GAM Run 08-80 Revised

by Mr. Wade Oliver
Texas Water Development Board
Groundwater Availability Modeling Section
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September 23, 2009

EXECUTIVE SUMMARY:

We ran the groundwater availability model for the northern portion of the Gulf Coast Aquifer, adjusting the annual pumpage in Southeast Texas Groundwater Conservation District to match pumpage totals requested by the district for a 2006 to 2060 predictive simulation. This model run, which used a steady growth scenario of a 2.125 percent of 2006 pumpage increase per year, results in the following:

- average water level drawdowns in the district between 2006 and 2060 in the Chicot Aquifer portion of the Gulf Coast Aquifer range from 3 feet in Tyler County to 17 feet in Hardin County, with an average drawdown of 12 feet in the district;

- average water level drawdowns in the district between 2006 and 2060 in the Evangeline Aquifer portion of the Gulf Coast Aquifer range from 17 feet in Tyler County to 28 feet in Hardin County, with an average drawdown of 23 feet in the district;

- average water level drawdowns in the district between 2006 and 2060 in the Jasper Aquifer portion of the Gulf Coast Aquifer range from 19 feet in Newton County to 32 feet in Hardin County, with an average drawdown of 25 feet in the district;

REQUESTOR:

Mr. John Martin of Southeast Texas Groundwater Conservation District.

DESCRIPTION OF REQUEST:

Mr. John Martin requested a run of the groundwater availability model for the northern portion of the Gulf Coast Aquifer, adjusting the amount of pumping within the district for each year from 2006 to 2060 to match a steady growth scenario of a 2.125 percent of 2006 pumpage increase per year. The 2006 estimate of pumping was supplied by the district.

METHODS:

The pumping in the model for areas within the district was adjusted as specified by the district for each year between 2006 and 2060. For the years 2006 to 2050, pumping in areas outside of the district was left unchanged from the predictive scenario described in Kasmarek and others (2005), which was based on regional water planning estimates (TWDB, 2002).

Between 2051 and 2060, the 2050 pumping from the predictive scenario described in Kasmarek and others (2005) was held constant in the areas outside the district.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the run using the groundwater availability model for the northern portion of the Gulf Coast Aquifer are described below:

- We used Version 2.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer. See Kasmarek and Robinson (2004) and Kasmarek and others (2005) for assumptions and limitations of the model.

- We used Groundwater Vistas version 5.3 Build 10 (Environmental Simulations, Inc., 2007) as the interface to process model output.

- The model includes four layers representing the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer (Layer 4).

- The model contains 129 individual stress periods representing the calibration and predictive time periods. See Table 1 for the specific time period represented by each stress period and its length.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) of the entire model for the year 2000 is 31 feet for the Chicot Aquifer, 45 feet for the Evangeline Aquifer, and 38 feet for the Jasper Aquifer (Kasmarek and others, 2005).

- The calibrated portion of the groundwater availability model for the northern portion of the Gulf Coast Aquifer ends in 2000 while the requested pumping begins in 2006. To represent pumping during this interim period as realistically as possible, the pumping in the district was uniformly increased between the historical pumping in 2000 and the requested pumping in 2006. The pumpage distribution for this interim period was the same distribution used for the 2006 to 2060 predictive simulation described in the Pumpage section below

- Recharge, evapotranspiration, and surface water inflows and outflows were modeled using the MODFLOW general-head boundary package as described in Kasmarek and Robinson (2004).

- The pumpage specified in the district for each year of the 2006 to 2060 predictive simulation was distributed spatially and among the model layers as described in the Pumpage section below.

Pumpage

The pumpage values in the groundwater availability model were adjusted as requested for the steady growth scenario provided by the district. In this scenario, the increase of pumpage per year is 2.125 percent of the total pumpage in 2006 as provided by the district - an additional 2,073 acre-feet per year. The pumpage values requested by the district and assigned in the groundwater availability model are shown in Table 2.

Groundwater pumping was distributed spatially across the district as well as vertically among the four layers in the model representing the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining Unit, and the Jasper Aquifer. The spatial distribution of pumping in 2005 was used because it is considered to be more comprehensive than that of the historical calibration period (Kasmarek and others, 2005). From this base, the additional amount of pumping required to achieve the requested totals was distributed evenly among all model cells that contained pumping in the year 2005. For the vertical distribution, the percent of pumping in each layer of the model for each cell was held constant. For example, if 40 percent of the pumping in one area of the model in the year 2000 was in the Evangeline Aquifer, the pumping for each of the years between 2006 and 2060 was also 40 percent of the total for that area.

It should be noted that one cell in the baseline predictive pumpage distribution (the year 2005 of the predictive model) had an unrealistically large volume of pumping (row 50, column 211, layer 4). To correct for this, the pumpage in this cell was reassigned to the value in the model for the year 2000, the end of the calibration period.

Pumpage in areas outside of the district was not changed from the predictive scenario for the years 2006 to 2050 described in Kasmarek and others (2005). For the years 2051 to 2060, pumping outside of the district was held constant at 2050 levels as described in Kasmarek and others (2005).

Table 1. Stress periods for the calibration and predictive periods of the groundwater availability model and the time period each represents.

Stress Period	Time Period	Length (days)	Stress Period	Time Period	Length (days)	Stress Period	Time Period	Length (days)
1	Steady-State	3650000	44	1986	365	87	2018	365
2	1891-1900	3650	45	1987	365	88	2019	365
3	1901-1930	10950	46	Jan-88	31	89	2020	365
4	1931-1940	3650	47	Feb-88	29	90	2021	365
5	1941-1945	1825	48	Mar-88	31	91	2022	365
6	1946-1953	2920	49	Apr-88	30	92	2023	365
7	1954-1960	2555	50	May-88	31	93	2024	365
8	1961-1962	730	51	Jun-88	30	94	2025	365
9	1963-1970	2920	52	Jul-88	31	95	2026	365
10	1971-1973	1095	53	Aug-88	31	96	2027	365
11	1974-1975	730	54	Sep-88	30	97	2028	365
12	1976	365	55	Oct-88	31	98	2029	365
13	1977	365	56	Nov-88	30	99	2030	365
14	1978	365	57	Dec-88	31	100	2031	365
15	1979	365	58	1989	365	101	2032	365
16	Jan-80	31	59	1990	365	102	2033	365
17	Feb-80	28	60	1991	365	103	2034	365
18	Mar-80	31	61	1992	365	104	2035	365
19	Apr-80	30	62	1993	365	105	2036	365
20	May-80	31	63	1994	365	106	2037	365
21	Jun-80	30	64	1995	365	107	2038	365
22	Jul-80	31	65	1996	365	108	2039	365
23	Aug-80	31	66	1997	365	109	2040	365
24	Sep-80	30	67	1998	365	110	2041	365
25	Oct-80	31	68	1999	365	111	2042	365
26	Nov-80	30	69	2000	365	112	2043	365
27	Dec-80	31	70	2001	365	113	2044	365
28	1981	365	71	2002	365	114	2045	365
29	Jan-82	31	72	2003	365	115	2046	365
30	Feb-82	28	73	2004	365	116	2047	365
31	Mar-82	31	74	2005	365	117	2048	365
32	Apr-82	30	75	2006	365	118	2049	365
33	May-82	31	76	2007	365	119	2050	365
34	Jun-82	30	77	2008	365	120	2051	365
35	Jul-82	31	78	2009	365	121	2052	365
36	Aug-82	31	79	2010	365	122	2053	365
37	Sep-82	30	80	2011	365	123	2054	365
38	Oct-82	31	81	2012	365	124	2055	365
39	Nov-82	30	82	2013	365	125	2056	365
40	Dec-82	31	83	2014	365	126	2057	365
41	1983	365	84	2015	365	127	2058	365
42	1984	365	85	2016	365	128	2059	365
43	1985	365	86	2017	365	129	2060	365

Table 2. Pumpage input into the groundwater availability model requested by Southeast Texas Groundwater Conservation District. These values reflect a 2.125 percent increase each year relative to 2006. All pumpage is reported in acre-feet per year.

Year	Pumpage	Year	Pumpage	Year	Pumpage
2006	97,565	2025	136,957	2044	176,349
2007	99,638	2026	139,030	2045	178,422
2008	101,712	2027	141,103	2046	180,495
2009	103,785	2028	143,177	2047	182,569
2010	105,858	2029	145,250	2048	184,642
2011	107,931	2030	147,323	2049	186,715
2012	110,005	2031	149,396	2050	188,788
2013	112,078	2032	151,470	2051	190,862
2014	114,151	2033	153,543	2052	192,935
2015	116,224	2034	155,616	2053	195,008
2016	118,298	2035	157,689	2054	197,081
2017	120,371	2036	159,763	2055	199,155
2018	122,444	2037	161,836	2056	201,228
2019	124,517	2038	163,909	2057	203,301
2020	126,591	2039	165,982	2058	205,374
2021	128,664	2040	168,056	2059	207,448
2022	130,737	2041	170,129	2060	209,521
2023	132,810	2042	172,202		
2024	134,884	2043	174,275		

RESULTS:

Water budget results throughout the course of the model run are shown in Appendicies A, B, and C. Appendix A contains a chart of results in the district for each component of the water budget by stress period of the model run. Appendix B contains tables of the water budget for Southeast Texas Groundwater Conservation District by county, and for the district as a whole, for each decade between 2006 and 2060. Appendix C contains tables of the water budget within Groundwater Management Area 14 for all counties outside the district. The components of the water budgets are described below.

- Recharge and Surface Water Inflow—areally distributed recharge due to precipitation falling on the outcrop (where the aquifer is exposed at land surface) areas of aquifers as well as inflow from surface water features such as rivers and streams. Recharge is always shown as "Inflow" into the water budget. In the groundwater availability model for the northern portion of the Gulf Coast Aquifer, recharge is modeled using the MODFLOW General Head Boundary package.

- Evapotranspiration and Surface Water Outflow—water that flows out of an aquifer due to direct evaporation and plant transpiration (together called evapotranspiration) as well as outflow to surface water features such as rivers, streams, and springs (drains). This component of the budget will always be shown as "Outflow." In the groundwater availability model for the northern portion of the Gulf Coast Aquifer, surface water outflow is modeled using the MODFLOW General Head Boundary package.

- 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 simulated in the model using the MODFLOW Well package. It is important to note that values in Appendix B for wells in the water budget may not precisely match the pumpage amounts requested in Table 2 because of dry cells, as described below.

- Interbed Storage—describes the change in water stored in the aquifer due to compaction of clay layers and is separate from the change in storage term described below. This compaction, and subsequent loss of storage volume in the aquifer, is considered to be largely permanent. Interbed storage - simulated in the model using the MODFLOW Interbed Storage package – is included primarily for the purpose of simulating land-surface subsidence. Refer to Kasmarek and Robinson (2004) and Kasmarek and others (2005) for more details about the Interbed Storage package and land-surface subsidence.

- Change in Storage—changes in the water stored in the aquifer. The "Inflow" storage component is water that is removed from storage in the aquifer (that is, water levels decline). The "Outflow" storage component is water that is added back into storage in the aquifer (that is, water levels increase). This component of the budget is often seen as water both going into and out of the aquifer because 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.

