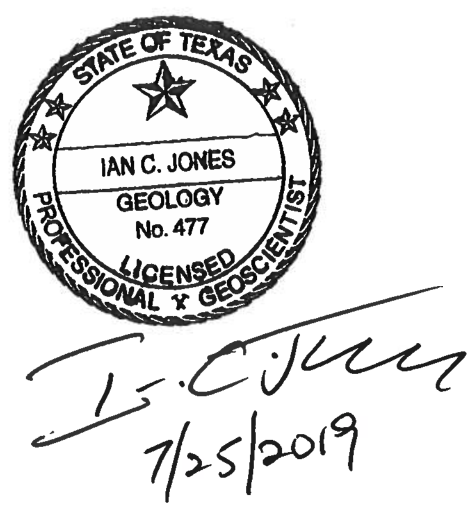
GAM Run 19-020: Rolling Plains Groundwater Conservation District Groundwater Management Plan

Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-463-6641
July 30, 2019



This page is intentionally blank.

GAM Run 19-020: Rolling Plains Groundwater Conservation District Groundwater Management Plan

Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-463-6641
July 30, 2019

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.

The TWDB provides data and information to the Rolling Plains Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. 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
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Rolling Plains Groundwater Conservation District should be adopted by the district on or before June 17, 2020 and submitted to the Executive Administrator of the TWDB on or before July 17, 2020. The current management plan for the Rolling Plains Groundwater Conservation District expires on September 15, 2020.

We used two groundwater availability models to estimate the management plan information for the aquifers within the Rolling Plains Groundwater Conservation District. Information for the Seymour and Blaine aquifers is from the groundwater availability model for the Seymour and Blaine aquifers (Ewing and others, 2004) and from the groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties (Jigmond and others, 2014).

This report replaces GAM Run 14-009 (Wade and Boghici, 2015), as the approach used for analyzing model results has been since refined. 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 the tables 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. We do not have a model for the Cross Timbers Aquifer. Please contact Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov for any information you may need about this aquifer for your groundwater conservation district management plan.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), we used the two groundwater availability models mentioned above to estimate the information for the Rolling Plains Groundwater Conservation District management plan. Using ZONEBUDGET Version 3.01 (Harbaugh, 2009), we extracted water budgets from the models' results for the (post-1980) historical model periods for the Seymour and Blaine aquifers (January 1980 through December 1999), and for the Seymour Aquifer in Haskell, Knox, and Baylor counties (January 1980 through December 2005). In this report we summarize the average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district.

PARAMETERS AND ASSUMPTIONS:

Seymour and Blaine Aquifers

- We used version 1.01 of the groundwater availability model for the Seymour and Blaine Aquifers 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.
- We ran the model with MODFLOW-2000 (Harbaugh and others, 2000).

Seymour Aquifer in Haskell, Knox, and Baylor Counties

- We used version 1.01 of the refined groundwater availability model for the Seymour Aquifer in Haskell, Knox, and Baylor counties 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.
- We ran the model with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Seymour and Blaine aquifers located within Rolling Plains Groundwater Conservation District and averaged over the historical calibration periods, as shown in Tables 1 and 2.

1. 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.

2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.

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

4. 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 and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1 and 2. 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.

TABLE 1. SUMMARIZED INFORMATION FOR THE SEYMOUR AQUIFER FOR 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	2,945
Estimated net annual volume of flow between each aquifer in the district	Flow from Seymour Aquifer into Permian units	7,134*

* Based on model results from Ewing and others (2004)

