GAM Run 16-001: Panhandle Groundwater Conservation District Management Plan

by Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 936-0883
April 28, 2016

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), 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 Panhandle 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 Panhandle Groundwater Conservation District should be adopted by the district on or before February 13, 2017 and submitted to the Executive Administrator of the TWDB on or before March 15, 2017. The current management plan for the Panhandle Groundwater Conservation District expires on May 14, 2017.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the High Plains Aquifer System (Deeds and Jigmond, 2015) and the Seymour and Blaine aquifers (Ewing and others, 2004). This model run replaces the results of GAM Run 11-021 (Jones, 2012) that used version 2.01 of the groundwater availability model for the northern portion of the Ogallala Aquifer (Dutton, 2004), version 1.01 of the groundwater availability model for the Seymour and Blaine aquifers (Ewing and others, 2004), and version 1.01 of the groundwater availability model of the Dockum Aquifer (Ewing and others, 2008). Tables 1 through 3 summarize the groundwater availability model data required by statute, and Figures 1 through 3 show the area of the respective models from which the values in the table were extracted. If after review of the figures, the Panhandle 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 High Plains Aquifer System (Deeds and Jigmond, 2015) and the Seymour and Blaine aquifers (Ewing and others, 2004) were run for this analysis. Panhandle Groundwater Conservation District water budgets were extracted for the historical model period used for calibration of the models using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, 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 system 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 Seymour Aquifer does not occur within the Panhandle Groundwater Conservation District.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

High Plains Aquifer System: Dockum, Edwards-Trinity (High Plains), Rita Blanca, and Ogallala aquifers

- Version 1.01 of the groundwater availability model for the High Plains Aquifer System was used for this analysis. See Deeds and Jigmond (2015) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes 4 layers which generally represent the Ogallala Aquifer and other younger geologic units overlying the Dockum Aquifer (Layer 1), the Rita Blanca and Edwards-Trinity (High Plains) aquifers (Layer 2), upper portion of the Dockum Aquifer (Layer 3), and the lower portion of the Dockum Aquifer (Layer 4). The Rita Blanca and Edwards-Trinity (High Plains) aquifers do not occur within the Panhandle Groundwater Conservation District.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

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 through 3.

- 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.

The information needed for the District's management plan is summarized in Tables 1 through 3. 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.