- 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 that define the amount of leakage that can occur.

Table 3 below shows the average drawdown between 2006 and 2060 for each county and district within Groundwater Management Area 14. Note that a negative drawdown value indicates an increase in water levels. For Southeast Texas Groundwater Conservation District, average drawdowns for each county range from 3 to 17 feet by 2060 for the Chicot Aquifer, increasing steadily through time. Average county drawdowns range from 17 to 28 feet for the Evangeline Aquifer and 19 to 32 feet for the Jasper Aquifer in the district. The overall average drawdown within the district for the Chicot, Evangeline, and Jasper aquifers between 2006 and 2060 is 12, 23, and 25 feet, respectively. Figures 1, 2, and 3 show the average drawdown for each county within Groundwater Management Area 14 between 2006 and 2060 and the extent of each aquifer. It is important to note that the results presented in Table 3 and Figures 1, 2, and 3 for areas outside Southeast Texas Groundwater Conservation District reflect pumping based on regional water planning estimates as summarized in the *Water for Texas—2002* State Water Plan (TWDB, 2002).

As stated above, Appendix A contains charts for each component of the water budget by stress period of the model run. Of particular interest is Figure A-2 of Appendix A, which shows net recharge to be relatively constant through the historical calibration period (up through stress period 69), at which point it begins to steadily increase through the predictive period as pumping (shown in Figure A-1) increases. This is due to the use of the MODFLOW General Head Boundary package to simulate recharge, evapotranspiration, and interaction of the aquifer with rivers and streams. Note that “net recharge” here refers to recharge to the aquifer sourced from precipitation and surface water inflow minus evapotranspiration and surface water outflow. As pumping increases (and water levels fall), one would expect evapotranspiration and the amount of water discharging to surface water to decrease (or the inflow from surface water to increase). These all contribute to an increase in net recharge. However, the amount of recharge to the aquifer sourced from precipitation is independent of the amount of pumping. Because the general-head boundary package simulates all of these components collectively, the contribution of each to the increase in net recharge cannot be directly assessed. Refer to Kasmarek and Robinson (2004) for more information regarding the use of the MODFLOW General Head Boundary Package in the groundwater availability model.

Appendix D shows a comparison of the drawdown (from 2006) within the district to the annual pumping rate. It is important to note that the drawdown value is cumulative representing the drawdown between 2006 and the year in which the pumping occurred (that is, the drawdown is affected by the pumping prior to the year in which it is calculated). Results of this analysis show a very consistent increase in drawdown with increasing pumpage. Also, as pumpage increases, water levels in the Chicot Aquifer decline relatively rapidly compared to water levels in the Jasper Aquifer, which decline more slowly as indicated by the slopes of the trendlines. Similarly, as pumpage increases, water levels in the Jasper Aquifer decline more rapidly than those in the Evangeline Aquifer.

The amount of water actually pumped out of the aquifer in the model may differ somewhat from the pumping amounts listed in Table 1. An example of this can be seen in Appendix B, where the total amount of water pumped from the model (Wells) in the district in the year 2060 is 209,124 acre-feet per year compared to the input of 209,521 acre-feet per year into the model (Table 2). This 0.2 percent difference between the requested pumping and the model output pumping for the year 2060 is the largest deviation from the request during the predictive model run. The primary reason for this difference is the occurrence of dry cells. When the water level in a cell declines below the bottom of the aquifer in the cell, the cell goes dry and pumping can no longer occur. The total amount of pumpage in the district is, therefore, reduced. It should be noted that dry cells were not considered when calculating the average drawdown over each aquifer. However, since the dry cells occurred primarily along the updip extents of the aquifers where they are thin, the effect of this is considered to be minimal.

It is also 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, model cells that straddle county boundaries were assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 3. Average drawdown (decline in water levels from 2006) reported by decade for each county and groundwater conservation district in Groundwater Management Area 14. A negative drawdown value indicates an increase in water levels.

	Chicot Aquifer						Evangeline Aquifer						Jasper Aquifer					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Austin	2	6	9	11	13	15	1	3	4	6	7	8	4	9	12	13	14	15
Brazoria	4	8	11	13	15	17	3	7	10	12	14	16	-	-	-	-	-	-
Brazos	-	-	-	-	-	-	-	-	-	-	-	-	0	1	2	2	2	3
Chambers	3	7	10	12	14	17	2	5	7	9	11	14	-	-	-	-	-	-
Fort Bend	4	6	6	7	9	11	3	4	4	6	8	10	17	44	54	58	60	62
Galveston	2	5	7	9	12	14	1	3	4	6	8	10	-	-	-	-	-	-
Grimes	0	0	0	0	0	0	0	1	1	1	1	1	6	12	15	17	19	21
Hardin	1	5	8	11	14	17	3	8	13	18	23	28	4	11	17	22	27	32
Harris	0	-12	-23	-27	-27	-27	-2	-32	-45	-49	-49	-49	37	78	90	95	98	101
Jasper	1	3	5	7	9	11	3	7	11	15	20	24	2	5	9	13	17	22
Jefferson	1	4	7	9	12	14	1	4	7	10	13	15	-	-	-	-	-	-
Liberty	3	8	10	12	14	16	3	8	11	13	14	16	18	46	56	61	65	69
Montgomery	2	3	3	3	3	3	7	15	20	24	27	30	40	70	82	89	95	99
Newton	1	3	5	6	8	9	2	6	10	14	18	22	2	5	8	12	15	19
Orange	1	3	5	7	9	11	1	4	7	10	13	16	-	-	-	-	-	-
Polk	0	1	1	1	2	2	0	0	1	1	1	1	2	5	7	9	12	14
San Jacinto	0	0	1	1	1	1	0	1	1	1	2	2	10	21	28	33	37	40
Tyler	0	1	1	2	2	3	1	4	7	10	13	17	3	8	13	19	25	31
Walker	0	0	0	0	0	0	0	1	1	1	1	1	3	7	11	14	17	20
Waller	2	4	4	4	4	4	1	0	0	1	1	1	15	31	36	39	41	42
Washington	-	-	-	-	-	-	0	0	0	0	0	0	1	2	3	4	4	5
Bluebonnet GCD	2	4	6	7	7	8	1	2	2	3	4	4	7	15	18	20	22	24
Brazoria County GCD	4	8	11	13	15	17	3	7	10	12	14	16	-	-	-	-	-	-
Brazos Valley GCD	-	-	-	-	-	-	-	-	-	-	-	-	0	1	2	2	2	3
Fort Bend Subsidence District	4	6	6	7	9	11	3	4	4	6	8	10	17	44	54	58	60	62
Harris-Galveston Coastal Subsidence District	1	-8	-17	-20	-19	-19	-1	-25	-35	-38	-38	-37	37	78	90	95	98	101
Lone Star GCD	2	3	3	3	3	3	7	15	20	24	27	30	40	70	82	89	95	99
Lower Trinity GCD	0	0	1	1	1	2	0	0	1	1	1	1	5	11	15	19	22	24
Southeast Texas GCD	1	4	6	8	10	12	2	7	11	15	19	23	2	7	11	16	21	25

REFERENCES:

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

Kasmarek, M.C., and Robinson, J.L., 2004, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5102, 111 p.

Kasmarek, M.C., Reece, B.D., and Houston, N.A., 2005, Evaluation of groundwater flow and land-surface subsidence caused by hypothetical withdrawals in the northern part of the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2005-5024, 70 p.

Texas Water Development Board, 2002, Water for Texas – 2002—Volumes I-III; Texas Water Development Board Document No. GP-7-1, 155 p.

Cynthia K. Ridgeway is Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G., on September 23, 2009.

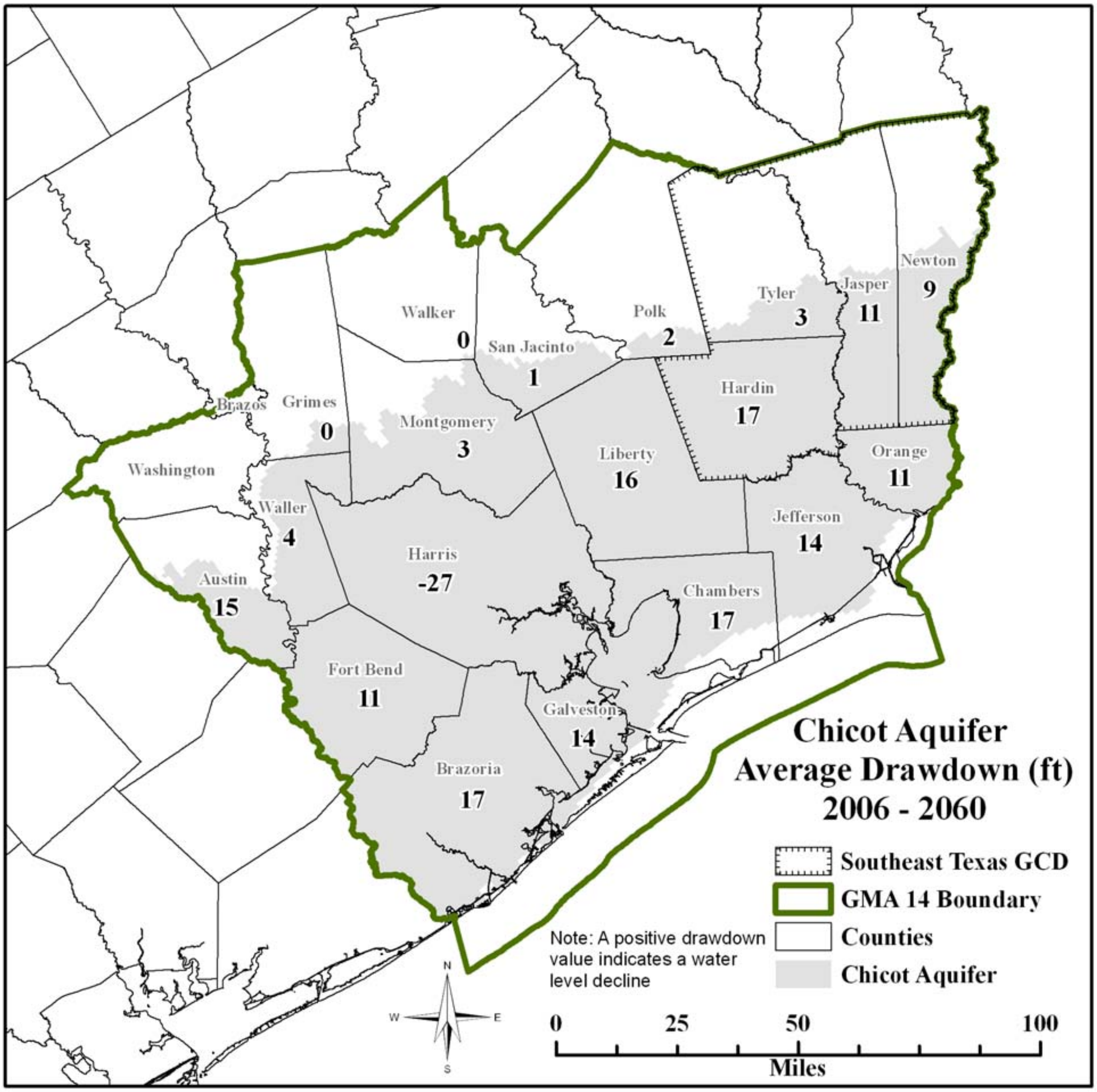

Figure 1. Average drawdown (decline in water levels) in the Chicot Aquifer by county from the beginning of 2006 to the end of 2060. A negative drawdown value indicates an increase in water levels.

