GAM Run 10-063 MAG

by Mr. Wade Oliver and Mr. Robert G. Bradley, P.G.

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
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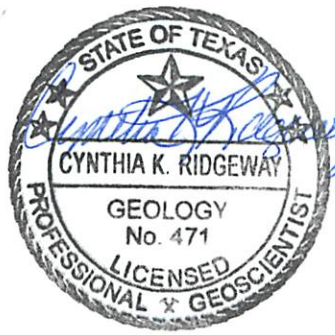

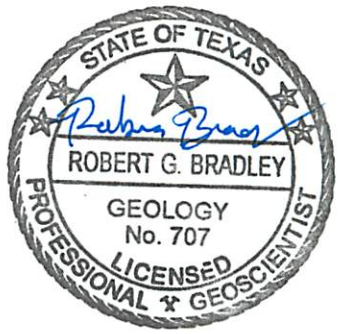

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on December 14, 2011.

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EXECUTIVE SUMMARY:

In response to receiving the adopted desired future conditions for the Trinity Aquifer in Groundwater Management Area 8, the Texas Water Development Board completed Groundwater Availability Model (GAM) Run 08-84mag, which reported the "managed available groundwater" that achieves the adopted desired future conditions. Subsequent to the release of GAM Run 08-84mag, the Middle Trinity Groundwater Conservation District requested that the Texas Water Development Board reevaluate the "managed available groundwater" for Comanche and Erath counties. This resulted in the completion of Aquifer Assessment 09-07, which addressed these counties. In April 2011, the groundwater conservation districts in Groundwater Management Area 8 readopted the desired future conditions for the Trinity Aquifer previously adopted in September 2008.

This report, an update to GAM Run 08-84mag and Aquifer Assessment 09-07, incorporates the changes above and addresses the readopted desired future conditions. In addition, the pumping estimates previously reported as "managed available groundwater" in the above reports are reported here as "modeled available groundwater" to reflect changes in statute effective September 1, 2011. The modeled available groundwater for the Trinity Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 8 is approximately 261,000 acre-feet per year.

REQUESTOR:

Mr. Eddy Daniel of North Texas Groundwater Conservation District on behalf of Groundwater Management Area 8

DESCRIPTION OF REQUEST:

In a letter dated August 31, 2011, Mr. Eddy Daniel provided the Texas Water Development Board (TWDB) with the desired future conditions of the Trinity Aquifer adopted in a resolution, dated April 27, 2011, by the members of Groundwater Management Area 8. This resolution referenced the desired future conditions previously adopted for the aquifer on September 17, 2008 by the groundwater conservation districts within Groundwater Management Area 8. These are summarized in Table 1.

In response to receiving the initially adopted desired future conditions from September 2008, the Texas Water Development Board completed Groundwater Availability Model (GAM) Run 08-84mag, which reported the "managed available groundwater" that achieves the above desired future conditions (Wade, 2009). On June 12, 2009, the general manager and consultants for the Middle Trinity Groundwater Conservation District met with Texas Water Development Board staff to discuss issues they had concerning GAM Run 08-84mag. After discussion, staff reevaluated pumping estimates using a water-budget approach based on the desired future conditions for Comanche and Erath counties and released this analysis as Aquifer Assessment 09-07 on November 22, 2010 (Bradley, 2010). This report, an update to GAM Run 08-84mag and Aquifer Assessment 09-07, incorporates the two changes above. In addition, the pumping estimates previously reported as "managed available groundwater" in the above reports are

reported here as "modeled available groundwater" to reflect changes in statute effective September 1, 2011.

METHODS:

Groundwater Management Area 8 contains the Trinity Aquifer, a major aquifer in Texas as defined in the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 8, the Trinity Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. This is distinct from "managed available groundwater," shown in the draft version of this report dated December 20, 2010, which was a permitting value and accounted for the estimated use of the aquifer exempt from permitting. This change was made to reflect changes in statute by the 82nd Texas Legislature, effective September 1, 2011.

Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits. The estimated amount of pumping exempt from permitting, which the Texas Water Development Board is now required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

PARAMETERS AND ASSUMPTIONS:

The groundwater availability model for the northern portion of the Trinity Aquifer was used for the results presented in this report outside of Comanche and Erath counties. In those counties, a water budget approach was used. The parameters and assumptions for developing the modeled available groundwater are described below:

Groundwater Availability Model for the Northern Portion of the Trinity Aquifer

- The results for modeled available groundwater presented here are based on the results reported as "managed available groundwater" in GAM Run 08-84mag (Wade, 2009) for all areas except Comanche and Erath counties. See GAM Run 08-84mag for a full description of the methods and assumptions associated with the model simulation. Because GAM Run 08-84mag presented constant pumping from 2000 to 2050, it was assumed for the purposes of this analysis that pumping from 2051 to 2060 was also constant at the same level. As summarized in Table 1, desired future conditions were defined by the groundwater conservation districts in Groundwater Management Area 8 for 2050. It is expected that pumping from 2051 to 2060 would cause additional

drawdown, but this analysis does not estimate drawdown in 2060. Pumping estimates for 2060 were important to include for purposes of regional water planning.

