

GTA Aquifer Assessment 07-05mag

by **Robert G. Bradley, P.G.**

Texas Water Development Board
Groundwater Technical Assistance Section
(512) 936-0870
July 10, 2008

REQUESTOR:

Cheryl Maxwell, of the Clearwater Underground Water Conservation District acting on behalf of Groundwater Management Area 8.

DESCRIPTION OF REQUEST:

In a letter dated December 26, 2007, Ms. Cheryl Maxwell provided the Texas Water Development Board (TWDB) with the desired future conditions for the Edwards (Balcones Fault Zone), Blossom, Brazos River Alluvium, Nacatoch, and Woodbine aquifers in Groundwater Management Area 8 and requested that TWDB estimate managed available groundwater values. This aquifer analysis presents the managed available groundwater for the Brazos River Alluvium Aquifer in Groundwater Management Area 8.

DESIRED FUTURE CONDITIONS:

- Maintain approximately 90 percent of the estimated saturated thickness after 50 years in Milam County.
- Maintain approximately 100 percent of the saturated thickness after 50 years in Falls County.
- Maintain approximately 82 percent of the estimated saturated thickness after 50 years in McLennan County.
- Maintain approximately 90 percent of the estimated saturated thickness after 50 years in Hill and Bosque counties.

METHODS:

The desired future conditions requested for the Brazos River Alluvium Aquifer were based on maintaining a percentage of the estimated saturated thickness left in 50 years.

The aquifer was subdivided by county and groundwater conservation district boundaries. The areal extent of each aquifer subdivision was calculated. These areas were used to calculate estimated recharge and pumped volumes.

To determine the volume from storage used, the areas were multiplied by the estimated aquifer specific yield, and then by the percent of drained saturated

thickness necessary to maintain the desired future condition. This volume was then divided by 50 years to obtain a yearly volume.

Recharge to the aquifer was calculated by multiplying each area by the average precipitation and an estimated recharge rate.

Water-level data from the TWDB groundwater database was used to calculate average saturated thickness. Shah and Houston (2007) provided raster surface elevations for the top and bottom of the Brazos River Alluvium. Every water level measurement was assigned an elevation from the top of aquifer data. The base of aquifer elevations at every well were subtracted from the water level elevations. This resulted in a saturated thickness for every water-level measurement for the aquifer. Average saturated thickness was determined by averaging all saturated thickness estimates within an aquifer subdivision.

The calculations were done in a Microsoft Excel worksheet.

PARAMETERS AND ASSUMPTIONS:

- The Brazos River Alluvium Aquifer in GMA 8 is wholly contained in the Brazos River Basin and the Brazos G Regional Water Planning Group boundaries.
- The average total thickness of the Brazos River Alluvium is 28 feet in Bosque and Falls counties, combined; 33 feet in McLennan and Falls counties, individually; and 55 feet in Milam County (Shah and Houston (2007)).
- Estimated saturated thickness of 35 feet in the GMA 8 submission is overestimated based on data from Shah and Houston (2007).
- The areas for each subdivision were calculated from the Texas Water Development Board (TWDB) shapefile for the Brazos River Alluvium, projected into the GAM projection (Anaya, 2001).
- Areas, in acres, were calculated within ArcGIS 9.2.
- Average annual precipitation was used to calculate recharge volumes.
- The average annual precipitation for the aquifer area was determined from the Texas Climatic Atlas (Narasimhan and others, 2008).
- Average annual precipitation was estimated to be 35 inches for Bosque, Hill and McLennan counties, and 37 inches for Falls and Milam counties (Table 1).
- Recharge from precipitation is estimated to be 7.5 percent of annual precipitation (Williams, 2007; Cronin and Wilson, 1967).
- An average saturated thickness for each aquifer subdivision is used to make volume calculations.
- Bosque and Falls counties were combined to determine aquifer thickness and average saturated thickness.
- The managed available groundwater volume estimates are the amount that is depleted from the aquifer to maintain the desired future condition.

- Annual volumes are calculated by dividing the total volume by 50 years.
- Total annual managed available groundwater is calculated by adding the annual volume to the recharge volume.
- Specific yield of the aquifer is estimated to be 0.15 (Cronin and Wilson, 1967, pp.2, 27).

RESULTS:

The recharge estimate for the Brazos River Alluvium Aquifer in GMA 8 is 33,042 acre-feet per year.