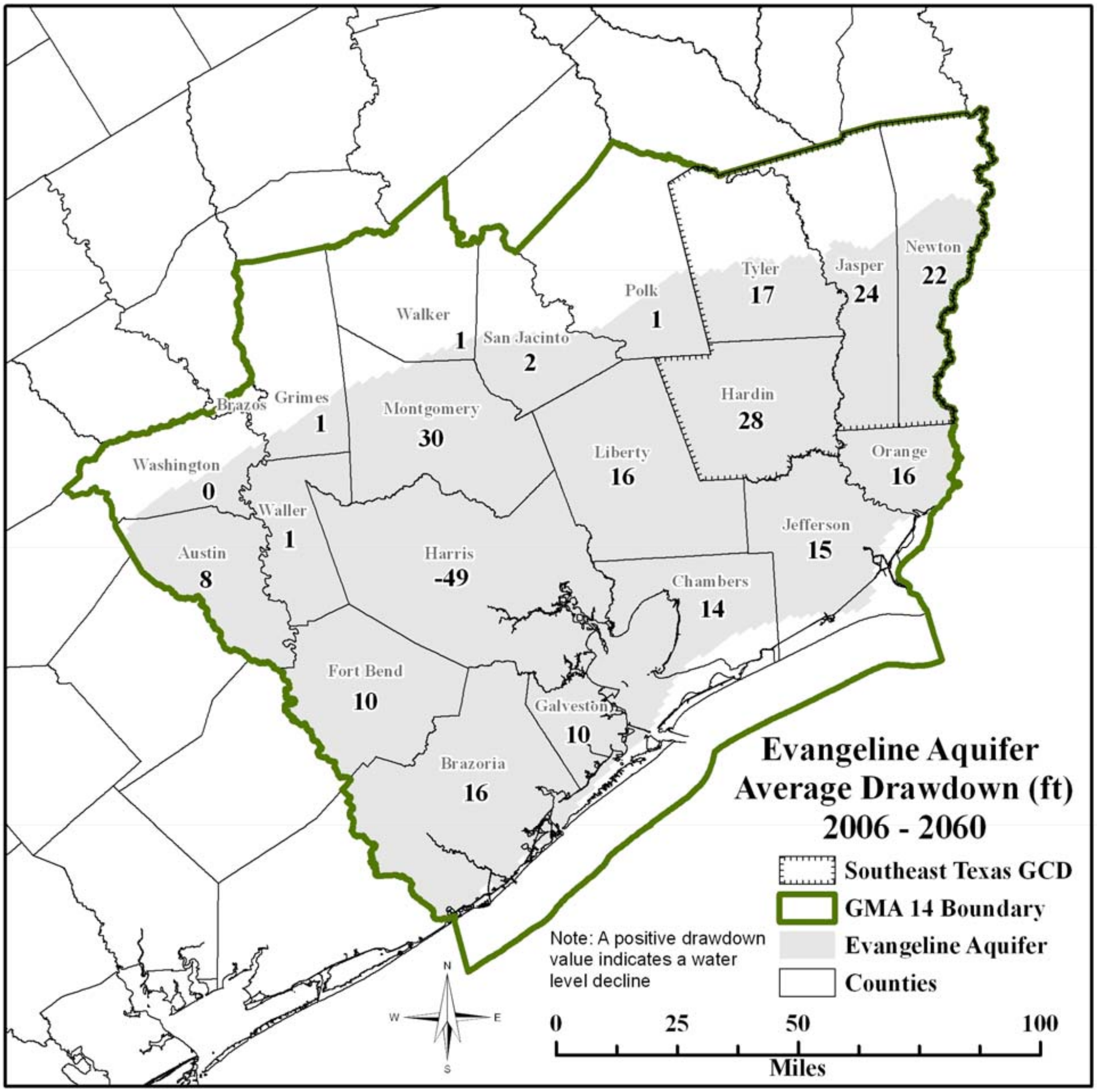

Figure 2. Average drawdown (decline in water levels) in the Evangeline Aquifer by county from the beginning of 2006 to the end of 2060. A negative drawdown value indicates an increase in water levels.

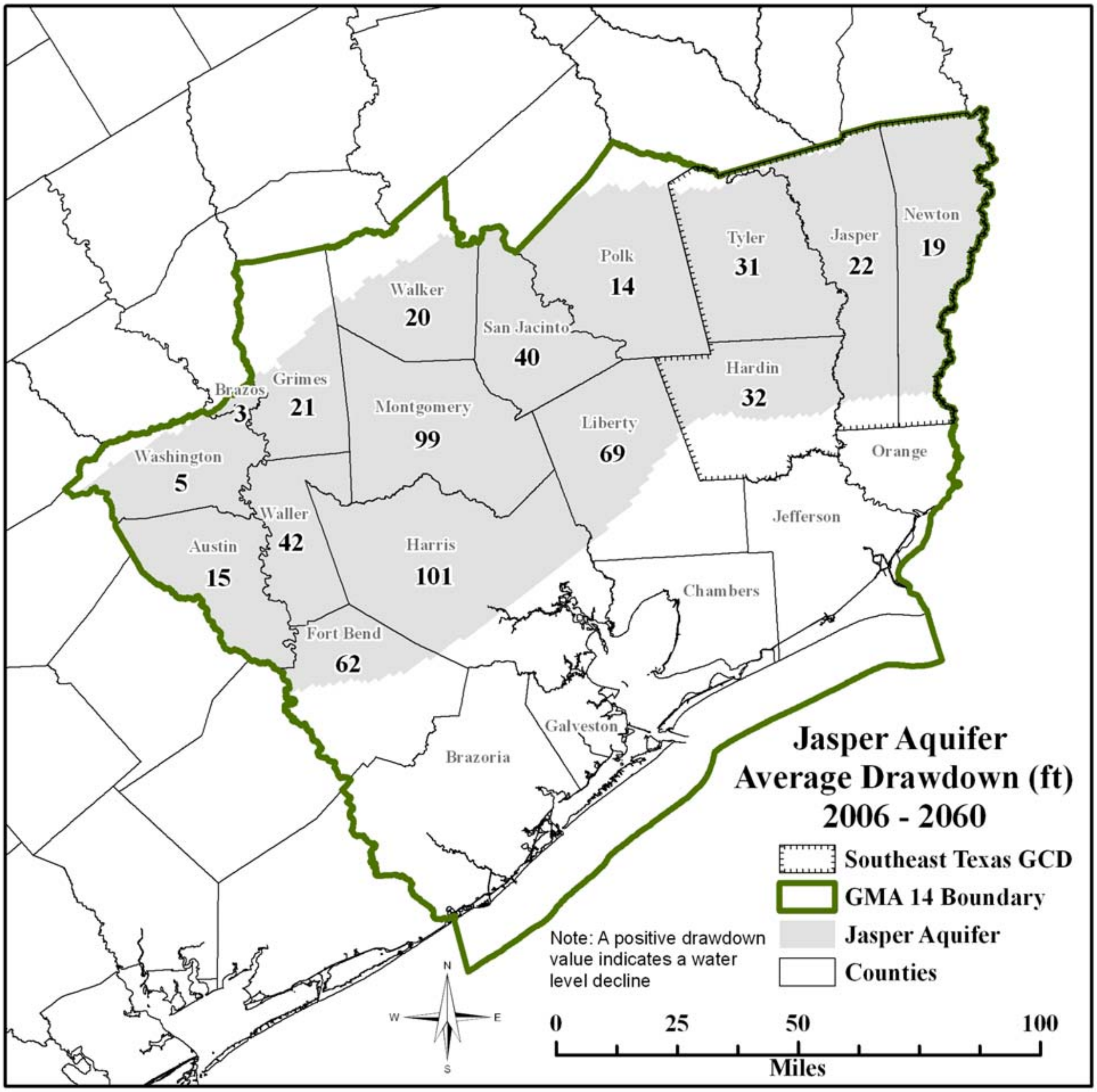

Figure 3. Average drawdown (decline in water levels) in the Jasper Aquifer by county from the beginning of 2006 to the end of 2060. A negative drawdown value indicates an increase in water levels.

Appendix A

Water budgets for each stress period in the calibration and predictive periods of the groundwater availability model in Southeast Texas Groundwater Conservation District

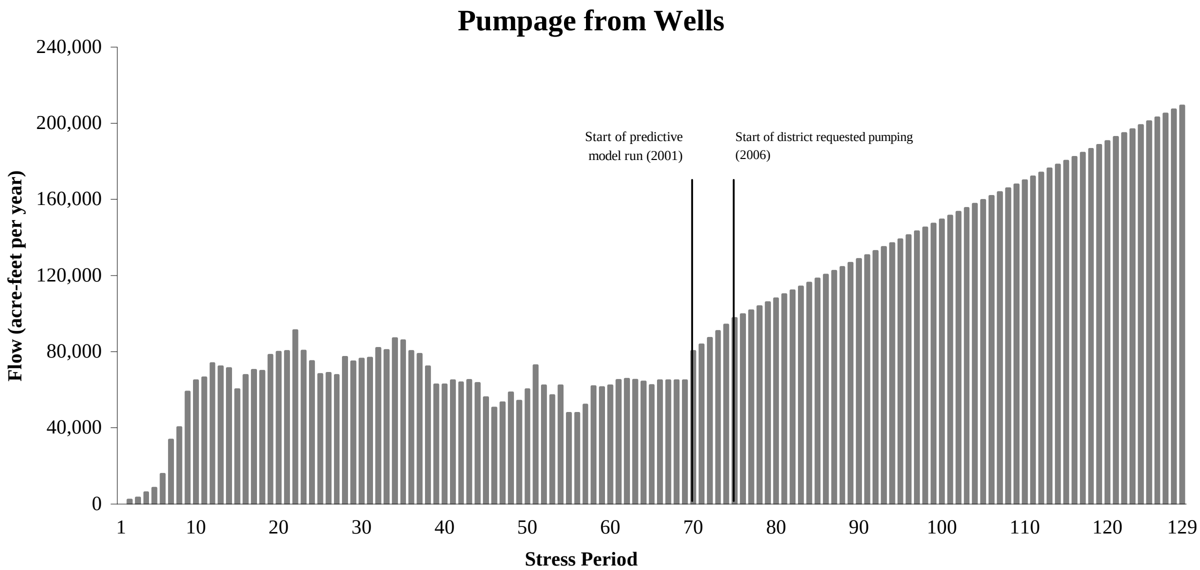

Figure A-1. Pumpage output from Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. See Table 1 for the time period represented by each stress period.

