GAM Run 12-014: Kinney County Groundwater Conservation District Management Plan

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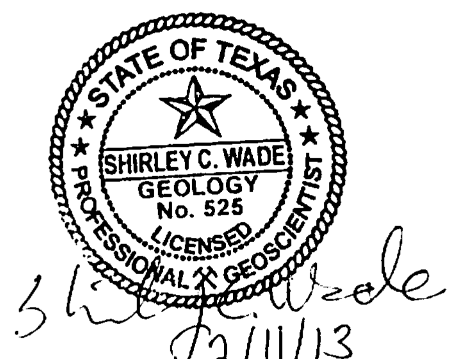
February 11, 2013



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EXECUTIVE SUMMARY:

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

The purpose of this report is to provide Part 2 of a two-part package of information to Kinney County Groundwater Conservation District for its groundwater management plan. This groundwater management plan is due for approval by the executive administrator of the Texas Water Development Board (TWDB) before June 19, 2013.

This report discusses the method, assumptions, and results from GAM run 12-014 using the Kinney County Groundwater Conservation District model developed by Hutchison and others (2011). The model has four layers representing the following hydrogeologic units (from top to bottom): Carrizo-Wilcox Aquifer (layer 1), Upper Cretaceous Unit (layer 2), Edwards (Balcones Fault Zone) Aquifer/Edwards portion of the Edwards-Trinity (Plateau) Aquifer (layer 3), and Trinity portion of the Edwards-Trinity (Plateau) Aquifer (layer 4). Tables 1 and 2 summarize the groundwater availability model data for the official aquifers required by the statute. Figures 1 and 2 show the area of the model from which the values in the tables were extracted using different combination of model layers (as referenced below).

METHODS:

The Kinney County Groundwater Conservation District model (Hutchison and others, 2011) was used for this analysis. Water budgets for selected years—1980 through 2005—of the transient model period were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009) and the average annual water budget values for recharge, surface water outflow, lateral inflow to the district, lateral outflow from the district, and flow between aquifers/geologic units located within the district are summarized in this report. Please note that the Edwards (Balcones Fault Zone) Aquifer was simulated in model layer 3, while the Edwards-Trinity (Plateau) Aquifer was simulated in model layers 3 and 4.

PARAMETERS AND ASSUMPTIONS:

Edwards (Balcones Fault Zone) and Edwards-Trinity (Plateau) Aquifers

- The Kinney County Groundwater Conservation District model developed by Hutchison and others (2011) was used for this management plan data analysis. The model was calibrated to water level and spring flux collected from 1950 to 2005; however, data were extracted only for the period from 1980 to 2005 for the management plan. These dates were used to avoid skewing the data as a result of the drought of the 1950s. The period from 1980 to 2005 includes both drought and wet climatic conditions.
- The model has four layers representing the following hydrogeologic units (from top to bottom): Carrizo-Wilcox Aquifer (layer 1), Upper Cretaceous Unit (layer 2), Edwards (Balcones Fault Zone) Aquifer/Edwards portion of the Edwards-Trinity (Plateau) Aquifer (layer 3), and Trinity portion of the Edwards-Trinity (Plateau) Aquifer (layer 4). 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 components were extracted from the groundwater budget for the Edwards (Balcones Fault Zone) Aquifer and the Edwards-Trinity (Plateau) Aquifer and averaged over the 1980 to 2005 portion of the model runs in the district (Tables 1 and 2). These selected components are:

- Precipitation recharge—The spatially-distributed recharge due to precipitation within the district.
- Surface water outflow—The total water discharging from the aquifers to surface water features such as streams, reservoirs, and springs.
- Flow into and out of district—The lateral flow within the aquifers between the district and adjacent counties and other areas.
- Flow between aquifers—The flow between 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 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 district or county boundaries, 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 (Figures 1 and 2).

LIMITATIONS

The groundwater model used for this analysis is the best available scientific tool to meet the stated objective. 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 streamflow are specific to a particular historic time period.

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 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.

REFERENCES:

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.

Hutchison, William R., Shi, Jerry, and Jigmond, Marius, 2011, Groundwater Flow Model of the Kinney County Area, Texas Water Development Board, 138 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., http://www.nap.edu/catalog.php?record_id=11972.

TABLE 1: SUMMARIZED INFORMATION FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER THAT IS NEEDED FOR KINNEY COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE APPROXIMATE AND REPORTED IN ACRE-FEET PER YEAR.