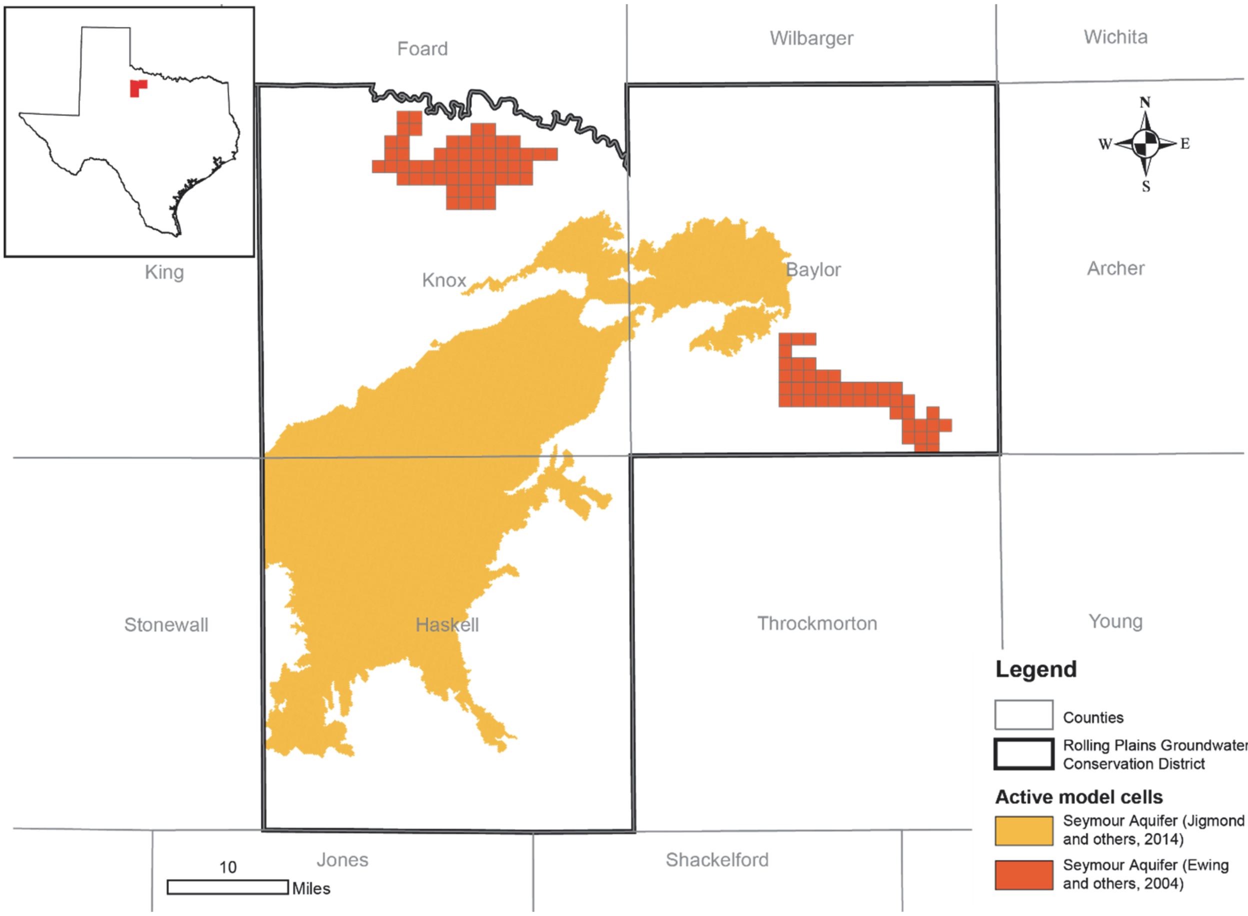


FIGURE 1 AREA OF THE GROUNDWATER AVAILABILITY MODELS FOR THE SEYMOUR AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE BLAINE AQUIFER FOR 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	Blaine Aquifer	702
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	1,823
Estimated annual volume of flow out of the district within each aquifer in the district	Blaine Aquifer	3
Estimated net annual volume of flow between each aquifer in the district	Flow from the Blaine Aquifer into adjacent Permian units	4,922