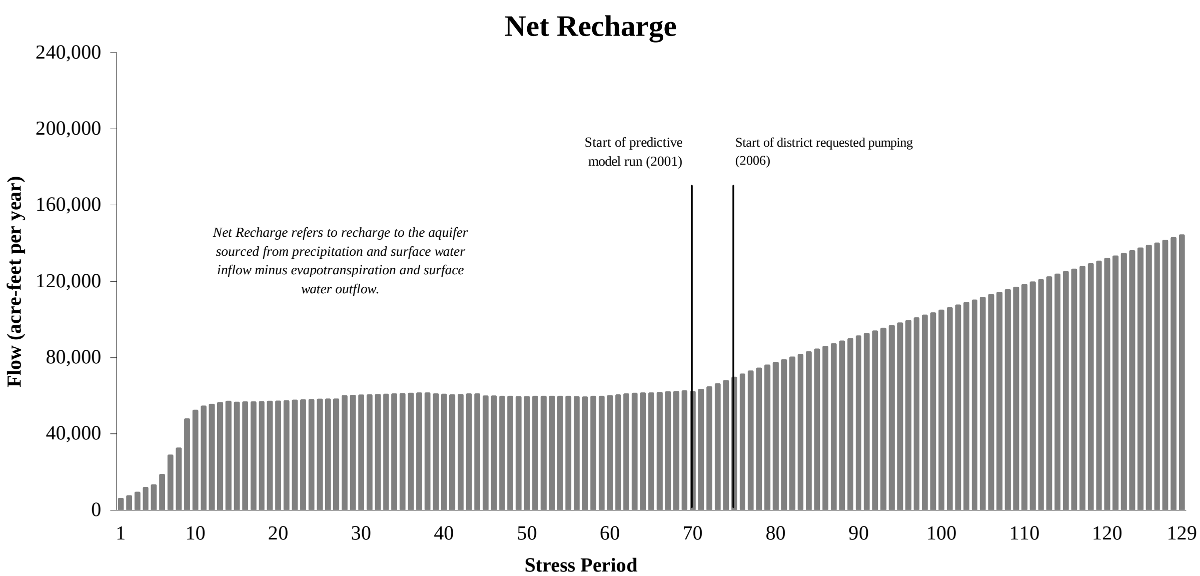

Figure A-2. Net recharge to Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. Note that net recharge refers to recharge to the aquifer sourced from precipitation and surface water inflow minus evapotranspiration and surface water outflow. See Table 1 for the time period represented by each stress period.

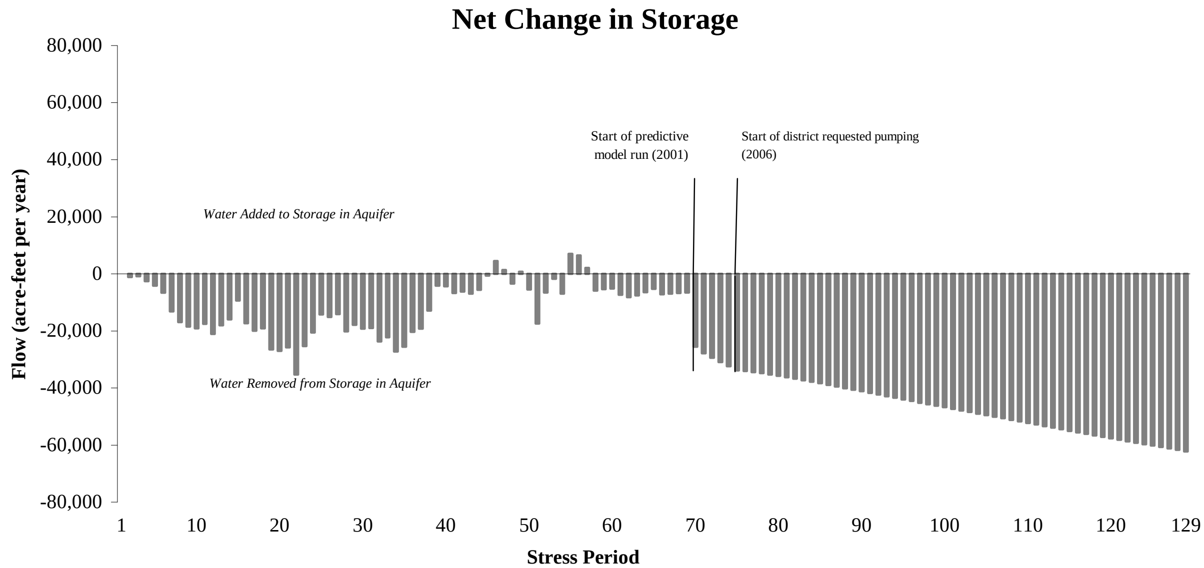

Figure A-3. Net change in storage in the Gulf Coast aquifer in Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. Note that water added to storage reflects an increase in water levels while water removed from storage indicates a water level decline. The above figure includes change in storage due to sediment compaction. See Table 1 for the time period represented by each stress period.

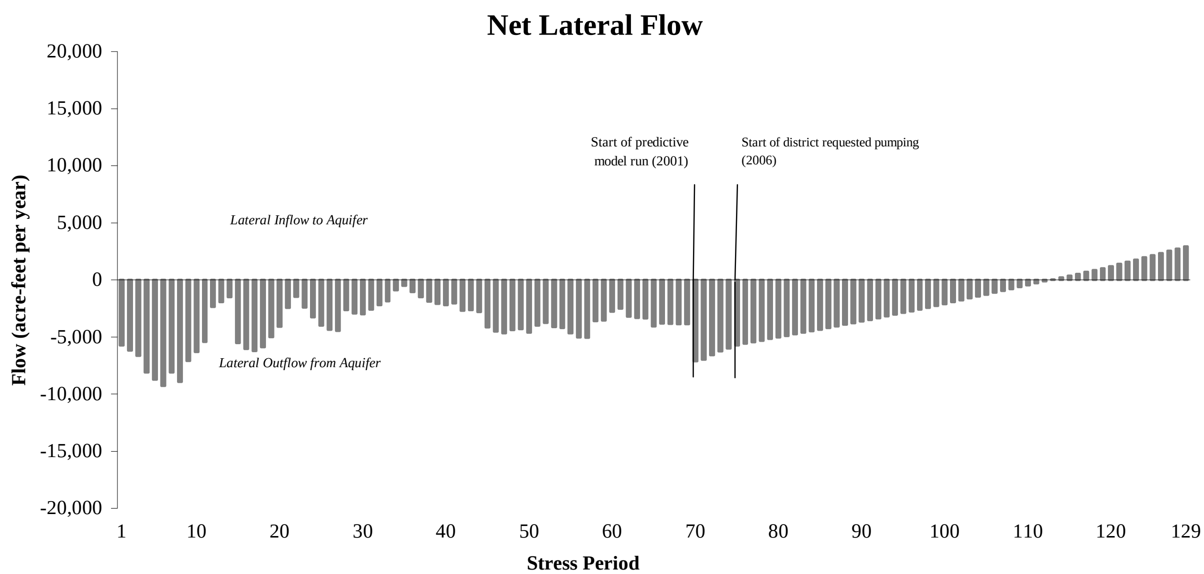

Figure A-4. Net lateral flow into or out of Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. See Table 1 for the time period represented by each stress period.

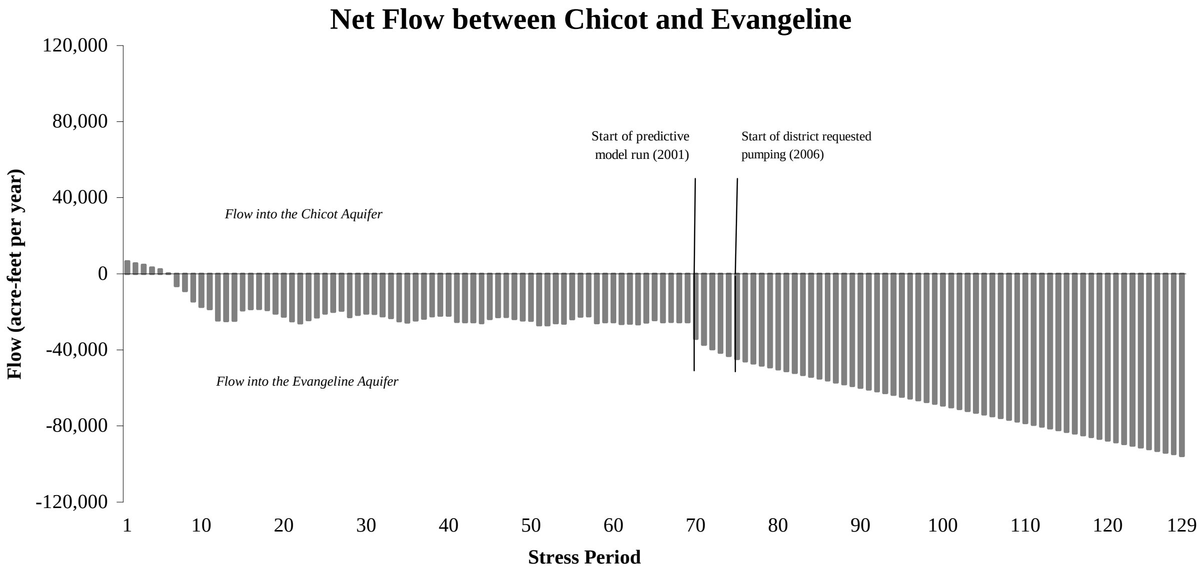

Figure A-5. Net vertical flow between the Chicot and Evangeline aquifers in Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. See Table 1 for the time period represented by each stress period.

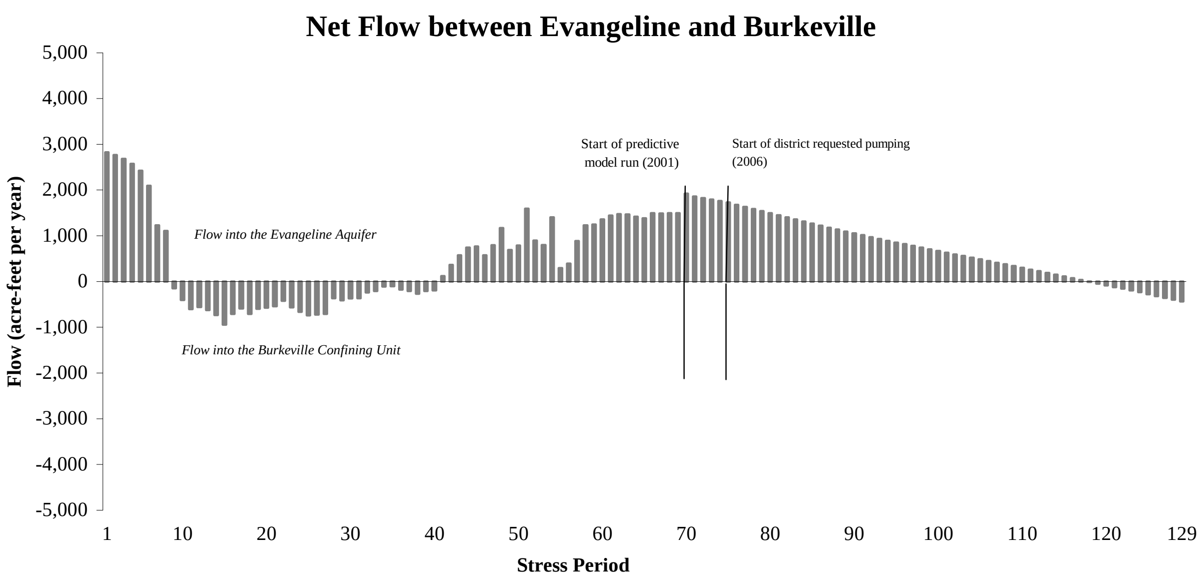

Figure A-6. Net vertical flow between the Evangeline Aquifer and the Burkeville Confining Unit in Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. See Table 1 for the time period represented by each stress period.

