GAM Run 22-012: Comal Trinity Groundwater Conservation District Management Plan

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Groundwater Division
Groundwater Modeling Department
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October 14, 2022

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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.

The TWDB provides data and information to the Comal Trinity 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 which 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 Comal Trinity Groundwater Conservation District should be adopted by the district on or before January 25, 2023 and submitted to the executive administrator of the TWDB on or before February 24, 2023. The current management plan for the Comal Trinity Groundwater Conservation District expires on April 25, 2023.

We used the groundwater availability model for the Hill Country portion of the Trinity Aquifer (Jones and others, 2011), hereafter called the Southern portion of the Trinity Aquifer, to estimate the management plan information for the aquifers within the Comal Trinity Groundwater Conservation District. The Edwards (Balcones Fault Zone) Aquifer occurs within the boundaries of Comal Trinity Groundwater Conservation District but was excluded from this report because this district does not have jurisdiction over that aquifer. Additionally, the portion of the Trinity Aquifer System that underlies the Edwards (Balcones Fault Zone) Aquifer was not included in the groundwater availability model on the basis that it is likely that very little flow occurs between the modeled Southern portion of the Trinity Aquifer and the Southern portion of the Trinity Aquifer underlying the Edwards (Balcones Fault Zone) Aquifer (Jones and others, 2011).

This report replaces the results of GAM Run 16-022 (Wade, 2016). We performed routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. Table 1 summarizes the groundwater availability model data required by statute. Figure 1 shows the area of the model from which the values in Table 1 were extracted. Figure 2 provides a generalized diagram of the groundwater flow components provided in Table 1. If, after review of the figures, the Comal Trinity 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 model mentioned above was used to estimate information for the Comal Trinity Groundwater Conservation District management plan. Water budgets were extracted for the historical model period for the Southern portion of the Trinity Aquifer (1981-1997) 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, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Trinity Aquifer

- We used version 2.01 of the groundwater availability model for the Southern portion of the Trinity Aquifer. See Jones and others (2011) for assumptions and limitations of the groundwater availability model.
- The groundwater availability model includes four layers, representing (from top to bottom):
    1. The Edwards Group of the Edwards-Trinity (Plateau) Aquifer,
    2. the Upper Trinity hydrostratigraphic unit,
    3. the Middle Trinity hydrostratigraphic unit, and
    4. the Lower Trinity hydrostratigraphic unit.
- We determined the overall water budget for the outcrop area of the Southern portion of the Trinity Aquifer (Layers 2 through 4 collectively) within Comal County Groundwater Conservation District. Layer one is not present in the district.
- The General-Head (GHB) package of MODFLOW was used to represent flow across the Balcones Fault Zone to capture interaction between the outcrop area of the Trinity Aquifer with the Edwards (Balcones Fault Zone) Aquifer and the deep Trinity Aquifer units located below the Edwards (Balcones Fault Zone) Aquifer. This flow is summarized in Table 1 as the estimated average net flow "From the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer and the deep Trinity Aquifer."
- Water budgets were estimated by averaging over the period 1981 to 1997 (stress periods 2 through 18).
- Only the outcrop area of the Southern portion of the Trinity Aquifer was modeled. The down-dip extent that underlies the Edwards (Balcones Fault Zone) Aquifer is not modeled.
- The model was run using MODFLOW-96 (Harbaugh and McDonald, 1996).

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 groundwater availability model results for the Southern portion of the Trinity Aquifer located within the Comal Trinity Groundwater Conservation District and averaged over the historical calibration period, as shown in Table 1.

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 Table 1. 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 SOUTHERN PORTION OF THE TRINITY AQUIFER THAT IS NEEDED FOR THE COMAL TRINITY 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	Trinity Aquifer	42,457
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Trinity Aquifer	15,601
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	38,106
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	28,422
Estimated net annual volume of flow between each aquifer in the district	From the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer and deep Trinity Aquifer	38,912*

* In the Comal Trinity Groundwater Conservation District, groundwater generally flows east from the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer and the confined parts of the Trinity Aquifer that underlie the Edwards (Balcones Fault Zone) Aquifer.