The volume of water available in the Brazos River Alluvium Aquifer for the counties in Groundwater Management Area 8 were confirmed to meet the desired future conditions developed by groundwater conservation districts in Groundwater Management Area 8. The results (Figure 1, Tables 2 and 3) show 33,644 acre-feet per year of managed available groundwater for the Brazos River Alluvium Aquifer in Groundwater Management Area 8. Under the authority of the McLennan County Groundwater Conservation District, the county has 15,023 acre-feet per year of managed available groundwater in the Brazos River Alluvium Aquifer. Post Oak Savannah Groundwater Conservation District has 475 acre-feet per year. In the remainder of the aquifer, Bosque, Hill, and Falls Counties have a total of 18,146 acre-feet per year of managed available groundwater.

Table 1. Estimated total annual recharge volume for the Brazos River Alluvium Aquifer by geographic subdivisions (See Figure 1).

| GMA | Aquifer | County | GCD | Map area | Areal extent (acres) | Average precipitation (inches) | Average precipitation (feet) | Recharge rate (percent) | Estimated annual recharge (acre-feet) |
|-------|-----------------------|----------|-----------------------|----------|----------------------|--------------------------------|------------------------------|-------------------------|---------------------------------------|
| 8 | Brazos River Alluvium | Bosque | None | 1 | 3,752 | 35 | 2.9 | 7.5 | 821 |
| | | Hill | None | 2 | 952 | 35 | 2.9 | 7.5 | 208 |
| | | | | 3 | 1,907 | 35 | 2.9 | 7.5 | 417 |
| | | McLennan | McLennan GCD | 4 | 66,047 | 35 | 2.9 | 7.5 | 14,448 |
| | | Falls | None | 5 | 72,146 | 37 | 3.1 | 7.5 | 16,684 |
| | | Milam | Post Oak Savannah GCD | 6 | 2,005 | 37 | 3.1 | 7.5 | 464 |
| Total | | | | | | | | | 33,042 |