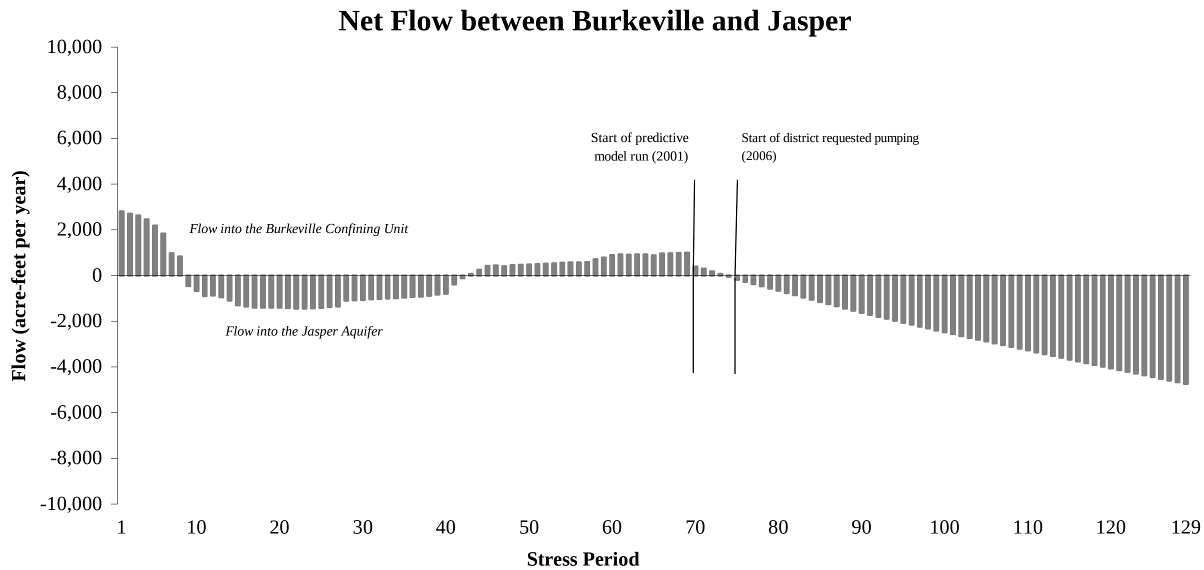

Figure A-7. Net vertical flow between the Burkeville Confining Unit and the Jasper Aquifer in Southeast Texas Groundwater Conservation District for each stress period in the groundwater availability model. See Table 1 for the time period represented by each stress period.

Appendix B

Water budget tables for 2006 – 2060 predictive model run by decade and county in Southeast Texas Groundwater Conservation District

Table B-1. Water budgets for 2010 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	29,925	0	0	0	33,674	1,819	3	5,228	18,790	4,580	2	6,055	11,169	6,364	7	3,935	93,559	12,763	13	15,217
Sediment Compaction	38	94	0	0	44	335	0	0	9	21	0	0	0	5	0	0	91	456	0	0
Vertical Leakage Upper	-	23,859	0	0	-	17,779	524	1,125	-	7,274	797	1,399	-	5,253	1,245	1,935	-	54,165	2,566	4,459
Vertical Leakage Lower	2	1,297	1,263	-	674	1,073	1,001	-	2,856	1,393	1,316	-	1,492	340	310	-	5,024	4,102	3,889	-
Lateral Flow	5,746	4,998	6	1,884	8,758	13,317	8	1,841	4,324	2,855	8	1,323	1,049	1,018	16	1,230	2,772	5,144	17	1,774
Total Inflow	*35,711*	*30,248*	*1,269*	*1,884*	*43,150*	*34,323*	*1,536*	*8,194*	*25,979*	*16,123*	*2,123*	*8,777*	*13,710*	*12,980*	*1,578*	*7,100*	*101,446*	*76,630*	*6,485*	*21,450*
Outflow																				
Pumping	1,891	18,573	0	0	10,410	30,481	22	10,140	201	9,679	0	7,055	0	8,579	102	8,681	12,502	67,312	124	25,876
Evapotranspiration and Surface Water Outflow	1,142	0	0	0	10,112	439	1	2,625	14,706	880	1	4,510	6,186	2,533	0	2,725	32,146	3,852	2	9,860
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	2	1,297	1,263	-	674	1,073	1,001	-	2,856	1,393	1,316	-	1,492	340	310	-	5,024	4,102	3,889
Vertical Leakage Lower	23,859	0	0	-	17,779	524	1,125	-	7,274	797	1,399	-	5,253	1,245	1,935	-	54,165	2,566	4,459	-
Lateral Flow	11,559	11,832	2	790	6,222	3,962	11	1,587	5,231	3,823	5	1,159	2,689	2,653	9	2,022	8,597	5,226	5	1,053
Total Outflow	*38,451*	*30,407*	*1,299*	*2,053*	*44,523*	*36,080*	*2,232*	*15,353*	*27,412*	*18,035*	*2,798*	*14,040*	*14,128*	*16,502*	*2,386*	*13,738*	*107,410*	*83,980*	*8,692*	*40,678*
Inflow - Outflow	-2,740	-159	-30	-169	-1,373	-1,757	-696	-7,159	-1,433	-1,912	-675	-5,263	-418	-3,522	-808	-6,638	-5,964	-7,350	-2,207	-19,228
Storage Change	-2,741	-157	-29	-168	-1,372	-1,757	-697	-7,160	-1,433	-1,912	-675	-5,264	-417	-3,522	-808	-6,640	-5,963	-7,348	-2,208	-19,232
Model Error	1	-2	-1	-1	-1	0	1	1	0	0	0	1	-1	0	0	2	-1	-2	1	4
Model Error (%)	0.00%	0.01%	0.08%	0.05%	0.00%	0%	0.04%	0.01%	0%	0%	0%	0.01%	0.01%	0%	0%	0.01%	0.00%	0.00%	0.01%	0.01%

Table B-2. Water budgets for 2020 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	33,501	0	0	0	35,561	1,962	3	5,704	20,081	4,840	2	6,507	12,304	6,975	8	4,142	101,446	13,777	13	16,352
Sediment Compaction	53	237	0	0	60	443	0	0	8	55	0	0	0	8	0	0	121	744	0	0
Vertical Leakage Upper	-	27,694	3	5	-	19,668	577	1,363	-	8,772	858	1,606	-	6,528	1,382	2,265	-	62,662	2,820	5,239
Vertical Leakage Lower	0	1,220	1,186	-	502	1,043	972	-	2,214	1,351	1,279	-	1,065	298	272	-	3,781	3,912	3,710	-
Lateral Flow	5,878	5,266	7	1,966	8,815	13,578	8	1,884	4,387	3,001	8	1,329	1,045	1,028	16	1,389	2,874	5,648	18	1,936
Total Inflow	*39,432*	*34,417*	*1,196*	*1,971*	*44,938*	*36,694*	*1,560*	*8,951*	*26,690*	*18,019*	*2,147*	*9,442*	*14,414*	*14,837*	*1,678*	*7,796*	*108,222*	*86,743*	*6,561*	*23,527*
Outflow																				
Pumping	2,258	22,972	0	0	10,431	33,322	22	12,523	270	12,524	0	9,192	0	11,518	137	11,334	12,959	80,336	160	33,049
Evapotranspiration and Surface Water Outflow	867	0	0	0	9,524	339	1	2,388	13,695	766	1	4,127	5,453	2,220	0	2,544	29,540	3,325	2	9,059
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	0	1,220	1,186	-	502	1,043	972	-	2,214	1,351	1,279	-	1,065	298	272	-	3,781	3,912	3,710
Vertical Leakage Lower	27,694	3	5	-	19,668	577	1,363	-	8,772	858	1,606	-	6,528	1,382	2,265	-	62,662	2,820	5,239	-
Lateral Flow	11,459	11,598	2	942	6,239	3,956	11	1,648	5,058	3,745	5	1,207	2,774	2,728	9	2,015	8,279	4,803	5	1,179
Total Outflow	*42,278*	*34,573*	*1,227*	*2,128*	*45,862*	*38,696*	*2,440*	*17,531*	*27,795*	*20,107*	*2,963*	*15,805*	*14,755*	*18,913*	*2,709*	*16,165*	*113,440*	*95,065*	*9,318*	*46,997*
Inflow - Outflow	-2,846	-156	-31	-157	-924	-2,002	-880	-8,580	-1,105	-2,088	-816	-6,363	-341	-4,076	-1,031	-8,369	-5,218	-8,322	-2,757	-23,470
Storage Change	-2,846	-156	-31	-156	-926	-2,000	-880	-8,579	-1,106	-2,087	-815	-6,364	-342	-4,077	-1,031	-8,374	-5,219	-8,321	-2,757	-23,474
Model Error	0	0	0	-1	2	-2	0	-1	1	-1	-1	1	1	1	0	5	1	-1	0	4
Model Error (%)	0.00%	0.00%	0.00%	0.05%	0.00%	0%	0.00%	0.01%	0%	0%	0%	0.01%	0.01%	0%	0%	0.03%	0.00%	0.00%	0.00%	0.01%

Table B-3. Water budgets for 2030 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	37,027	0	0	0	37,233	2,139	4	6,278	21,332	5,151	2	7,038	13,397	7,633	8	4,408	108,989	14,923	14	17,724
Sediment Compaction	84	446	0	0	89	545	0	0	7	99	0	0	0	12	0	0	181	1,102	0	0
Vertical Leakage Upper	-	31,335	8	10	-	21,594	630	1,586	-	10,324	925	1,809	-	7,859	1,514	2,577	-	71,113	3,078	5,981
Vertical Leakage Lower	0	1,193	1,160	-	389	1,013	943	-	1,665	1,312	1,240	-	739	263	242	-	2,793	3,782	3,585	-
Lateral Flow	6,036	5,555	7	1,993	8,861	13,840	8	1,933	4,461	3,157	9	1,329	1,043	1,038	16	1,563	2,970	6,154	18	2,077
Total Inflow	*43,147*	*38,529*	*1,175*	*2,003*	*46,572*	*39,131*	*1,585*	*9,797*	*27,465*	*20,043*	*2,176*	*10,176*	*15,179*	*16,805*	*1,780*	*8,548*	*114,933*	*97,074*	*6,695*	*25,782*
Outflow																				
Pumping	2,625	27,371	0	0	10,452	36,162	23	14,891	340	15,369	0	11,328	0	14,457	172	13,988	13,416	93,360	195	40,207
Evapotranspiration and Surface Water Outflow	644	0	0	0	9,071	243	1	2,172	12,858	671	1	3,720	4,793	1,912	0	2,357	27,366	2,826	2	8,249
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	0	1,193	1,160	-	389	1,013	943	-	1,665	1,312	1,240	-	739	263	242	-	2,793	3,782	3,585
Vertical Leakage Lower	31,335	8	10	-	21,594	630	1,586	-	10,324	925	1,809	-	7,859	1,514	2,577	-	71,113	3,078	5,981	-
Lateral Flow	11,294	11,312	2	968	6,305	3,970	11	1,703	4,932	3,705	5	1,257	2,866	2,808	8	1,981	7,965	4,360	5	1,170
Total Outflow	*45,898*	*38,691*	*1,205*	*2,128*	*47,422*	*41,394*	*2,634*	*19,709*	*28,454*	*22,335*	*3,127*	*17,545*	*15,518*	*21,430*	*3,020*	*18,568*	*119,860*	*106,417*	*9,965*	*53,211*
Inflow - Outflow	-2,751	-162	-30	-125	-850	-2,263	-1,049	-9,912	-989	-2,292	-951	-7,369	-339	-4,625	-1,240	-10,020	-4,927	-9,343	-3,270	-27,429
Storage Change	-2,750	-154	-30	-123	-849	-2,263	-1,049	-9,911	-988	-2,287	-950	-7,369	-338	-4,625	-1,240	-10,019	-4,926	-9,330	-3,269	-27,422
Model Error	-1	-8	0	-2	-1	0	0	-1	-1	-5	-1	0	-1	0	0	-1	-1	-13	-1	-7
Model Error (%)	0.00%	0.02%	0.00%	0.09%	0.00%	0%	0.00%	0.00%	0%	0%	0%	0.00%	0.01%	0%	0%	0.01%	0.00%	0.01%	0.01%	0.01%

