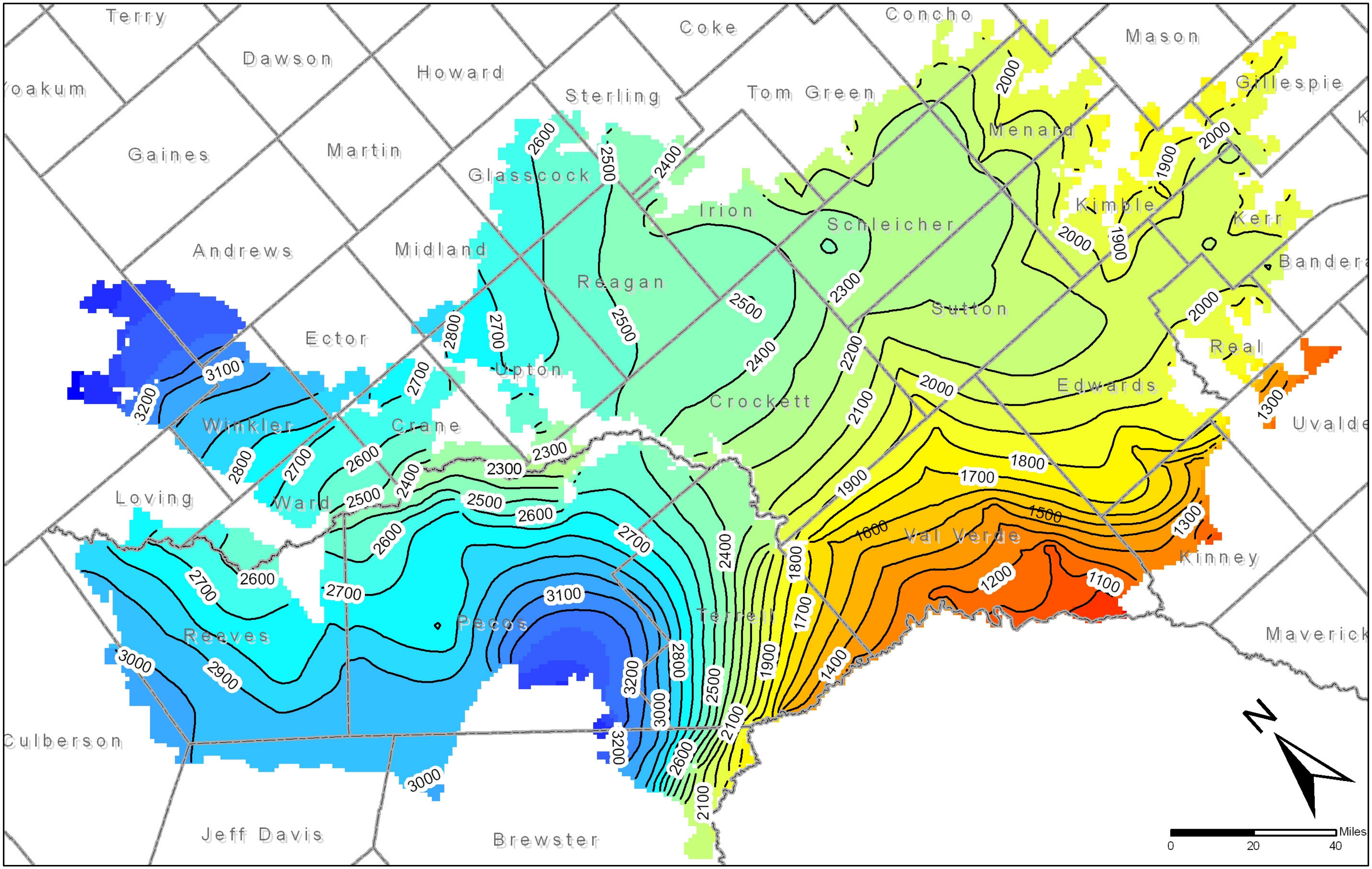

Figure 1. Initial water level elevations for the predictive model run in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer) of the groundwater availability model for Edwards- Trinity (Plateau) Aquifer. Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