- 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. The last three years of the simulation drought-of-record recharge conditions were assumed, which were defined as the years 1954 to 1956.

- Groundwater conservation district boundaries were updated since the release of GAM Run 08-84mag. The results presented here correspond to the official district boundaries as of the date of this report.

Water Budget Approach for Comanche and Erath Counties

- The modeled available groundwater presented for Comanche and Erath counties is based on Aquifer Assessment 09-07 (Bradley, 2010). See Aquifer Assessment 09-07 for a full description of the methods and assumptions associated with the water budget calculations.

- The Hensell and Hosston members were grouped as the Twin Mountains Formation in Aquifer Assessment 09-07. To be consistent with the desired future conditions, however, it was necessary to split the pumping in Aquifer Assessment 09-07 into the Hensell and Hosston members. In Comanche County, 10 percent of the pumping in the Twin Mountains Formation was assigned to the Hensell member while 90 percent was assigned to the Hosston. In Erath County, 35 percent of the pumping in Aquifer Assessment 09-07 was assigned to the Hensell with the remaining 65 percent assigned to the Hosston. These percentages were developed after a preliminary review of available pumping information and discussion with Joe Cooper of Middle Trinity Groundwater Conservation District.

RESULTS:

The modeled available groundwater for the Trinity Aquifer in Groundwater Management Area 8 as a result of the desired future conditions is approximately 261,000 acre-feet per year between 2010 and 2060. This pumping has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2). These areas are shown in Figure 2.

Since the desired future conditions are specified for individual units of the Trinity Aquifer (Paluxy, Glen Rose, Hensell, and Hosston) based on the layering used in the model, the modeled available groundwater is shown for each unit in the subsequent tables. Tables 3, 4, 5, and 6 show the modeled available groundwater summarized by county in the Paluxy, Glen Rose, Hensell, and Hosston units of the Trinity Aquifer, respectively. Tables 7, 8, 9, and 10 show the modeled available groundwater summarized by regional water planning area for the same units, respectively. Tables 11, 12, 13, and 14 show the modeled available groundwater summarized by river basin for each of the above units, respectively. The modeled available groundwater summarized by groundwater conservation district is shown for the Paluxy, Glen Rose, Hensell, and Hosston units in tables 15, 16, 17, and 18, respectively. Notice that the pumping is totaled both excluding and including areas outside of a groundwater conservation district.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. 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 develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition(s).

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount

of groundwater that can be pumped to meet the adopted desired future condition. 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 future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

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.

Bradley, R.G., 2010, GTA Aquifer Assessment 09-07: Texas Water Development Board, GTA Aquifer Assessment 09-07 Report, 19 p.

National Research Council, 2007, Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.

Texas Water Development Board, 2007, Water for Texas – 2007—Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

Wade, S., 2009, GAM Run 08-84mag, Texas Water Development Board GAM Run 08-84mag Report, 37 p.

Table 1. Desired future conditions (in feet of drawdown) for each unit of the Trinity Aquifer adopted by members of Groundwater Management Area 8.

County	Average water level decrease (feet)			
	Paluxy	Glen Rose	Hensell	Hosston
Bell	134	155	286	319
Bosque	26	33	201	220
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
Grayson	175	161	160	165
Hamilton	0	2	39	51
Hill	209	253	381	406
Hood	1	2	16	56
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

