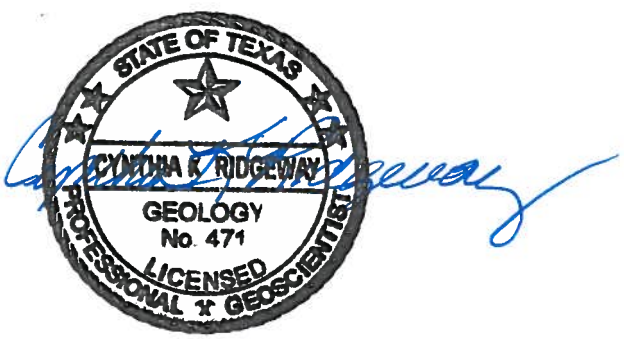
GAM Run 10-058 MAG: Modeled Available Groundwater for the Seymour Aquifer in Groundwater Management Area 6

by Wade Oliver
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-3132
December 7, 2011



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 7, 2011.

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EXECUTIVE SUMMARY:

The modeled available groundwater for the Seymour Aquifer as a result of the desired future conditions adopted by the members of Groundwater Management Area 6 declines from approximately 174,000 acre-feet per year to 148,000 acre-feet per year between 2010 and 2060. This is shown divided by county, river basin, and regional water planning area in Table 1 for use in the regional water planning process. Modeled available groundwater is summarized by county, regional water planning area, river basin, geographic area, and groundwater conservation district in tables 2 through 6. The estimates were taken from Scenario 9 of Groundwater Availability Modeling Task 11-006, which meets each of the desired future conditions adopted by the groundwater conservation districts within Groundwater Management Area 6.

REQUESTOR:

Mr. Mike McGuire of Rolling Plains Groundwater Conservation District on behalf of Groundwater Management Area 6

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. McGuire provided the Texas Water Development Board (TWDB) with the desired future conditions of the Seymour and Blaine aquifers in Groundwater Management Area 6. After an analysis using the groundwater availability model for the Seymour and Blaine aquifers, TWDB notified Mr. McGuire on January 6, 2011 that some desired future conditions were not compatible with one

another. In a letter dated July 28, 2011, Mr. McGuire provided the TWDB with amended desired future conditions for the aquifers based on the modeling analysis documented in Groundwater Availability Modeling (GAM) Task 11-006 (Oliver, 2011). The desired future conditions for the Seymour Aquifer, as described in Resolution 2010-005 and amended in Resolution 2011-002, are described below:

1. *The Desired Future Condition for Pod 1 in Collingsworth and Childress Counties, Pod 2 in Hall County and that part of Pod 3 in Hall County, all located in the Mesquite Groundwater Conservation District, is that condition whereby 50 percent of the current volume in storage will remain in 50 years (2060)*

2. *That part of Pod 1 in Childress County that is located in Gateway Groundwater Conservation District is considered not relevant for planning purposes*

3. *The Desired Future Condition for that part of Pod 3 in Motley County and that part of Pod 4 in Childress, Foard, and Hardeman counties, located in Gateway Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 1 foot over the next 50 years (2060)*

4. *The Desired Future Condition for that part of Pod 4 in Wichita and Wilbarger counties, not located within a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 1 foot over the next 50 years (2060)*

5. *The Desired Future Condition for Pod 5 in Archer, Clay, Wichita and Wilbarger counties, not located within a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 2 feet over the next 50 years (2060)*

6. *The Desired Future Condition for Pod 6, that part of Pod 7 in Baylor, Knox and Haskell Counties, and that part of Pod 8 in Baylor County, located in Rolling Plains Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 18 feet over the next 50 years (2060)*

7. *The Desired Future Condition for that part of Pod 7 in Stonewall County is that condition whereby the total decline in water levels will be no more than 24 feet over the next 50 years (2060)*

