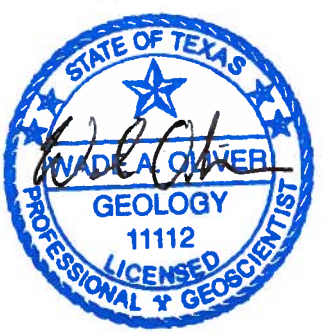
GAM Run 11-008: Trinity Aquifer Model Runs for Central Texas Groundwater Conservation District

by Wade Oliver
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-3132
January 27, 2012



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GAM RUN 11-008: TRINITY AQUIFER MODEL RUNS FOR CENTRAL TEXAS GROUNDWATER CONSERVATION DISTRICT

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EXECUTIVE SUMMARY:

This report describes the methods and results for a series of four 50-year predictive simulations using the groundwater availability model for the northern portion of the Trinity Aquifer. These simulations were performed at the request of Central Texas Groundwater Conservation District in order to evaluate the impact on the Trinity Aquifer of pumping between 5,000 and 20,000 acre-feet per year distributed into areas specified by the district. Results indicate that the average drawdown in the aquifer in the district ranges from 13 to 21 feet for this range of pumping conditions.

REQUESTOR:

Mr. Richard Bowers on behalf of Central Texas Groundwater Conservation District

DESCRIPTION OF REQUEST:

Mr. Bowers requested that the Texas Water Development Board (TWDB) provide the average drawdown in the Trinity Aquifer in Central Texas Groundwater Conservation District (that is, Burnet County) for four scenarios containing different levels of pumping within the district. The requested pumping scenarios are 5,000 (Scenario 1), 10,000 (Scenario 2), 15,000 (Scenario 3), and 20,000 (Scenario 4) acre-feet per year. In addition, Mr. Bowers provided a map prepared by the district indicating how pumping should be distributed. This figure is shown in Appendix A and specifies the percentage of the total pumping for the district that should be applied to each of five zones.

METHODS:

In order to estimate the impact of pumping for each of the above scenarios requested by Central Texas Groundwater Conservation District, the groundwater availability model for the northern portion of the Trinity Aquifer was used. As requested by the district, pumping was distributed spatially as shown in Appendix A.

The base pumping distribution in the model prior to adjusting to the zones in Appendix A was the same distribution used for development of the desired future conditions for Groundwater Management Area 8. This is documented in Oliver and Bradley (2010), Wade (2009), and Donnelly (2008).

The amount of pumping in each of the zones for each scenario was determined by the percentage specified by the district. This pumping was then distributed into the individual layers of the model based on the amount of pre-existing pumping in each model layer in the zone in the base distribution. For example, in the 50 percent zone, Layer 5 of the model contained 20 percent of the pumping in the base distribution. For Scenario 2 containing 10,000 acre-feet per year for the district, pumping in Layer 5 was 20 percent of the 5,000 acre-feet per year for the zone (1,000 acre-feet per year).

When it was necessary to increase the pumping in an area, the amount of the increase was spread evenly among all cells in the layer in the zone that contained pumping in the base distribution. When decreasing the pumping in an area, the pumping was decreased by a uniform factor.

PARAMETERS AND ASSUMPTIONS:

- Version 1.01 of the groundwater availability model for the northern portion of the Trinity Aquifer was used for this analysis. See Bené and others (2004) for assumptions and limitations of the model.
- The model includes seven layers which generally correspond to the Woodbine Aquifer (Layer 1), the Washita and Fredericksburg Groups (Layer 2), the Paluxy Formation (Layer 3), the Glen Rose Formation (Layer 4), the Hensell Formation (Layer 5), the Pearsall/Cow Creek/Hammett/Sligo Members (Layer 6), and the Hosston Formation (Layer 7).
- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the four main aquifers in the

model (Woodbine, Paluxy, Hensell, and Hosston) for the calibration and verification time periods (1980 to 2000) ranged from approximately 38 to 75 feet. The root mean squared error was less than ten percent of the maximum change in water levels across the model (Bené and others, 2004).

- Average annual recharge conditions based on climate data from 1980 to 1999 were assumed for the first 47 years of the simulation. During the last three years of the simulation, drought-of-record recharge conditions were assumed. This is defined as the years 1954 to 1956.

RESULTS:

Tables 1 and 2 below show the results of the four scenarios described above. The results include the pumping output from the groundwater availability model by year (Table 1) and the average drawdown in the Trinity Aquifer in the district over the 50-year simulation (Table 2). With pumping increasing from 5,000 to 20,000 acre-feet per year, the average drawdown in the aquifer in the district increases from 13 to 21 feet.

