

GAM Run 06-30

by Shirley Wade, P.G.

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0883
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EXECUTIVE SUMMARY:

We ran GWSIM-IV, one of the TWDB groundwater availability models of the San Antonio Segment of the Edwards Balcones Fault Zone Aquifer, to determine the effects of various levels of pumping in the Edwards Aquifer on discharge to the Leona Gravel Aquifer. Results suggest that for every 100,000 acre-feet increase in total pumping per year, there is a 500 to 1,000 acre-feet per month decrease in discharge from Leona Springs.

REQUESTOR:

Mr. Vic Hilderbran of the Uvalde Underground Water Conservation District.

DESCRIPTION OF REQUEST:

Mr. Hilderbran requested we use the groundwater availability model for the San Antonio Segment of the Edwards Balcones Fault Zone Aquifer to assess the effects of permitted pumping in the Edwards Aquifer on discharge from the Edwards Aquifer to the Leona Gravel Aquifer.

METHODS:

Mr. Hilderbran's preference was to use the MODFLOW-DCM model of the San Antonio Segment of the Edwards Aquifer, developed by Southwest Research Institute for the Edwards Aquifer Authority (Painter and Basagaoglu, 2007); however, since that model has not yet been reviewed by the Texas Water Development Board, and is therefore not an official groundwater availability model at the present time, we used GWSIM-IV (Thorkildsen and McElhaney, 1992) for the model runs.

To address the request, we:

- Ran GWSIM-IV with historical recharge and historical pumping and compared Leona Springs discharge with historical estimates from Brune (1975), and
- Ran GWSIM-IV in predictive mode with historical recharge and permitted pumping distribution at seven fixed pumping volumes ranging from zero to 600,000 acre-feet per year and compared Leona Springs discharge for the seven pumping volumes.

PARAMETERS, ASSUMPTIONS, AND LIMITATIONS:

- Because Leona springs is poorly understood and not well quantified, model estimates of discharge to Leona springs include uncertainty due to model estimation and uncertainty about the hydrogeology.
- We used GWSIM-IV, one of the TWDB groundwater availability models of the San Antonio Segment of the Edwards Balcones Fault Zone Aquifer.
- See Thorkildsen and McElhaney (1992) and Klemt and others (1979) for a description of the GWSIM-IV model development and calibration.
- The model includes one layer representing the Edwards Formation.
- Recharge rates are based on U.S. Geological Survey estimates of historical recharge from 1934 to 1989.
- The permit distribution is based on permits as of June 2005.

RESULTS:

The trend and lows of the model simulated historical discharge at Leona Springs generally compare well with the spring flow data (Figure 1). However, the model does not capture the high spring flows. The lack of agreement for high flows may be due to local components of flow not represented in the regional model.

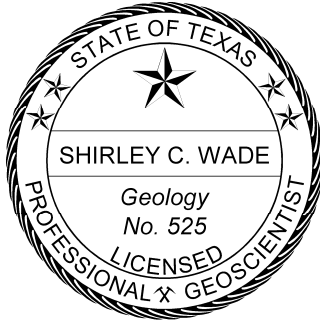
Comparison of simulated Leona spring discharge for different levels of fixed annual pumping suggest that for every 100,000 acre-feet increase in pumping per year, there is a 500 to 1,000 acre-feet per month decrease in discharge from Leona Springs (Figure 2). For pumping greater than 100,000 acre-feet per year, the model suggests Leona Springs will cease to flow during a drought similar to the 1950s drought. With a fixed pumping rate of greater than 400,000 acre-feet per year, the model suggests Leona Springs will only flow during very wet periods (Figure 2). It should be noted that these simulations do not account for critical period management so that we could hold pumping levels constant through time for comparison purposes. Critical period management will reduce total permitted pumping by up to 40 percent in the San Antonio pool and up to 35 percent in the Uvalde pool during extreme drought.

REFERENCES:

- Brune, G., 1975, Major and Historical Springs of Texas: Texas Water Development Board Report 189, 94 p.
- Klemt, W. B., Knowles, T. R., Elder, G. and Sieh, T., 1979, Ground-water resources and model applications for the Edwards (Balcones Fault Zone) aquifer in the San Antonio region, Texas: Texas Department of Water Resources Report 239, 88 p.