8. *The Desired Future Condition for that part of Pod 8 in Throckmorton and Young Counties, none of which are located in a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 3 feet over the next 50 years (2060)*

9. *The Desired Future Condition for Pods 9 and 10 in Kent and Stonewall counties, not located within a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 4 feet over the next 50 years (2060)*

10. *The Desired Future Condition for that part of Pod 11 in Fisher County, located in Clear Fork Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 1 foot over the next 50 years (2060)*

11. *The Desired Future Condition for that part of Pod 11 in Jones and Stonewall Counties, and Pods 12, 13, 14, and 15, located in Jones County, not located within a Groundwater Conservation District, is that condition whereby the total decline in water levels will be no more than 1 foot over the next 50 years (2060)*

In response to receiving the adopted desired future conditions, the TWDB has estimated the modeled available groundwater for the Seymour Aquifer in Groundwater Management Area 6.

METHODS:

The Seymour Aquifer is divided into distinct, isolated areas informally referred to as "pods." The locations of each of the pods in the Seymour Aquifer are shown in Figure 1. The geographic areas referenced in each of the 11 desired future conditions, numbered in the same way as they are above, are shown in Figure 2. Figure 3 shows the location of the aquifer relative to regional water planning areas, river basins, and groundwater conservation districts.

As described above, the TWDB previously completed GAM Task 11-006 using the Groundwater Availability Model for the Seymour and Blaine aquifers to assist the members of Groundwater Management Area 6 in developing desired future conditions (Oliver, 2011). One of the simulations in GAM Task 11-006, Scenario 9, meets each of the desired future conditions for both the Seymour and Blaine aquifers. Because of this, the results of Scenario 9 were used for developing the modeled available groundwater estimates shown in this report.

PARAMETERS AND ASSUMPTIONS:

- We used version 1.01 of the groundwater availability model for the Seymour and Blaine aquifers. See Ewing and others (2004) for assumptions and limitations of the model.
- The results presented here were taken directly from the Scenario 9 groundwater availability model simulation in GAM Task 11-006. See Oliver (2011) for additional details about the methods and assumptions associated with the model run.
- The model includes two layers representing the Seymour Aquifer (Layer 1) and the Blaine Aquifer and other Permian sediments (Layer 2).
- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) for the entire model for the period of 1990 to 1999 is 19.6 feet for the Seymour Aquifer and 26.4 feet for the Blaine Aquifer. This represents one percent and three percent of the range of measured water levels, respectively (Ewing and others, 2004).
- Average annual recharge conditions were assumed in the simulation based on 1975 to 1999 climate data.

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. 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.

RESULTS:

The modeled available groundwater for the Seymour Aquifer in Groundwater Management Area 6 consistent with the desired future conditions declines from approximately 174,000 acre-feet per year to 148,000 acre-feet per year between 2010 and 2060. Table 1 contains the modeled available groundwater subdivided by county, regional water planning area, and river basin for use in the regional water planning process.

Tables 2, 3, 4, 5, and 6 contain the modeled available groundwater summarized by county, regional water planning area, river basin, geographic area, and groundwater conservation district, respectively. In tables 2, 3, 4, and 6, the results have been subdivided by geographic area as well.

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.

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 groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these 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:

Ewing, J.E., Jones, T.L., Pickens, J.F., Chastain-Howley, A., Dean, K.E., Spear, A.A., 2004, Groundwater availability model for the Seymour Aquifer: Final report prepared for the Texas Water Development Board by INTERA, Inc., 533 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.

Oliver, W, 2011, GAM Task 11-006, Texas Water Development Board GAM Task Report, 26 p.