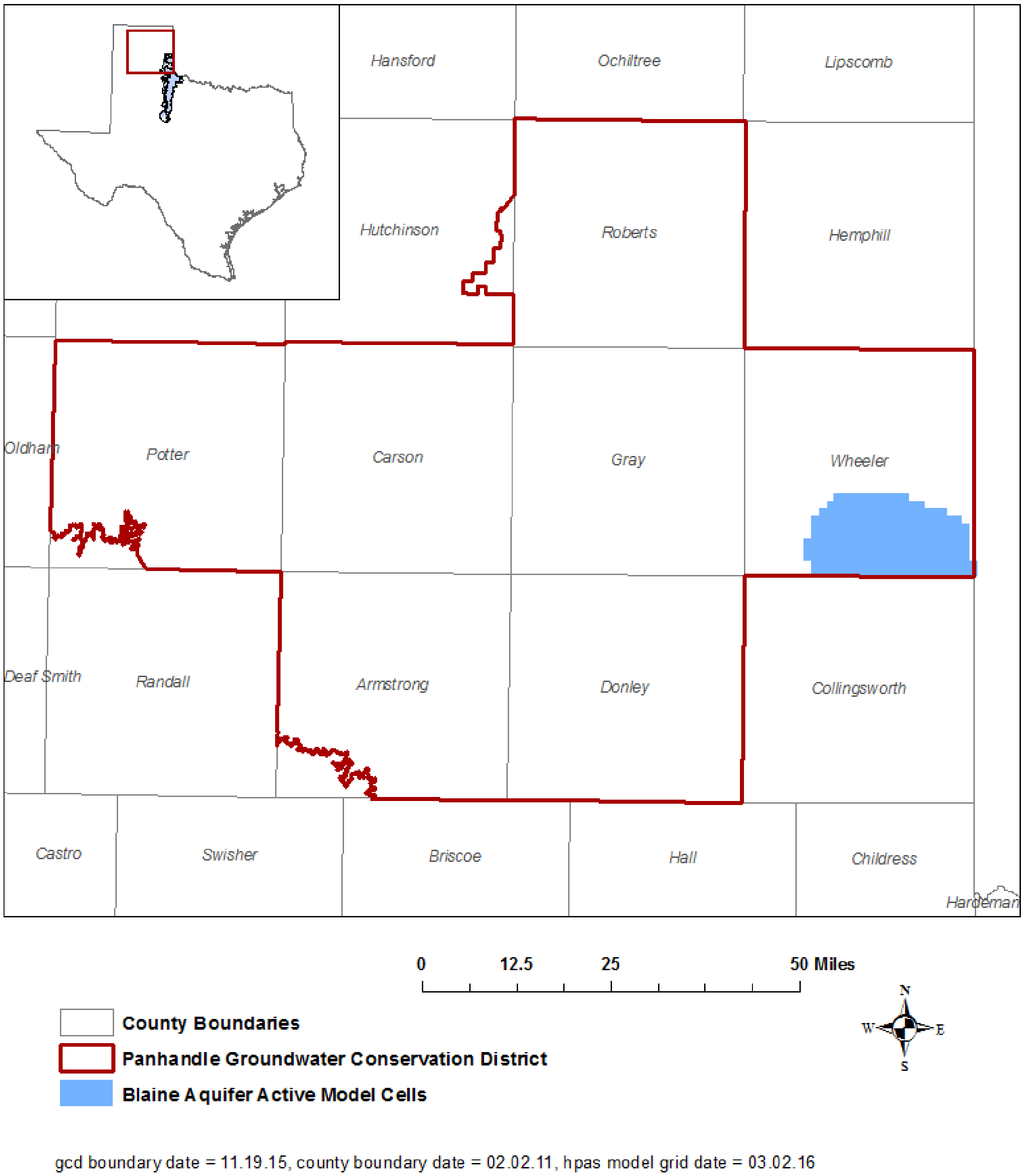

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SEYMOUR AND BLAINE AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED [THE BLAINE AQUIFER EXTENT MODELED WITHIN THE DISTRICT BOUNDARY].

TABLE 1: SUMMARIZED INFORMATION FOR THE BLAINE AQUIFER THAT IS NEEDED FOR THE PANHANDLE 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	3,702
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Blaine Aquifer	5,165
Estimated annual volume of flow into the district within each aquifer in the district	Blaine Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Blaine Aquifer	5,096
Estimated net annual volume of flow between each aquifer in the district	Blaine Aquifer	0*

*The model assumes a no-flow boundary at the base of the Blaine Aquifer.

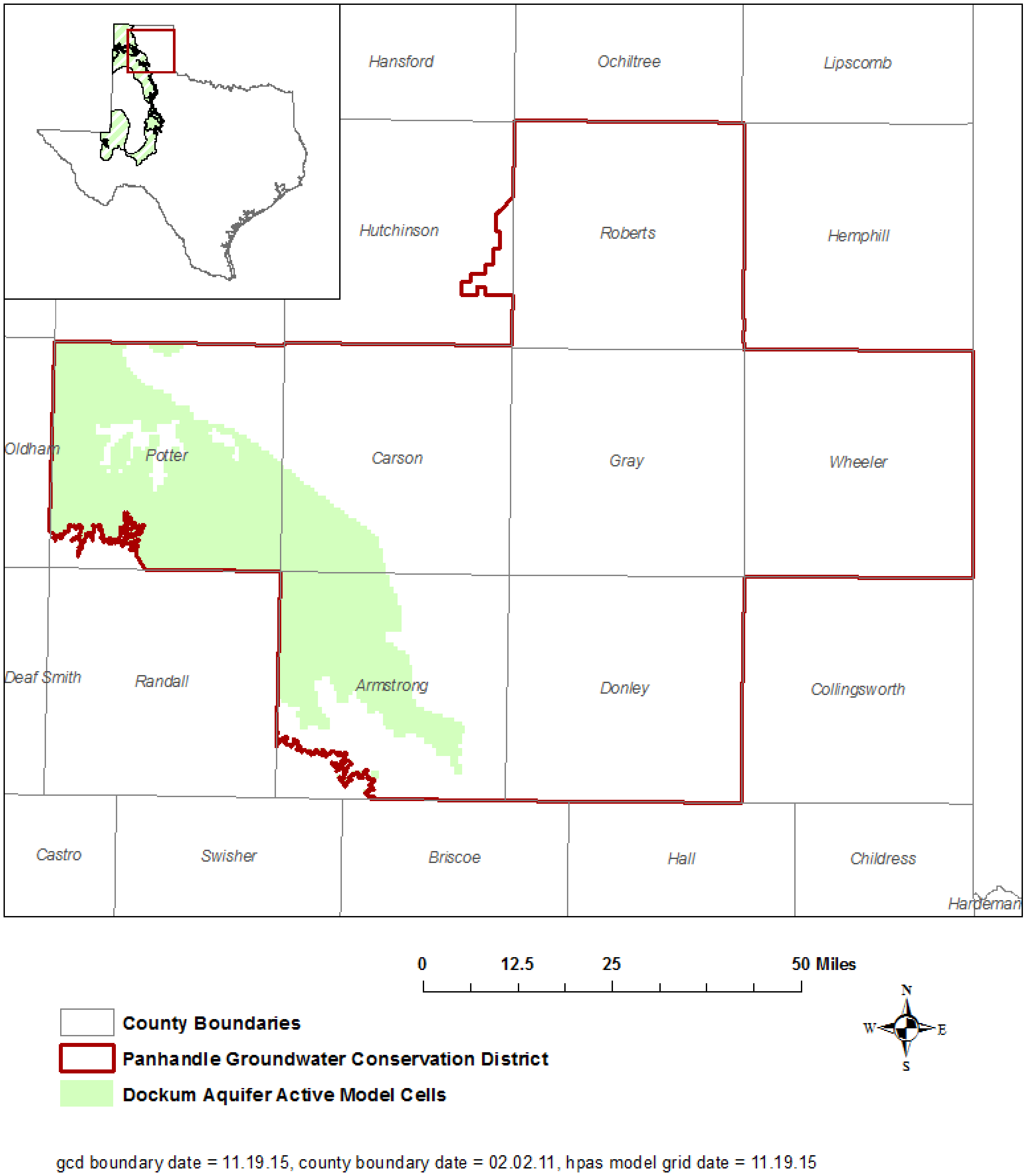

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED [THE DOCKUM AQUIFER EXTENT MODELED WITHIN THE DISTRICT BOUNDARY].