Notice in Table 1 that in each of the scenarios, the pumping output from the model decreases with time during the simulation. This is due to the presence of inactive (or "dry") cells. A cell becomes inactive when the water level in the cell drops below the base of the aquifer. In this situation, pumping can no longer occur. In the scenarios below, the impact of dry cells increases as the amount of pumping increases. Additionally, though not shown here, the impact of dry cells is much more significant in the zone with 50 percent of the pumping because of the high pumping allocation and relatively small area.

It is important to note that, even though pumping in areas outside of Central Texas Groundwater Conservation District was held at the same levels used during development of the existing desired future conditions, increases in pumping within the district can result in increases in drawdown in areas outside the district. Appendix B shows the drawdown for each layer of the model loosely associated with the various units of the Trinity Aquifer, and for the aquifer as a whole, for each county within Groundwater Management Area 8. Tables B-1 through B-4 correspond to scenarios 1 through 4, respectively. Table B-5 shows the existing desired future conditions for comparison.

Appendix C contains the same information as Appendix B, but is organized by layer of the Trinity Aquifer model to more clearly show the differences in drawdown among model scenarios. Tables C-1 through C-4 correspond to the model layers which

generally represent the Paluxy, Glen Rose, Hensell, and Hosston units of the Trinity Aquifer, respectively. Table C-5 contains the average drawdown by county in the Trinity Aquifer as a whole for each scenario.

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> "Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historic time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the

future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine Groundwater Availability Model: contract report to the Texas Water Development Board by R.W. Harden and Associates, 391 p.

Donnelly, A., 2008, GAM Run 08-06, Texas Water Development Board GAM Run 08-06 Report, 44 p.

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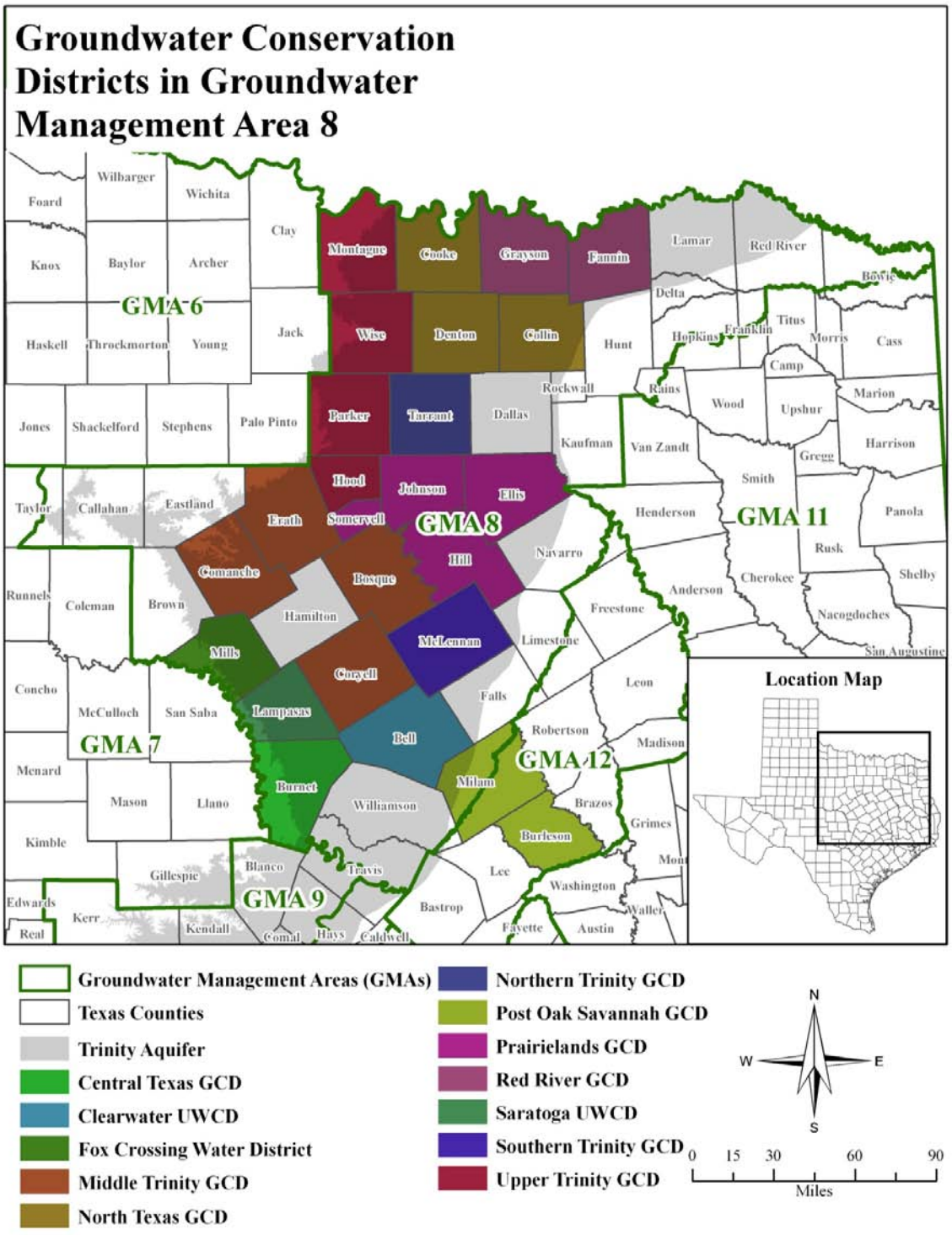