TABLE 1: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER IN GROUNDWATER MANAGEMENT AREA 6. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Archer	B	Red	35	35	35	35	35	35
Baylor	B	Brazos	3,207	3,168	3,168	3,168	3,168	3,168
		Red	681	642	619	619	619	619
Childress	A	Red	716	732	717	712	712	712
Clay	B	Red	787	787	787	787	787	787
Collingsworth	A	Red	17,542	16,010	14,250	13,348	11,329	10,241
Fisher	G	Brazos	2,936	2,935	2,931	2,920	2,915	2,733
Foard	B	Red	4,907	4,906	4,691	4,662	4,662	4,691
Hall	A	Red	12,406	12,020	11,462	10,866	11,085	11,172
Hardeman	B	Red	430	430	430	431	431	431
Haskell	G	Brazos	49,464	46,180	44,575	42,358	42,524	43,617
Jones	G	Brazos	2,918	2,918	2,918	2,918	2,918	2,918
Kent	G	Brazos	1,184	1,181	1,180	1,180	1,179	1,179
Knox	G	Brazos	40,076	37,628	34,244	30,288	28,569	30,979
		Red	2,350	1,591	1,365	1,213	1,136	1,061
Motley	O	Red	1,783	1,776	1,769	1,769	1,685	1,685
Stonewall	G	Brazos	240	233	230	224	215	214
Throckmorton	G	Brazos	115	115	115	115	115	115
Wichita	B	Red	2,240	2,295	2,295	2,288	2,291	2,291
Wilbarger	B	Red	29,263	29,421	29,421	29,421	29,297	28,925
Young	G	Brazos	309	309	258	258	258	258
Total			**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

TABLE 2: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER BY COUNTY AND GEOGRAPHIC AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	*Geographic Area*	*Year*					
		2010	*2020*	*2030*	*2040*	*2050*	*2060*
Archer	5	35	35	35	35	35	35
Baylor	6	3,888	3,810	3,787	3,787	3,787	3,787
Childress	1	68	54	54	33	33	33
	2	164	194	179	179	179	179
	3	484	484	484	500	500	500
Clay	5	787	787	787	787	787	787
Collingsworth	1	17,542	16,010	14,250	13,348	11,329	10,241
Fisher	10	2,936	2,935	2,931	2,920	2,915	2,733
Foard	3	4,907	4,906	4,691	4,662	4,662	4,691
Hall	1	12,406	12,020	11,462	10,866	11,085	11,172
Hardeman	3	430	430	430	431	431	431
Haskell	6	49,464	46,180	44,575	42,358	42,524	43,617
Jones	11	2,918	2,918	2,918	2,918	2,918	2,918
Kent	9	1,184	1,181	1,180	1,180	1,179	1,179
Knox	6	42,426	39,219	35,609	31,501	29,705	32,040
Motley	3	1,783	1,776	1,769	1,769	1,685	1,685
Stonewall	7	203	203	203	203	203	203
	9	37	30	27	21	12	11
Throckmorton	8	115	115	115	115	115	115
Wichita	4	334	334	334	334	337	337
	5	1,906	1,961	1,961	1,954	1,954	1,954
Wilbarger	4	29,263	29,421	29,421	29,421	29,297	28,925
Young	8	309	309	258	258	258	258
Total		**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

TABLE 3: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER BY REGIONAL WATER PLANNING AREA AND GEOGRAPHIC AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Region	*Geographic Area*	*Year*					
		2010	*2020*	*2030*	*2040*	*2050*	*2060*
A	1	30,016	28,084	25,766	24,247	22,447	21,446
	2	164	194	179	179	179	179
	3	484	484	484	500	500	500
B	3	5,337	5,336	5,121	5,093	5,093	5,122
	4	29,597	29,755	29,755	29,755	29,634	29,262
	5	2,728	2,783	2,783	2,776	2,776	2,776
	6	3,888	3,810	3,787	3,787	3,787	3,787
G	6	91,890	85,399	80,184	73,859	72,229	75,657
	7	203	203	203	203	203	203
	8	424	424	373	373	373	373
	9	1,221	1,211	1,207	1,201	1,191	1,190
	10	2,936	2,935	2,931	2,920	2,915	2,733
	11	2,918	2,918	2,918	2,918	2,918	2,918
O	3	1,783	1,776	1,769	1,769	1,685	1,685
Total		**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