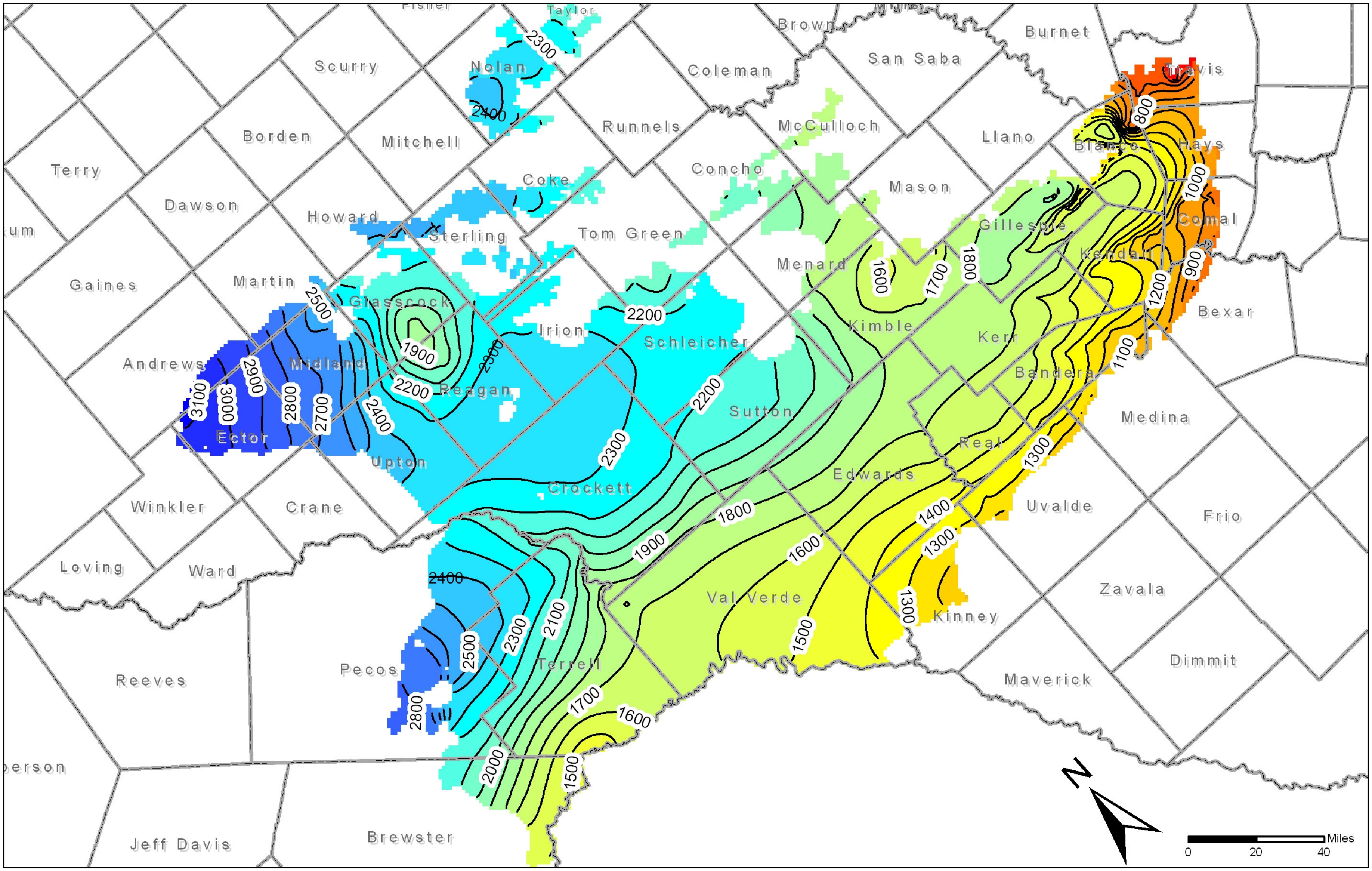

Figure 2. Initial water level elevations for the predictive model run in Layer 1 (Trinity Aquifer) of the groundwater availability model for Edwards- Trinity (Plateau) Aquifer. Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