FIGURE 1: LOCATION MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCDS) WITHIN GROUNDWATER MANAGEMENT AREA 8. UWCD REFERS TO UNDERGROUND WATER CONSERVATION DISTRICT

TABLE 1: PUMPING IN THE TRINITY AQUIFER IN CENTRAL TEXAS GROUNDWATER CONSERVATION DSITRICT (BURNET COUNTY) FOR EACH SCENARIO.

Pumping by Year (acre-feet per year)	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*
Year 1	4,998	9,997	14,984	19,934
Year 10	4,998	9,992	14,974	19,860
Year 20	4,996	9,974	14,389	17,682
Year 30	4,994	9,634	12,773	16,348
Year 40	4,979	8,847	12,276	15,727
Year 50	4,922	8,388	11,891	15,203

TABLE 2: AVERAGE DRAWDOWN FOR THE TRINITY AQUIFER AS A WHOLE IN CENTRAL TEXAS GROUNDWATER CONSERVATION DISTRICT (BURNET COUNTY) FOR EACH SCENARIO.

Drawdown (feet)	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*
Burnet County	13	16	19	21

APPENDIX A: PUMPING ZONES PROVIDED BY CENTRAL TEXAS GROUNDWATER CONSERVATION DISTRICT

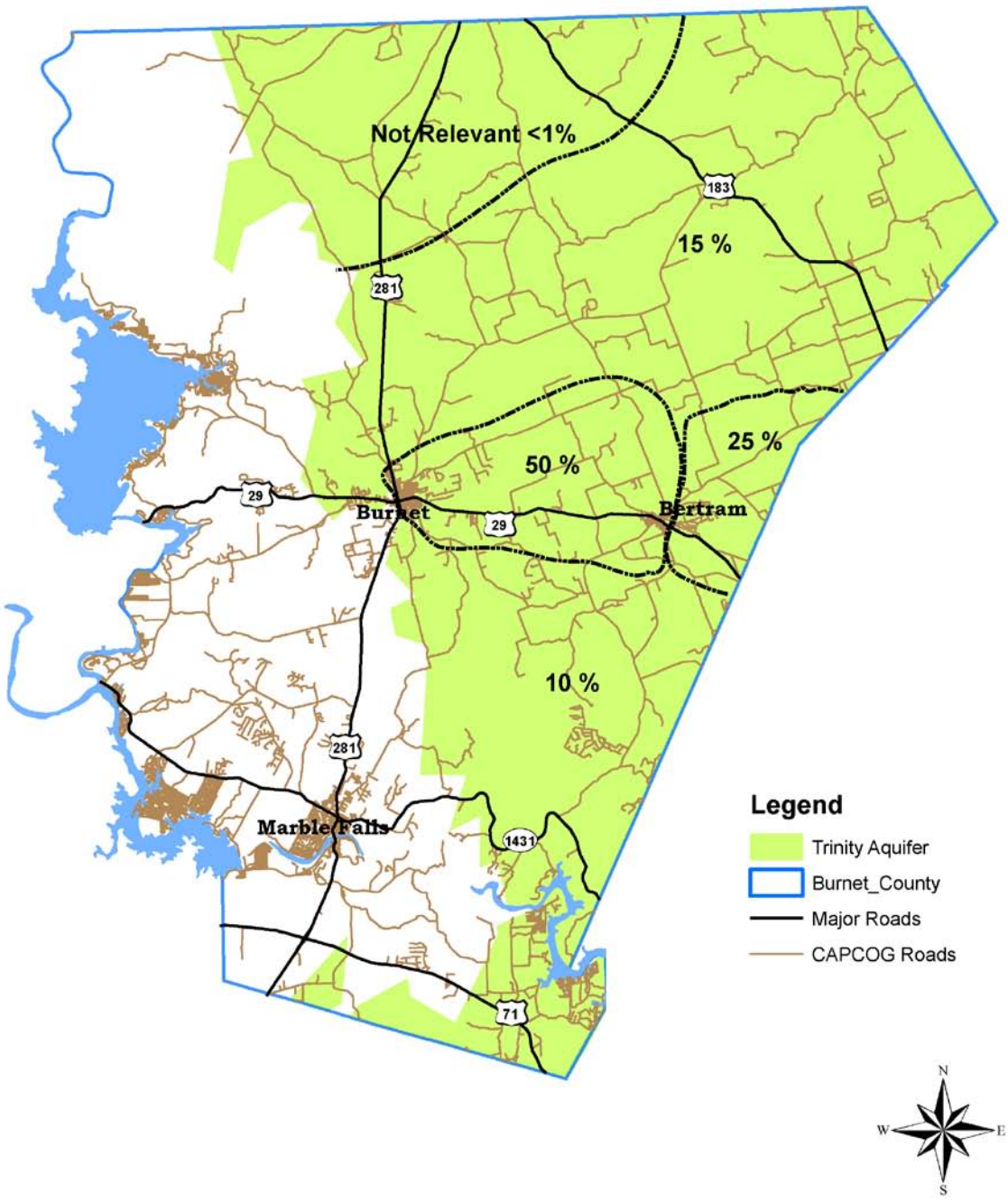

FIGURE A-1: PUMPING ZONES FOR BURNET COUNTY. THIS FIGURE WAS PROVIDED BY CENTRAL TEXAS GROUNDWATER CONSERVATION DISTRICT.

APPENDIX B: AVERAGE DRAWDOWN IN THE TRINITY AQUIFER BY COUNTY FOR EACH SCENARIO

TABLE B-1: AVERAGE DRAWDOWN IN FEET FOR SCENARIO 1 (5,000 ACRE-FEET PER YEAR IN CENTRAL TEXAS GROUNDWATER CONSERVVATION DISTRICT) IN EACH COUNTY BY UNIT OF THE TRINITY AQUIFER. THE AVERAGE FOR THE TRINTY AQUIFER AS A WHOLE IS ALSO SHOWN.

