# GAM run 06-11

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## REQUESTOR:

Mr. Lee Sweeten, Real-Edwards Conservation and Reclamation District (District).

## DESCRIPTION OF REQUEST:

Mr. Sweeten requested that we run the Edwards-Trinity (Plateau) aquifer groundwater availability model (GAM) to provide him with the input numbers for his district's management plan. The management plan requires recharge from precipitation, surface-water inflow, surface-water outflow, inflow into the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower). In addition to District totals, Mr. Sweeten also requested values for these same parameters for each county (Real and Edwards) in the District.

## METHODS:

To address the request, we:

- ran the transient GAM for the Edwards-Trinity(Plateau) aquifer and extracted water budgets for each year of the 1980 through 1999 period and

- averaged the twenty-year period for recharge, surface water inflow, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper) and net inter-aquifer flow (lower).

## PARAMETERS AND ASSUMPTIONS:

- In the analysis, the pumpage distribution is the same as for the transient calibrated model described in Anaya and Jones (2004).

- The root mean squared error (a measure of the difference between simulated and actual water levels during model calibration) in the entire Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium GAM for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2004).

- The model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2) in the Real-Edwards Conservation and Reclamation District.

## RESULTS:

Water budgets for Real-Edwards Conservation and Reclamation District are presented in Tables one to nine. These tables show the average annual flow, in acre-feet, of water into (Inflow) and out of (Outflow) each aquifer in the GAM for the Edwards-Trinity (Plateau) aquifer in each county for the years 1980 to 1999. The components of the budgets shown in Tables one to nine include:

- Springs and seeps—This is water that drains from an aquifer if water levels are above the elevation of the spring or seep. This component is always shown as "Outflow", or discharge, from an aquifer. Springs and seeps are modeled in the GAM for the Edwards-Trinity (Plateau) aquifer using the MODFLOW Drain package, and are found along the margins of the aquifer, primarily in the northern and eastern parts of the modeled region.

- Wells—This is water produced from wells in each aquifer. In the GAM for the Edwards-Trinity (Plateau) aquifer, this component is always shown as "Outflow" from an aquifer, because all wells included in the GAM produce (rather than inject) water. Wells are modeled in the GAM for the Edwards-Trinity (Plateau) aquifer using the MODFLOW Well package.

- Recharge—This component simulates areally distributed recharge due to precipitation falling on the outcrop areas of aquifers. Recharge is always shown as "Inflow" into an aquifer. This component does not include runoff from precipitation events that may later recharge an aquifer as stream losses, which is included in the model using the stream package, described above. Recharge is modeled in the GAM for the Edwards-Trinity (Plateau) aquifer using the MODFLOW Recharge package.

- Storage—This component is water stored in the aquifer. The storage component that is included in "Inflow" is water that is removed from storage in the aquifer (that is, water levels decline). The storage component that is included in "Outflow" is water that is added back into storage in the aquifer (that is, water levels increase). This component of the budget is often seen as water both going into and out of the aquifer because this is a county-wide budget, and water levels will decline in some areas (water is being removed from storage) and will rise in others (water is being added to storage).

- Lateral flow between counties—This component describes lateral flow within an aquifer between Real and Edwards and adjacent counties.

It is important to note that sub-regional water budgets for individual counties, such as Real and Edwards County, are not exact. This is due to the one-mile spacing of the model grid and because we assumed each model cell is assigned to a single county. The water budgets for an individual cell containing a county boundary are assigned to either one county or the other and therefore very minor variations in the county-wide budgets may be observed.

## REFERENCES:

Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p.

Table 1. Summary of average annual water budgets for the Edwards aquifer in Edwards County for 1980 to 1999. Flows reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Flow Parameter | Total Inflow—Edwards aquifer | Total Outflow—Edwards aquifer |
|---|---|---|
| Springs and Seeps | 0 | 5,425 |
| Wells | 0 | 820 |
| Streams | 10,440 | 36,364 |
| Recharge | 75,133 | 0 |
| Storage | 3,084 | 5,045 |

Table 2. Summary of average lateral flows for the Edwards Formation in Edwards County for 1980 to 1999. Flows are reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Counties Contributing Flow within the Edwards aquifer | Total Inflow Edwards County–Edwards aquifer | Total Outflow Edwards County--Edwards aquifer |
|---|---|---|
| Kerr | 1,412 | 1,177 |
| Kimble | 2,252 | 3,454 |
| Kinney | 1,524 | 15,974 |
| Real | 667 | 1,337 |
| Sutton | 3,308 | 2,280 |
| Uvalde | 1 | 464 |
| Val Verde | 22 | 20,881 |
| Edwards | 3 | 4,655 |