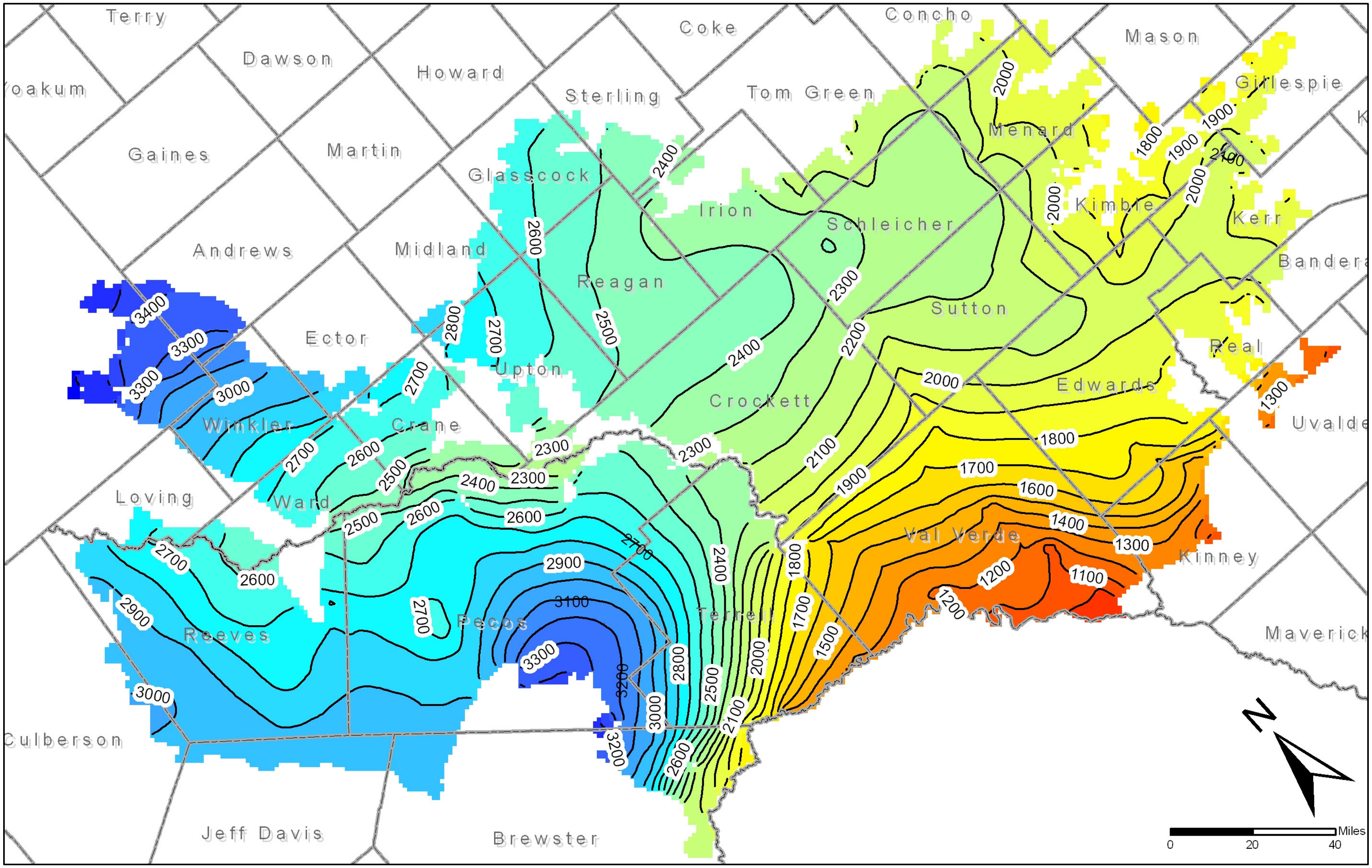

Figure 3. Water level elevations after 50 years using baseline pumpage in Layer 1 (Edwards and associated limestones and the Pecos Valley Aquifer). Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