Table 2. Modeled available groundwater in acre-feet for the Trinity Aquifer in Groundwater Management Area 8 by county, regional water planning area, and river basin.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Bell	G	Brazos	7,068	7,068	7,068	7,068	7,068	7,068
Bosque	G	Brazos	5,849	5,849	5,849	5,849	5,849	5,849
Brown	F	Brazos	28	28	28	28	28	28
		Colorado	2,017	2,017	2,017	2,017	2,017	2,017
Burnet	K	Brazos	2,723	2,723	2,723	2,723	2,723	2,723
		Colorado	823	823	823	823	823	823
Callahan	G	Brazos	1,792	1,792	1,792	1,792	1,792	1,792
		Colorado	1,985	1,985	1,985	1,985	1,985	1,985
Collin	C	Sabine	0	0	0	0	0	0
		Trinity	2,104	2,104	2,104	2,104	2,104	2,104
Comanche	G	Brazos	32,115	32,115	32,115	32,115	32,115	32,115
		Colorado	120	120	120	120	120	120
Cooke	C	Red	1,284	1,284	1,284	1,284	1,284	1,284
		Trinity	5,566	5,566	5,566	5,566	5,566	5,566
Coryell	G	Brazos	3,716	3,716	3,716	3,716	3,716	3,716
Dallas	C	Trinity	5,458	5,458	5,458	5,458	5,458	5,458
Delta	D	Sulphur	362	362	362	362	362	362
Denton	C	Trinity	19,333	19,333	19,333	19,333	19,333	19,333
Eastland	G	Brazos	4,489	4,489	4,489	4,489	4,489	4,489
		Colorado	231	231	231	231	231	231
Ellis	C	Trinity	3,959	3,959	3,959	3,959	3,959	3,959
Erath	G	Brazos	32,926	32,926	32,926	32,926	32,926	32,926
Falls	G	Brazos	169	169	169	169	169	169
Fannin	C	Red	617	617	617	617	617	617
		Sulphur	0	0	0	0	0	0
		Trinity	83	83	83	83	83	83
Franklin	D	Sulphur	0	0	0	0	0	0
Grayson	C	Red	7,722	7,722	7,722	7,722	7,722	7,722
		Trinity	1,678	1,678	1,678	1,678	1,678	1,678
Hamilton	G	Brazos	2,144	2,144	2,144	2,144	2,144	2,144
Hill	G	Brazos	3,086	3,086	3,086	3,086	3,086	3,086
		Trinity	61	61	61	61	61	61
Hood	G	Brazos	11,081	11,081	11,081	11,081	11,081	11,081
		Trinity	64	64	64	64	64	64
Hunt	D	Sabine	0	0	0	0	0	0
		Sulphur	0	0	0	0	0	0
		Trinity	551	551	551	551	551	551
Johnson	G	Brazos	4,940	4,940	4,940	4,940	4,940	4,940
		Trinity	7,931	7,931	7,931	7,931	7,931	7,931
Kaufman	C	Sabine	45	45	45	45	45	45
		Trinity	1,136	1,136	1,136	1,136	1,136	1,136

Table 2. Continued.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Lamar	D	Red	1,320	1,320	1,320	1,320	1,320	1,320
		Sulphur	2	2	2	2	2	2
Lampasas	G	Brazos	2,925	2,925	2,925	2,925	2,925	2,925
		Colorado	192	192	192	192	192	192
Limestone	G	Brazos	69	69	69	69	69	69
		Trinity	0	0	0	0	0	0
McLennan	G	Brazos	20,690	20,690	20,690	20,690	20,690	20,690
Milam	G	Brazos	288	288	288	288	288	288
Mills	K	Brazos	1,273	1,273	1,273	1,273	1,273	1,273
		Colorado	1,128	1,128	1,128	1,128	1,128	1,128
Montague	B	Brazos	0	0	0	0	0	0
		Red	129	129	129	129	129	129
		Trinity	2,545	2,545	2,545	2,545	2,545	2,545
Navarro	C	Trinity	1,873	1,873	1,873	1,873	1,873	1,873
Parker	C	Brazos	2,799	2,799	2,799	2,799	2,799	2,799
		Trinity	12,449	12,449	12,449	12,449	12,449	12,449
Red River	D	Red	263	263	263	263	263	263
		Sulphur	267	267	267	267	267	267
Rockwall	C	Sabine	0	0	0	0	0	0
		Trinity	958	958	958	958	958	958
Somervell	G	Brazos	2,485	2,485	2,485	2,485	2,485	2,485
Tarrant	C	Trinity	18,747	18,747	18,747	18,747	18,747	18,747
Taylor	G	Brazos	153	153	153	153	153	153
		Colorado	278	278	278	278	278	278
Travis	K	Brazos	8	8	8	8	8	8
		Colorado	3,882	3,882	3,882	3,882	3,882	3,882
Williamson	G	Brazos	1,514	1,514	1,514	1,514	1,514	1,514
		Colorado	68	68	68	68	68	68
	K	Brazos	157	157	157	157	157	157
		Colorado	61	61	61	61	61	61
Wise	C	Trinity	9,282	9,282	9,282	9,282	9,282	9,282
Total			**261,061**	**261,061**	**261,061**	**261,061**	**261,061**	**261,061**

