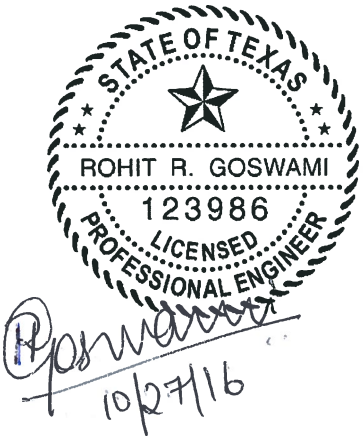
GAM Run 16-011: Duval County Groundwater Conservation District Management Plan

Rohit R. Goswami, Ph.D., P.E.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-0495
October 21, 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.

The TWDB provides data and information to the Duval County 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 Section. 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 Duval County Groundwater Conservation District should be adopted by the district on or before July 11, 2017, and submitted to the Executive Administrator of the TWDB on or before August 10, 2017. The current management plan for the Duval County Groundwater Conservation District expires on October 9, 2017.

The Gulf Coast Aquifer System and the Yegua-Jackson Aquifer occur in the Duval County Groundwater Conservation District. Information for the Gulf Coast Aquifer System was extracted from version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004). Information for the Yegua-Jackson Aquifer was extracted from version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and others, 2010).

This report discusses the methods, assumptions, and results from model runs using the groundwater availability models for the central portion of the Gulf Coast Aquifer System and the Yegua-Jackson Aquifer. This report replaces the results of GAM Run 11-001 (Hasan, 2011). GAM Run 16-011 meets current standards set after the release of GAM Run 11-001. Tables 1 and 2 summarize the groundwater availability model data required by statute. Figures 1 and 2 show the areas of the models from which the values in Tables 1 and 2 were extracted. If after review of the figures, the Duval County 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 for the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004) and the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and other, 2010) were used to extract information for this report. The water budgets for the Duval County Groundwater Conservation District were extracted for the historical model periods (1981 through 1999 for the Gulf Coast Aquifer System and 1980 through 1997 for the Yegua-Jackson Aquifer) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the two aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer System

1. We used version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.

2. The model for the central portion of the Gulf Coast Aquifer assumes partially penetrating wells in the Evangeline Aquifer due to a lack of data for aquifer properties in the deeper section of the aquifer located closer to the Gulf of Mexico. This means the areas where wells are drilled into the Evangeline Aquifer are represented using data from the shallow portions of the aquifer, such as the outcrop or just below the Chicot Aquifer closer to the Gulf of Mexico. Lower portions of the aquifer near the Gulf of Mexico are not accessible with existing wells so deeper wells will be needed to understand the aquifer properties over the entire thickness of the aquifer.

3. This groundwater availability model includes four layers, which generally represent the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer including parts of the Catahoula Formation (Layer 4).

4. The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Yegua-Jackson Aquifer

1. We used version 1.01 of the groundwater availability model for the central portion of the Yegua-Jackson Aquifer for this analysis. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.

2. This groundwater availability model includes five layers, which generally correspond to: outcrop of Yegua-Jackson Aquifer and younger overlying units (Layer 1), upper portion of the Jackson Group (Layer 2), lower portion of the Jackson Group (Layer 3), upper portion of the Yegua Group (Layer 4), and lower portion of the Yegua Group (Layer 5).

3. 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 groundwater availability models for the Gulf Coast Aquifer System and the Yegua-Jackson Aquifer within the 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 GULF COAST AQUIFER SYSTEM FOR THE DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST ONE ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	18,509
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Gulf Coast Aquifer System	11,537
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	3,830
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	10,341
Estimated net annual volume of flow between each aquifer in the district[1]	Not applicable	Not applicable

[1] The groundwater availability model for the central portion of the Gulf Coast Aquifer System assumes a no flow barrier at the base of the aquifer.