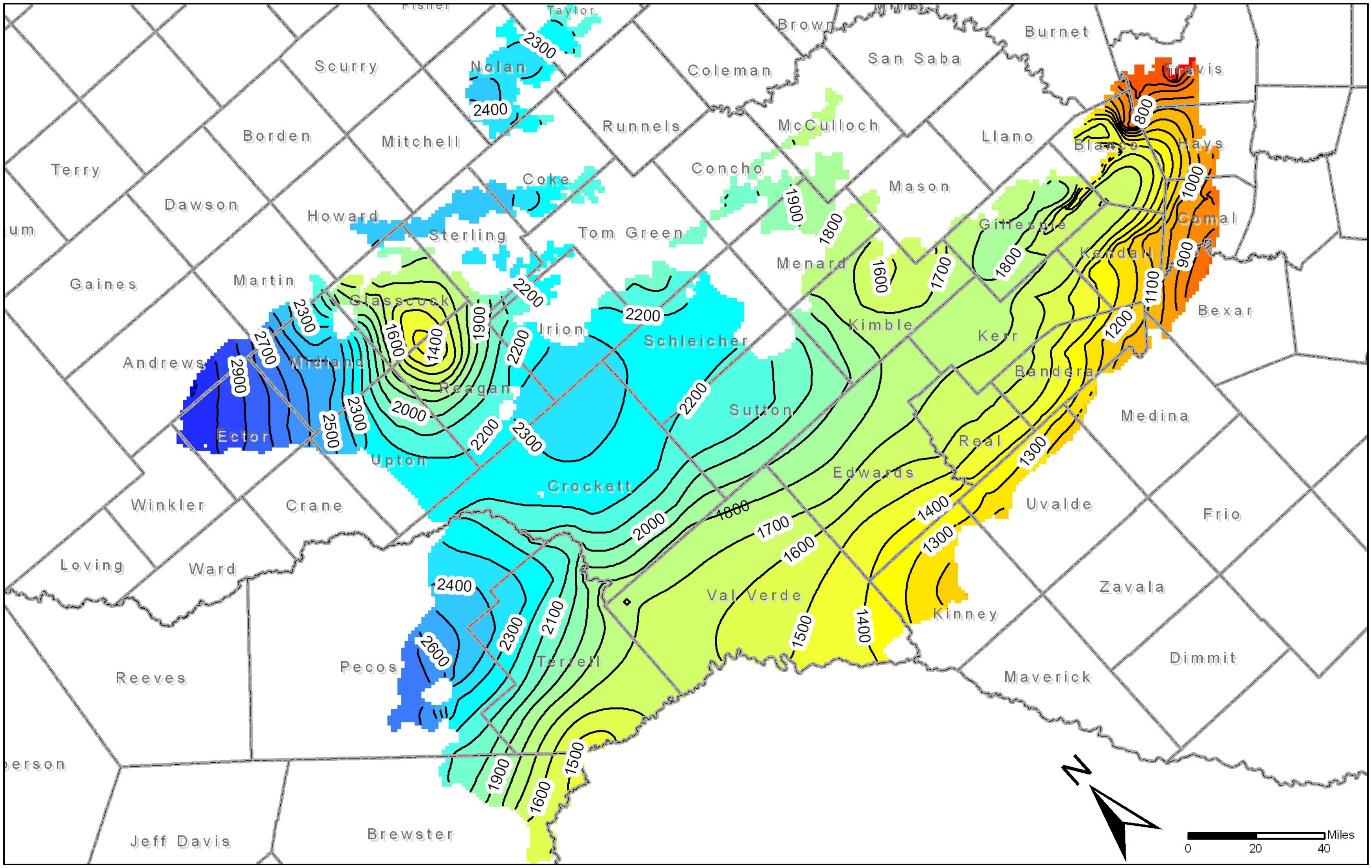

Figure 4. Water level elevations after 50 years using baseline pumpage in Layer 2 (Trinity Aquifer). Water level elevations are in feet above mean sea level. Contour interval is 100 feet.

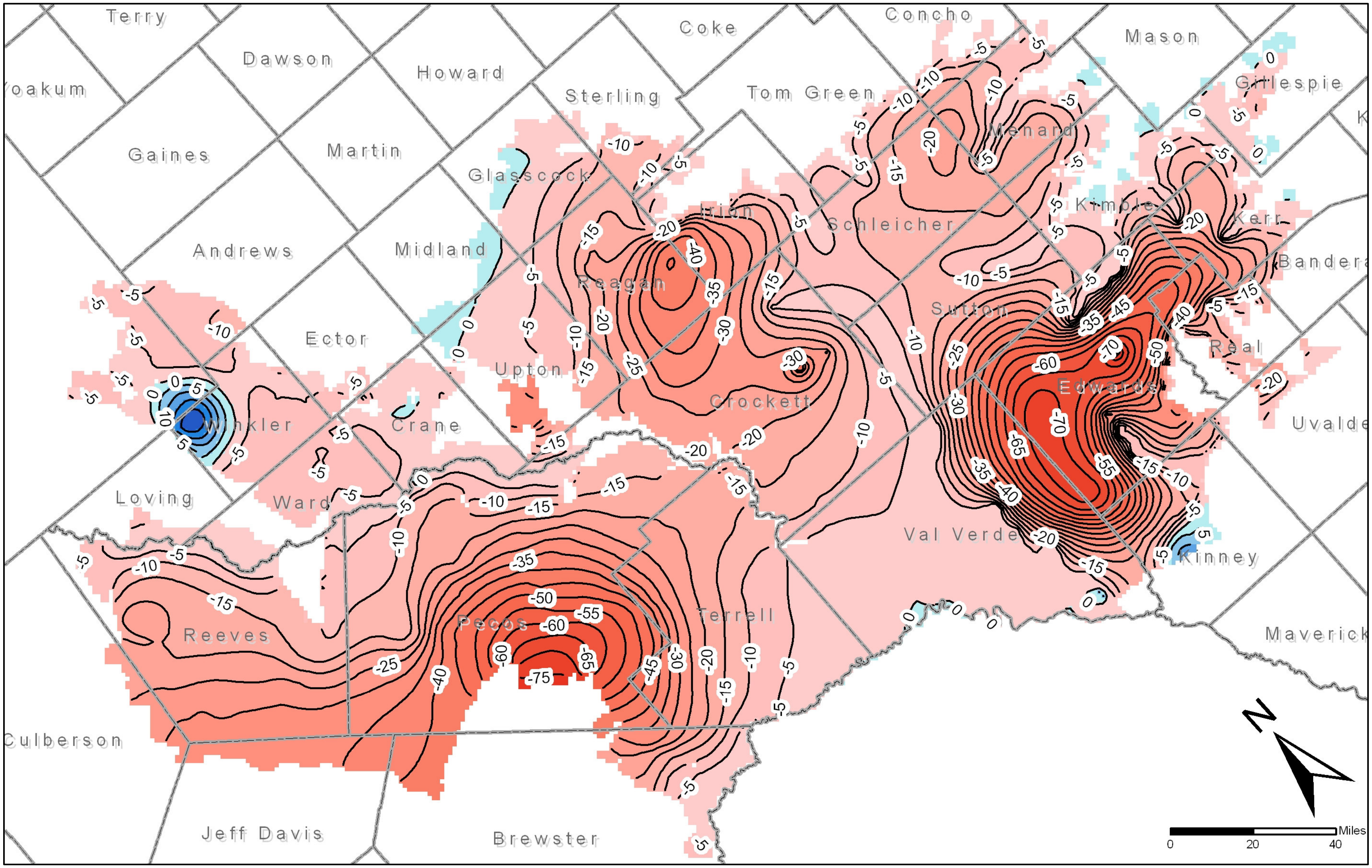

Figure 5. Changes in water levels after 50 years using baseline pumpage in Layer 1. Drawdowns are in feet. Contour interval is 5 feet. Decreases in water levels (drawdowns) are shown in red. Increases in water levels are shown in blue.

