GAM Run 11-006

by Mr. Wade Oliver

Texas Water Development Board
Groundwater Availability Modeling Section
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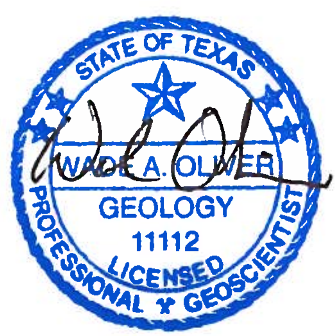

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EXECUTIVE SUMMARY:

This report describes the methods and results for a 50-year predictive simulation using the groundwater availability model for the northern portion of the Trinity Aquifer. This simulation was performed at the request of Clearwater Underground Water Conservation District in order to estimate the amount of pumping that meets the desired future conditions for the district while accounting for the pumping in Scenario 4 of GAM Run 11-005 in neighboring Central Texas Groundwater Conservation District. The pumping that achieves the desired future conditions of 134 feet, 155 feet, 286 feet, and 319 feet of drawdown in the Paluxy, Glen Rose, Hensell and Hosston units of the Trinity Aquifer is approximately 6,160 acre-feet per year.

REQUESTOR:

Ms. Cheryl Maxwell on behalf of Clearwater Underground Water Conservation District

DESCRIPTION OF REQUEST:

Ms. Maxwell requested that the Texas Water Development Board (TWDB) estimate the pumping in Clearwater Underground Water Conservation District (that is, Bell County) that meets the current desired future conditions of 134 feet, 155 feet, 286 feet, and 319 feet of drawdown for the Paluxy, Glen Rose, Hensell and Hosston units of the Trinity Aquifer, respectively. Ms. Maxwell requested that pumping outside of the district be set to the levels in Scenario 4 of Groundwater Availability Model (GAM) Run 11-005 (Oliver, 2011). The request was in response to the analysis in GAM Run 11-005 which showed that increased pumping in neighboring Central Texas Groundwater Conservation District (Burnet County) resulted in drawdowns greater than the currently adopted desired future conditions in Clearwater Underground Water Conservation District.

METHODS:

In order to estimate the pumping in Clearwater Underground Water Conservation District necessary to achieve the current desired future conditions in light of a potential increase in pumping in the neighboring Central Texas Groundwater Conservation District (Burnet County), the groundwater availability model for the northern portion of the Trinity Aquifer was used. The locations of the Trinity Aquifer and groundwater conservation districts within Groundwater Management Area 8 are shown in Figure 1.

The base pumping distribution used in the simulation was the same distribution shown as Scenario 4 in GAM Run 11-005. The amount of pumping assigned to each of the units of the Trinity Aquifer in the district was adjusted iteratively until the desired future conditions were achieved. When increasing the pumping in the district, the amount of the increase in pumping was spread evenly among all cells in the layer in the district that contained pumping in the base distribution. When decreasing the pumping in a layer in the district, the pumping in each cell was reduced by a uniform factor relative to the base distribution.

PARAMETERS AND ASSUMPTIONS:

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

- 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:

Table 1 below shows the results of the simulation described above. The results include the pumping output from the groundwater availability model by year and the average drawdown for each unit of the Trinity Aquifer in the district over the 50-year simulation. When pumping outside of Clearwater Underground Water Conservation District is held at the levels in Scenario 4 of GAM Run 11-005, pumping of approximately 6,160 acre-feet per year within the district achieves the desired future conditions within Bell County.

Notice in Table 1 that the pumping output from the model decreases slightly 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 cells drops below the base of the aquifer. In this situation, pumping can no longer occur.

Since changes in pumping within one district can affect the water levels in nearby districts, the drawdowns in each county in Groundwater Management Area 8 for the simulation are included as an appendix.

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objective. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to future pumping, 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 the impacts of future pumping 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 impacts of that pumping.

In addition, certain assumptions have been made regarding future precipitation, recharge, and stream flow in evaluating the impacts of future pumping. Those assumptions also need to be considered and compared to actual future data.

Given these limitations, users of this information are cautioned that the results should not be considered a definitive, permanent prediction of the changes in groundwater storage. 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 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.

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.

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, Draft GAM Run 11-005, Texas Water Development Board GAM Run 11-005 Draft Report, 17 p.

Table 1. Pumping and average drawdown for each unit of the Trinity Aquifer in Clearwater Underground Water Conservation District (Bell County).

		Paluxy	Glen Rose	Hensell	Hosston	Total
Pumping (acre-feet per year)	**Year 1**	122	925	830	4,300	6,177
	Year 10	105	925	830	4,300	6,160
	Year 20	105	925	830	4,300	6,160
	Year 30	105	925	830	4,300	6,160
	Year 40	105	925	830	4,300	6,160
	Year 50	105	925	830	4,300	6,160
Average Drawdown (feet)		134	155	286	319	225