Painter, S. and H. Basagaoglu, 2007, Robust Representation of Dry Cells in MODFLOW, Final project report prepared by Southwest Research Institute, San Antonio, Texas for the Edwards Aquifer Authority.

Thorkildsen, D., and McElhaney, P. D., 1992, Model refinement and applications for the Edwards (Balcones Fault Zone) aquifer in the San Antonio region, Texas: Texas Water Development Board Report 340, 33 p.



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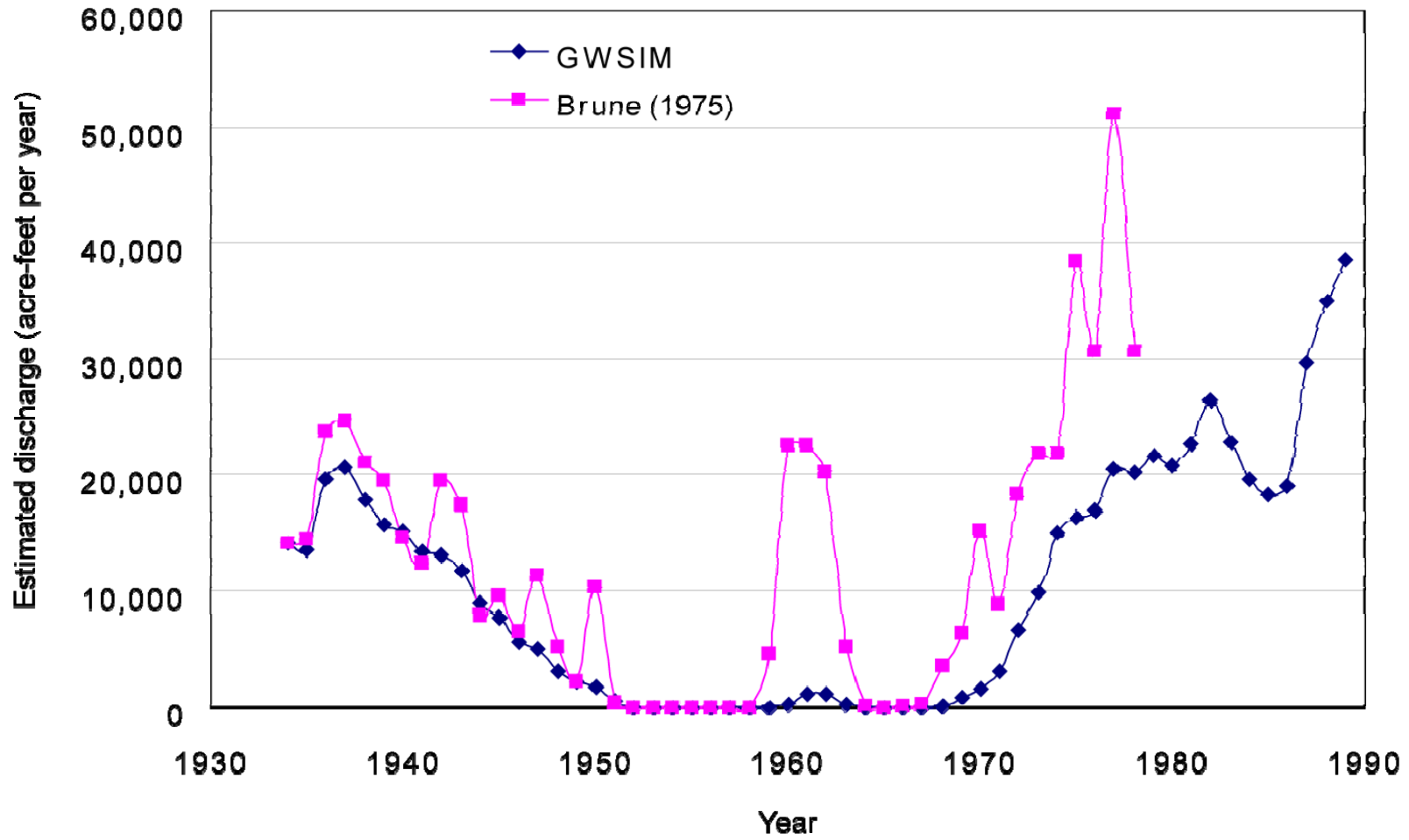


Figure 1. Model simulated discharge at Leona Springs (GWSIM) compared with historical spring flow estimates (Brune, 1975).