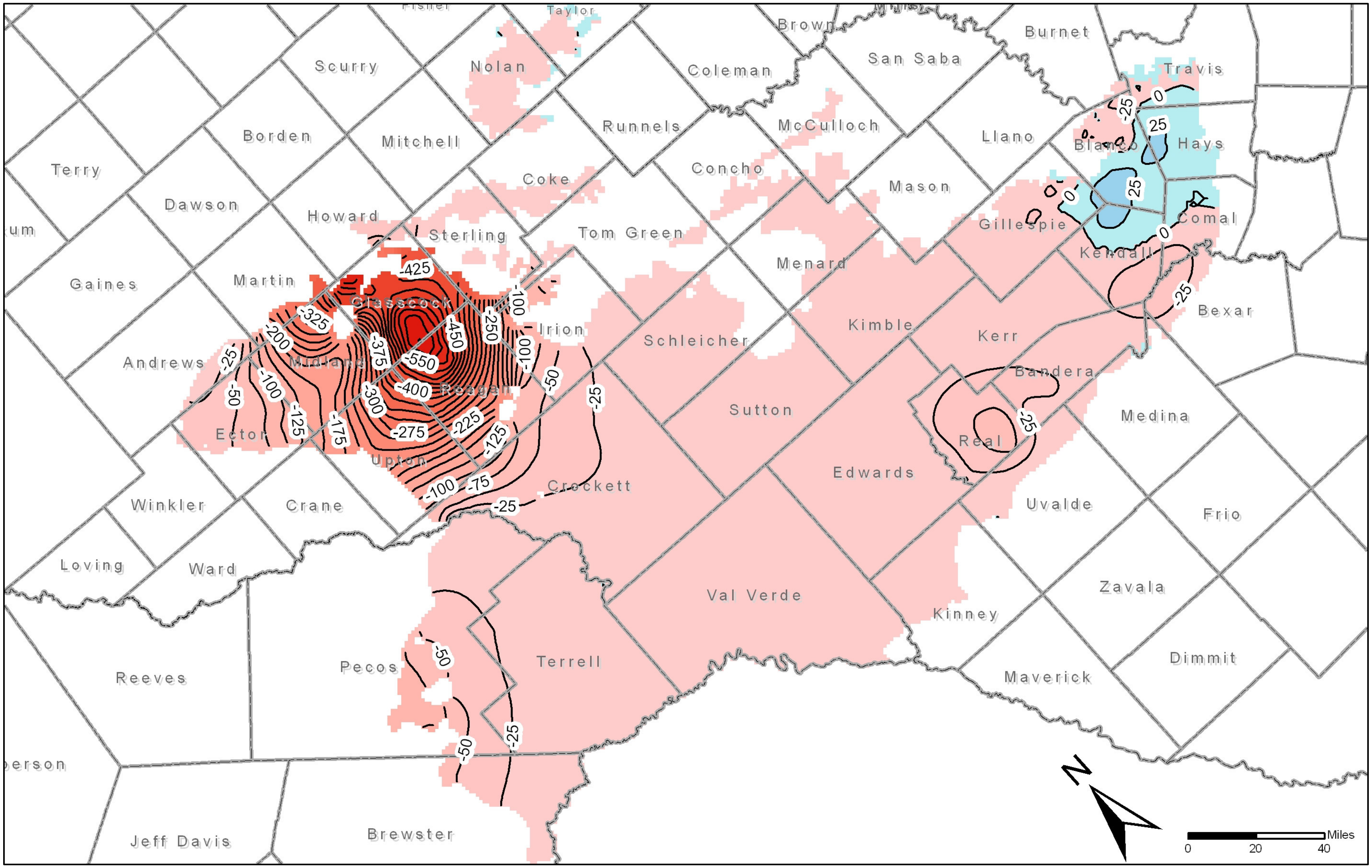

Figure 6. Changes in water levels after 50 years using baseline pumpage in Layer 2 (Trinity Aquifer). Drawdowns are in feet. Contour interval is 25 feet. Decreases in water levels (drawdowns) are shown in red. Increases in water levels are shown in blue.

Table A-1. Annual water budgets for each county at the end of the 50-year predictive portion of the model run using the requested pumpage and drought-of-record recharge in the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (in acre-feet per year).

