
GAM RUN 11-001: DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

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June 15, 2011



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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 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.

The purpose of this report is to provide information to Duval County Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Duval County Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before July 25, 2012.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the central section of the Gulf Coast Aquifer and the Yegua Jackson Aquifer. Tables 1 through 2 summarize the groundwater

availability model data required by the statute, and figures 1 through 2 show the area of each model from which the values in the respective tables were extracted. If after review of the figures, Duval County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the Texas Water Development Board immediately.

METHODS:

We ran the groundwater availability model for the central section of the Gulf Coast Aquifer and (1) extracted the water budget for each year of the 1981 through 2000 period and (2) averaged the 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).

We ran the groundwater availability model for Yegua Jackson Aquifer and (1) extracted water budgets for each year of the 1980 through 1997 period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district for the sections of the Yegua Jackson Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

Groundwater Availability model for the central section of the Gulf Coast Aquifer

- Version 1.01 of the groundwater availability model for the central section of the Gulf Coast Aquifer was used for this Analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.
- The model for the central section of the Gulf Coast Aquifer assumes partially penetrating wells in the Evangeline Aquifer due to a lack of data for aquifer properties in the lower section of the aquifer.
- The model includes four layers representing: 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, as appropriate (Layer 4).
- The mean absolute error (a measure of the difference between simulated and measured water levels) in the entire model for 1999 is 26 feet, which is

4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).

- Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) was used as the interface to process model output.

Groundwater Availability model for the Yegua-Jackson Aquifer

- Version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer was used for this analysis. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers, which generally correspond to (from top to bottom):
 1. outcrop section for the Yegua-Jackson Aquifer and younger overlying units,
 2. the upper portion of the Jackson Group,
 3. the lower portion of the Jackson Group,
 4. the upper portion of the Yegua Group, and
 5. the lower portion of the Yegua Group.
- An overall water budget for the district was determined for the Yegua-Jackson Aquifer (Layer 1 through Layer 5, collectively for the portions that represent the Yegua-Jackson Aquifer).
- The recharge used for the model run represents average recharge as described in Deeds and others (2010).
- As reported in Deeds and others (2010), the mean absolute errors (a measure of the difference between simulated and measured water levels during model calibration) for the Jackson Group (combined upper and lower Jackson units), Upper Yegua, and Lower Yegua portions of the Yegua-Jackson Aquifer for the historical-calibration period of the model are 31.1, 23.9, and 24.5 feet, respectively. These represent 10.3, 5.7 and 6.3 percent of the hydraulic head drop across each model area, respectively.
- Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) was used as the interface to process model output.

- The model results presented in this report were extracted from all areas of the model representing the units comprising the Yegua Jackson Aquifer. For this reason, the reported values may reflect water of quality ranging from fresh to brackish and saline. This is especially true for the subcrop sections of the aquifer in the northwestern part of the District.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability models. Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibration and verification section of each model run (1981 through 2000 for the central section of the Gulf Coast Aquifer and 1980 through 1997 for the Yegua Jackson Aquifer) in the district as shown in tables 1 through 2. The components of the modified budget shown in tables 1 through 2 include:

- Precipitation recharge—This is the 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 drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.
- Flow between aquifers—The vertical 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. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

The information needed for the District’s management plan is summarized in tables 1 through 2..

TABLE 1: SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER THAT IS NEEDED FOR DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS INCLUDE BRACKISH WATERS.

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	18,536
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	11,543
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	3,832
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	10,348
Estimated net annual volume of flow between each aquifer in the district	Not applicable	Not applicable