County	*Layer 3 (Paluxy)*	*Layer 4 (Glen Rose)*	*Layer 5 (Hensell)*	*Layer 7 (Hosston)*	*Trinity Aquifer Average*
Bell	134	155	289	319	226
Bosque	26	33	201	220	120
Bowie	44	41	44	45	44
Brown	0	0	1	1	1
Burnet	1	1	12	31	13
Callahan	-	-	0	2	2
Collin	298	247	224	236	251
Comanche	0	0	2	10	5
Cooke	26	43	60	78	52
Coryell	15	15	159	179	97
Dallas	240	224	263	290	254
Delta	175	163	162	159	165
Denton	98	134	180	214	156
Eastland	0	0	0	0	0
Ellis	264	283	337	362	311
Erath	1	1	11	27	12
Falls	279	354	461	481	394
Fannin	212	197	182	181	193
Franklin	116	105	106	106	108
Grayson	175	161	160	165	165
Hamilton	0	2	40	51	25
Hill	209	252	382	406	312
Hood	1	2	16	56	23
Hopkins	153	139	142	140	143
Hunt	286	245	215	223	242
Johnson	37	83	208	234	141
Kaufman	303	286	295	312	299
Lamar	132	130	136	134	133
Lampasas	0	1	12	23	11
Limestone	328	392	476	492	422
McLennan	251	291	492	527	390
Milam	252	295	340	346	308
Mills	0	0	3	12	4
Montague	0	1	3	12	6
Navarro	344	353	400	413	377
Parker	5	6	16	40	18
Red River	82	77	78	78	79
Rockwall	346	272	248	265	283
Somervell	1	4	53	113	49
Tarrant	33	74	160	173	110
Taylor	-	-	-	3	3
Travis	124	61	100	118	99
Williamson	109	88	145	170	128
Wise	4	14	23	53	28

TABLE B-2: AVERAGE DRAWDOWN IN FEET FOR SCENARIO 2 (10,000 ACRE-FEET PER YEAR IN CENTRAL TEXAS GROUNDWATER CONSERVVATION DISTRICT) IN EACH COUNTY BY UNIT OF THE TRINITY AQUIFER. THE AVERAGE FOR THE TRINTY AQUIFER AS A WHOLE IS ALSO SHOWN.