	Andrews		Bandera		Bexar		Blanco		Brewster		Burnet	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	0	0	--	--	--	--	0	0	--	--
Storage	1,201	0	0	94	--	--	--	--	4,296	0	--	--
Springs and Seeps (Drain Package)	0	0	0	1,627	--	--	--	--	0	21,844	--	--
Inter-aquifer Flow (GHB Package)	0	1,266	0	0	--	--	--	--	0	0	--	--
Wells	0	60	0	28	--	--	--	--	0	85	--	--
Streams and Rivers (Stream Package)	0	0	3,549	772	--	--	--	--	0	0	--	--
Recharge	1,377	0	1,259	0	--	--	--	--	14,193	0	--	--
Lateral Inflow	851	2,113	691	2,895	--	--	--	--	6,983	3,751	--	--
Vertical Leakage Downward	--	--	5	83	--	--	--	--	1,236	1,076	--	--
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	526	1,871	0	0	0	0	0	0	0	529
Storage	254	2	3,987	444	0	311	6,554	1,552	1,071	72	0	93
Springs and Seeps (Drain Package)	0	0	0	0	0	0	0	12,615	0	0	0	668
Inter-aquifer Flow (GHB Package)	3,260	864	0	2,243	0	21,710	0	7	0	0	0	0
Wells	0	8	0	2,303	0	2,399	0	744	0	588	0	114
Streams and Rivers (Stream Package)	0	0	4,372	22,053	0	0	0	9,601	1,608	12,395	0	0
Recharge	2,982	0	35,898	0	11,321	0	33,319	0	4,315	0	1,391	0
Vertical Leakage Upward	--	--	83	5	--	--	--	--	1,076	1,236	--	--
Lateral Inflow	294	5,919	15,445	31,374	18,126	5,011	5,094	20,452	6,204	0	1,208	1,190

Table A-1. (continued)

	Coke		Comal		Concho		Crane		Crockett		Culberson	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	--	--	--	--	0	0	0	0	0	0	0	0
Storage	--	--	--	--	559	67	2,807	10	12,261	17	1,429	0
Springs and Seeps (Drain Package)	--	--	--	--	0	4,077	0	0	0	0	0	0
Inter-aquifer Flow (GHB Package)	--	--	--	--	0	0	89	1,809	0	42	66	439
Wells	--	--	--	--	0	108	0	552	0	4,794	0	37
Streams and Rivers (Stream Package)	--	--	--	--	0	0	59	7,681	9,874	5,185	0	0
Recharge	--	--	--	--	3,514	0	3,920	0	30,263	0	1,647	0
Lateral Inflow	--	--	--	--	2,469	1,584	5,147	1,994	9,363	32,320	637	3,316
Vertical Leakage Downward	--	--	--	--	7	711	--	--	292	19,832	--	--
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	7,339	5,007	0	0	0	0	0	0	--	--
Storage	949	0	0	437	182	105	73	0	1,421	0	--	--
Springs and Seeps (Drain Package)	0	4,557	0	0	0	2,474	0	0	0	0	--	--
Inter-aquifer Flow (GHB Package)	0	53	2,800	8,556	0	20	3	3	0	3,463	--	--
Wells	0	21	0	3,059	0	169	0	5	0	698	--	--
Streams and Rivers (Stream Package)	0	0	873	22,203	0	0	0	0	196	11,583	--	--
Recharge	2,963	0	18,227	0	2,395	0	101	0	1,471	0	--	--
Vertical Leakage Upward	--	--	--	--	711	7	--	--	19,832	292	--	--
Lateral Inflow	1,138	432	18,981	8,867	781	1,302	900	1,070	7,975	14,902	--	--

Table A-1. (continued)

	Ector		Edwards		Gillespie		Glasscock		Hays		Howard	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	--	--	--	--
Storage	673	1	0	2,987	0	908	412	0	--	--	--	--
Springs and Seeps (Drain Package)	0	0	0	2,783	0	7,937	0	833	--	--	--	--
Inter-aquifer Flow (GHB Package)	0	432	0	0	0	0	0	0	--	--	--	--
Wells	0	48	0	7,049	0	616	0	54	--	--	--	--
Streams and Rivers (Stream Package)	0	0	14,288	19,543	1,091	1,096	0	0	--	--	--	--
Recharge	539	0	55,471	0	8,698	0	5,696	0	--	--	--	--
Lateral Inflow	336	1,057	8,578	41,283	3,611	1,883	540	1,978	--	--	--	--
Vertical Leakage Downward	0	14	19	3,794	519	1,492	362	4,063	--	--	--	--
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	0	0
Storage	3,547	0	1,092	36	864	2,173	11,966	0	6,794	194	282	0
Springs and Seeps (Drain Package)	0	0	0	0	0	6,161	0	0	0	0	0	0
Inter-aquifer Flow (GHB Package)	11	2,578	0	0	0	7	16,611	66	0	15,003	785	24
Wells	0	5,489	0	745	0	3,354	0	59,226	0	2,818	0	585
Streams and Rivers (Stream Package)	0	0	3,092	331	3,295	18,389	0	0	0	3,033	0	0
Recharge	8,978	0	2,412	0	31,164	0	3,036	0	21,262	0	922	0
Vertical Leakage Upward	14	0	3,794	19	1,492	519	4,063	362	--	--	--	--
Lateral Inflow	3,473	8,004	11,964	21,234	1,401	7,174	34,312	10,576	7,074	14,118	226	1,609

