

# GAM run 05-18

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Groundwater Availability Modeling Section  
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April 29, 2005

## REQUESTOR:

Lonnie Stewart, Bee Groundwater Conservation District, Live Oak Underground Water Conservation District, and McMullen Groundwater Conservation District

## DESCRIPTION OF REQUEST:

Mr. Stewart requested the following information from the groundwater availability model (GAM) of the southern part of the Queen City-Sparta and Carrizo-Wilcox aquifer systems (Kelley and others, 2004):

- Water budget in Bee, Live Oak, and McMullen counties.

## METHODS:

To address the request, we:

- ran the GAM for the southern part of the Queen City and Sparta aquifers which includes the Carrizo-Wilcox system and queried the budget files for each model layer in Bee, Live Oak, and McMullen counties for the years 2010 and 2020 with long-term average recharge.

## PARAMETERS AND ASSUMPTIONS:

We used the following assumptions in this analysis:

- see Deeds and others (2003) for additional information concerning the Carrizo-Wilcox aquifer and Kelley and others (2004) for Queen City and Sparta aquifer assumptions and limitations;
- the pumpage is based on the 2002 Regional Water Plan demands; and
- recharge represents average conditions for the predictive period.

## **RESULTS:**

### **Water budget**

Table 1 shows the water budget for Bee, Live Oak, and McMullen counties for 2010 and 2020.

The Queen City-Sparta and Carrizo-Wilcox aquifer systems have no outcrop area in the three counties; therefore, the direct infiltration recharge is zero in Table 1. There is a small amount of positive downward flow from younger sediments listed in the “GHB in” column.

Some groundwater conservation districts also include cross-formational flow in their total recharge estimate. Texas Water Development Board (TWDB) rules concerning groundwater management plan certification define recharge as "The addition of water from precipitation or runoff by seepage or infiltration to an aquifer from the land surface, streams, or lakes directly into a formation or indirectly by way of leakage from another formation." We show infiltration from land surface in the recharge column in Table 1. We also show cross-formational leakage into the aquifers in Table 1 in the columns “upper Z flow in and lower Z flow in.”

## **REFERENCES:**

- Deeds, N., Kelley, V., Fryar, D., and Jones, T., 2003, Groundwater Availability Model for the Southern Carrizo-Wilcox Aquifer: Final Report prepared for the Texas Water Development Board by INTERA Inc.
- Kelley, V. A., Deeds, N. E., Fryar, D. G., Nicot, J. P., Jones, T. L., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin J. L., 2004, Groundwater availability model for the Queen City and Sparta aquifers: Final report prepared for the Texas Water Development Board by INTERA Inc.

Table 1. 2010 and 2020 flow budget for Bee, Live Oak, and McMullen counties based on the GAM for the central part of the Queen City and Sparta and Carrizo-Wilcox aquifer systems (values in acre-feet per year for average recharge conditions).

County	Lyr	Change in Storage	X-flow in	X-flow out	upper		lower		Wells	Recharge	ET	Streams	GHB in	GHB out	Total	
					Z flow in	Z flow out	Z flow in	Z flow out							In	Out
<b>2010</b>																
<b>Bee</b>	1	3	2	-1	0	0	27	-44	0	0	0	0	44	-31	76	-76
	2	3	17	-48	44	-27	17	-5	0	0	0	0	0	0	81	-80
	3	9	2	-2	5	-17	8	-5	0	0	0	0	0	0	25	-25
	4	11	31	-47	5	-8	8	0	0	0	0	0	0	0	55	-55
	5	6	188	-169	0	-8	6	-3	-20	0	0	0	0	0	200	-200
	6	7	12	-8	3	-6	12	0	-20	0	0	0	0	0	34	-34
	7	5	25	-9	0	-12	11	0	-20	0	0	0	0	0	41	-41
	8	-95	260	-134	0	-11	0	0	-20	0	0	0	0	0	260	-260
	All	-51	537	-418	57	-89	89	-57	-80	0	0	0	44	-31	772	-771
<b>Live Oak</b>	1	148	23	-16	0	0	602	-1	0	0	0	0	4	-760	778	-778
	2	46	91	-47	1	-602	511	0	0	0	0	0	0	0	649	-649
	3	340	16	-91	0	-511	246	-1	0	0	0	0	0	0	602	-602
	4	64	93	-112	1	-246	200	-1	0	0	0	0	0	0	358	-358
	5	16	1,001	-578	1	-200	27	-93	-173	0	0	0	0	0	1,045	-1,044
	6	27	36	-190	93	-27	62	0	0	0	0	0	0	0	219	-219
	7	-16	59	-41	0	-62	59	0	0	0	0	0	0	0	128	-128
	8	-428	797	-310	0	-59	0	0	0	0	0	0	0	0	797	-797
	All	197	2,116	-1,385	96	-1,707	1,707	-96	-173	0	0	0	4	-760	4,576	-4,575
<b>McMullen</b>	1	256	403	-488	0	0	2,046	-224	-97	0	0	0	623	-2,519	3,342	-3,342
	2	60	83	-92	224	-2,046	1,960	-189	0	0	0	0	0	0	2,330	-2,330
	3	797	943	-671	189	-1,960	901	-164	-36	0	0	0	0	0	2,912	-2,912
	4	-8	222	-71	164	-901	810	-216	0	0	0	0	0	0	1,234	-1,234
	5	-217	3,687	-1,295	216	-810	762	-322	-2,022	0	0	0	0	0	4,669	-4,669
	6	-318	867	-167	322	-762	81	-13	-10	0	0	0	0	0	1,316	-1,316
	7	-175	151	-37	13	-81	138	-1	-8	0	0	0	0	0	302	-302
	8	-842	1,218	-232	1	-138	0	0	-6	0	0	0	0	0	1,219	-1,219
	All	-447	7,574	-3,053	1,129	-6,698	6,698	-1,129	-2,179	0	0	0	623	-2,519	17,324	-17,324