County	*Layer 3 (Paluxy)*	*Layer 4 (Glen Rose)*	*Layer 5 (Hensell)*	*Layer 7 (Hosston)*	*Trinity Aquifer Average*
Bell	134	156	292	323	227
Bosque	26	33	201	220	121
Bowie	44	41	44	45	44
Brown	0	0	1	1	1
Burnet	2	1	14	39	16
Callahan	-	-	0	2	2
Collin	298	247	224	236	251
Comanche	0	0	2	10	5
Cooke	26	43	60	78	52
Coryell	15	15	159	179	97
Dallas	240	224	263	290	254
Delta	175	163	162	159	165
Denton	98	134	180	214	156
Eastland	0	0	0	0	0
Ellis	264	283	337	362	312
Erath	1	1	11	27	12
Falls	280	355	463	482	395
Fannin	212	197	182	181	193
Franklin	116	105	106	106	108
Grayson	175	161	160	165	165
Hamilton	0	2	40	51	25
Hill	209	253	382	406	313
Hood	1	2	16	56	23
Hopkins	153	139	142	140	143
Hunt	286	245	215	223	242
Johnson	37	83	208	234	141
Kaufman	303	286	296	312	299
Lamar	132	130	136	134	133
Lampasas	0	1	12	23	11
Limestone	328	392	477	493	423
McLennan	251	292	492	528	391
Milam	253	296	342	348	310
Mills	0	0	3	12	4
Montague	0	1	3	12	6
Navarro	344	353	400	413	378
Parker	5	6	16	40	18
Red River	82	77	78	78	79
Rockwall	346	272	248	265	283
Somervell	1	4	53	113	49
Tarrant	33	74	160	173	110
Taylor	-	-	-	3	3
Travis	124	62	101	121	101
Williamson	109	89	149	176	131
Wise	4	14	23	53	28

TABLE B-3: AVERAGE DRAWDOWN IN FEET FOR SCENARIO 3 (15,000 ACRE-FEET PER YEAR IN CENTRAL TEXAS GROUNDWATER CONSERVVATION DISTRICT) IN EACH COUNTY BY UNIT OF THE TRINITY AQUIFER. THE AVERAGE FOR THE TRINTY AQUIFER AS A WHOLE IS ALSO SHOWN.

County	*Layer 3 (Paluxy)*	*Layer 4 (Glen Rose)*	*Layer 5 (Hensell)*	*Layer 7 (Hosston)*	*Trinity Aquifer Average*
Bell	134	156	294	325	229
Bosque	26	33	201	220	121
Bowie	44	41	44	45	44
Brown	0	0	1	1	1
Burnet	2	1	15	45	19
Callahan	-	-	0	2	2
Collin	298	247	224	236	251
Comanche	0	0	2	10	5
Cooke	26	43	60	78	52
Coryell	15	15	160	180	97
Dallas	240	224	263	290	254
Delta	175	163	162	159	165
Denton	98	134	180	214	157
Eastland	0	0	0	0	0
Ellis	265	283	337	362	312
Erath	1	1	11	27	12
Falls	280	355	464	484	396
Fannin	212	197	182	181	193
Franklin	116	105	106	106	108
Grayson	175	161	160	165	165
Hamilton	0	2	40	51	25
Hill	209	253	383	406	313
Hood	1	2	16	56	23
Hopkins	153	139	142	140	143
Hunt	286	245	215	223	242
Johnson	37	83	208	234	141
Kaufman	303	286	296	313	299
Lamar	132	130	136	134	133
Lampasas	0	2	12	24	12
Limestone	328	392	477	494	423
McLennan	251	292	493	529	391
Milam	253	297	343	350	311
Mills	0	0	3	12	4
Montague	0	1	3	12	6
Navarro	344	354	401	413	378
Parker	5	6	16	40	18
Red River	82	77	78	78	79
Rockwall	346	272	248	265	283
Somervell	1	4	53	113	49
Tarrant	33	74	160	173	110
Taylor	-	-	-	3	3
Travis	125	62	103	123	102
Williamson	110	89	152	180	133
Wise	4	14	23	53	28

TABLE B-4: AVERAGE DRAWDOWN IN FEET FOR SCENARIO 4 (20,000 ACRE-FEET PER YEAR IN CENTRAL TEXAS GROUNDWATER CONSERVVATION DISTRICT) IN EACH COUNTY BY UNIT OF THE TRINITY AQUIFER. THE AVERAGE FOR THE TRINTY AQUIFER AS A WHOLE IS ALSO SHOWN.