Table 3. Modeled available groundwater for the Paluxy unit of the Trinity Aquifer summarized by county in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Bell	96	96	96	96	96	96
Bosque	1,013	1,013	1,013	1,013	1,013	1,013
Brown	18	18	18	18	18	18
Burnet	182	182	182	182	182	182
Collin	1,762	1,762	1,762	1,762	1,762	1,762
Comanche	2,292	2,292	2,292	2,292	2,292	2,292
Cooke	3,528	3,528	3,528	3,528	3,528	3,528
Coryell	254	254	254	254	254	254
Dallas	433	433	433	433	433	433
Delta	0	0	0	0	0	0
Denton	9,822	9,822	9,822	9,822	9,822	9,822
Eastland	4	4	4	4	4	4
Ellis	400	400	400	400	400	400
Erath	13,614	13,614	13,614	13,614	13,614	13,614
Falls	0	0	0	0	0	0
Fannin	288	288	288	288	288	288
Grayson	4,708	4,708	4,708	4,708	4,708	4,708
Hamilton	291	291	291	291	291	291
Hill	1,254	1,254	1,254	1,254	1,254	1,254
Hood	942	942	942	942	942	942
Hunt	551	551	551	551	551	551
Johnson	9,493	9,493	9,493	9,493	9,493	9,493
Kaufman	102	102	102	102	102	102
Lamar	0	0	0	0	0	0
Lampasas	13	13	13	13	13	13
Limestone	0	0	0	0	0	0
McLennan	231	231	231	231	231	231
Milam	0	0	0	0	0	0
Mills	5	5	5	5	5	5
Montague	505	505	505	505	505	505
Navarro	413	413	413	413	413	413
Parker	9,800	9,800	9,800	9,800	9,800	9,800
Red River	473	473	473	473	473	473
Rockwall	958	958	958	958	958	958
Somervell	120	120	120	120	120	120
Tarrant	10,544	10,544	10,544	10,544	10,544	10,544
Travis	3	3	3	3	3	3
Williamson	11	11	11	11	11	11
Wise	2,559	2,559	2,559	2,559	2,559	2,559
Total	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**

Table 4. Modeled available groundwater for the Glen Rose unit of the Trinity Aquifer summarized by county in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bell	880	880	880	880	880	880
Bosque	258	258	258	258	258	258
Brown	0	0	0	0	0	0
Burnet	205	205	205	205	205	205
Collin	0	0	0	0	0	0
Comanche	0	0	0	0	0	0
Cooke	0	0	0	0	0	0
Coryell	784	784	784	784	784	784
Dallas	0	0	0	0	0	0
Delta	0	0	0	0	0	0
Denton	0	0	0	0	0	0
Eastland	0	0	0	0	0	0
Ellis	0	0	0	0	0	0
Erath	41	41	41	41	41	41
Falls	2	2	2	2	2	2
Fannin	0	0	0	0	0	0
Franklin	0	0	0	0	0	0
Grayson	0	0	0	0	0	0
Hamilton	46	46	46	46	46	46
Hill	10	10	10	10	10	10
Hood	4	4	4	4	4	4
Hunt	0	0	0	0	0	0
Johnson	24	24	24	24	24	24
Kaufman	0	0	0	0	0	0
Lamar	0	0	0	0	0	0
Lampasas	773	773	773	773	773	773
Limestone	4	4	4	4	4	4
McLennan	265	265	265	265	265	265
Milam	149	149	149	149	149	149
Mills	66	66	66	66	66	66
Montague	0	0	0	0	0	0
Navarro	0	0	0	0	0	0
Parker	192	192	192	192	192	192
Red River	0	0	0	0	0	0
Rockwall	0	0	0	0	0	0
Somervell	134	134	134	134	134	134
Tarrant	112	112	112	112	112	112
Travis	2,612	2,612	2,612	2,612	2,612	2,612
Williamson	760	760	760	760	760	760
Wise	5	5	5	5	5	5
Total	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**

Table 5. Modeled available groundwater for the Hensell unit of the Trinity Aquifer summarized by county in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bell	1,099	1,099	1,099	1,099	1,099	1,099
Bosque	1,749	1,749	1,749	1,749	1,749	1,749
Brown	79	79	79	79	79	79
Burnet	690	690	690	690	690	690
Callahan	123	123	123	123	123	123
Collin	103	103	103	103	103	103
Comanche	2,995	2,995	2,995	2,995	2,995	2,995
Cooke	1,611	1,611	1,611	1,611	1,611	1,611
Coryell	1,765	1,765	1,765	1,765	1,765	1,765
Dallas	1,121	1,121	1,121	1,121	1,121	1,121
Delta	181	181	181	181	181	181
Denton	3,112	3,112	3,112	3,112	3,112	3,112
Eastland	79	79	79	79	79	79
Ellis	1,142	1,142	1,142	1,142	1,142	1,142
Erath	6,745	6,745	6,745	6,745	6,745	6,745
Falls	22	22	22	22	22	22
Fannin	203	203	203	203	203	203
Grayson	2,345	2,345	2,345	2,345	2,345	2,345
Hamilton	1,109	1,109	1,109	1,109	1,109	1,109
Hill	933	933	933	933	933	933
Hood	3,595	3,595	3,595	3,595	3,595	3,595
Hunt	0	0	0	0	0	0
Johnson	1,065	1,065	1,065	1,065	1,065	1,065
Kaufman	240	240	240	240	240	240
Lamar	661	661	661	661	661	661
Lampasas	885	885	885	885	885	885
Limestone	15	15	15	15	15	15
McLennan	4,190	4,190	4,190	4,190	4,190	4,190
Milam	36	36	36	36	36	36
Mills	946	946	946	946	946	946
Montague	362	362	362	362	362	362
Navarro	256	256	256	256	256	256
Parker	1,441	1,441	1,441	1,441	1,441	1,441
Red River	19	19	19	19	19	19
Rockwall	0	0	0	0	0	0
Somervell	741	741	741	741	741	741
Tarrant	2,535	2,535	2,535	2,535	2,535	2,535
Travis	156	156	156	156	156	156
Williamson	415	415	415	415	415	415
Wise	1,480	1,480	1,480	1,480	1,480	1,480
Total	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**