Table 3. Summary of average annual water budgets for the Trinity aquifer in Edwards County for 1980 to 1999. Flows reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Flow Parameter | Total Inflow--Trinity aquifer | Total Outflow--Trinity aquifer |
|---|---|---|
| Springs and Seeps | 0 | 0 |
| Wells | 0 | 96 |
| Streams | 2,222 | 1,374 |
| Recharge | 3,221 | 0 |
| Storage | 256 | 527 |

Table 4. Summary of average lateral flows for the Trinity aquifer in Edwards County for 1980 to 1999. Flows are reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Counties Contributing Flow within the Trinity aquifer | Total Inflow Edwards County--Trinity aquifer | Total Outflow Edwards County—Trinity aquifer |
|---|---|---|
| Edwards Co | 4,655 | 3 |
| Kerr | 85 | 342 |
| Kimble | 898 | 387 |
| Kinney | 0 | 10,045 |
| Real | 3,848 | 3,971 |
| Sutton | 4,350 | 0 |
| Uvalde | 0 | 2,848 |
| Val Verde | 3,343 | 3,282 |

Table 5. Summary of average annual water budgets for the Edwards aquifer in Real County for 1980 to 1999. Flows reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Flow Parameter | Total Inflow Real County--Edwards aquifer | Total Outflow Real County--Edwards aquifer |
|---|---|---|
| Springs and Seeps | 0 | 10,492 |
| Wells | 0 | 150 |
| Streams | 259 | 6,104 |
| Recharge | 13,656 | 0 |
| Storage | 494 | 655 |

Table 6. Summary of average lateral flows for the Edwards aquifer in Real County for 1980 to1999. Flows are reported in acre-feet per year. Values are probably only accurate to two significant figures.

| Counties Contributing Flow within the Edwards aquifer | Total Inflow Real County–Edwards aquifer | Total Outflow Real County--Edwards aquifer |
|---|---|---|
| Bandera | 1,505 | 35 |
| Edwards | 1,337 | 667 |
| Kerr | 3,489 | 702 |
| Uvalde | 0 | 1,229 |
| Real | 26 | 731 |

Table 7 Summary of average annual water budgets for the Trinityaquifer in Real County for 1980 to 1999. Flows reported in acre-feet per year. Values are probably only accurate to two significant figures.

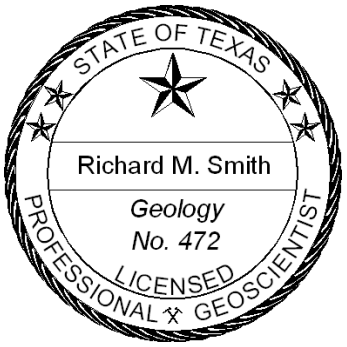
| Flow Parameter | Total Inflow Real County–Trinity aquifer | Total Outflow Real County–Trinity aquifer |
|---|---|---|
| Springs and Seeps | 0 | 0 |
| Wells | 0 | 396 |
| Streams | 6,626 | 2,553 |
| Recharge | 9,784 | 0 |
| Storage | 717 | 876 |

Table 8. Summary of average lateral flows for the Trinity aquifer in Real County for 1980 to 1999. Flows are reported in acre-feet per year. Values are probably only accurate to two significant figures

| Counties Contributing Flow within the Trinity aquifer | Total Inflow Real County–Trinity aquifer | Total Outflow Real County–Trinity aquifer |
|---|---|---|
| Bandera | 731 | 26 |
| Edwards | 2,566 | 4,154 |
| Kerr | 3,971 | 3,848 |
| Uvalde | 1,239 | 459 |
| Real | 0 | 13,317 |

Table 9. Summary of flows for the Real-Edwards Conservation and Reclamation District in acre-feet per year

| Aquifer | Edwards Aquifer (Plateau) | Trinity Aquifer (Plateau) |
|---|---|---|
| Precipitation recharge | 85,393 | 12,663 |
| Average Surface water inflow | 10,894 | 8,861 |
| Average Surface water outflow | 57,336 | 3,863 |
| Average flow into district | 13,435 | 12,465 |
| Average flow out of district | 45,854 | 34,791 |
| Net flow from Edwards(upper) | 0 | 5,294 |
| Net flow to Trinity (lower) | -5,294 | 0 |

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