County	*Layer 3 (Paluxy)*	*Layer 4 (Glen Rose)*	*Layer 5 (Hensell)*	*Layer 7 (Hosston)*	*Trinity Aquifer Average*
Bell	135	157	296	327	230
Bosque	26	33	201	220	121
Bowie	44	41	44	45	44
Brown	0	0	1	1	1
Burnet	3	2	16	50	21
Callahan	-	-	0	2	2
Collin	298	247	224	236	251
Comanche	0	0	2	10	5
Cooke	26	43	60	78	52
Coryell	15	15	160	180	97
Dallas	240	224	263	290	254
Delta	175	163	162	159	165
Denton	98	134	180	214	157
Eastland	0	0	0	0	0
Ellis	265	283	337	362	312
Erath	1	1	11	27	12
Falls	280	356	465	485	396
Fannin	212	197	182	181	193
Franklin	116	105	106	106	108
Grayson	175	161	160	165	165
Hamilton	0	2	40	51	25
Hill	209	253	383	407	313
Hood	1	2	16	56	23
Hopkins	153	139	142	140	143
Hunt	286	245	215	223	242
Johnson	37	83	208	234	141
Kaufman	303	286	296	313	299
Lamar	132	130	136	134	133
Lampasas	0	2	12	24	12
Limestone	328	392	478	494	423
McLennan	251	292	493	530	391
Milam	254	298	345	351	312
Mills	0	0	3	12	4
Montague	0	1	3	12	6
Navarro	344	354	401	414	378
Parker	5	6	16	40	18
Red River	82	77	78	78	79
Rockwall	346	272	248	265	283
Somervell	1	4	53	113	49
Tarrant	33	74	160	173	110
Taylor	-	-	-	3	3
Travis	125	62	104	124	103
Williamson	110	90	154	183	135
Wise	4	14	23	53	28

TABLE B-5: DESIRED FUTURE CONDITIONS FOR EACH COUNTY BY UNIT OF THE TRINITY AQUIFER ADOPTED BY THE GROUNDWATER CONSERVATION DISTRICTS IN GROUNDWATER MANAGEMENT AREA 8 IN SEPTEMBER 2008. ALL VALUES ARE AVERAGE DRAWDOWN IN FEET.

County	*Layer 3 (Paluxy)*	*Layer 4 (Glen Rose)*	*Layer 5 (Hensell)*	*Layer 7 (Hosston)*
Bell	134	155	286	319
Bosque	26	33	201	220
Bowie	n/a	n/a	n/a	n/a
Brown	0	0	1	1
Burnet	1	1	11	29
Callahan	n/a	n/a	0	2
Collin	298	247	224	236
Comanche	0	0	2	11
Cooke	26	42	60	78
Coryell	15	15	156	179
Dallas	240	224	263	290
Delta	175	162	162	159
Denton	98	134	180	214
Eastland	0	0	0	0
Ellis	265	283	336	362
Erath	1	1	11	27
Falls	279	354	459	480
Fannin	212	196	182	181
Franklin	n/a	n/a	n/a	n/a
Grayson	175	161	160	165
Hamilton	0	2	39	51
Hill	209	253	381	406
Hood	1	2	16	56
Hopkins	n/a	n/a	n/a	n/a
Hunt	286	245	215	223
Johnson	37	83	208	234
Kaufman	303	286	295	312
Lamar	132	130	136	134
Lampasas	0	1	12	23
Limestone	328	392	475	492
McLennan	251	291	489	527
Milam	252	294	337	344
Mills	0	0	3	12
Montague	0	1	3	12
Navarro	344	353	399	413
Parker	5	6	16	40
Red River	82	77	78	78
Rockwall	346	272	248	265
Somervell	1	4	53	113
Tarrant	33	75	160	173
Taylor	n/a	n/a	n/a	3
Travis	124	61	98	116
Williamson	108	88	142	166
Wise	4	14	23	53

APPENDIX C: AVERAGE DRAWDOWN BY COUNTY FOR EACH LAYER OF THE TRINTY AQUIFER

TABLE C-1: AVERAGE DRAWDOWN IN FEET FOR THE PALUXY UNIT OF THE TRINITY AQUIFER (LAYER 3) IN EACH COUNTY BY SCENARIO. THE CORRESPONDING DESIRED FUTURE CONDITIONS ADOPTED IN SEPTEMBER 2008 ARE ALSO SHOWN.