Table 6. Modeled available groundwater for the Hosston unit of the Trinity Aquifer summarized by county in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Bell	4,993	4,993	4,993	4,993	4,993	4,993
Bosque	2,829	2,829	2,829	2,829	2,829	2,829
Brown	1,948	1,948	1,948	1,948	1,948	1,948
Burnet	2,469	2,469	2,469	2,469	2,469	2,469
Callahan	3,654	3,654	3,654	3,654	3,654	3,654
Collin	239	239	239	239	239	239
Comanche	26,948	26,948	26,948	26,948	26,948	26,948
Cooke	1,711	1,711	1,711	1,711	1,711	1,711
Coryell	913	913	913	913	913	913
Dallas	3,904	3,904	3,904	3,904	3,904	3,904
Delta	181	181	181	181	181	181
Denton	6,399	6,399	6,399	6,399	6,399	6,399
Eastland	4,637	4,637	4,637	4,637	4,637	4,637
Ellis	2,417	2,417	2,417	2,417	2,417	2,417
Erath	12,526	12,526	12,526	12,526	12,526	12,526
Falls	145	145	145	145	145	145
Fannin	209	209	209	209	209	209
Franklin	0	0	0	0	0	0
Grayson	2,347	2,347	2,347	2,347	2,347	2,347
Hamilton	698	698	698	698	698	698
Hill	950	950	950	950	950	950
Hood	6,604	6,604	6,604	6,604	6,604	6,604
Hunt	0	0	0	0	0	0
Johnson	2,289	2,289	2,289	2,289	2,289	2,289
Kaufman	839	839	839	839	839	839
Lamar	661	661	661	661	661	661
Lampasas	1,446	1,446	1,446	1,446	1,446	1,446
Limestone	50	50	50	50	50	50
McLennan	16,004	16,004	16,004	16,004	16,004	16,004
Milam	103	103	103	103	103	103
Mills	1,384	1,384	1,384	1,384	1,384	1,384
Montague	1,807	1,807	1,807	1,807	1,807	1,807
Navarro	1,204	1,204	1,204	1,204	1,204	1,204
Parker	3,815	3,815	3,815	3,815	3,815	3,815
Red River	38	38	38	38	38	38
Rockwall	0	0	0	0	0	0
Somervell	1,490	1,490	1,490	1,490	1,490	1,490
Tarrant	5,556	5,556	5,556	5,556	5,556	5,556
Taylor	431	431	431	431	431	431
Travis	1,119	1,119	1,119	1,119	1,119	1,119
Williamson	614	614	614	614	614	614
Wise	5,238	5,238	5,238	5,238	5,238	5,238
Total	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**

Table 7. Modeled available groundwater for the Paluxy unit of the Trinity Aquifer summarized by regional water planning area in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
B	505	505	505	505	505	505
C	45,317	45,317	45,317	45,317	45,317	45,317
D	1,024	1,024	1,024	1,024	1,024	1,024
F	18	18	18	18	18	18
G	29,628	29,628	29,628	29,628	29,628	29,628
K	190	190	190	190	190	190
Total	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**

Table 8. Modeled available groundwater for the Glen Rose unit of the Trinity Aquifer summarized by regional water planning area in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
B	0	0	0	0	0	0
C	309	309	309	309	309	309
D	0	0	0	0	0	0
F	0	0	0	0	0	0
G	4,016	4,016	4,016	4,016	4,016	4,016
K	3,001	3,001	3,001	3,001	3,001	3,001
Total	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**

Table 9. Modeled available groundwater for the Hensell unit of the Trinity Aquifer summarized by regional water planning area in Groundwater Management Area 12 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
B	362	362	362	362	362	362
C	15,589	15,589	15,589	15,589	15,589	15,589
D	861	861	861	861	861	861
F	79	79	79	79	79	79
G	27,514	27,514	27,514	27,514	27,514	27,514
K	1,839	1,839	1,839	1,839	1,839	1,839
Total	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**

Table 10. Modeled available groundwater for the Hosston unit of the Trinity Aquifer summarized by regional water planning area in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
B	1,807	1,807	1,807	1,807	1,807	1,807
C	33,878	33,878	33,878	33,878	33,878	33,878
D	880	880	880	880	880	880
F	1,948	1,948	1,948	1,948	1,948	1,948
G	87,271	87,271	87,271	87,271	87,271	87,271
K	5,025	5,025	5,025	5,025	5,025	5,025
Total	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**