Management Plan requirement	Aquifer and other units	TWDB Kinney GCD Model (1980 – 2005)
Estimated annual amount of recharge from precipitation to the district	Edwards (Balcones Fault Zone) Aquifer	17,674
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards (Balcones Fault Zone) Aquifer	514
Estimated annual volume of flow into the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	268
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	12,346
Estimated net annual volume of flow between each aquifer in the district	From Upper Cretaceous Units to Edwards (Balcones Fault Zone) Aquifer	15,597
	From Edwards-Trinity (Plateau) Aquifer to Edwards (Balcones Fault Zone) Aquifer	11,514
	From Edwards (Balcones Fault Zone) to Edwards-Trinity Units	33,598

TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR KINNEY COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE APPROXIMATE AND REPORTED IN ACRE-FEET PER YEAR.

Management Plan requirement	Aquifer and other units	TWDB Kinney GCD Model (1980 – 2005)
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	48,216
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	33,439
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	148,792
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	74,709
Estimated net annual volume of flow between each aquifer in the district	From Upper Cretaceous Units to Edwards-Trinity (Plateau) Aquifer	40,848
	From Edwards-Trinity (Plateau) Aquifer to Edwards (Balcones Fault Zone) Aquifer	11,514
	From Edwards-Trinity (Plateau) Aquifer to Edwards-Trinity Units	105,311

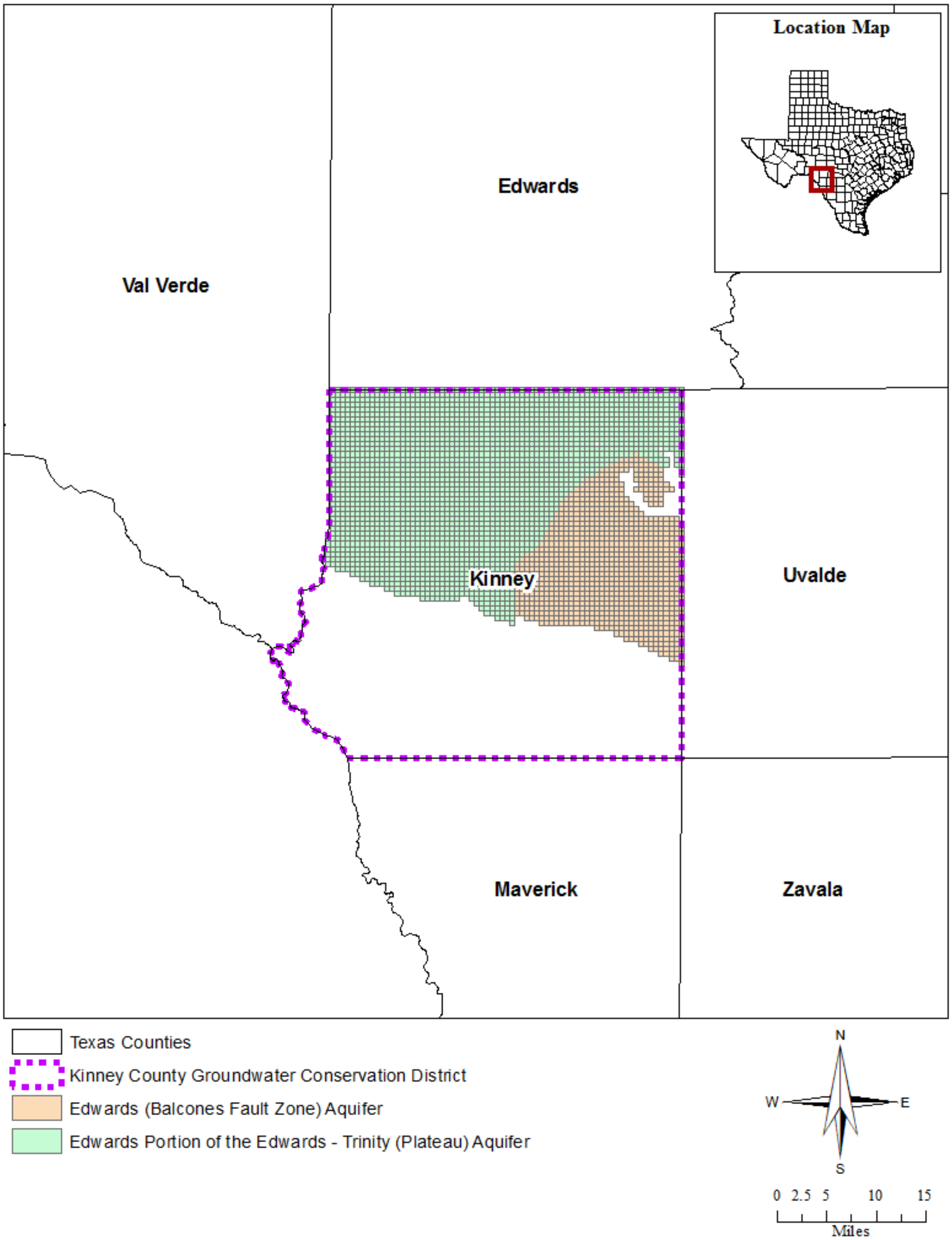

FIGURE 1: THE EDWARDS (BALCONES FAULT ZONE) AQUIFER AND EDWARDS PORTION OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN MODEL LAYER 3 FROM WHICH THE INFORMATION IN TABLES 1 AND 2 WAS EXTRACTED FOR THE KINNEY COUNTY GROUNDWATER CONSERVATION DISTRICT.