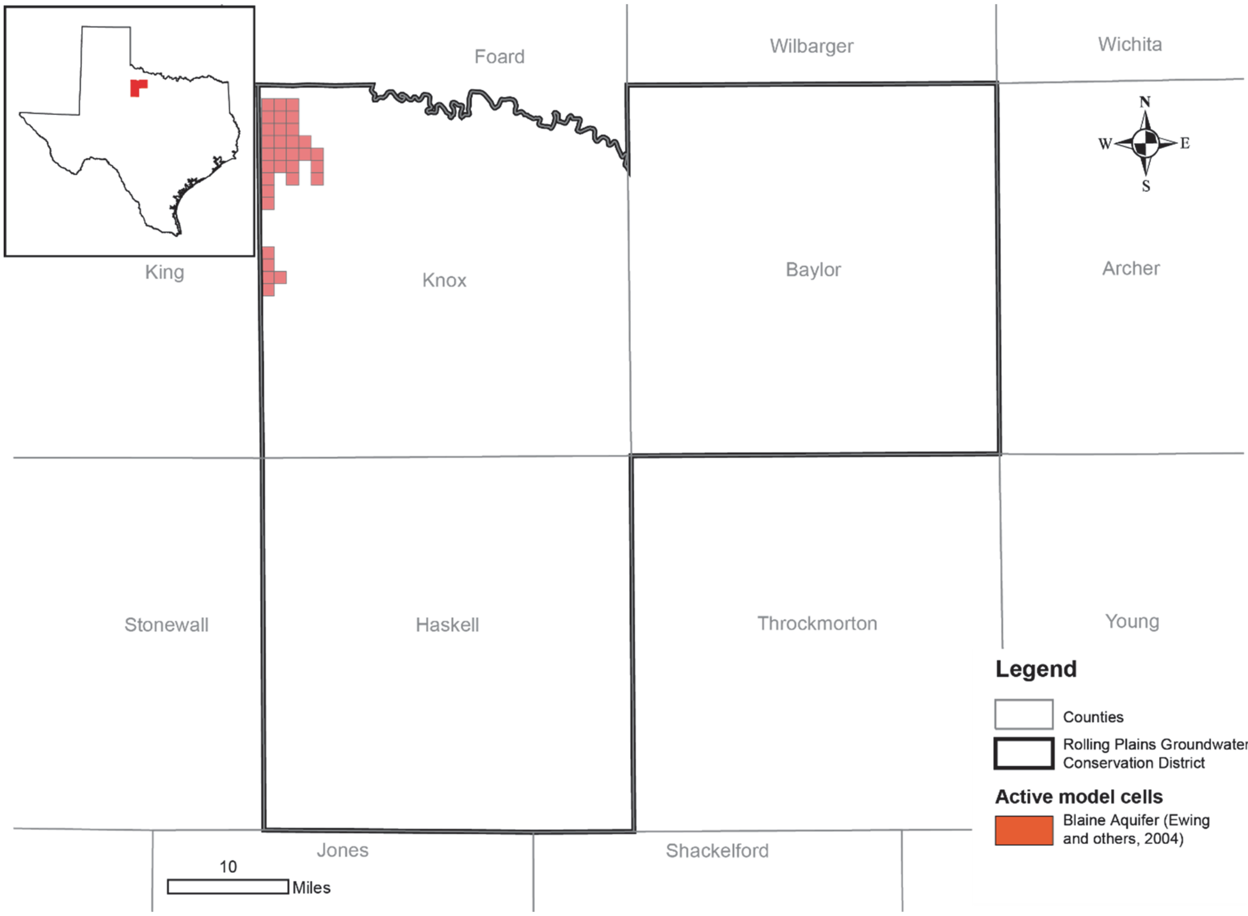


FIGURE 2 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE BLAINE AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. 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 historical groundwater flow conditions includes the assumptions about the location in the aquifer where historical pumping was placed. Understanding the amount and location of historical 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 historical 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. Historical 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:

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., http://www.twdb.texas.gov/groundwater/models/gam/symr/SYMR_Model_Report.pdf.

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models: U.S. Geological Survey Groundwater Software.

Harbaugh, A. W., Banta, E. R., Hill, M. C., and McDonald, M. G., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- User guide to modularization concepts and the Ground-Water Flow Process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Jigmond, M., Hutchison, W. R., and Shi, J., 2014, Final Report: Groundwater Availability Model of the Seymour Aquifer in Haskell, Knox, and Baylor Counties, 185 p., http://www.twdb.texas.gov/groundwater/models/gam/symr_hkb/Seymour_HKB_GAM_Report_Sealed_021414.pdf.

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., http://www.nap.edu/catalog.php?record_id=11972.

Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf.

Wade, S. C., and Boghici, R., 2015, GAM Run 14-009: Texas Water Development Board, GAM Run 14-009 Report, 12 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR14-009.pdf.