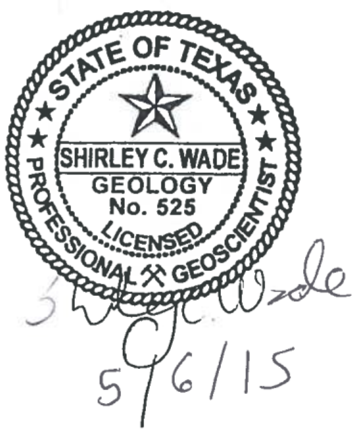
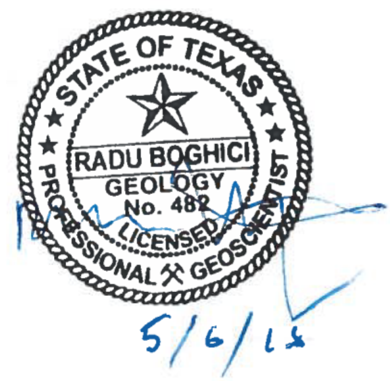
GAM Run 14-009: Rolling Plains Groundwater Conservation District Management Plan

by Shirley C. Wade, Ph.D., P.G., and Radu Boghici, P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
May 6, 2015





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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report—Part 2 of a two-part package of information from the TWDB to the Rolling Plains Groundwater Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Estimated Historical Water Use/State Water Plan data report. The District will receive this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, stephen.allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for the Rolling Plains Groundwater Conservation District should be adopted by the district on or before August 31, 2015 and submitted to the executive administrator of the TWDB on or before September 30, 2015. The current management plan for the Rolling Plains Groundwater Conservation District expires on November 29, 2015.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the Seymour and Blaine aquifers (Ewing and others, 2004) and the refined groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties (Jigmond and others, 2014). This model run replaces the results of GAM Run 10-021 (Hassan, 2010). GAM Run 14-009 meets current standards set after the release of GAM Run 10-021 and includes results from the recently released refined groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties (Jigmond and others, 2014).

Tables 1 and 2 summarize the groundwater availability model data required by statute, and Figures 1 and 2 show the area of the models from which the values in Tables 1 and 2 were extracted. If after review of the figures, the Rolling Plains Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models for the Seymour and Blaine Aquifers (Ewing and others, 2004) and the Seymour Aquifer in Haskell, Knox, and Baylor counties (Jigmond and others, 2014) were run for this analysis. Rolling Plains Groundwater Conservation District water budgets were extracted for the historical model periods (1980 through 1999 and 1980 through 2005) for the groundwater availability models for the Seymour and Blaine Aquifers (Ewing and others, 2004) and the Seymour Aquifer in Haskell, Knox, and Baylor counties (Jigmond and others, 2014), respectively, using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, discharge to surface waterbodies, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of the aquifer located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Seymour and Blaine Aquifers

- Version 1.01 of the groundwater availability model for the Seymour and Blaine Aquifers was used for this analysis. See Ewing and others (2004) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes two layers, representing the Seymour Aquifer (Layer 1), and the Blaine Aquifer (Layer 2). In areas where the Blaine Aquifer does not exist the model roughly replicates various Permian units located in the area.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

Seymour Aquifer in Haskell, Knox, and Baylor Counties

- Version 1.01 of the refined groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties was used for this analysis. See Jigmond and others (2014) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes one layer representing the Seymour Aquifer in Haskell, southern Knox, western Baylor, and a small portion of eastern Stonewall counties.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model run in the district, as shown in Tables 1 and 2.

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and springs.

- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—The net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Areas of the Seymour Aquifer located in northern Knox County (Knox pod) and central to southeastern Baylor County (Baylor pod) are not included in the refined groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties (Figure 2). For those areas, water budgets were extracted from Version 1.01 of the groundwater availability model for the Seymour and Blaine Aquifers. For the remainder of the Seymour Aquifer in Rolling Plains Groundwater Conservation District, the budget components were extracted from the refined model. The budget components from the two models are combined in Table 2.

Please note that the results of this model run are different from the results of the model run 10-021 (Hassan, 2010) that were obtained solely from the original groundwater availability model (Version 1.01 of the groundwater availability model for the Seymour and Blaine Aquifers) that addressed the Seymour Aquifer. The changes can be attributed to several characteristics of the new model, such as differences in model layering, boundary conditions, hydraulic properties distribution, and the use of different MODFLOW modeling packages.