TABLE 4: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER BY RIVER BASIN AND GEOGRAPHIC AREA EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Basin	*Geographic Area*	*Year*					
		2010	*2020*	*2030*	*2040*	*2050*	*2060*
Brazos	6	92,747	86,976	81,987	75,814	74,261	77,764
	7	203	203	203	203	203	203
	8	424	424	373	373	373	373
	9	1,221	1,211	1,207	1,201	1,191	1,190
	10	2,936	2,935	2,931	2,920	2,915	2,733
	11	2,918	2,918	2,918	2,918	2,918	2,918
Red	1	30,016	28,084	25,766	24,247	22,447	21,446
	2	164	194	179	179	179	179
	3	7,604	7,596	7,374	7,362	7,278	7,307
	4	29,597	29,755	29,755	29,755	29,634	29,262
	5	2,728	2,783	2,783	2,776	2,776	2,776
	6	3,031	2,233	1,984	1,832	1,755	1,680
Total		**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

TABLE 5: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER BY GEOGRAPHIC AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Geographic Area	*Year*					
	2010	*2020*	*2030*	*2040*	*2050*	*2060*
1	30,016	28,084	25,766	24,247	22,447	21,446
2	164	194	179	179	179	179
3	7,604	7,596	7,374	7,362	7,278	7,307
4	29,597	29,755	29,755	29,755	29,634	29,262
5	2,728	2,783	2,783	2,776	2,776	2,776
6	95,778	89,209	83,971	77,646	76,016	79,444
7	203	203	203	203	203	203
8	424	424	373	373	373	373
9	1,221	1,211	1,207	1,201	1,191	1,190
10	2,936	2,935	2,931	2,920	2,915	2,733
11	2,918	2,918	2,918	2,918	2,918	2,918
Total	**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

TABLE 6: MODELED AVAILABLE GROUNDWATER FOR THE SEYMOUR AQUIFER BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND GEOGRAPHIC AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

District	Geographic Area	Year					
		2010	2020	2030	2040	2050	2060
Clear Fork GCD	10	2,936	2,935	2,931	2,920	2,915	2,733
Gateway GCD	2	164	194	179	179	179	179
	3	7,604	7,596	7,374	7,362	7,278	7,307
Mesquite GCD	1	30,016	28,084	25,766	24,247	22,447	21,446
Rolling Plains GCD	6	95,778	89,209	83,971	77,646	76,016	79,444
No District	4	29,597	29,755	29,755	29,755	29,634	29,262
	5	2,728	2,783	2,783	2,776	2,776	2,776
	7	203	203	203	203	203	203
	8	424	424	373	373	373	373
	9	1,221	1,211	1,207	1,201	1,191	1,190
	11	2,918	2,918	2,918	2,918	2,918	2,918
Total		**173,589**	**165,312**	**157,460**	**149,580**	**145,930**	**147,831**