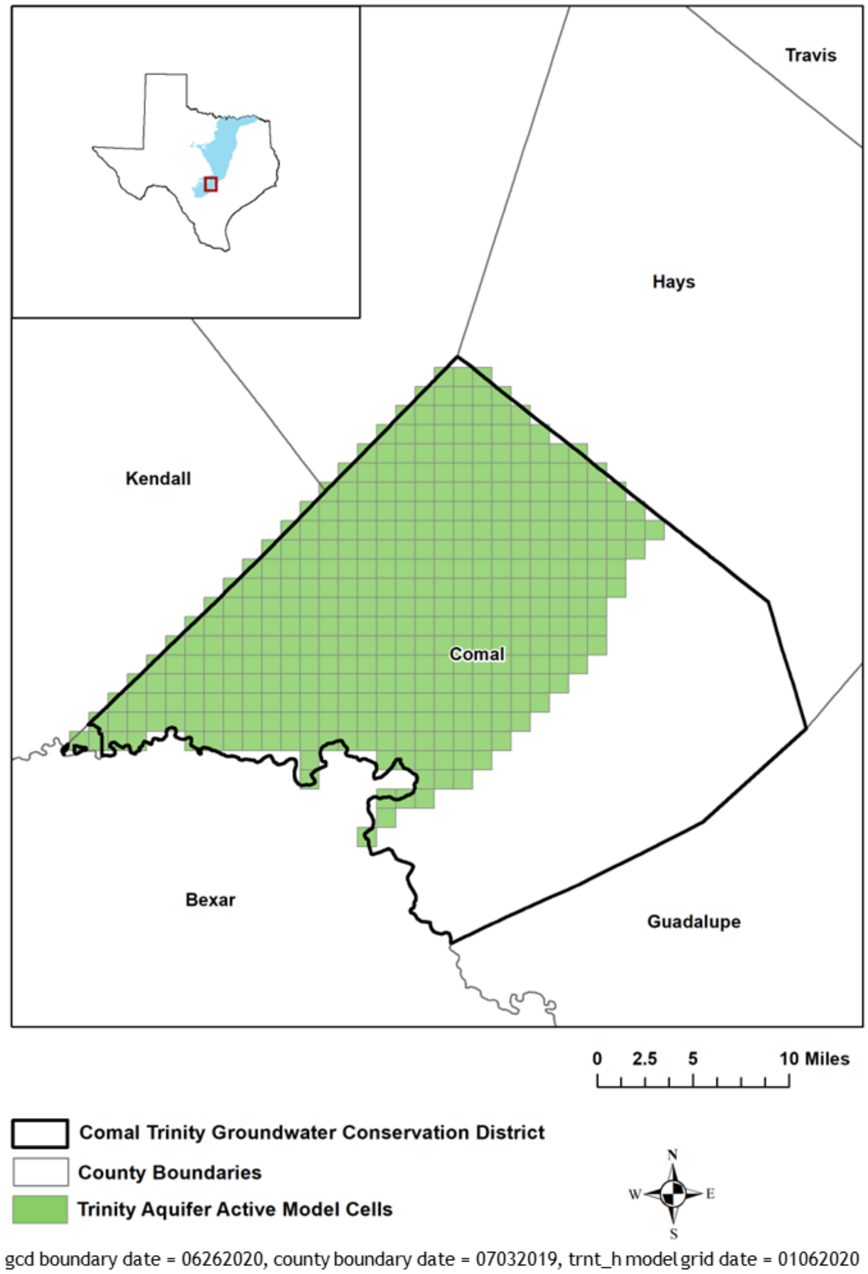

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE TRINITY AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE SOUTHERN PORTION OF THE TRINITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