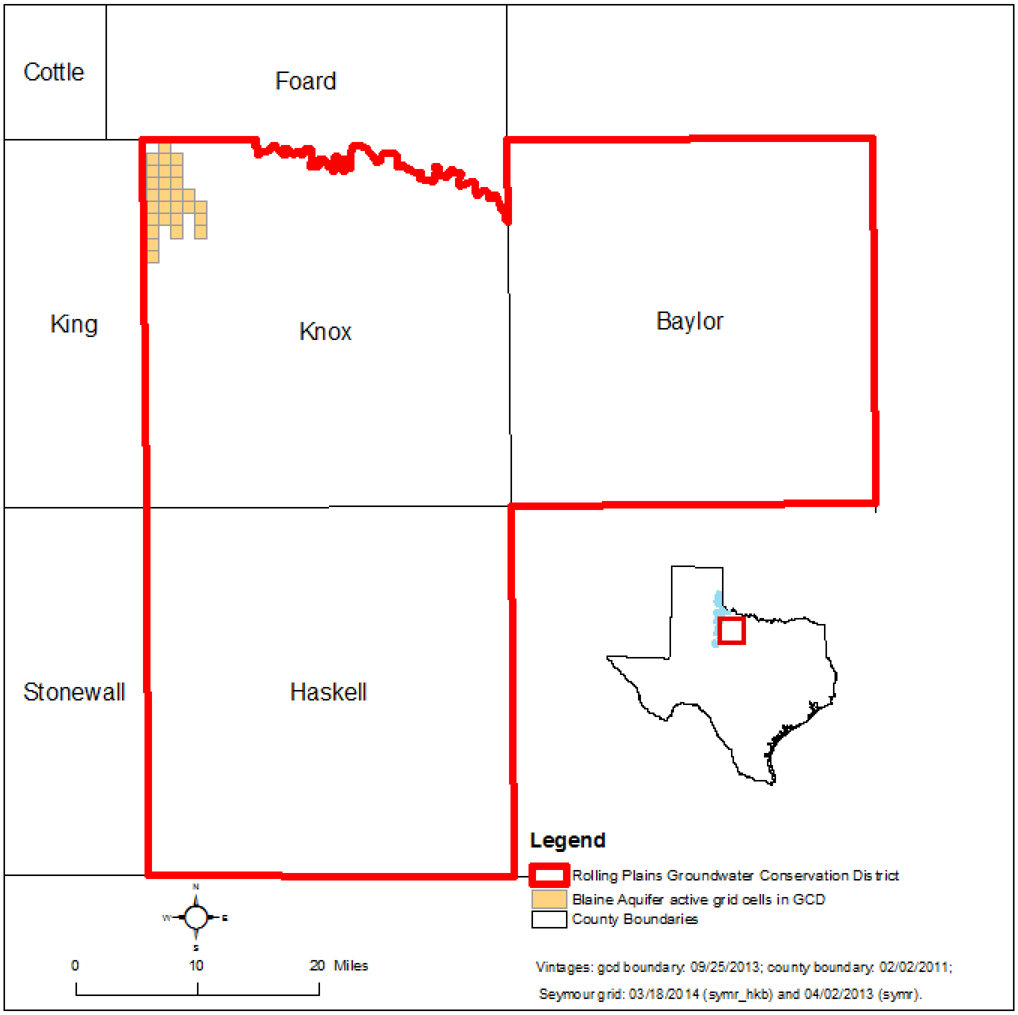

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE BLAINE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 1: SUMMARIZED INFORMATION FOR THE BLAINE AQUIFER THAT IS NEEDED FOR THE ROLLING PLAINS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*[1]
Estimated annual amount of recharge from precipitation to the district	Blaine Aquifer	641
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Blaine Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Blaine Aquifer	1,468
Estimated annual volume of flow out of the district within each aquifer in the district	Blaine Aquifer	0
Estimated net annual volume of flow between each aquifer in the district	Net flow from Blaine into adjacent Permian Units	4,381

[1] Small portions of the Blaine Aquifer were not calibrated in the model; therefore, those areas are not included in the budget analysis.