Table 11. Modeled available groundwater for the Paluxy unit of the Trinity Aquifer summarized by river basin in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	23,223	23,223	23,223	23,223	23,223	23,223
Colorado	193	193	193	193	193	193
Red	4,943	4,943	4,943	4,943	4,943	4,943
Sabine	4	4	4	4	4	4
Sulphur	267	267	267	267	267	267
Trinity	48,052	48,052	48,052	48,052	48,052	48,052
Total	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**

Table 12. Modeled available groundwater for the Glen Rose unit of the Trinity Aquifer summarized by river basin in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	4,263	4,263	4,263	4,263	4,263	4,263
Colorado	2,753	2,753	2,753	2,753	2,753	2,753
Red	0	0	0	0	0	0
Sabine	0	0	0	0	0	0
Sulphur	0	0	0	0	0	0
Trinity	310	310	310	310	310	310
Total	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**

Table 13. Modeled available groundwater for the Hensell unit of the Trinity Aquifer summarized by river basin in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	29,030	29,030	29,030	29,030	29,030	29,030
Colorado	585	585	585	585	585	585
Red	3,129	3,129	3,129	3,129	3,129	3,129
Sabine	9	9	9	9	9	9
Sulphur	182	182	182	182	182	182
Trinity	13,309	13,309	13,309	13,309	13,309	13,309
Total	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**

Table 14. Modeled available groundwater for the Hosston unit of the Trinity Aquifer summarized by river basin in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	87,971	87,971	87,971	87,971	87,971	87,971
Colorado	7,254	7,254	7,254	7,254	7,254	7,254
Red	3,263	3,263	3,263	3,263	3,263	3,263
Sabine	32	32	32	32	32	32
Sulphur	182	182	182	182	182	182
Trinity	32,107	32,107	32,107	32,107	32,107	32,107
Total	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**

Table 15. Modeled available groundwater for the Paluxy unit of the Trinity Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District. WD refers to Water District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Central Texas GCD	182	182	182	182	182	182
Clearwater UWCD	96	96	96	96	96	96
Fox Crossing WD	5	5	5	5	5	5
Middle Trinity GCD	17,173	17,173	17,173	17,173	17,173	17,173
North Texas GCD	15,112	15,112	15,112	15,112	15,112	15,112
Northern Trinity GCD	10,544	10,544	10,544	10,544	10,544	10,544
Post Oak Savannah GCD	0	0	0	0	0	0
Prairielands GCD	11,267	11,267	11,267	11,267	11,267	11,267
Red River GCD	4,996	4,996	4,996	4,996	4,996	4,996
Saratoga UWCD	13	13	13	13	13	13
Southern Trinity GCD	231	231	231	231	231	231
Upper Trinity GCD	13,806	13,806	13,806	13,806	13,806	13,806
Total (excluding non-district areas)	**73,425**	**73,425**	**73,425**	**73,425**	**73,425**	**73,425**
No District	3,257	3,257	3,257	3,257	3,257	3,257
Total (including non-district areas)	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**	**76,682**

Table 16. Modeled available groundwater for the Glen Rose unit of the Trinity Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District. WD refers to Water District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Central Texas GCD	205	205	205	205	205	205
Clearwater UWCD	880	880	880	880	880	880
Fox Crossing WD	66	66	66	66	66	66
Middle Trinity GCD	1,083	1,083	1,083	1,083	1,083	1,083
North Texas GCD	0	0	0	0	0	0
Northern Trinity GCD	112	112	112	112	112	112
Post Oak Savannah GCD	149	149	149	149	149	149
Prairielands GCD	168	168	168	168	168	168
Red River GCD	0	0	0	0	0	0
Saratoga UWCD	773	773	773	773	773	773
Southern Trinity GCD	265	265	265	265	265	265
Upper Trinity GCD	201	201	201	201	201	201
Total (excluding non-district areas)	**3,902**	**3,902**	**3,902**	**3,902**	**3,902**	**3,902**
No District	3,424	3,424	3,424	3,424	3,424	3,424
Total (including non-district areas)	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**	**7,326**

Table 17. Modeled available groundwater for the Hensell unit of the Trinity Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District. WD refers to Water District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Central Texas GCD	690	690	690	690	690	690
Clearwater UWCD	1,099	1,099	1,099	1,099	1,099	1,099
Fox Crossing WD	946	946	946	946	946	946
Middle Trinity GCD	13,254	13,254	13,254	13,254	13,254	13,254
North Texas GCD	4,826	4,826	4,826	4,826	4,826	4,826
Northern Trinity GCD	2,535	2,535	2,535	2,535	2,535	2,535
Post Oak Savannah GCD	36	36	36	36	36	36
Prairielands GCD	3,881	3,881	3,881	3,881	3,881	3,881
Red River GCD	2,548	2,548	2,548	2,548	2,548	2,548
Saratoga UWCD	885	885	885	885	885	885
Southern Trinity GCD	4,190	4,190	4,190	4,190	4,190	4,190
Upper Trinity GCD	6,878	6,878	6,878	6,878	6,878	6,878
Total (excluding non-district areas)	**41,768**	**41,768**	**41,768**	**41,768**	**41,768**	**41,768**
No District	4,476	4,476	4,476	4,476	4,476	4,476
Total (including non-district areas)	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**	**46,244**