Table A-1. (continued)

	Irion		Jeff Davis		Kendall		Kerr		Kimble		Kinney	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	0	0	--	--	0	0	0	0	0	0
Storage	311	87	1,466	0	--	--	0	1,544	9	1,836	1,998	948
Springs and Seeps (Drain Package)	0	4,992	0	0	--	--	0	7,095	0	18,340	0	7,143
Inter-aquifer Flow (GHB Package)	0	0	11	12	--	--	0	0	0	0	0	12,064
Wells	0	232	0	141	--	--	0	559	0	251	0	4,148
Streams and Rivers (Stream Package)	690	4,312	0	0	--	--	8,526	4,702	1,247	3,574	1,268	13,150
Recharge	9,091	0	4,382	0	--	--	15,116	0	19,947	0	34,642	0
Lateral Inflow	6,724	2,066	1,918	7,644	--	--	3,505	11,965	16,388	6,471	15,693	13,613
Vertical Leakage Downward	266	5,388	--	--	--	--	9	1,211	66	7,134	8	885
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	0	0	0	0
Storage	962	0	--	--	4,637	697	3,576	661	803	359	116	16
Springs and Seeps (Drain Package)	0	1,186	--	--	0	0	0	0	0	4,284	0	0
Inter-aquifer Flow (GHB Package)	637	548	--	--	0	0	0	0	0	0	28	12,724
Wells	0	200	--	--	0	3,515	0	3,622	0	592	0	2,684
Streams and Rivers (Stream Package)	0	0	--	--	1,031	28,737	3,515	14,066	7,013	23,850	0	0
Recharge	1,243	0	--	--	33,048	0	21,387	0	5,813	0	939	0
Vertical Leakage Upward	5,388	266	--	--	--	--	1,211	9	7,134	66	885	8
Lateral Inflow	3,230	9,299	--	--	9,907	15,613	6,395	17,671	11,860	3,368	15,199	1,734

Table A-1. (continued)

	Loving		Martin		Mason		McCulloch		Medina		Menard	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	--	--	0	0
Storage	525	79	--	--	0	51	0	50	--	--	1,620	354
Springs and Seeps (Drain Package)	0	0	--	--	0	673	0	563	--	--	0	3,576
Inter-aquifer Flow (GHB Package)	2	163	--	--	0	0	0	0	--	--	0	0
Wells	0	32	--	--	0	0	0	2	--	--	0	927
Streams and Rivers (Stream Package)	962	1,814	--	--	0	0	0	0	--	--	0	10,290
Recharge	452	0	--	--	697	0	528	0	--	--	13,251	0
Lateral Inflow	1,862	1,719	--	--	324	214	270	75	--	--	7,538	4,458
Vertical Leakage Downward	--	--	--	--	17	99	23	130	--	--	7	2,821
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	--	--	0	0	0	0	0	0	590	595	0	0
Storage	--	--	1,087	0	7	115	9	744	862	34	892	31
Springs and Seeps (Drain Package)	--	--	0	0	0	2,074	0	4,672	0	0	0	1,154
Inter-aquifer Flow (GHB Package)	--	--	1,762	83	0	0	0	320	0	25,096	0	0
Wells	--	--	0	94	0	3	0	29	0	69	0	918
Streams and Rivers (Stream Package)	--	--	0	0	0	0	0	0	0	0	711	1,292
Recharge	--	--	2,051	0	1,218	0	4,529	0	5,850	0	2,202	0
Vertical Leakage Upward	--	--	--	--	99	17	130	23	--	--	2,821	7
Lateral Inflow	--	--	4,849	9,584	1,733	846	1,381	254	23,695	5,208	1,457	4,689

Table A-1. (continued)