County	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Desired Future Condition*
Bell	134	134	134	135	134
Bosque	26	26	26	26	26
Bowie	44	44	44	44	n/a
Brown	0	0	0	0	0
Burnet	1	2	2	3	1
Callahan	-	-	-	-	n/a
Collin	298	298	298	298	298
Comanche	0	0	0	0	0
Cooke	26	26	26	26	26
Coryell	15	15	15	15	15
Dallas	240	240	240	240	240
Delta	175	175	175	175	175
Denton	98	98	98	98	98
Eastland	0	0	0	0	0
Ellis	264	264	265	265	265
Erath	1	1	1	1	1
Falls	279	280	280	280	279
Fannin	212	212	212	212	212
Franklin	116	116	116	116	n/a
Grayson	175	175	175	175	175
Hamilton	0	0	0	0	0
Hill	209	209	209	209	209
Hood	1	1	1	1	1
Hopkins	153	153	153	153	n/a
Hunt	286	286	286	286	286
Johnson	37	37	37	37	37
Kaufman	303	303	303	303	303
Lamar	132	132	132	132	132
Lampasas	0	0	0	0	0
Limestone	328	328	328	328	328
McLennan	251	251	251	251	251
Milam	252	253	253	254	252
Mills	0	0	0	0	0
Montague	0	0	0	0	0
Navarro	344	344	344	344	344
Parker	5	5	5	5	5
Red River	82	82	82	82	82
Rockwall	346	346	346	346	346
Somervell	1	1	1	1	1
Tarrant	33	33	33	33	33
Taylor	-	-	-	-	n/a
Travis	124	124	125	125	124
Williamson	109	109	110	110	108
Wise	4	4	4	4	4

TABLE C-2: AVERAGE DRAWDOWN IN FEET FOR THE GLEN ROSE UNIT OF THE TRINITY AQUIFER (LAYER 4) IN EACH COUNTY BY SCENARIO. THE CORRESPONDING DESIRED FUTURE CONDITIONS ADOPTED IN SEPTEMBER 2008 ARE ALSO SHOWN.

County	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Desired Future Condition*
Bell	155	156	156	157	155
Bosque	33	33	33	33	33
Bowie	41	41	41	41	n/a
Brown	0	0	0	0	0
Burnet	1	1	1	2	1
Callahan	-	-	-	-	n/a
Collin	247	247	247	247	247
Comanche	0	0	0	0	0
Cooke	43	43	43	43	42
Coryell	15	15	15	15	15
Dallas	224	224	224	224	224
Delta	163	163	163	163	162
Denton	134	134	134	134	134
Eastland	0	0	0	0	0
Ellis	283	283	283	283	283
Erath	1	1	1	1	1
Falls	354	355	355	356	354
Fannin	197	197	197	197	196
Franklin	105	105	105	105	n/a
Grayson	161	161	161	161	161
Hamilton	2	2	2	2	2
Hill	252	253	253	253	253
Hood	2	2	2	2	2
Hopkins	139	139	139	139	n/a
Hunt	245	245	245	245	245
Johnson	83	83	83	83	83
Kaufman	286	286	286	286	286
Lamar	130	130	130	130	130
Lampasas	1	1	2	2	1
Limestone	392	392	392	392	392
McLennan	291	292	292	292	291
Milam	295	296	297	298	294
Mills	0	0	0	0	0
Montague	1	1	1	1	1
Navarro	353	353	354	354	353
Parker	6	6	6	6	6
Red River	77	77	77	77	77
Rockwall	272	272	272	272	272
Somervell	4	4	4	4	4
Tarrant	74	74	74	74	75
Taylor	-	-	-	-	n/a
Travis	61	62	62	62	61
Williamson	88	89	89	90	88
Wise	14	14	14	14	14

TABLE C-3: AVERAGE DRAWDOWN IN FEET FOR THE HENSELL UNIT OF THE TRINITY AQUIFER (LAYER 5) IN EACH COUNTY BY SCENARIO. THE CORRESPONDING DESIRED FUTURE CONDITIONS ADOPTED IN SEPTEMBER 2008 ARE ALSO SHOWN.