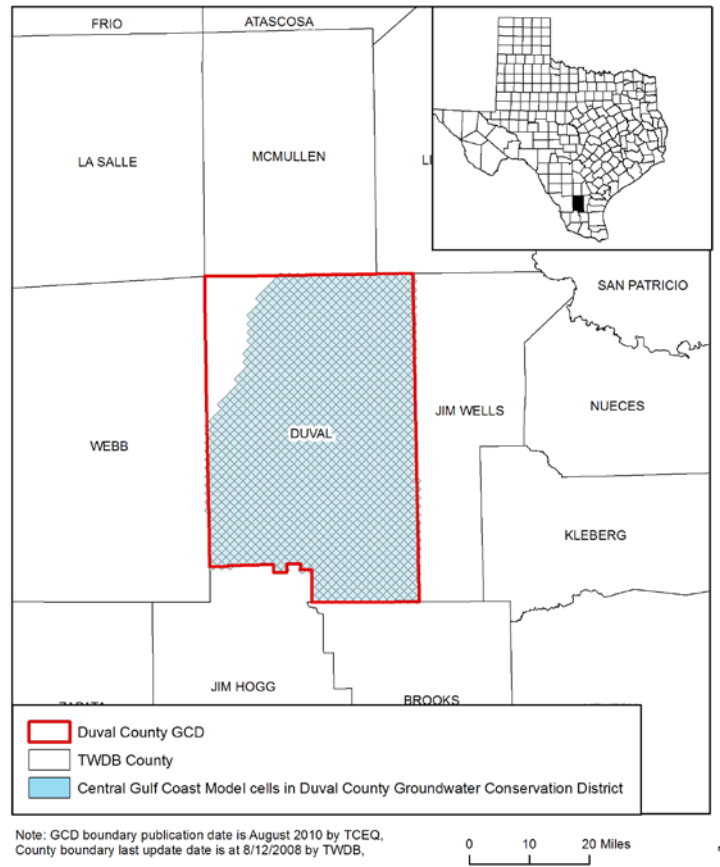


FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER THAT IS NEEDED FOR DUVAL COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
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	344
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	361
Estimated net annual volume of flow between each aquifer in the district	Outflow from the Yegua-Jackson Aquifer to the upper Catahoula Formation	2

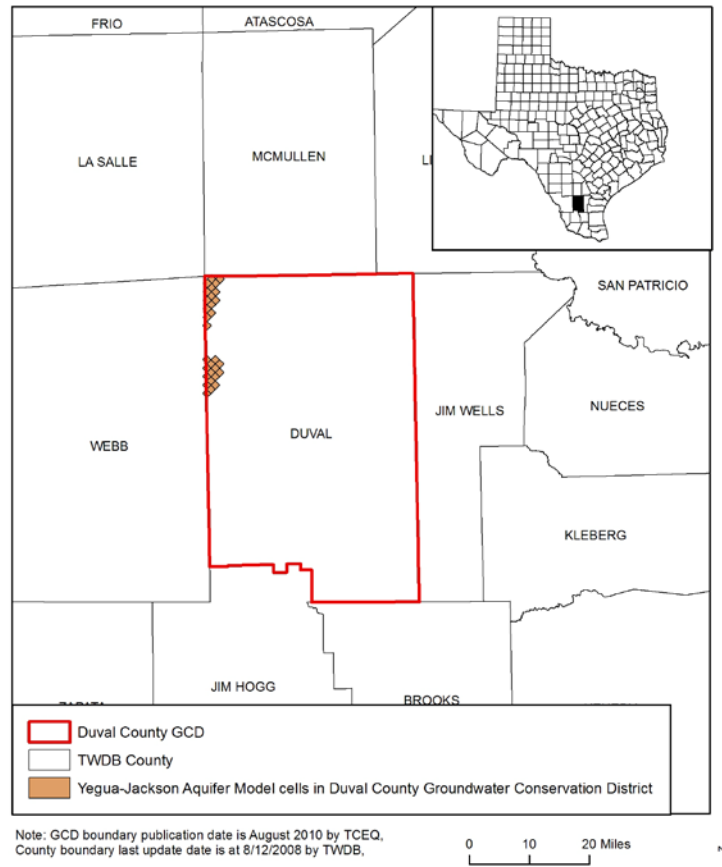


FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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 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.

It is important to also 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 (see figures 1 through 2)

REFERENCES:

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- 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: Final report prepared for the Texas Water Development Board by INTERA, Inc., 582 p., <http://www.twdb.state.tx.us/gam/ygjk/ygjk.htm>.
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- 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.