County	Lyr	Change in Storage	X-flow in	X-flow out	upper		lower		Wells	Recharge	ET	Streams	GHB in	GHB out	Total	
					Z flow in	Z flow out	Z flow in	Z flow out							In	Out
<b>2020</b>																
<b>Bee</b>	1	6	2	-1	0	0	24	-46	0	0	0	0	45	-30	77	-77
	2	3	16	-52	46	-24	17	-6	0	0	0	0	0	0	82	-82
	3	12	2	-3	6	-17	8	-7	0	0	0	0	0	0	27	-27
	4	11	29	-50	7	-8	11	0	0	0	0	0	0	0	58	-58
	5	7	173	-155	0	-11	8	-2	-20	0	0	0	0	0	188	-188
	6	9	11	-7	2	-8	13	0	-20	0	0	0	0	0	35	-35
	7	2	23	-8	0	-13	15	0	-20	0	0	0	0	0	41	-41
	8	-84	249	-130	0	-15	0	0	0	-20	0	0	0	0	249	-249
	All	-34	505	-406	61	-96	96	-61	-80	0	0	0	0	45	-30	757
<b>Live Oak</b>	1	118	23	-17	0	0	581	-2	0	0	0	0	5	-708	727	-727
	2	36	97	-49	2	-581	495	0	0	0	0	0	0	0	630	-630
	3	259	18	-98	0	-495	316	0	0	0	0	0	0	0	593	-593
	4	59	97	-119	0	-316	278	0	0	0	0	0	0	0	434	-434
	5	33	980	-539	0	-278	36	-59	-173	0	0	0	0	0	1,049	-1,049
	6	34	43	-171	59	-36	72	0	0	0	0	0	0	0	207	-207
	7	-25	54	-38	0	-72	80	0	0	0	0	0	0	0	139	-139
	8	-377	758	-301	0	-80	0	0	0	0	0	0	0	0	758	-758
	All	137	2,070	-1,332	61	-1,858	1,858	-61	-173	0	0	0	0	5	-708	4,537
<b>McMullen</b>	1	101	416	-487	0	0	2,052	-199	-93	0	0	0	643	-2,433	3,227	-3,227
	2	23	88	-91	199	-2,052	1,995	-160	0	0	0	0	0	0	2,308	-2,308
	3	297	1,004	-689	160	-1,995	1,312	-60	-29	0	0	0	0	0	2,849	-2,849
	4	-4	237	-76	60	-1,312	1,208	-113	0	0	0	0	0	0	1,523	-1,523
	5	-66	3,979	-1,464	113	-1,208	849	-216	-1,988	0	0	0	0	0	4,947	-4,947
	6	-157	903	-160	216	-849	84	-27	-9	0	0	0	0	0	1,207	-1,207
	7	-236	160	-29	27	-84	169	0	-7	0	0	0	0	0	356	-356
	8	-851	1,221	-197	0	-169	0	0	0	-5	0	0	0	0	1,221	-1,221
	All	-893	8,008	-3,193	775	-7,669	7,669	-775	-2,131	0	0	0	0	643	-2,433	17,638

Notes:

Layer 1: Sparta aquifer

Layer 2: Weches Formation

Layer 3: Queen City aquifer

Layer 4: Reklaw Formation

Layer 5: Carrizo sand

Layer 6: Upper Wilcox formation

Layer 7: Middle Wilcox formation

Layer 8: Lower Wilcox formation

All: sum of layers

1. **Change in Storage** refers to water that is extracted from storage or added to storage.  
A positive number means water is extracted from storage. A negative number means water is added to storage.
2. **GHB** refers to flow into or out of the top of the Sparta from younger sediments.
3. **ET** refers to groundwater extraction due to evapotranspiration.
4. **X-flow in** refers to lateral flow into the county.
5. **X-flow out** refers to lateral flow out of the county.
6. **upper - Z-flow in** refers to flow into the layer from the layer above.
7. **upper - Z-flow out** refers to flow out of the layer into the layer above.
8. **lower - Z-flow in** refers to flow into the layer from the layer below.
9. **lower - Z-flow out** refers to flow out of the layer into the layer below.
10. **Wells** is for pumping.
11. A negative sign refers to flow out of the layer in the county.
12. A positive sign refers to flow into the layer in the county.
13. The numbers are rounded to the nearest 1 acre-foot. Values in the water budget are probably only accurate to two significant figures.