	Midland		Nolan		Pecos		Reagan		Real		Reeves	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	--	--	0	0	0	0	0	0	0	0
Storage	10	15	--	--	51,713	82	231	159	0	770	85,900	14
Springs and Seeps (Drain Package)	0	0	--	--	0	0	0	474	0	6,233	0	0
Inter-aquifer Flow (GHB Package)	0	0	--	--	34	5,089	0	0	0	0	208	4,168
Wells	0	3	--	--	0	83,272	0	1,001	0	2,844	0	107,747
Streams and Rivers (Stream Package)	0	0	--	--	169	18,608	0	0	259	3,834	977	35,261
Recharge	1,776	0	--	--	106,399	0	12,492	0	9,799	0	56,111	0
Lateral Inflow	185	980	--	--	14,754	46,909	4,150	2,783	6,458	2,328	14,882	11,728
Vertical Leakage Downward	177	1,132	--	--	1,817	21,458	316	12,711	49	532	--	--
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	--	--
Storage	25,128	0	636	112	4,628	48	10,705	0	858	44	--	--
Springs and Seeps (Drain Package)	0	0	0	8,395	0	0	0	0	0	0	--	--
Inter-aquifer Flow (GHB Package)	2,740	765	0	0	0	0	14,327	235	0	0	--	--
Wells	0	21,137	0	151	0	2,236	0	60,815	0	8,680	--	--
Streams and Rivers (Stream Package)	0	0	0	0	0	16,817	0	0	8,413	446	--	--
Recharge	10,617	0	8,891	0	5,318	0	11	0	7,023	0	--	--
Vertical Leakage Upward	1,132	177	--	--	21,458	1,817	12,711	316	532	49	--	--
Lateral Inflow	19,293	37,104	162	1,037	10,499	21,079	37,333	13,930	9,793	17,365	--	--

Table A-1. (continued)

	Schleicher		Sterling		Sutton		Taylor		Terrell		Tom Green	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	--	--	0	0	0	0
Storage	4,411	8	106	0	3,701	293	--	--	13,176	0	756	4
Springs and Seeps (Drain Package)	0	0	0	1,626	0	0	--	--	0	4,247	0	7,267
Inter-aquifer Flow (GHB Package)	0	0	0	0	0	0	--	--	0	0	0	0
Wells	0	3,723	0	82	0	3,425	--	--	0	308	0	159
Streams and Rivers (Stream Package)	8,928	6,397	0	0	4,411	21,917	--	--	182	33,164	0	1,041
Recharge	16,970	0	2,231	0	20,413	0	--	--	28,859	0	5,254	0
Lateral Inflow	4,450	19,452	1,017	1,112	16,838	14,088	--	--	43,624	33,495	6,710	2,533
Vertical Leakage Downward	11	5,247	266	772	719	6,396	--	--	318	15,107	8	1,721
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	0	0	0	0	0	0	0	0	0	0	0	0
Storage	84	0	1,185	0	516	0	0	369	1,346	0	207	27
Springs and Seeps (Drain Package)	0	0	0	1,266	0	0	0	3,951	0	0	0	3,579
Inter-aquifer Flow (GHB Package)	0	0	993	1,153	0	0	0	0	0	0	196	32
Wells	0	9	0	293	0	20	0	117	0	724	0	582
Streams and Rivers (Stream Package)	0	0	0	0	371	0	0	0	149	19,156	211	3,169
Recharge	0	0	2,974	0	0	0	4,089	0	429	0	2,126	0
Vertical Leakage Upward	5,247	11	772	266	6,396	719	--	--	15,107	318	1,721	8
Lateral Inflow	2,114	7,429	2,545	5,524	5,502	12,055	443	89	19,843	16,714	7,214	4,292

Table A-1. (continued)

	Travis		Upton		Uvalde		Val Verde		Ward		Winkler	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Edwards and Pecos Valley Aquifer (Layer 1)												
Reservoirs (Constant Head Cells)	--	--	0	0	0	0	17,280	47,301	0	0	0	0
Storage	--	--	1,036	563	0	139	3,965	491	4,568	17	4,011	628
Springs and Seeps (Drain Package)	--	--	0	0	0	2,125	0	758	0	0	0	0
Inter-aquifer Flow (GHB Package)	--	--	5	862	0	5,783	0	0	2	4,802	0	3,683
Wells	--	--	0	337	0	241	0	14,405	0	5,821	0	558
Streams and Rivers (Stream Package)	--	--	0	0	0	0	28,551	112,493	433	12,511	0	0
Recharge	--	--	10,264	0	5,809	0	57,067	0	4,754	0	3,458	0
Lateral Inflow	--	--	1,049	4,876	2,864	1,197	74,006	8,571	17,733	4,383	5,056	7,691
Vertical Leakage Downward	--	--	286	5,981	849	32	3,443	613	--	--	--	--
Trinity (Layer 2)												
Reservoirs (Constant Head Cells)	3,729	30,406	0	0	0	0	0	0	--	--	0	0
Storage	1,915	202	8,415	0	559	115	578	0	--	--	44	0
Springs and Seeps (Drain Package)	0	0	0	0	0	0	0	0	--	--	0	0
Inter-aquifer Flow (GHB Package)	13,237	348	7,564	47	997	21,566	0	0	--	--	0	23
Wells	0	1,721	0	20,266	0	501	0	157	--	--	0	1
Streams and Rivers (Stream Package)	7	6,258	0	0	2,990	15,900	13	1,871	--	--	0	0
Recharge	10,468	0	1,883	0	15,525	0	98	0	--	--	81	0
Vertical Leakage Upward	--	--	5,981	286	32	849	613	3,443	--	--	--	--
Lateral Inflow	9,610	30	17,630	21,025	24,572	5,730	11,753	7,599	--	--	49	150