Table 18. Modeled available groundwater for the Hosston unit of the Trinity Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 8 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District. WD refers to Water District.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Central Texas GCD	2,469	2,469	2,469	2,469	2,469	2,469
Clearwater UWCD	4,993	4,993	4,993	4,993	4,993	4,993
Fox Crossing WD	1,384	1,384	1,384	1,384	1,384	1,384
Middle Trinity GCD	43,216	43,216	43,216	43,216	43,216	43,216
North Texas GCD	8,349	8,349	8,349	8,349	8,349	8,349
Northern Trinity GCD	5,556	5,556	5,556	5,556	5,556	5,556
Post Oak Savannah GCD	103	103	103	103	103	103
Prairielands GCD	7,146	7,146	7,146	7,146	7,146	7,146
Red River GCD	2,556	2,556	2,556	2,556	2,556	2,556
Saratoga UWCD	1,446	1,446	1,446	1,446	1,446	1,446
Southern Trinity GCD	16,004	16,004	16,004	16,004	16,004	16,004
Upper Trinity GCD	17,464	17,464	17,464	17,464	17,464	17,464
Total (excluding non-district areas)	**110,686**	**110,686**	**110,686**	**110,686**	**110,686**	**110,686**
No District	20,123	20,123	20,123	20,123	20,123	20,123
Total (including non-district areas)	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**	**130,809**