County	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Desired Future Condition*
Bell	289	292	294	296	286
Bosque	201	201	201	201	201
Bowie	44	44	44	44	n/a
Brown	1	1	1	1	1
Burnet	12	14	15	16	11
Callahan	0	0	0	0	0
Collin	224	224	224	224	224
Comanche	2	2	2	2	2
Cooke	60	60	60	60	60
Coryell	159	159	160	160	156
Dallas	263	263	263	263	263
Delta	162	162	162	162	162
Denton	180	180	180	180	180
Eastland	0	0	0	0	0
Ellis	337	337	337	337	336
Erath	11	11	11	11	11
Falls	461	463	464	465	459
Fannin	182	182	182	182	182
Franklin	106	106	106	106	n/a
Grayson	160	160	160	160	160
Hamilton	40	40	40	40	39
Hill	382	382	383	383	381
Hood	16	16	16	16	16
Hopkins	142	142	142	142	n/a
Hunt	215	215	215	215	215
Johnson	208	208	208	208	208
Kaufman	295	296	296	296	295
Lamar	136	136	136	136	136
Lampasas	12	12	12	12	12
Limestone	476	477	477	478	475
McLennan	492	492	493	493	489
Milam	340	342	343	345	337
Mills	3	3	3	3	3
Montague	3	3	3	3	3
Navarro	400	400	401	401	399
Parker	16	16	16	16	16
Red River	78	78	78	78	78
Rockwall	248	248	248	248	248
Somervell	53	53	53	53	53
Tarrant	160	160	160	160	160
Taylor	-	-	-	-	n/a
Travis	100	101	103	104	98
Williamson	145	149	152	154	142
Wise	23	23	23	23	23

TABLE C-4: AVERAGE DRAWDOWN IN FEET FOR THE HOSSTON UNIT OF THE TRINITY AQUIFER (LAYER 7) IN EACH COUNTY BY SCENARIO. THE CORRESPONDING DESIRED FUTURE CONDITIONS ADOPTED IN SEPTEMBER 2008 ARE ALSO SHOWN.

County	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*	*Desired Future Condition*
Bell	319	323	325	327	319
Bosque	220	220	220	220	220
Bowie	45	45	45	45	n/a
Brown	1	1	1	1	1
Burnet	31	39	45	50	29
Callahan	2	2	2	2	2
Collin	236	236	236	236	236
Comanche	10	10	10	10	11
Cooke	78	78	78	78	78
Coryell	179	179	180	180	179
Dallas	290	290	290	290	290
Delta	159	159	159	159	159
Denton	214	214	214	214	214
Eastland	0	0	0	0	0
Ellis	362	362	362	362	362
Erath	27	27	27	27	27
Falls	481	482	484	485	480
Fannin	181	181	181	181	181
Franklin	106	106	106	106	n/a
Grayson	165	165	165	165	165
Hamilton	51	51	51	51	51
Hill	406	406	406	407	406
Hood	56	56	56	56	56
Hopkins	140	140	140	140	n/a
Hunt	223	223	223	223	223
Johnson	234	234	234	234	234
Kaufman	312	312	313	313	312
Lamar	134	134	134	134	134
Lampasas	23	23	24	24	23
Limestone	492	493	494	494	492
McLennan	527	528	529	530	527
Milam	346	348	350	351	344
Mills	12	12	12	12	12
Montague	12	12	12	12	12
Navarro	413	413	413	414	413
Parker	40	40	40	40	40
Red River	78	78	78	78	78
Rockwall	265	265	265	265	265
Somervell	113	113	113	113	113
Tarrant	173	173	173	173	173
Taylor	3	3	3	3	3
Travis	118	121	123	124	116
Williamson	170	176	180	183	166
Wise	53	53	53	53	53

TABLE C-5: AVERAGE DRAWDOWN IN FEET FOR THE TRINITY AQUIFER AS A WHOLE IN EACH COUNTY BY SCENARIO.

County	*Scenario 1*	*Scenario 2*	*Scenario 3*	*Scenario 4*
Bell	226	227	229	230
Bosque	120	121	121	121
Bowie	44	44	44	44
Brown	1	1	1	1
Burnet	13	16	19	21
Callahan	2	2	2	2
Collin	251	251	251	251
Comanche	5	5	5	5
Cooke	52	52	52	52
Coryell	97	97	97	97
Dallas	254	254	254	254
Delta	165	165	165	165
Denton	156	156	157	157
Eastland	0	0	0	0
Ellis	311	312	312	312
Erath	12	12	12	12
Falls	394	395	396	396
Fannin	193	193	193	193
Franklin	108	108	108	108
Grayson	165	165	165	165
Hamilton	25	25	25	25
Hill	312	313	313	313
Hood	23	23	23	23
Hopkins	143	143	143	143
Hunt	242	242	242	242
Johnson	141	141	141	141
Kaufman	299	299	299	299
Lamar	133	133	133	133
Lampasas	11	11	12	12
Limestone	422	423	423	423
McLennan	390	391	391	391
Milam	308	310	311	312
Mills	4	4	4	4
Montague	6	6	6	6
Navarro	377	378	378	378
Parker	18	18	18	18
Red River	79	79	79	79
Rockwall	283	283	283	283
Somervell	49	49	49	49
Tarrant	110	110	110	110
Taylor	3	3	3	3
Travis	99	101	102	103
Williamson	128	131	133	135
Wise	28	28	28	28