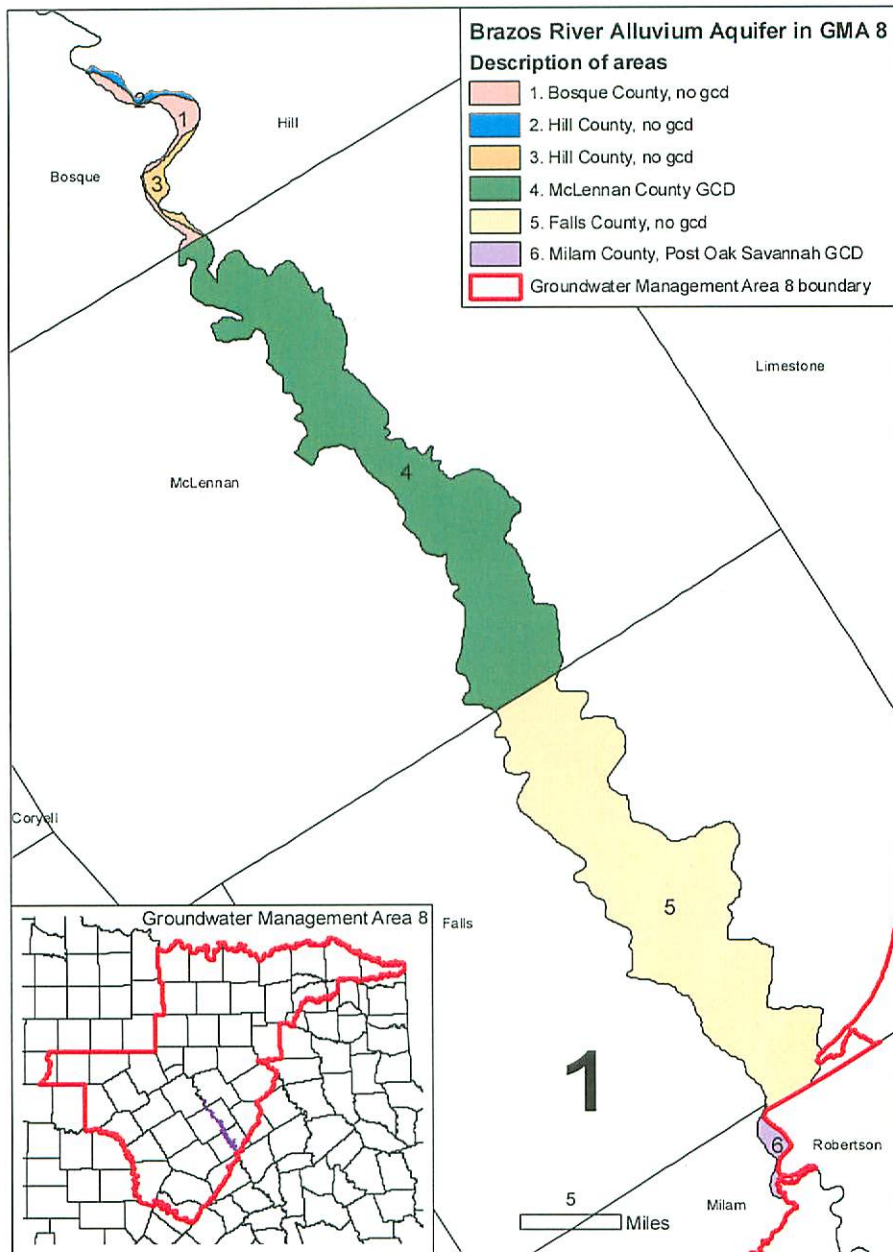


Figure 1. Geographic subdivisions for analyzing managed available groundwater the Brazos River Alluvium Aquifer in groundwater management area 8.

Table 2. Estimates of managed available groundwater for the Brazos River Alluvium Aquifer by geographic subdivisions (see Figure 1).

| GMA | Aquifer | County | GCD | Map area | Specific yield | Areal extent (acres) | Estimated saturated thickness (feet) | Desired future percent of saturated thickness | Desired future saturated thickness (feet) | Saturated thickness drained (feet) | Estimated total volume from storage (acre-feet) | Estimated annual volume from storage (acre-feet) | Estimated annual recharge (acre-feet) | Estimated Annual Total Volume (acre-feet) | |
|--------------|-----------------------|----------|-----------------------|----------|----------------|----------------------|--------------------------------------|---|---|------------------------------------|---|--|---------------------------------------|---|--------|
| 8 | Brazos River Alluvium | Bosque | None | 1 | 0.15 | 3,752 | 8 | | 90 | 7.2 | 450 | 9 | 821 | 830 | |
| | | Hill | None | 2 | 0.15 | 952 | 8 | | 90 | 7.2 | 114 | 2 | 208 | 210 | |
| | | | | 3 | 0.15 | 1,907 | 8 | | 90 | 7.2 | 229 | 5 | 417 | 422 | |
| | | McLennan | McLennan GCD | 4 | 0.15 | 66,047 | 16 | | 82 | 13.1 | 2.9 | 28,730 | 575 | 14,448 | 15,023 |
| | | Falls | None | 5 | 0.15 | 72,146 | 30 | | 100 | 30.0 | 0.0 | 0 | 0 | 16,684 | 16,684 |
| | | Milam | Post Oak Savannah GCD | 6 | 0.15 | 2,005 | 19 | | 90 | 17.1 | 1.9 | 571 | 11 | 464 | 475 |
| Total | | | | | | | | | | | | 602 | 33,042 | 33,644 | |

Table 3. Estimates of managed available groundwater for the Brazos River Alluvium Aquifer (See Figure 1).

| Aquifer | Map Key | County | RWPA | River Basin | GCD | GMA | GeoArea | Year | MAG (acre-feet per year) |
|-----------------------|---------|----------|------|-------------|--------|-----|----------|------|-----------------------------|
| Brazos River Alluvium | 1 | Bosque | G | Brazos | None | 8 | Bosque | n/a | 830 |
| Brazos River Alluvium | 2 | Hill | G | Brazos | None | 8 | Hill | n/a | 210 |
| Brazos River Alluvium | 3 | Hill | G | Brazos | None | 8 | Hill | n/a | 422 |
| Brazos River Alluvium | 4 | McLennan | G | Brazos | MCGCD | 8 | McLennan | n/a | 15,023 |
| Brazos River Alluvium | 5 | Falls | G | Brazos | None | 8 | Falls | n/a | 16,684 |
| Brazos River Alluvium | 6 | Milam | G | Brazos | POSGCD | 8 | Milam | n/a | 475 |

GCD = Groundwater conservation district.

GeoArea = Geographic areas defined by unique desired future conditions as specified by a groundwater management area.