TABLE 2: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR THE PANHANDLE 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	Dockum Aquifer	2,333
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	7,937
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	4,111
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	1,337
Estimated net annual volume of flow between each aquifer in the district	From overlying units into the Dockum Aquifer	2,663

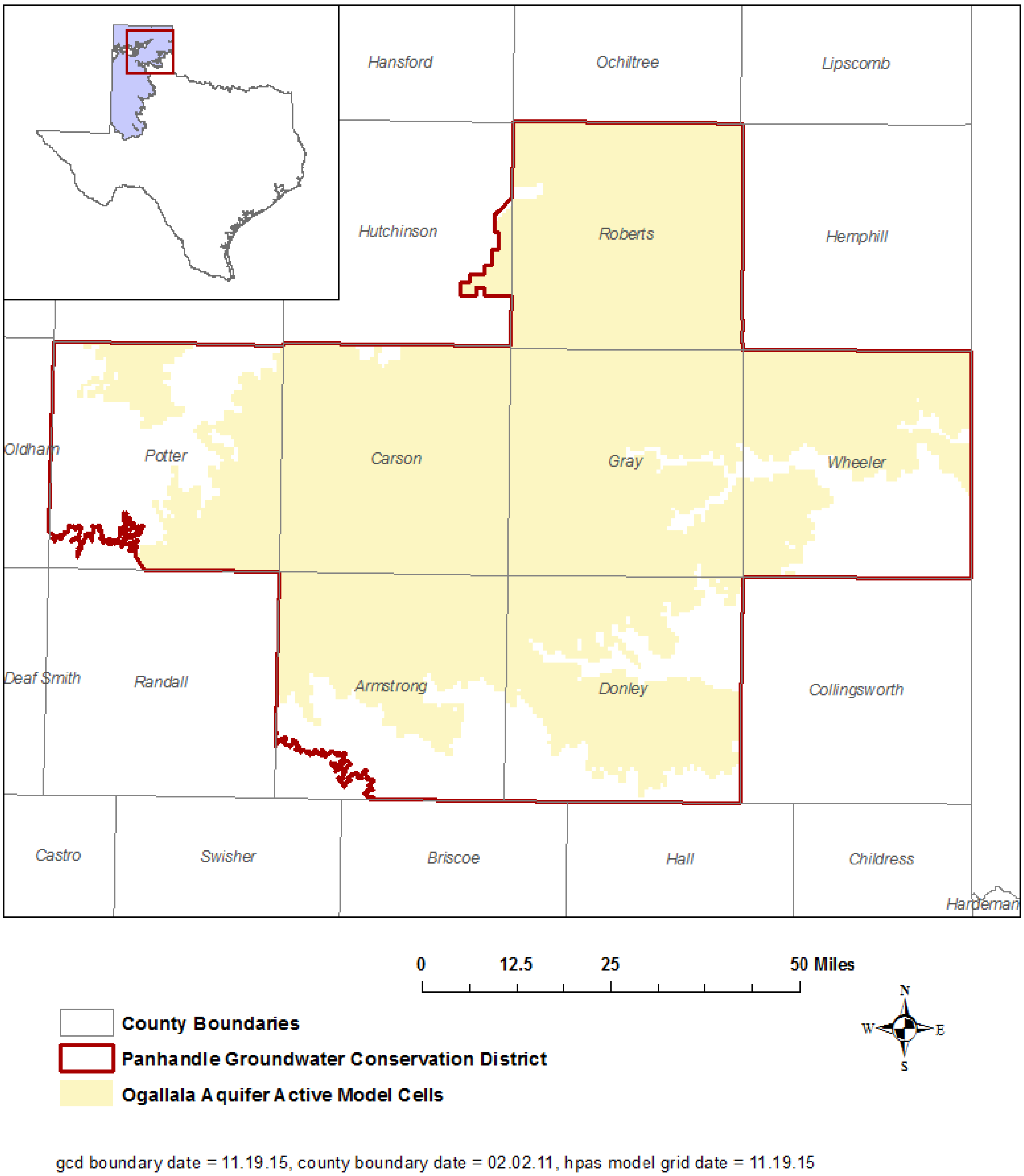

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED [THE OGALLALA AQUIFER EXTENT MODELED WITHIN THE DISTRICT BOUNDARY].

TABLE 3: SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER THAT IS NEEDED FOR THE PANHANDLE 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	Ogallala Aquifer	113,864
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	129,654
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	39,686
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	26,155
Estimated net annual volume of flow between each aquifer in the district	From the Ogallala Aquifer into Underlying units	2,663

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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