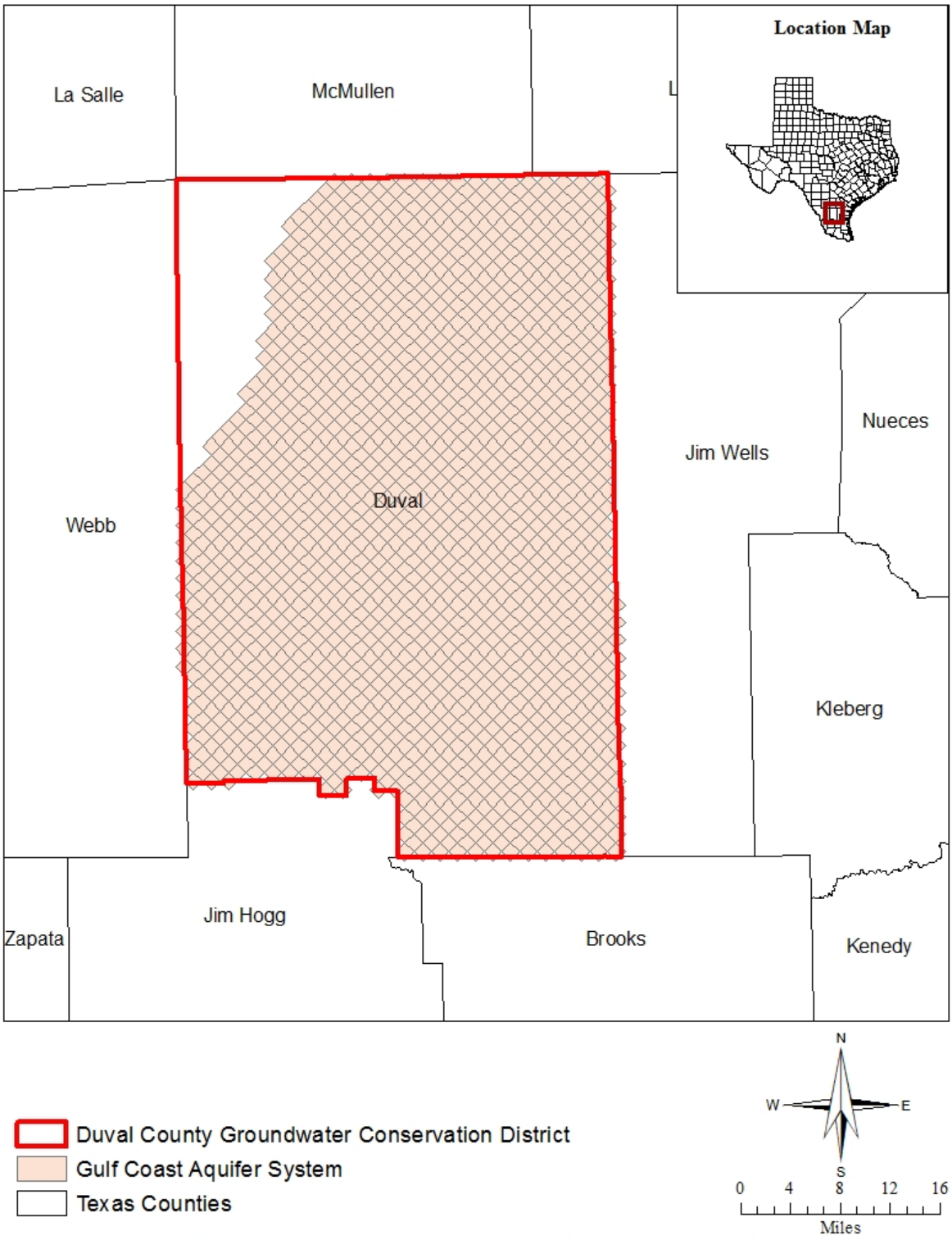


FIGURE1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED FOR THE DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT.

TABLE 2: SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER FOR THE DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST ONE ACRE-FOOT.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	12
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	296
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	131
Estimated net annual volume of flow between each aquifer in the district	Flow from the Yegua-Jackson subcrop to the Yegua-Jackson Aquifer (outcrop)	62
	Flow from Catahoula Formation to Yegua-Jackson Aquifer	103