GMA = Groundwater management area.

MAG = Managed available groundwater in units of acre-feet per year.

MCGCD = McLennan County Groundwater Conservation District

POSGCD = Post Oak Savannah Groundwater Conservation District

RWPA = Regional water planning area.

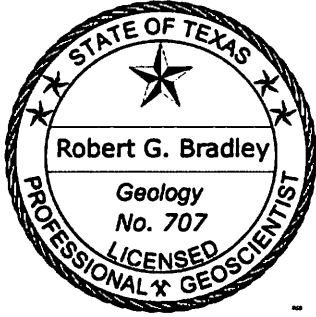
STIPULATIONS:

Additional data are needed to create improved estimates; however, these estimates are a simplistic interpretation of the requested conditions. These solutions assume homogeneous and isotropic aquifers; however, conditions for the Brazos River Alluvium may not behave in a uniform manner. Recharge is the largest variable and most influential variable used in these calculations.

Please note that estimates of managed available groundwater are based on the best available scientific tools that can be used to evaluate managed available groundwater and that these estimates may be based on assumptions made on the magnitude and distribution of pumping in the aquifer. Therefore, it is important for groundwater conservation districts to monitor whether or not their management of pumping is achieving their desired future conditions. Districts are encouraged to work with the Texas Water Development Board to better define available groundwater as better evidence becomes available for how the aquifer responds to the actual magnitude and distribution of pumping now and in the future.

REFERENCES:

- Anaya, R., 2001, GAM technical memo 01-01(rev a): Texas Water Development Board technical memorandum, 2p.
- Cronin, J., and Wilson, C., 1967, Ground water in the flood plain alluvium of the Brazos River, Whitney Dam to the vicinity of Richmond, Texas: Texas Water Development Board Report 41, 80p.
- Shah, S.D., and Houston, N.A., 2007, Geologic and Hydrogeologic Information for a Geodatabase for the Brazos River Alluvium Aquifer, Bosque County to Fort Bend County, Texas: U.S. Geological Survey Open-File Report 2007-1031, version 3, 10p.
- Narasimhan, B., Srinivasan, R., Quiring, S., and Nielsen-Gammon, J.W., 2008, Digital Climatic Atlas of Texas: Texas A&M University, Texas Water Development Board Contract, Report 2005-483-5591, 108p.
- Williams, C.R, 2007, Adopted desired future conditions of minor aquifers: memorandum to Cheryl Maxwell, Groundwater Management Area 8, 19p.



The seal appearing on this document was authorized by Robert G. Bradley, P.G., on July 10, 2008.



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November 7, 2008

Mr. Scott Mack, Chair
Region G
108 N. Cranbrook Court
Ingram, Texas 78025

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Mr. Mack:

The Texas State Water Code, Section 36.108, Subsection (o), states that Texas Water Development Board's executive administrator shall provide each district and regional water planning group located wholly or partly within a groundwater management area with the managed available groundwater in the management area based upon the desired future condition of the groundwater resource. This letter and the attached report (GTA Aquifer Assessment 07-05mag) are in response to this directive.

As noted in your letter dated December 26, 2007, the submitted desired future condition for the northern segment of the Brazos River Alluvium Aquifer in Groundwater Management Area 8 was as follows:

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Managed available groundwater is defined in the Texas Water Code as the amount of water that may be permitted by a district for beneficial use in accordance with the desired future condition of the aquifer as determined under Texas Water Code, Section 36.108. For various planning purposes, the managed available groundwater estimates have been reported at the combined aquifer, county, river basin, regional water planning area, groundwater management area, groundwater conservation district (if applicable), and geographic area/subdivision (if designated) level.

We understand that groundwater conservation districts have options on how to distribute managed available groundwater in a groundwater management area; therefore, we encourage open communication and coordination between groundwater conservation districts, regional water planning

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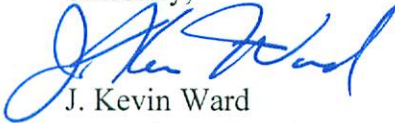
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Therefore, it is important for groundwater conservation districts to monitor whether or not their management of pumping is achieving their desired future conditions. Districts are encouraged to work with the TWDB to better define available groundwater as better data becomes available for how the aquifer responds to the actual magnitude and distribution of pumping now and in the future.