Table B-4. Water budgets for 2040 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	40,422	0	0	0	38,887	2,355	4	6,894	22,608	5,499	3	7,620	14,534	8,370	8	4,690	116,452	16,224	15	19,205
Sediment Compaction	103	708	0	0	123	640	0	0	7	179	0	0	0	19	0	0	234	1,546	0	0
Vertical Leakage Upper	-	34,821	11	14	-	23,536	689	1,800	-	11,958	1,001	2,009	-	9,256	1,643	2,865	-	79,571	3,344	6,688
Vertical Leakage Lower	0	1,189	1,155	-	303	986	917	-	1,228	1,271	1,199	-	500	234	217	-	2,031	3,681	3,488	-
Lateral Flow	6,196	5,848	7	1,989	8,915	14,118	8	1,980	4,534	3,321	9	1,324	1,047	1,052	16	1,744	3,066	6,687	19	2,218
Total Inflow	*46,721*	*42,566*	*1,173*	*2,003*	*48,228*	*41,635*	*1,618*	*10,674*	*28,377*	*22,228*	*2,212*	*10,953*	*16,081*	*18,931*	*1,884*	*9,299*	*121,783*	*107,709*	*6,866*	*28,111*
Outflow																				
Pumping	2,992	31,770	0	0	10,473	39,003	23	17,246	409	18,214	0	13,424	0	17,397	207	16,601	13,873	106,384	230	47,270
Evapotranspiration and Surface Water Outflow	477	0	0	0	8,665	159	1	1,957	12,135	581	1	3,299	4,200	1,628	0	2,153	25,477	2,369	2	7,409
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	0	1,189	1,155	-	303	986	917	-	1,228	1,271	1,199	-	500	234	217	-	2,031	3,681	3,488
Vertical Leakage Lower	34,821	11	14	-	23,536	689	1,800	-	11,958	1,001	2,009	-	9,256	1,643	2,865	-	79,571	3,344	6,688	-
Lateral Flow	11,078	10,945	2	967	6,383	3,988	11	1,748	4,824	3,694	5	1,307	2,960	2,890	8	1,921	7,619	3,865	5	1,125
Total Outflow	*49,368*	*42,726*	*1,205*	*2,122*	*49,057*	*44,142*	*2,821*	*21,868*	*29,326*	*24,718*	*3,286*	*19,229*	*16,416*	*24,058*	*3,314*	*20,892*	*126,540*	*117,993*	*10,606*	*59,292*
Inflow - Outflow	-2,647	-160	-32	-119	-829	-2,507	-1,203	-11,194	-949	-2,490	-1,074	-8,276	-335	-5,127	-1,430	-11,593	-4,757	-10,284	-3,740	-31,181
Storage Change	-2,645	-155	-30	-116	-829	-2,506	-1,203	-11,192	-948	-2,485	-1,075	-8,274	-335	-5,125	-1,430	-11,589	-4,755	-10,272	-3,739	-31,170
Model Error	-2	-5	-2	-3	0	-1	0	-2	-1	-5	1	-2	0	-2	0	-4	-2	-12	-1	-11
Model Error (%)	0.00%	0.01%	0.17%	0.14%	0.00%	0%	0.00%	0.01%	0%	0%	0%	0.01%	0.00%	0%	0%	0.02%	0.00%	0.01%	0.01%	0.02%

Table B-5. Water budgets for 2050 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	43,701	0	0	0	40,551	2,624	4	7,619	23,910	5,883	3	8,306	15,673	9,202	8	5,050	123,834	17,709	16	20,976
Sediment Compaction	144	1,075	0	0	174	701	0	0	8	262	0	0	0	33	0	0	326	2,071	0	0
Vertical Leakage Upper	-	38,212	15	18	-	25,517	754	2,010	-	13,690	1,082	2,208	-	10,662	1,775	3,142	-	88,081	3,626	7,378
Vertical Leakage Lower	0	1,186	1,153	-	235	960	892	-	875	1,228	1,156	-	314	208	194	-	1,424	3,582	3,394	-
Lateral Flow	6,353	6,132	8	1,972	8,969	14,425	8	2,027	4,610	3,480	9	1,317	1,053	1,068	17	1,941	3,157	7,224	20	2,370
Total Inflow	*50,198*	*46,605*	*1,176*	*1,990*	*49,929*	*44,227*	*1,658*	*11,656*	*29,403*	*24,543*	*2,250*	*11,831*	*17,040*	*21,173*	*1,994*	*10,133*	*128,741*	*118,667*	*7,056*	*30,724*
Outflow																				
Pumping	3,359	36,169	0	0	10,493	41,843	24	19,636	478	21,059	0	15,553	0	20,336	241	19,247	14,331	119,408	265	54,437
Evapotranspiration and Surface Water Outflow	348	0	0	0	8,280	100	0	1,753	11,451	499	1	2,873	3,659	1,380	0	1,942	23,738	1,979	1	6,569
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	0	1,186	1,153	-	235	960	892	-	875	1,228	1,156	-	314	208	194	-	1,424	3,582	3,394
Vertical Leakage Lower	38,212	15	18	-	25,517	754	2,010	-	13,690	1,082	2,208	-	10,662	1,775	3,142	-	88,081	3,626	7,378	-
Lateral Flow	10,858	10,583	2	957	6,471	4,017	11	1,790	4,731	3,694	5	1,358	3,053	2,971	8	1,858	7,284	3,383	4	1,076
Total Outflow	*52,777*	*46,767*	*1,206*	*2,110*	*50,761*	*46,949*	*3,005*	*24,071*	*30,350*	*27,209*	*3,442*	*20,940*	*17,374*	*26,776*	*3,599*	*23,241*	*133,434*	*129,820*	*11,230*	*65,476*
Inflow - Outflow	-2,579	-162	-30	-120	-832	-2,722	-1,347	-12,415	-947	-2,666	-1,192	-9,109	-334	-5,603	-1,605	-13,108	-4,693	-11,153	-4,174	-34,752
Storage Change	-2,579	-158	-31	-116	-832	-2,724	-1,347	-12,412	-947	-2,661	-1,192	-9,107	-333	-5,603	-1,606	-13,103	-4,691	-11,146	-4,175	-34,737
Model Error	0	-4	1	-4	0	2	0	-3	0	-5	0	-2	-1	0	1	-5	-2	-7	1	-15
Model Error (%)	0.00%	0.01%	0.08%	0.19%	0.00%	0%	0.00%	0.01%	0%	0%	0%	0.01%	0.01%	0%	0%	0.02%	0.00%	0.01%	0.01%	0.02%

Table B-6. Water budgets for 2060 in Southeast Texas Groundwater Conservation District by county and for the district as a whole. All values are in acre-feet per year.

	Hardin				Jasper				Newton				Tyler				Southeast Texas GCD			
	Chicot	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**	**Chicot**	**Evangeline**	**Burkeville**	**Jasper**
Inflow																				
Recharge and Surface Water Inflow	46,921	0	0	0	42,235	2,934	5	8,414	25,252	6,302	3	9,100	16,816	10,143	9	5,464	131,223	19,379	17	22,979
Sediment Compaction	196	1,400	0	0	226	747	0	0	7	307	0	0	0	50	0	0	429	2,504	0	0
Vertical Leakage Upper	-	41,605	18	22	-	27,498	824	2,216	-	15,507	1,172	2,410	-	12,072	1,910	3,403	-	96,682	3,924	8,051
Vertical Leakage Lower	0	1,185	1,151	-	175	932	866	-	600	1,188	1,117	-	186	183	172	-	960	3,488	3,307	-
Lateral Flow	6,505	6,426	8	1,946	9,030	14,769	8	2,072	4,673	3,662	9	1,306	1,061	1,090	17	2,148	3,263	7,846	20	2,530
Total Inflow	*53,622*	*50,616*	*1,177*	*1,968*	*51,666*	*46,880*	*1,703*	*12,702*	*30,532*	*26,966*	*2,301*	*12,816*	*18,063*	*23,538*	*2,108*	*11,015*	*135,875*	*129,899*	*7,268*	*33,560*
Outflow																				
Pumping	3,726	40,569	0	0	10,514	44,684	24	22,027	548	23,904	0	17,683	0	23,275	276	21,894	14,788	132,432	300	61,604
Evapotranspiration and Surface Water Outflow	248	0	0	0	7,937	61	0	1,552	10,829	424	1	2,477	3,179	1,183	0	1,730	22,192	1,668	1	5,758
Sediment Compaction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	-	0	1,185	1,151	-	175	932	866	-	600	1,188	1,117	-	186	183	172	-	960	3,488	3,307
Vertical Leakage Lower	41,605	18	22	-	27,498	824	2,216	-	15,507	1,172	2,410	-	12,072	1,910	3,403	-	96,682	3,924	8,051	-
Lateral Flow	10,582	10,193	1	940	6,532	4,058	11	1,827	4,583	3,689	5	1,409	3,141	3,045	8	1,781	6,831	2,885	4	1,015
Total Outflow	*56,161*	*50,780*	*1,208*	*2,091*	*52,481*	*49,802*	*3,183*	*26,272*	*31,467*	*29,789*	*3,604*	*22,686*	*18,392*	*29,599*	*3,870*	*25,577*	*140,493*	*141,869*	*11,844*	*71,684*
Inflow - Outflow	-2,539	-164	-31	-123	-815	-2,922	-1,480	-13,570	-935	-2,823	-1,303	-9,870	-329	-6,061	-1,762	-14,562	-4,618	-11,970	-4,576	-38,124
Storage Change	-2,537	-160	-31	-114	-815	-2,921	-1,481	-13,566	-933	-2,818	-1,303	-9,870	-328	-6,061	-1,762	-14,552	-4,612	-11,960	-4,577	-38,102
Model Error	-2	-4	0	-9	0	-1	1	-4	-2	-5	0	0	-1	0	0	-10	-6	-10	1	-22
Model Error (%)	0.00%	0.01%	0.00%	0.43%	0.00%	0%	0.03%	0.02%	0%	0%	0%	0.00%	0.01%	0%	0%	0.04%	0.00%	0.01%	0.01%	0.03%

Appendix C

Water budget tables for 2060 by county in Groundwater Management Area 14 (excluding Southeast Texas Groundwater Conservation District)

Table C-1. Water budgets for 2060 by county in Groundwater Management Area 14 (excluding counties in Southeast Texas GCD reported in Appendix B above). All values are in acre-feet per year.