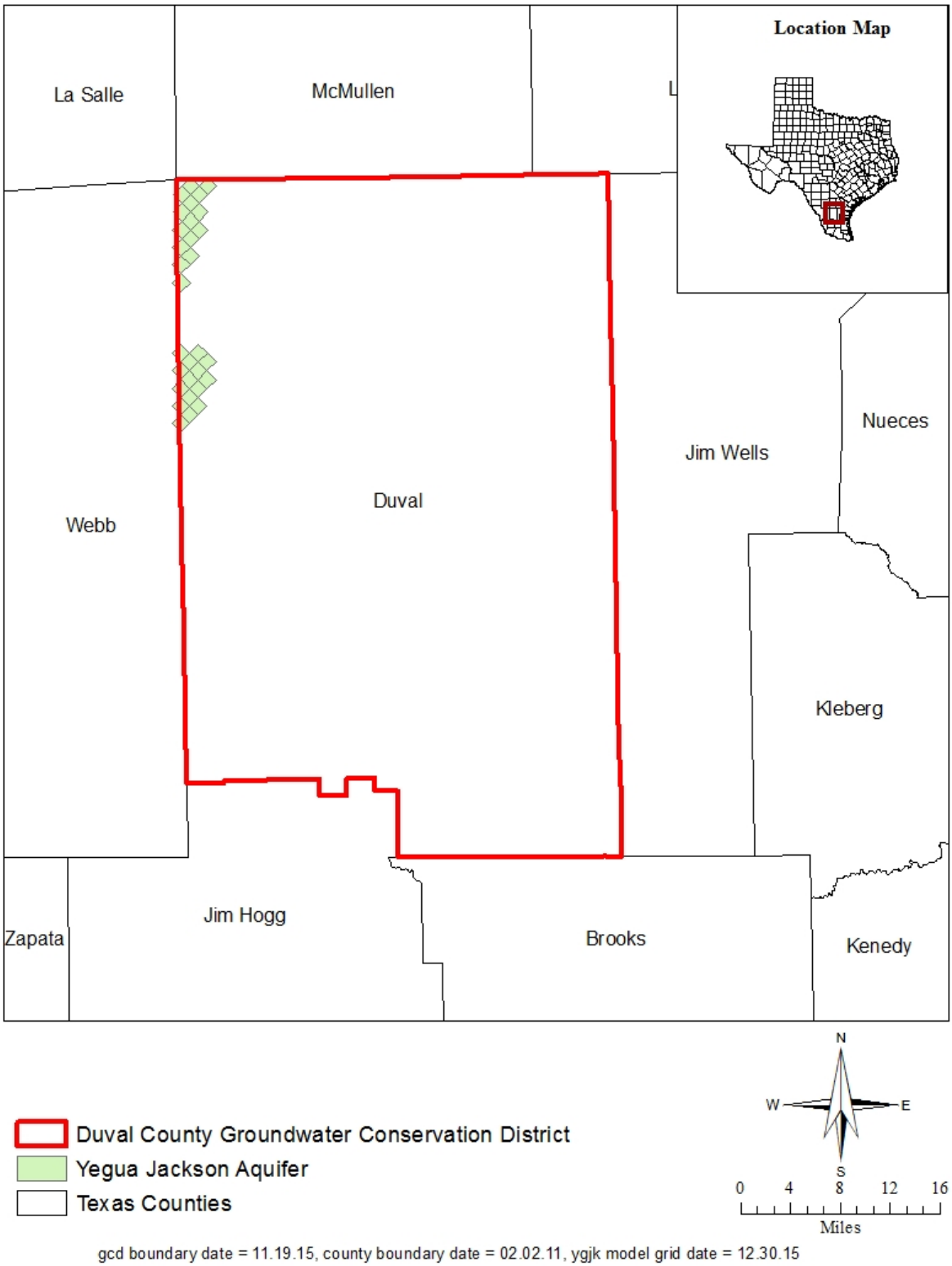


FIGURE2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED FOR THE DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT.

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.

REFERENCES:

Hassan, M. M., 2011, GAM Run 11-001: Texas Water Development Board, GAM Run 11-001 Report, 11 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR11-001.pdf

Chowdhury, Ali. H., Wade, S., Mace, R.E., and Ridgeway, C., 2004, Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999- Model Report, 114 p., http://www.twdb.texas.gov/groundwater/models/gam/glfc_c/TWDB_Recalibration_Report.pdf.

Deeds, N. E., Yan, T., Singh, A., Jones, T. L., Kelley, V. A., Knox, P. R., Young, S. C., 2010, Groundwater Availability Model for The Yegua-Jackson Aquifer, 582 p., http://www.twdb.texas.gov/groundwater/models/gam/ygjk/YGJK_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., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference groundwater-water flow model: U.S. Geological Survey Open-File Report 96-485, 56 p.

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.

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, 2015, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf

Waterstone Environmental Hydrology and Engineering Inc. and Parsons, 2003, Groundwater availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050, Central Gulf Coast, Texas Contract report to the Texas Water Development Board, 157 p.