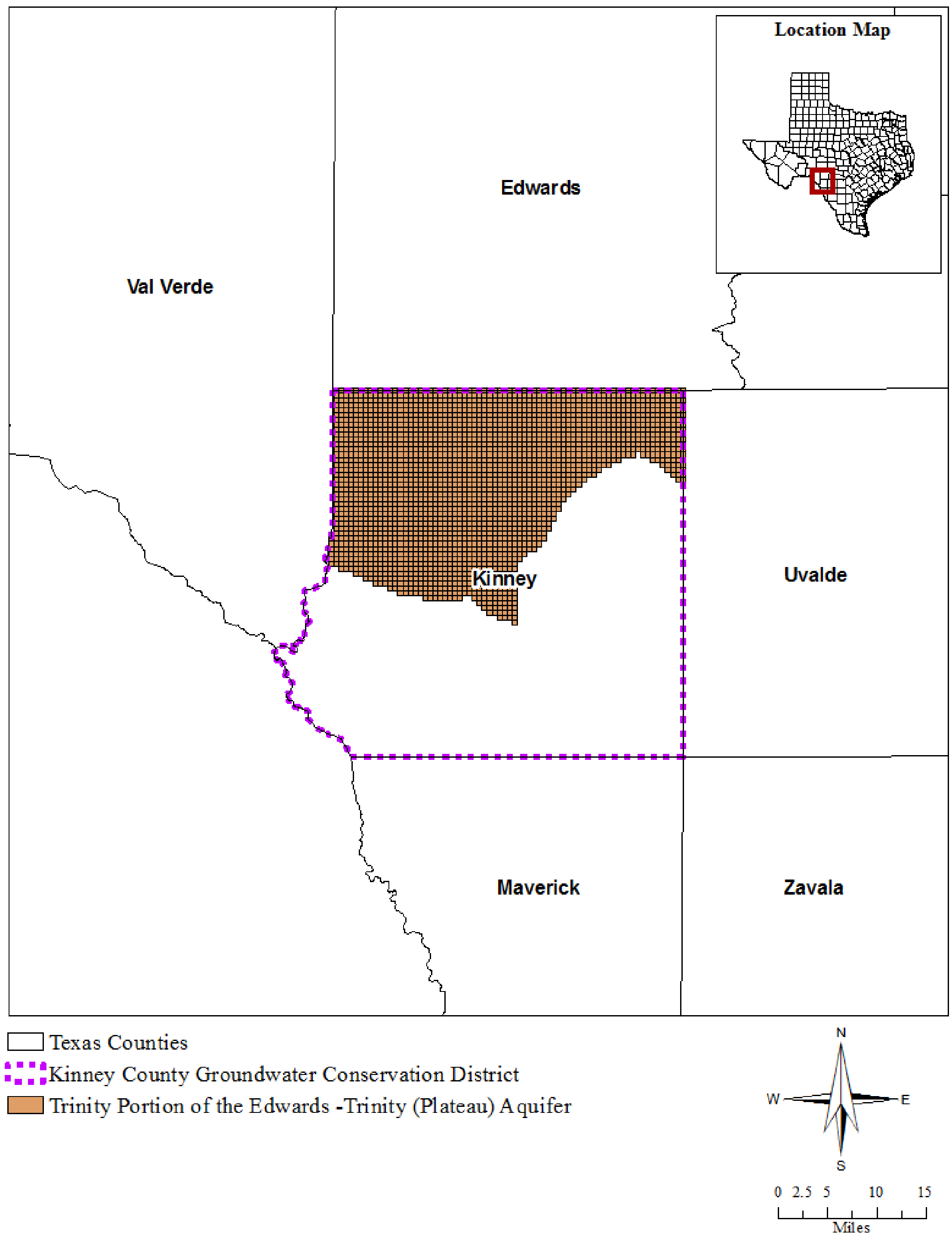

FIGURE 2: THE TRINITY PORTION OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN MODEL LAYER 4 FROM WHICH THE INFORMATION IN TABLES 1 AND 2 WAS EXTRACTED FOR THE KINNEY COUNTY GROUNDWATER CONSERVATION DISTRICT.