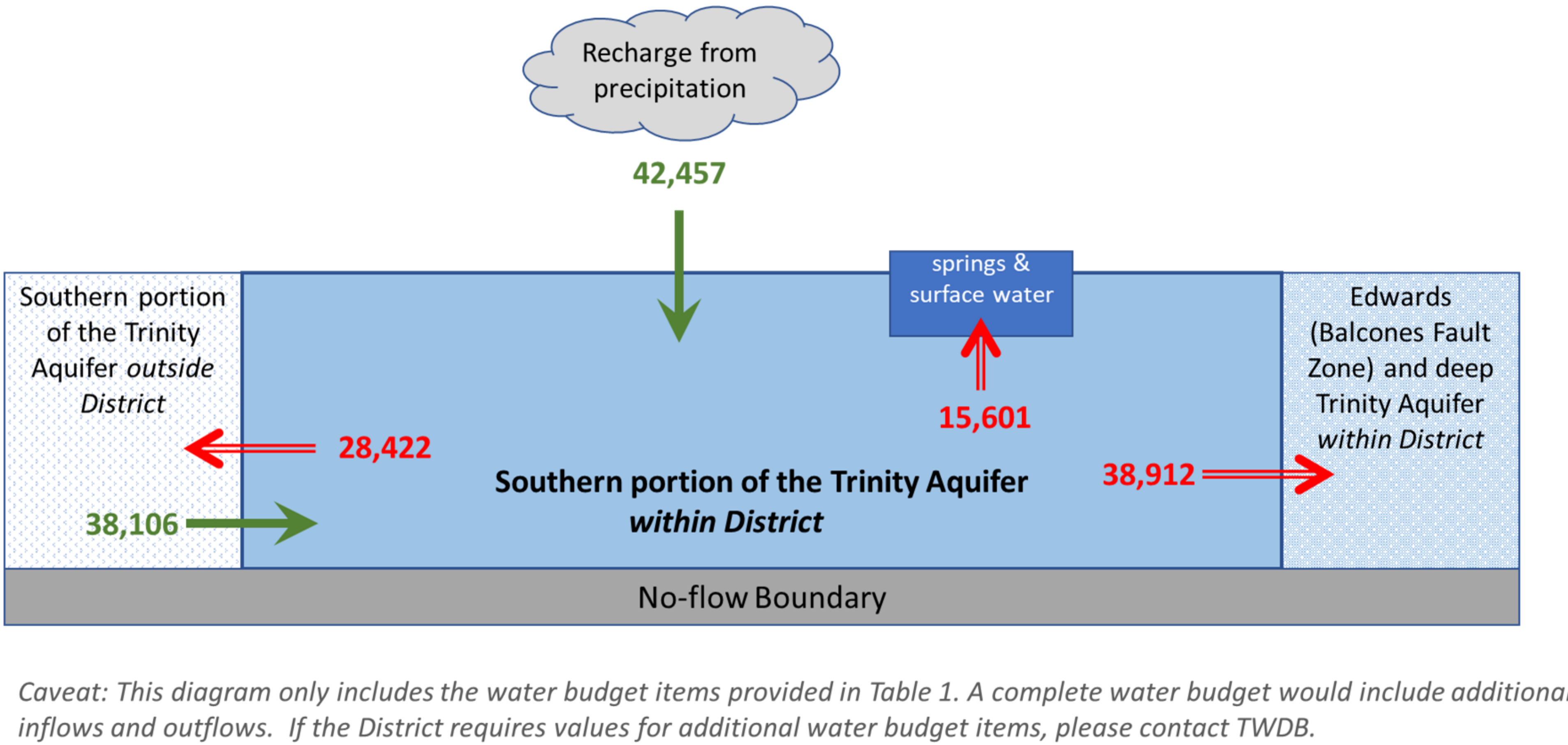

FIGURE 2: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 1, REPRESENTING DIRECTIONS OF FLOW FOR THE SOUTHERN PORTION OF THE TRINITY AQUIFER WITHIN COMAL TRINITY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

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 historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic 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 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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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.

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