Austin	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	18,358	11,447	0	0
Sediment Compaction	16	104	0	0
Vertical Leakage Upper	-	16,788	1,343	1,187
Vertical Leakage Lower	479	198	196	-
Lateral Flow	4,896	4,849	8	1,483
Total Inflow	*23,749*	*33,386*	*1,547*	*2,670*
Outflow				
Pumping	1,048	17,055	172	125
Evapotranspiration and Surface Water Outflow	520	7,458	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	479	198	196
Vertical Leakage Lower	16,788	1,343	1,187	-
Lateral Flow	8,446	7,070	13	2,355
Total Outflow	*26,802*	*33,405*	*1,570*	*2,676*
Inflow - Outflow	-3,053	-19	-23	-6
Storage Change	-3,051	-18	-22	-5
Model Error	-2	-1	-1	-1
Model Error (percent)	0.01%	0.00%	0.06%	0.04%

Brazoria	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	28,704	0	0	0
Sediment Compaction	4,967	5,208	0	0
Vertical Leakage Upper	-	1,932	0	0
Vertical Leakage Lower	7,815	0	0	-
Lateral Flow	17,287	9,057	0	0
Total Inflow	*58,773*	*16,197*	*0*	*0*
Outflow				
Pumping	47,818	3,020	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	7,815	0	0
Vertical Leakage Lower	1,932	0	0	-
Lateral Flow	9,119	5,455	0	0
Total Outflow	*58,869*	*16,290*	*0*	*0*
Inflow - Outflow	-96	-93	0	0
Storage Change	-85	-81	0	0
Model Error	-11	-12	0	0
Model Error (percent)	0.02%	0.07%	0.00%	0.00%

Brazos	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	0	0	0	235
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	0	0
Vertical Leakage Lower	0	0	0	-
Lateral Flow	0	0	0	286
Total Inflow	*0*	*0*	*0*	*521*
Outflow				
Pumping	0	0	0	393
Evapotranspiration and Surface Water Outflow	0	0	0	215
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	0	0
Vertical Leakage Lower	0	0	0	-
Lateral Flow	0	0	0	55
Total Outflow	*0*	*0*	*0*	*663*
Inflow - Outflow	0	0	0	-142
Storage Change	0	0	0	-142
Model Error	0	0	0	0
Model Error (percent)	0.00%	0.00%	0.00%	0.00%

Chambers	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	4,431	0	0	0
Sediment Compaction	3,111	2,823	0	0
Vertical Leakage Upper	-	581	0	0
Vertical Leakage Lower	4,521	0	0	-
Lateral Flow	9,597	8,429	0	0
Total Inflow	*21,660*	*11,833*	*0*	*0*
Outflow				
Pumping	16,505	242	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	4,521	0	0
Vertical Leakage Lower	581	0	0	-
Lateral Flow	4,626	7,119	0	0
Total Outflow	*21,712*	*11,882*	*0*	*0*
Inflow - Outflow	-52	-49	0	0
Storage Change	-51	-44	0	0
Model Error	-1	-5	0	0
Model Error (percent)	0.00%	0.04%	0.00%	0.00%

Fort Bend	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	82,721	0	0	0
Sediment Compaction	1,359	1,210	0	0
Vertical Leakage Upper	-	30,371	0	0
Vertical Leakage Lower	1,257	92	90	-
Lateral Flow	36,987	14,983	0	1,016
Total Inflow	*122,324*	*46,656*	*90*	*1,016*
Outflow				
Pumping	59,737	32,077	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	1,257	92	90
Vertical Leakage Lower	30,371	0	0	-
Lateral Flow	36,115	13,369	0	936
Total Outflow	*126,223*	*46,703*	*92*	*1,026*
Inflow - Outflow	-3,899	-47	-2	-10
Storage Change	-3,890	-38	-2	-8
Model Error	-9	-9	0	-2
Model Error (percent)	0.01%	0.02%	0.00%	0.20%

Galveston	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	745	0	0	0
Sediment Compaction	938	2,165	0	0
Vertical Leakage Upper	-	914	0	0
Vertical Leakage Lower	1,411	0	0	-
Lateral Flow	5,467	4,068	0	0
Total Inflow	*8,561*	*7,147*	*0*	*0*
Outflow				
Pumping	5,704	732	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	1,411	0	0
Vertical Leakage Lower	914	0	0	-
Lateral Flow	1,984	5,028	0	0
Total Outflow	*8,602*	*7,171*	*0*	*0*
Inflow - Outflow	-41	-24	0	0
Storage Change	-37	-24	0	0
Model Error	-4	0	0	0
Model Error (percent)	0.05%	0.00%	0.00%	0.00%

Grimes	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	1,298	1,033	2	3,087
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	1,280	836	1,192
Vertical Leakage Lower	80	12	8	-
Lateral Flow	0	276	3	537
Total Inflow	*1,378*	*2,601*	*849*	*4,816*
Outflow				
Pumping	0	939	0	3,691
Evapotranspiration and Surface Water Outflow	84	297	0	832
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	80	12	8
Vertical Leakage Lower	1,280	836	1,192	-
Lateral Flow	20	606	7	3,800
Total Outflow	*1,384*	*2,758*	*1,211*	*8,331*
Inflow - Outflow	-6	-157	-362	-3,515
Storage Change	-5	-156	-361	-3,514
Model Error	-1	-1	-1	-1
Model Error (percent)	0.07%	0.04%	0.08%	0.01%

Harris	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	119,636	0	0	0
Sediment Compaction	69	22	0	0
Vertical Leakage Upper	-	113,531	626	381
Vertical Leakage Lower	749	165	131	-
Lateral Flow	69,152	28,458	9	4,404
Total Inflow	*189,606*	*142,176*	*766*	*4,785*
Outflow				
Pumping	52,346	127,666	217	13
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	11	3	0	0
Vertical Leakage Upper	-	749	165	131
Vertical Leakage Lower	113,531	626	381	-
Lateral Flow	20,741	13,256	8	4,715
Total Outflow	*186,629*	*142,300*	*771*	*4,859*
Inflow - Outflow	2,977	-124	-5	-74
Storage Change	3,050	-20	-7	-60
Model Error	-73	-104	2	-14
Model Error (percent)	0.04%	0.07%	0.26%	0.29%

Jefferson	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	5,231	0	0	0
Sediment Compaction	341	304	0	0
Vertical Leakage Upper	-	3,456	0	0
Vertical Leakage Lower	61	0	0	-
Lateral Flow	2,986	2,031	0	0
Total Inflow	*8,619*	*5,791*	*0*	*0*
Outflow				
Pumping	2,038	85	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	61	0	0
Vertical Leakage Lower	3,456	0	0	-
Lateral Flow	3,269	5,766	0	0
Total Outflow	*8,763*	*5,912*	*0*	*0*
Inflow - Outflow	-144	-121	0	0
Storage Change	-108	-45	0	0
Model Error	-36	-76	0	0
Model Error (percent)	0.41%	1.29%	0.00%	0.00%

Liberty	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	39,347	0	0	0
Sediment Compaction	1,902	1,295	0	0
Vertical Leakage Upper	-	24,944	434	443
Vertical Leakage Lower	1,134	87	74	-
Lateral Flow	10,557	8,493	11	2,691
Total Inflow	*52,940*	*34,819*	*519*	*3,134*
Outflow				
Pumping	14,420	27,060	0	1,330
Evapotranspiration and Surface Water Outflow	2,837	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	1,134	87	74
Vertical Leakage Lower	24,944	434	443	-
Lateral Flow	11,720	6,244	2	1,778
Total Outflow	*53,921*	*34,872*	*532*	*3,182*
Inflow - Outflow	-981	-53	-13	-48
Storage Change	-977	-50	-13	-32
Model Error	-4	-3	0	-16
Model Error (percent)	0.01%	0.01%	0.00%	0.50%

Table C-1. cont.

Montgomery	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	55,346	1,462	1	999
Sediment Compaction	1	1,524	0	0
Vertical Leakage Upper	-	23,586	1,607	858
Vertical Leakage Lower	31	93	0	-
Lateral Flow	4,185	7,442	19	22,239
Total Inflow	*59,563*	*34,107*	*1,627*	*24,096*
Outflow				
Pumping	286	22,335	754	23,934
Evapotranspiration and Surface Water Outflow	1,107	415	0	13
Sediment Compaction	1	0	0	0
Vertical Leakage Upper	-	31	93	0
Vertical Leakage Lower	23,586	1,607	858	-
Lateral Flow	34,397	10,139	8	2,803
Total Outflow	*59,377*	*34,527*	*1,713*	*26,750*
Inflow - Outflow	186	-420	-86	-2,654
Storage Change	187	-420	-86	-2,621
Model Error	-1	0	0	-33
Model Error (percent)	0.00%	0.00%	0.00%	0.12%

Orange	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	19,862	0	0	0
Sediment Compaction	16	152	0	0
Vertical Leakage Upper	-	4,280	0	0
Vertical Leakage Lower	305	0	0	-
Lateral Flow	2,387	1,291	0	0
Total Inflow	*22,570*	*5,723*	*0*	*0*
Outflow				
Pumping	17,606	1,066	0	0
Evapotranspiration and Surface Water Outflow	0	0	0	0
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	305	0	0
Vertical Leakage Lower	4,280	0	0	-
Lateral Flow	824	4,414	0	0
Total Outflow	*22,710*	*5,785*	*0*	*0*
Inflow - Outflow	-140	-62	0	0
Storage Change	-122	-25	0	0
Model Error	-18	-37	0	0
Model Error (percent)	0.08%	0.64%	0.00%	0.00%

Polk	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	3,935	7,368	7	4,112
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	2,288	735	1,910
Vertical Leakage Lower	317	96	10	-
Lateral Flow	18	390	4	1,039
Total Inflow	*4,270*	*10,142*	*756*	*7,061*
Outflow				
Pumping	0	1,363	119	4,500
Evapotranspiration and Surface Water Outflow	448	4,938	2	2,151
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	317	96	10
Vertical Leakage Lower	2,288	735	1,910	-
Lateral Flow	1,612	2,821	48	4,527
Total Outflow	*4,348*	*10,174*	*2,175*	*11,188*
Inflow - Outflow	-78	-32	-1,419	-4,127
Storage Change	-78	-32	-1,418	-4,121
Model Error	0	0	-1	-6
Model Error (percent)	0.00%	0.00%	0.05%	0.05%