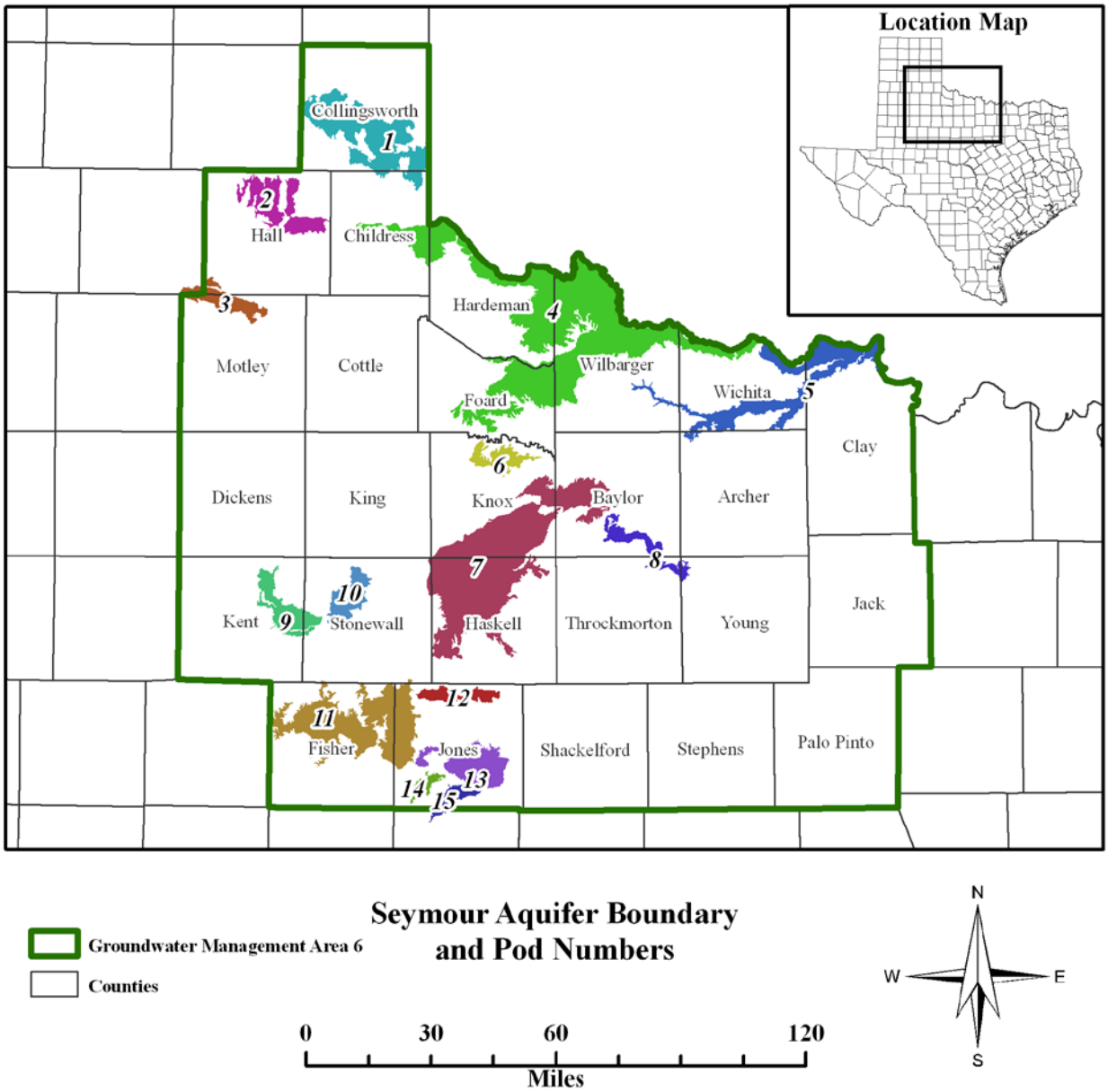

FIGURE 1: MAP SHOWING THE PODS MAKING UP THE SEYMOUR AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 6.