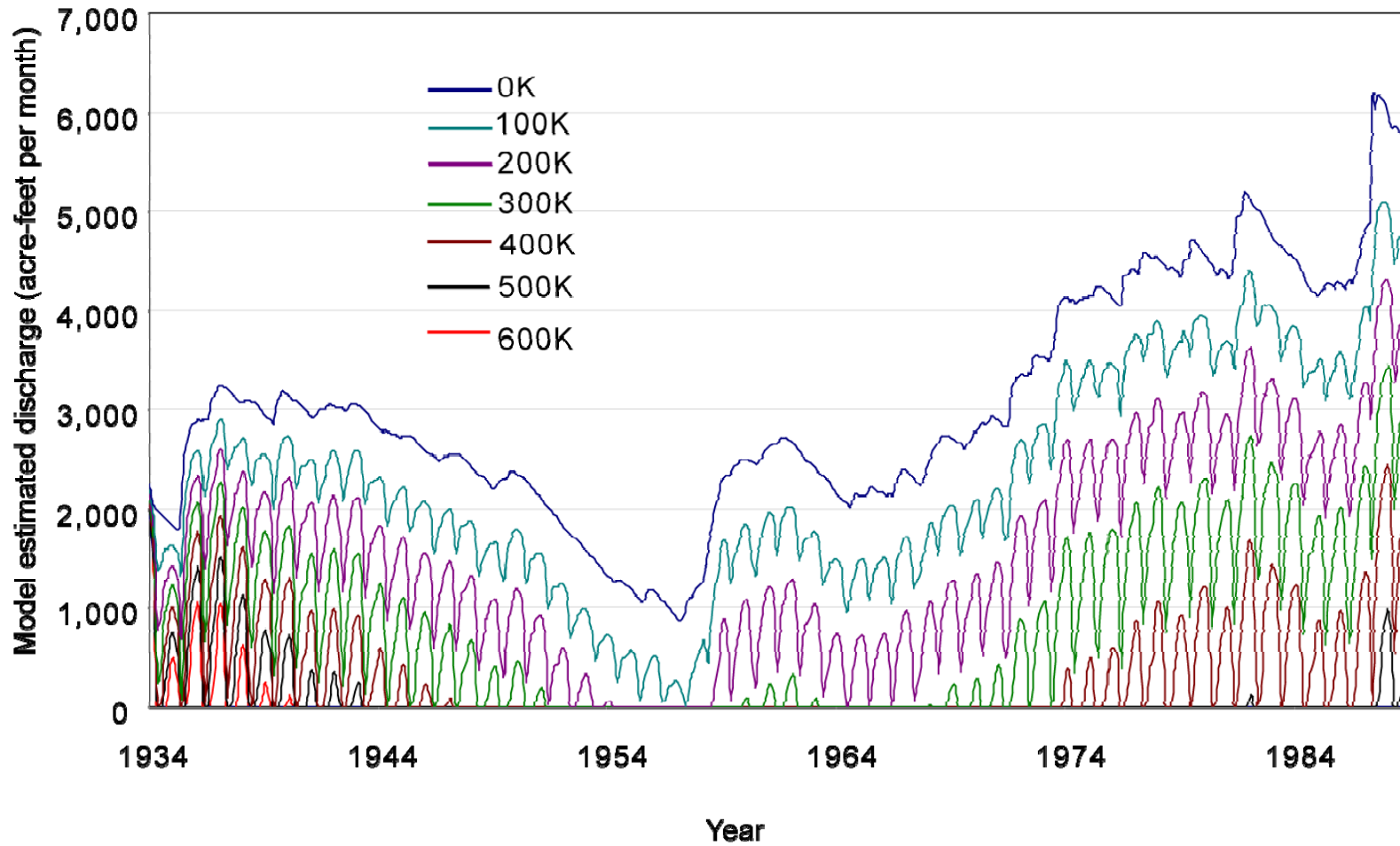


Figure 2. Model estimated discharge in Leona Springs at seven levels of fixed pumping: ranging from 0 (0K) through 600,000 (600K) acre-feet per year.