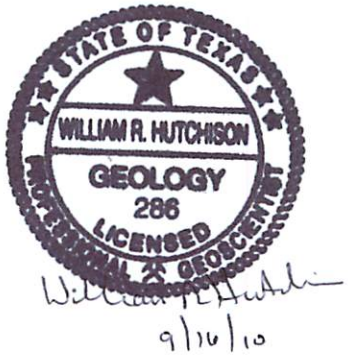
# GAM Task 10-006

**by William R. Hutchison, Ph.D, P.E., P.G.**
Texas Water Development Board
Groundwater Resources Division
(512) 463-5067
September 3, 2010

The seal appearing on this document was authorized by William R. Hutchison, P.E. 96287, P.G. 286 on September 3, 2010.

9/16/10



9/16/10

*This page is intentionally left blank*

## EXECUTIVE SUMMARY:

This report presents results of a GAM Task that was requested after a meeting of the Hudspeth County Underground Water Conservation District No. 1 Board of Directors on May 11, 2010. At that meeting, Texas Water Development Board staff presented a summary of the groundwater flow model of the Dell City area (Hutchison, 2008) in the context of the joint planning process. The documentation of that model included a series of predictive model runs under a variety of climatic and pumping scenarios.

This GAM Task report uses a subset of those simulation results to establish a relationship between groundwater pumping and aquifer drawdown after 50 years under average recharge conditions in the irrigated area of Dell City. Specifically, the request sought the net pumping in the irrigated area of Dell City under five alternative drawdown scenarios (0 foot, 5 feet, 10 feet, 15 feet and 20 feet). The following table summarizes the results

| Drawdown after 50 years (feet) | Net pumping (acre-feet per year) |
|---|---|
| 0 | 71,000 |
| 5 | 80,000 |
| 10 | 89,000 |
| 15 | 97,000 |
| 20 | 106,000 |

## ORIGIN OF TASK:

At the May 10, 2010 meeting of the Hudspeth County Underground Water Conservation District No. 1 (HCUWCD) Board of Directors, Texas Water Development Board staff presented a summary of the groundwater flow model of the Dell City area (Hutchison, 2008) in the context of the joint planning process. As a result of that meeting HCUWCD formally requested that the results of that model be used to assist in the establishment of a desired future condition of the Bone Spring-Victorio Peak Aquifer. On June 2, 2010, Janet Adams, on behalf of Groundwater Management Area 4, formally requested that previously published results of the groundwater flow model of the Dell City area be used to develop net pumping estimates associated with alternative desired future conditions in the irrigated area of Dell City under average recharge conditions.

## DESCRIPTION OF TASK:

The simulations completed as part the documentation of a groundwater flow model of the Dell City area (Hutchison, 2008) included the results of three separate models under a variety of climatic and pumping scenarios. This GAM Task report uses a subset of those model results to establish a relationship between groundwater pumping and aquifer drawdown after 50 years under average recharge conditions. Specifically, the request sought the net pumping in the irrigated area of Dell City under five alternative drawdown scenarios (0 foot, 5 feet, 10 feet, 15 feet and 20 feet).

The irrigated area of Dell City is presented in Figure 1. The irrigated area within the HCUWCD is about 53,000 acres. The model area was discretized into cells with dimensions of 2,000 feet by 2,000 feet (about 91 acres). The irrigated area within HCUWCD as shown in Figure 1 covers 580 cells.

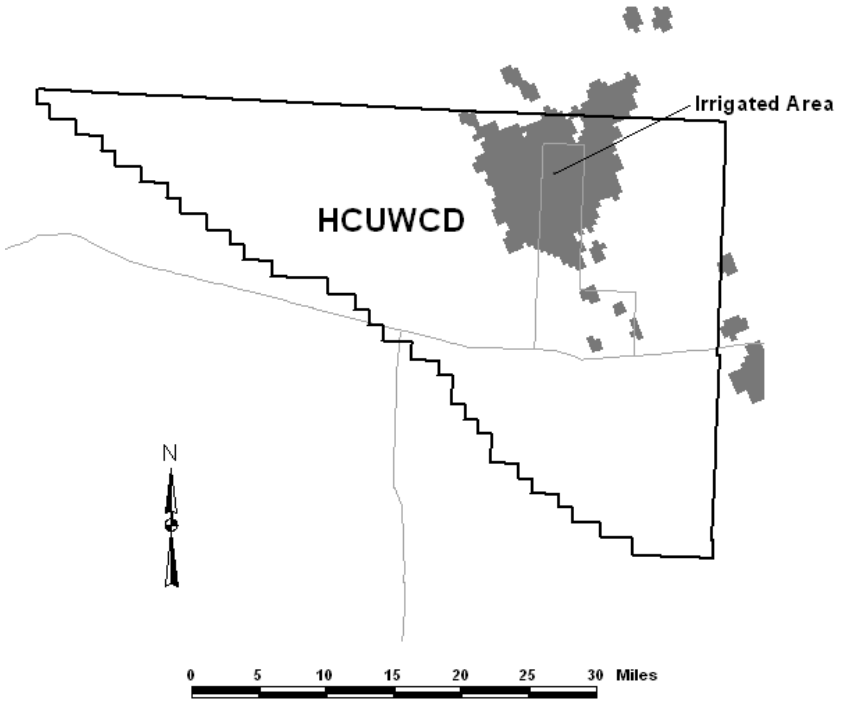



Figure 1. Irrigated area in the Hudspeth County Underground Water Conservation District No. 1 (HCUWCD) (from Hutchison, 2008)

## PARAMETERS AND ASSUMPTIONS:

- Three separate groundwater flow models were developed and documented (please refer to Hutchison (2008) for details of model development, calibration and application):
    - one based on flow paths conceptualized primarily on structural geology investigations
    - one based on isotope geochemical data of flow paths
    - a hybrid of the structural geology and isotope geochemistry based models.