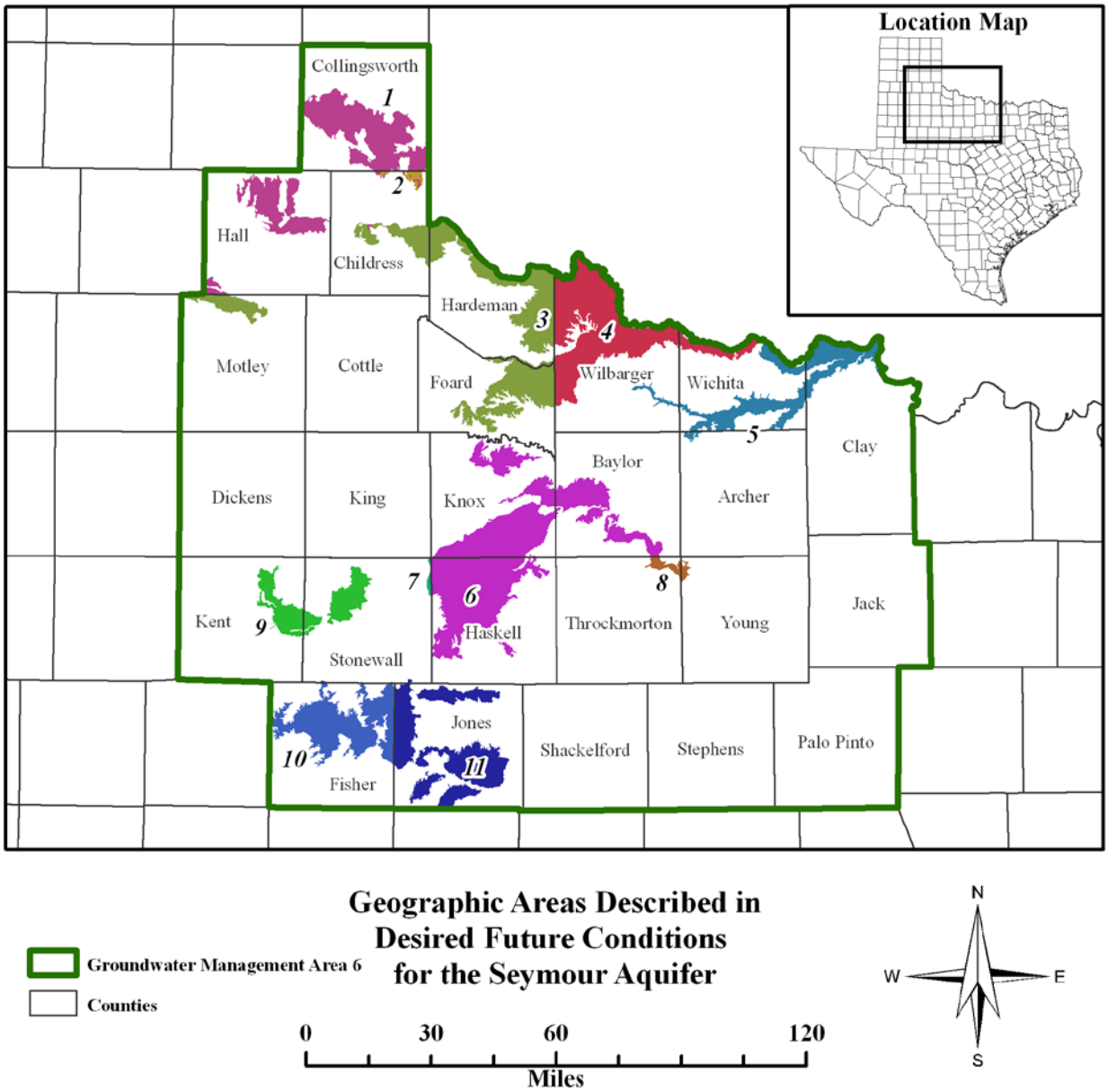

FIGURE 2: MAP SHOWING THE GEOGRAPHIC AREAS DESCRIBED IN THE DESIRED FUTURE CONDITIONS FOR THE SEYMOUR AQUFIER WITHIN GROUNDWATER MANAGEMENT AREA 6.