San Jacinto	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	9,092	1,392	4	761
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	7,325	986	2,050
Vertical Leakage Lower	1,246	72	24	-
Lateral Flow	166	898	28	4,632
Total Inflow	*10,504*	*9,687*	*1,042*	*7,443*
Outflow				
Pumping	0	1,497	230	1,520
Evapotranspiration and Surface Water Outflow	1,597	2,374	1	912
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	1,246	72	24
Vertical Leakage Lower	7,325	986	2,050	-
Lateral Flow	1,716	3,615	14	6,997
Total Outflow	*10,638*	*9,718*	*2,367*	*9,453*
Inflow - Outflow	-134	-31	-1,325	-2,010
Storage Change	-134	-30	-1,327	-1,999
Model Error	0	-1	2	-11
Model Error (percent)	0.00%	0.01%	0.08%	0.12%

Walker	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	1	297	4	7,194
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	0	74
Vertical Leakage Lower	0	0	0	-
Lateral Flow	0	6	1	1,693
Total Inflow	*1*	*303*	*5*	*8,961*
Outflow				
Pumping	0	191	0	4,567
Evapotranspiration and Surface Water Outflow	0	8	0	2,010
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	0	0
Vertical Leakage Lower	0	0	74	-
Lateral Flow	1	118	3	12,058
Total Outflow	*1*	*317*	*77*	*18,635*
Inflow - Outflow	0	-14	-72	-9,674
Storage Change	0	-16	-73	-9,618
Model Error	0	2	1	-56
Model Error (percent)	0.00%	0.63%	1.29%	0.30%

Waller	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	41,507	622	0	0
Sediment Compaction	8	21	0	0
Vertical Leakage Upper	-	34,707	768	761
Vertical Leakage Lower	60	118	105	-
Lateral Flow	1,446	7,288	12	3,223
Total Inflow	*43,021*	*42,756*	*885*	*3,984*
Outflow				
Pumping	464	34,070	0	256
Evapotranspiration and Surface Water Outflow	154	1,370	0	0
Sediment Compaction	1	0	0	0
Vertical Leakage Upper	-	60	118	105
Vertical Leakage Lower	34,707	768	761	-
Lateral Flow	7,779	6,532	7	3,635
Total Outflow	*43,105*	*42,800*	*886*	*3,996*
Inflow - Outflow	-84	-44	-1	-12
Storage Change	-84	-46	-1	-10
Model Error	0	2	0	-2
Model Error (percent)	0.00%	0.00%	0.00%	0.05%

Washington	Chicot	Evangeline	Burkeville	Jasper
Inflow				
Recharge and Surface Water Inflow	0	4,810	3	3,620
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	678	1,214
Vertical Leakage Lower	0	521	532	-
Lateral Flow	0	1,436	7	643
Total Inflow	*0*	*6,767*	*1,220*	*5,477*
Outflow				
Pumping	0	838	133	2,584
Evapotranspiration and Surface Water Outflow	0	3,852	2	1,990
Sediment Compaction	0	0	0	0
Vertical Leakage Upper	-	0	521	532
Vertical Leakage Lower	0	678	1,214	-
Lateral Flow	0	1,414	8	1,267
Total Outflow	*0*	*6,782*	*1,878*	*6,373*
Inflow - Outflow	0	-15	-658	-896
Storage Change	0	-14	-658	-896
Model Error	0	-1	0	0
Model Error (percent)	0.00%	0.01%	0.00%	0.00%

Appendix D

Relationship between drawdown (from 2006) and annual pumping in Southeast Texas Groundwater Conservation District

Figure D-1. Average drawdown (decline in water levels from the year 2006) in the Chicot Aquifer versus annual pumping in Southeast Texas Groundwater Conservation District. Note that average drawdown is cumulative (that is, it is affected by the pumping prior to the year in which it is calculated) whereas pumping is annual.

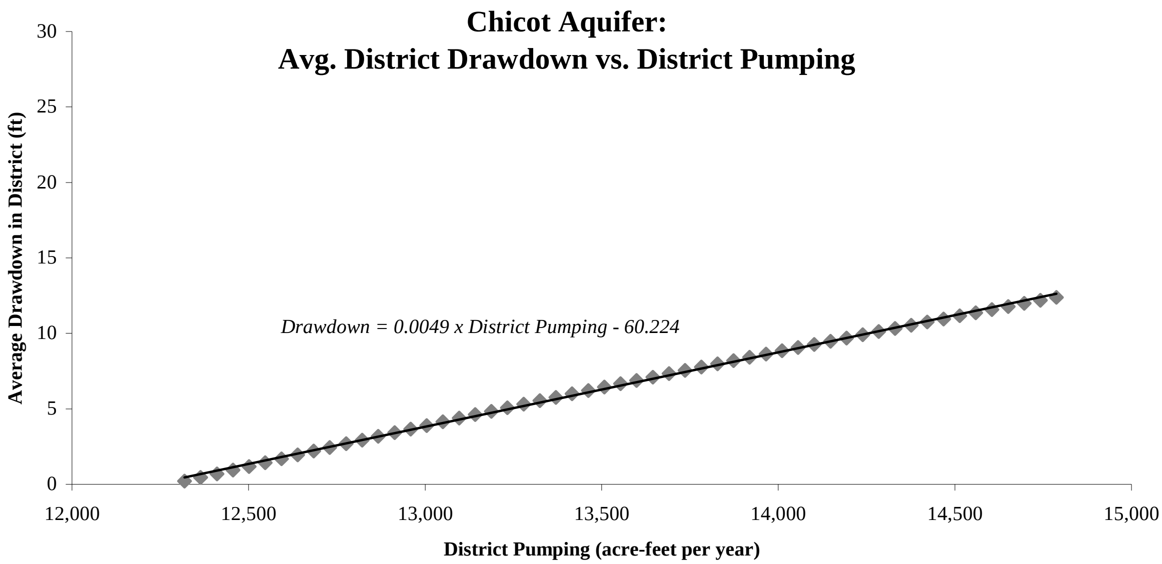

Figure D-2. Average drawdown (decline in water levels from the year 2006) in the Evangeline Aquifer versus annual pumping in Southeast Texas Groundwater Conservation District. Note that average drawdown is cumulative (that is, it is affected by the pumping prior to the year in which it is calculated) whereas pumping is annual.

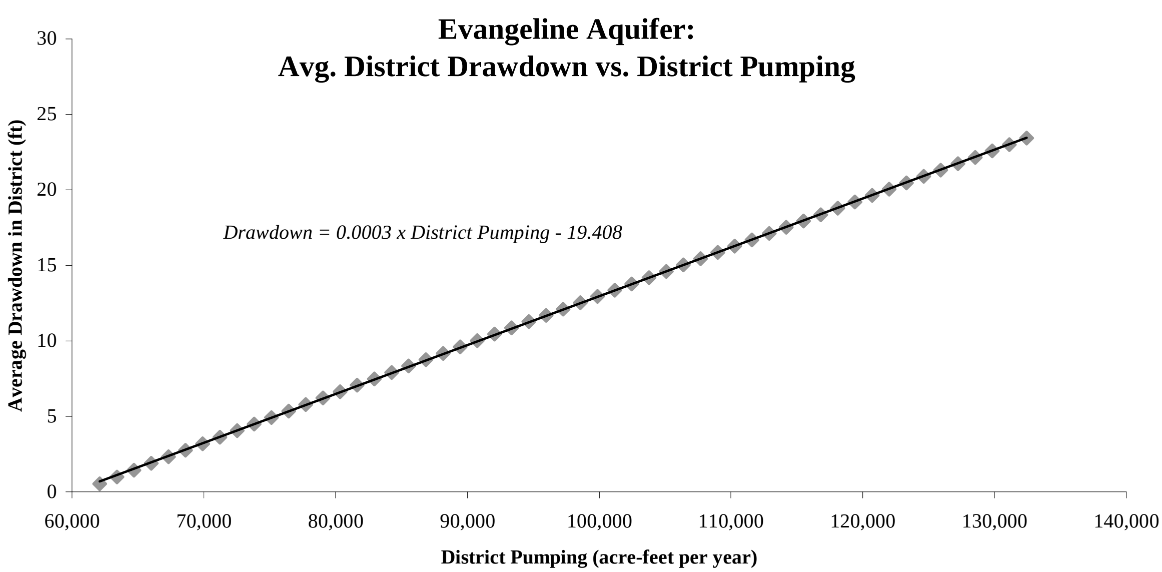

Figure D-3. Average drawdown (decline in water levels from the year 2006) in the Jasper Aquifer versus annual pumping in Southeast Texas Groundwater Conservation District. Note that average drawdown is cumulative (that is, it is affected by the pumping prior to the year in which it is calculated) whereas pumping is annual.

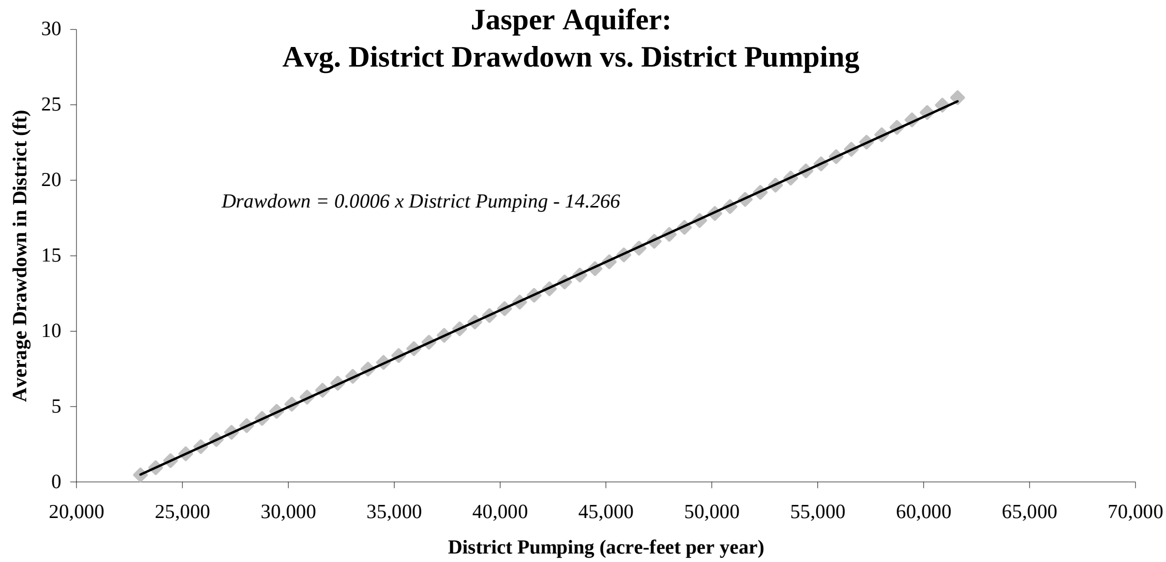

Figure D-4. Average drawdown (decline in water levels from the year 2006) in the Chicot, Evangeline, and Jasper aquifers versus annual pumping in Southeast Texas Groundwater Conservation District. Note that average drawdown is cumulative (that is, it is affected by the pumping prior to the year in which it is calculated) whereas pumping is annual.