- Each model has one layer representing the Bone Spring-Victorio Peak Aquifer, a portion of the Capitan Reef Aquifer, and other areas that contain groundwater (i.e. the Diablo Plateau).

- Calibration of the three models are summarized below using the average residual and the residual standard deviation divided by the range:

| Calibration statistic | Structural Geology Model | Isotope Geochemistry Model | Hybrid Model |
|---|---|---|---|
| **Average residual (feet)** | -0.73 | 1.13 | 1.85 |
| **Standard deviation of residuals divided by range** | 0.06 | 0.06 | 0.05 |

- Five alternative desired future conditions (expressed in terms of drawdown after 50 years) were evaluated.

- Initial conditions were specified as groundwater levels at the end of 2002 (the end of the calibration period of the model)

- Average recharge scenarios from Hutchison (2008) were used in the evaluation.

## RESULTS:

Results from Hutchison (2008) were used to develop estimates of net pumping over a range of alternative desired future conditions, expressed as drawdown after 50 years using end-of-2002 groundwater elevations as the initial condition for purposes of drawdown calculations. As described in Hutchison (2008), net pumping estimates were used in model calibration and application. Total pumping can be estimated by adding the net pumping and the estimated return flow from irrigation. As stated in the request, HCUWCD has requested estimates of net pumping. HCUWCD will provide an estimate of the return flow for later inclusion in total pumping estimates.

Figure 2 presents the results of the 144 simulations from Hutchison (2008) that include the three models described above, three "average" 50-year climatic scenarios based on tree-ring data from 1000 to 1988 (low, intermediate, and high variability) and 16 pumping scenarios. A best-fit line is also shown in Figure 2. This line has the equation:

$$\text{net pumping} = 1757.5*(\text{drawdown}) + 70{,}925$$

where: pumping in acre-feet per year
drawdown after 50 years in feet

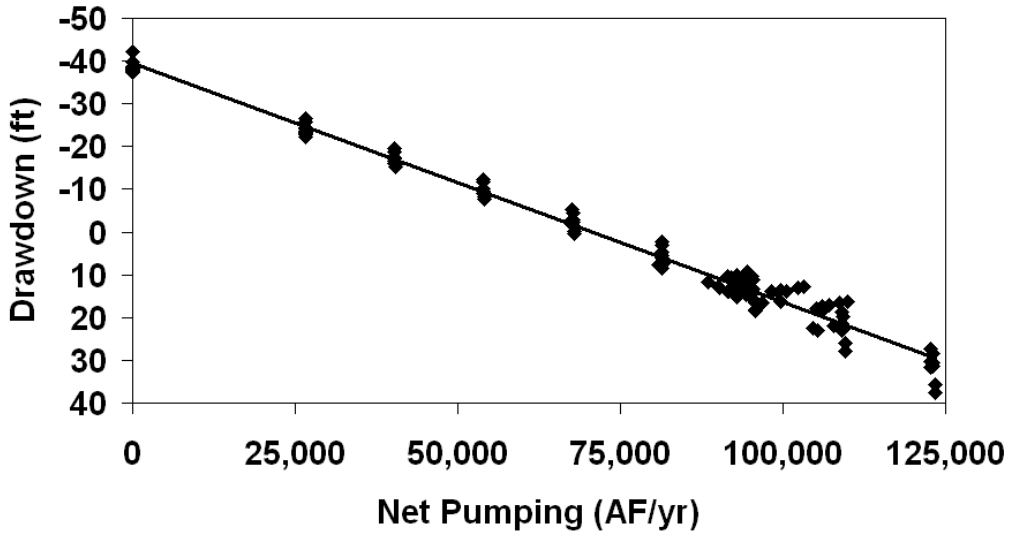



Figure 2. Net pumping (reported as acre-feet per year) versus 50-year average drawdown (reported in feet) in the irrigated area near Dell City under average recharge conditions. A negative drawdown indicates average rise in water levels.

Note that pumping scenarios below about 80,000, and above 110,000 acre-feet per year were simulated only as constant pumping and the collection of results appear as slight variations in drawdown for a given level of pumping. Pumping scenarios between about 90,000 and 110,000 acre-feet per year included simulations of constant pumping and simulations that included pumping reduction scenarios that include the approach used by HCUWCD and variations of that approach (please refer to Hutchison, 2008 for details).

Based on the regression equation presented above, estimates of net pumping for the requested alternative desired future conditions are presented below. Note that pumping amounts are rounded to the nearest thousand.

| **Drawdown after 50 years (feet)** | **Net pumping (acre-feet per year)** |
|---|---|
| 0 | 71,000 |
| 5 | 80,000 |
| 10 | 89,000 |
| 15 | 97,000 |
| 20 | 106,000 |

**REFERENCE:**

Hutchison, W.R., 2008. Preliminary Groundwater Flow Model, Dell City Area, Hudspeth and Culberson Counties, Texas. El Paso Water Utilities Hydrogeology Report 08-01, July 2008, 435 p.