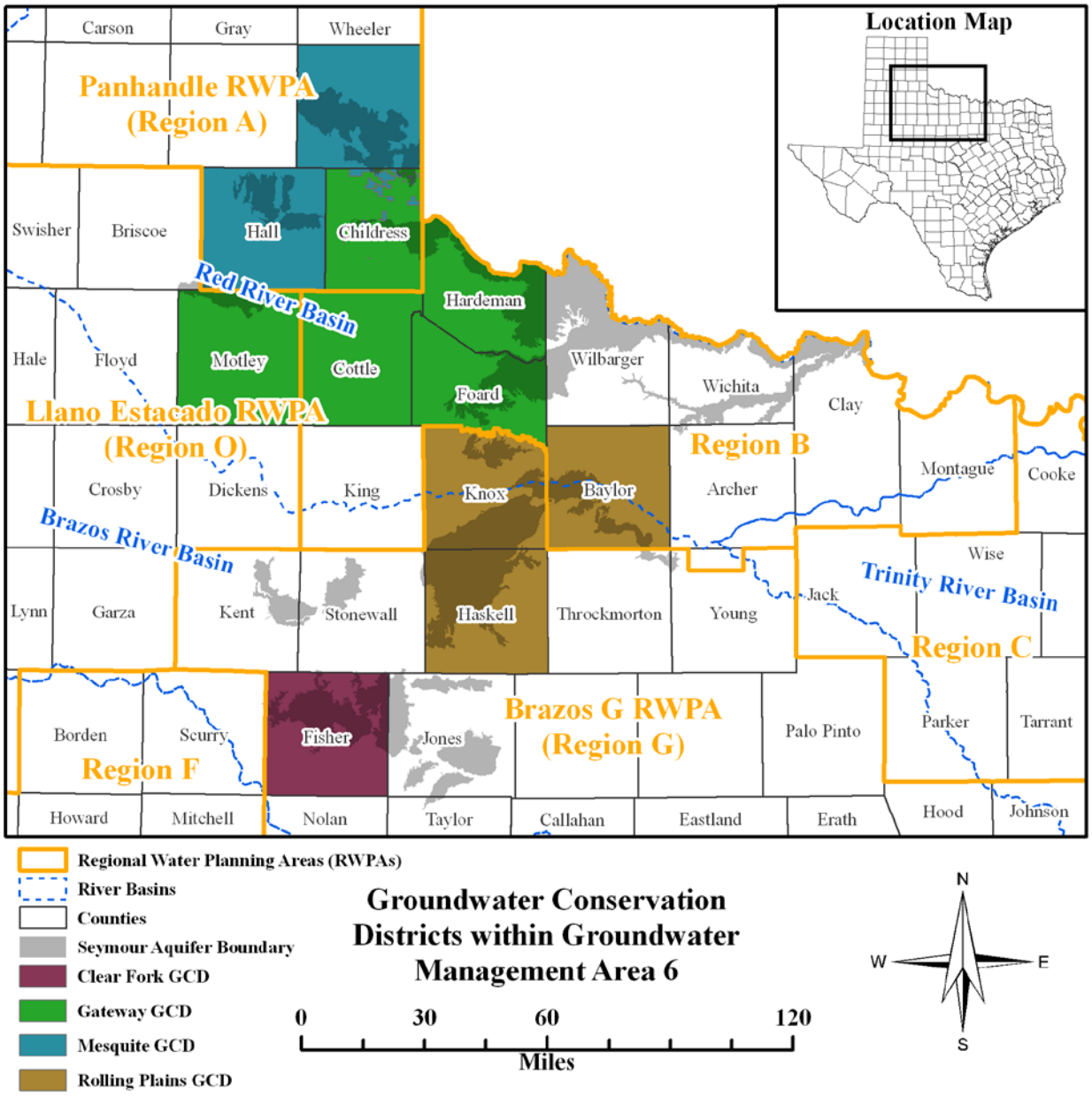

FIGURE 3: MAP SHOWING GROUNDWATER CONSERVATION DISTRICTS, REGIONAL WATER PLANNING AREAS, COUNTIES, AND RIVER BASINS IN AND NEIGHBORING GROUNDWATER MANAGEMENT AREA 6.