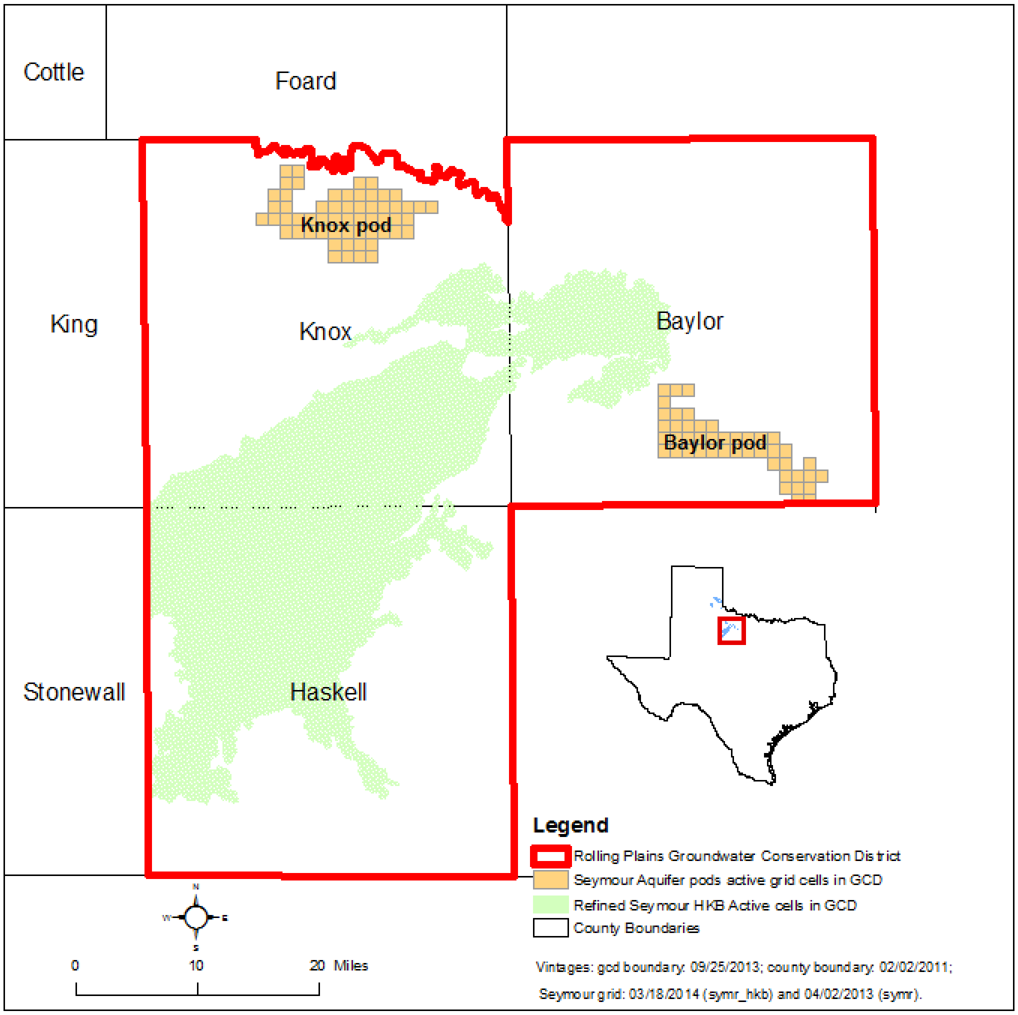

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS AND THE REFINED GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AQUIFER IN HASKELL, KNOX, AND BAYLOR COUNTIES FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE SEYMOUR AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY). BAYLOR AND KNOX POD BUDGETS ARE FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS.

TABLE 2: SUMMARIZED INFORMATION FOR THE SEYMOUR AQUIFER THAT IS NEEDED FOR THE ROLLING PLAINS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Seymour Aquifer	112,253
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Seymour Aquifer	61,661
Estimated annual volume of flow into the district within each aquifer in the district	Seymour Aquifer	62
Estimated annual volume of flow out of the district within each aquifer in the district	Seymour Aquifer	3,180
Estimated net annual volume of flow between each aquifer in the district	Flow from Seymour Aquifer into underlying Permian Units	Not applicable*

* The refined groundwater availability model for the Seymour Aquifer assumes a no-flow condition at the base.

LIMITATIONS:

The groundwater model(s) 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 interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related 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.

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