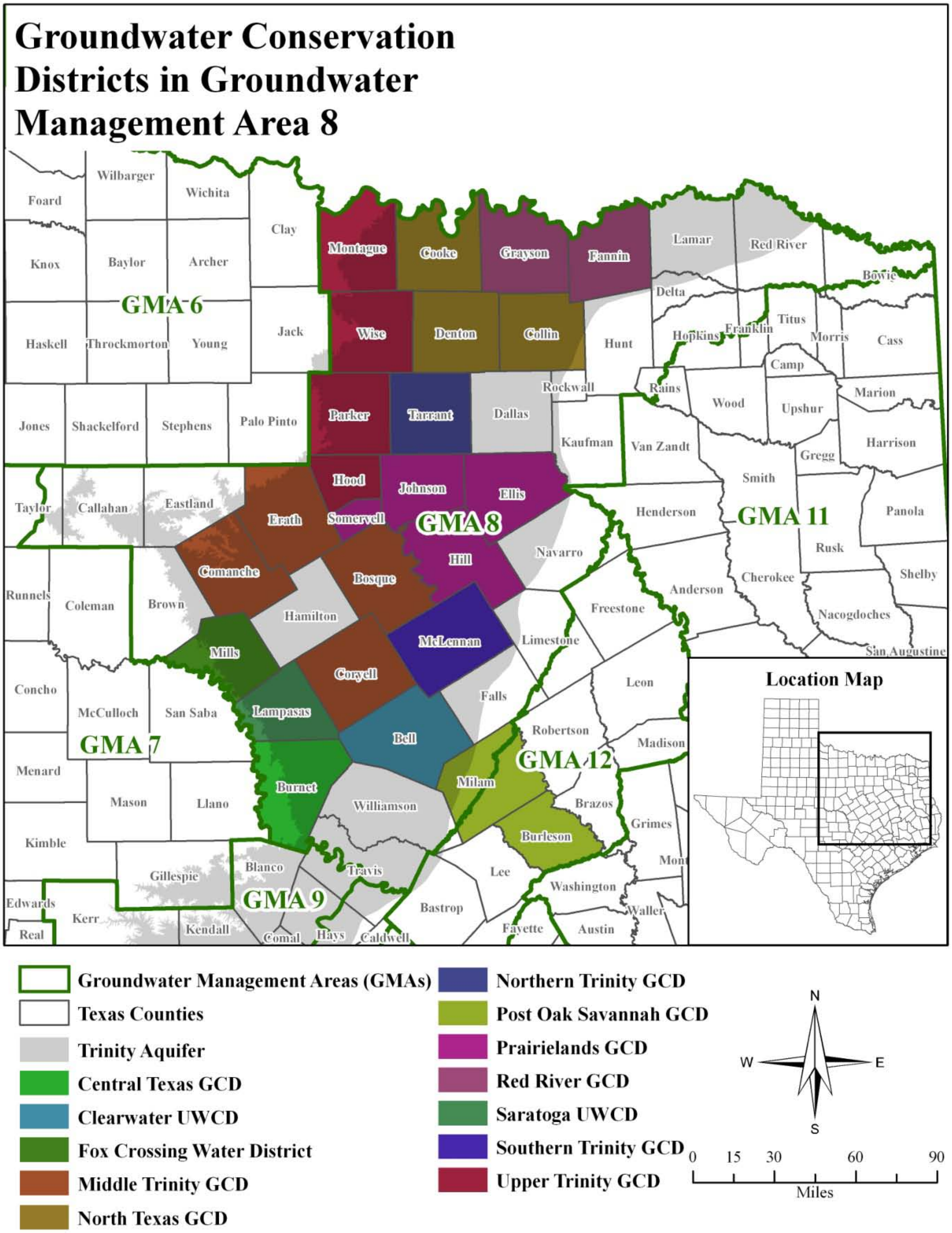

Figure 1. Counties and groundwater conservation districts (GCDs) within Groundwater Management Area 8. UWCD refers to Underground Water Conservation District.

Appendix

Average drawdown in the Trinity Aquifer by county

Table A-1. Average drawdown for each unit of the Trinity Aquifer in feet by county.

County	Layer 3 (Paluxy)	Layer 4 (Glen Rose)	Layer 5 (Hensell)	Layer 7 (Hosston)	Trinity Average
Bell	134	155	286	319	225
Bosque	26	33	200	219	120
Bowie	44	41	44	45	44
Brown	0	0	1	1	1
Burnet	3	3	21	68	28
Callahan	-	-	0	2	2
Collin	298	247	224	236	251
Comanche	0	0	2	10	5
Cooke	26	42	60	78	52
Coryell	15	15	158	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	282	336	361	311
Erath	1	1	11	27	12
Falls	278	351	454	472	388
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	380	404	311
Hood	1	2	16	56	23
Hopkins	153	139	142	140	143
Hunt	286	245	215	222	242
Johnson	37	82	208	234	140
Kaufman	303	286	295	312	299
Lamar	132	130	136	134	133
Lampasas	0	2	12	26	12
Limestone	327	390	472	488	419
McLennan	250	290	487	522	387
Milam	251	293	333	338	304
Mills	0	0	3	12	4
Montague	0	1	3	12	6
Navarro	343	352	398	411	376
Parker	5	6	16	40	18
Red River	82	77	78	78	79
Rockwall	346	272	247	265	282
Somervell	1	4	53	113	49
Tarrant	33	74	160	173	110
Taylor	-	-	-	3	3
Travis	124	61	100	121	100
Williamson	109	88	151	181	133
Wise	4	14	23	53	28