Sincerely,



J. Kevin Ward
Executive Administrator

Attachment: GTA Aquifer Assessment 07-05mag

- c: Cary Betz, Texas Commission of Environmental Quality, Water Supply Division
Kelly Mills, Texas Commission of Environmental Quality, Groundwater Planning and Assessment Division
Carolyn Brittin, Deputy Executive Administrator, TWDB, Water Resources Planning and Information Division
Bill Mullican, Deputy Executive Administrator, TWDB, Water Science and Conservation
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Robert Bradley, P.G., TWDB, Groundwater Technical Assistance Section
David Dunn, HDR Engineering



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November 7, 2008

Ms. Tricia Law
McLennan County Groundwater Conservation District
3015 Bellmead Drive
Waco, Texas 76705

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Ms. Law:

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November 7, 2008

Mr. Richard Bowers, General Manager
Central Texas Groundwater Conservation District
P.O. Box 870
Burnet, Texas 78611

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in
Groundwater Management Area 8

Dear Mr.  Bowers:

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November 7, 2008

Ms. Cheryl Maxwell, General Manager
Clearwater Underground Water Conservation District
P.O. Box 729
Belton, Texas 76513

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in
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Dear Ms. Maxwell:

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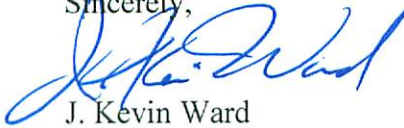


Clearwater Underground Water Conservation District
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November 7, 2008

Mr. Rodney Carlisle, Board President
Fox Crossing Water District
P.O. Box 926
Goldthwaite, Texas 76844

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Mr. Carlisle:

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J. Kevin Ward
Executive Administrator

Attachment: GTA Aquifer Assessment 07-05mag

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Joe M. Crutcher, *Member*

November 7, 2008

Mr. Joe Cooper, General Manager
Middle Trinity Groundwater Conservation District
150 North Harbin Drive, Suite 434
Stephenville, Texas 76401

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in
Groundwater Management Area 8

Dear Mr. Cooper:

The Texas State Water Code, Section 36.108, Subsection (o), states that Texas Water Development Board's executive administrator shall provide each district and regional water planning group located wholly or partly within a groundwater management area with the managed available groundwater in the management area based upon the desired future condition of the groundwater resource. This letter and the attached report (GTA Aquifer Assessment 07-05mag) are in response to this directive.

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November 7, 2008

Mr. Russell Laughlin, Board President
Northern Trinity Groundwater Conservation District
13600 Heritage Parkway, Suite 200
Fort Worth, Texas 76177

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Mr. Laughlin:

The Texas State Water Code, Section 36.108, Subsection (o), states that Texas Water Development Board's executive administrator shall provide each district and regional water planning group located wholly or partly within a groundwater management area with the managed available groundwater in the management area based upon the desired future condition of the groundwater resource. This letter and the attached report (GTA Aquifer Assessment 07-05mag) are in response to this directive.

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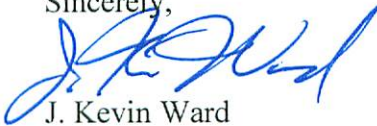
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November 7, 2008

Mr. Gary Westbrook, General Manager
Post Oak Savannah Groundwater Conservation District
P.O. Box 92
Milano, Texas 76556

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in
Groundwater Management Area 8


Dear Mr. Westbrook:

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November 7, 2008

Mr. Randy McGuire, Board Member/Manager
Saratoga Underground Water Conservation District
P.O. Box 231
Lampasas, Texas 76550

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Mr. McGuire:

The Texas State Water Code, Section 36.108, Subsection (o), states that Texas Water Development Board's executive administrator shall provide each district and regional water planning group located wholly or partly within a groundwater management area with the managed available groundwater in the management area based upon the desired future condition of the groundwater resource. This letter and the attached report (GTA Aquifer Assessment 07-05mag) are in response to this directive.

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November 7, 2008

The Honorable John Firth, Coryell County Judge
Tablerock Groundwater Conservation District
620 East Main
Gatesville, Texas 76528

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Judge Firth:

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Joe M. Crutcher, *Member*

November 7, 2008

Mr. Mike Massey, Board President
Upper Trinity Groundwater Conservation District
P.O. Box 1786
Granbury, Texas 76048

Re: Managed available groundwater estimates for the Brazos River Alluvium Aquifer in Groundwater Management Area 8

Dear Mr. Massey:

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