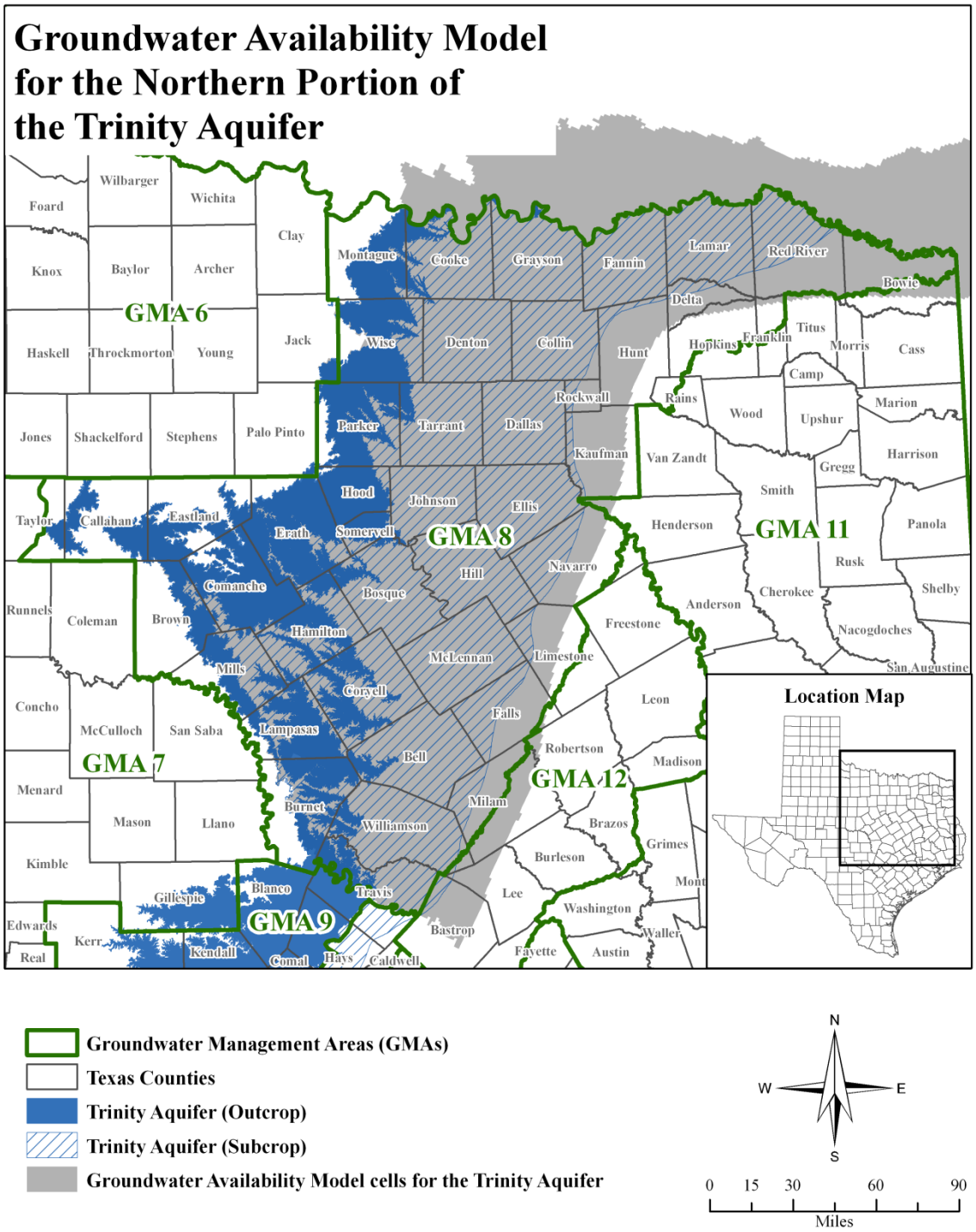

Figure 1. Map showing the areas of the groundwater availability model representing the northern portion of the Trinity Aquifer and the boundary of Groundwater Management Area 8.

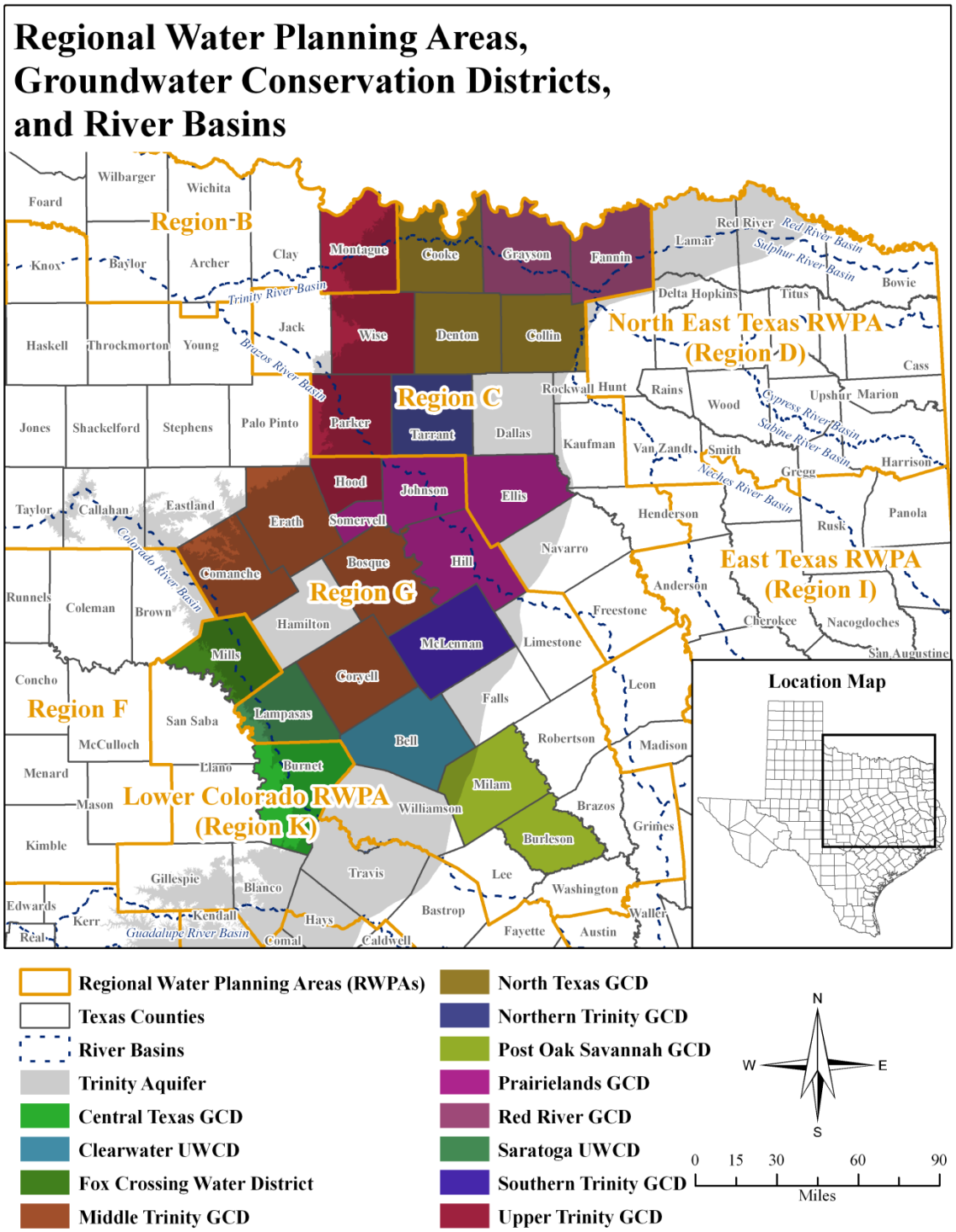

Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in and neighboring Groundwater Management Area 8.