Study 5
Updated Water Management Strategies for Water User Groups in McLennan County

Prepared for:

BRAZOS G
WATER PLANNING GROUP

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Brazos River Authority

April 2009

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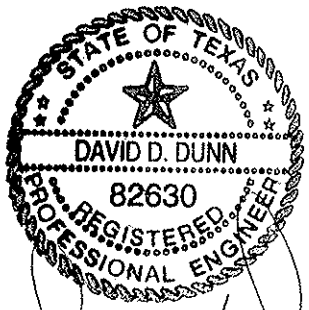

4-28-2009

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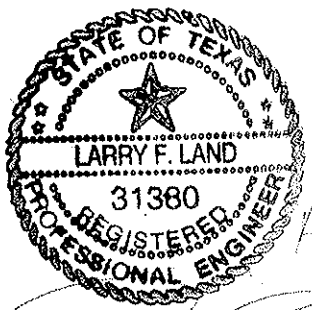

Apr 28, 2009

Larry F. Land, P.E.

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Executive Summary

A study has been conducted to update the potential water management strategies for Water User Groups (WUGs) in McLennan County. The primary purpose of the study was to identify potential water management strategies for these WUGs other than the City of Waco (Waco) and the Trinity Aquifer. The study included compiling information including: water demands, primary and secondary water supplies, Trinity Aquifer wells, and pumpage from the Trinity Aquifer, and contacting representatives of each WUG regarding their plans for future water supplies, and updates on groundwater availability from the Trinity Aquifer.

The estimated annual water demands of all the WUGs from the 2006 Brazos G Regional Water Plan range from approximately 16,700 acre-feet (acft) in 2010 to approximately 24,200 acft in 2060. Adding in the County-Other demands, the range is from approximately 23,300 acft in 2010 to approximately 32,100 acft in 2060. The total pumpage from the Trinity Aquifer is estimated to range from approximately 17,642 acft/yr in the early 2000s to approximately 25,820 acft/yr in year 2060.

Of the 20 WUGs, 18 have all or part of their primary water supply coming from the Trinity Aquifer and 2 have all their supply coming from Waco. Five of the WUGs have a supplemental supply from Waco; and, seven have a supplemental supply from a surface water source other than Waco. Other water supplies being used by one or more utilities include: the Brazos River, Bluebonnet Water Supply Corporation (WSC) which gets its water from Lake Belton, and Tri-County Special Utility District (SUD).

TCEQ data show that there are about 55 Trinity Aquifer wells owned and operated by municipal WUGs in McLennan County. A typical well is about 1,750 feet deep and yields 250 gallons per minute (gpm). A very good well would yield over 400 gpm.

Based on interviews with representatives of WUGs, most have relatively short-term plans to continue with their past practices. In general, these practices are to install new Trinity Aquifer wells as needed, of which several have immediate plans to construct new wells, and to rely or expand interconnects with other neighboring water utilities for emergencies. Three of the 17 WUGs who rely on Trinity Aquifer wells expressed an opinion that they may need to connect to Waco or rely more and more on Waco for their water supply. Several expressed an interest in either remaining independent of Waco or becoming independent of Waco.

The availability of water from the Trinity Aquifer in McLennan County is in the process of undergoing a major revision. Previously, Brazos G in their 2001 and 2006 Plans adopted a groundwater availability estimate of 1,718 acft/yr, which was originally estimated by the Texas Water Development Board (TWDB). Now, representatives of groundwater districts within Groundwater Management Area 8 have formulated Future Desired Conditions, which will be processed by the TWDB to provide a revised groundwater availability estimate (called "Managed Available Groundwater"). The preliminary estimate of the revised groundwater availability for McLennan County is expected to be 20,700 acft/yr.

Potential new water supply strategies for McLennan County that do not include the Trinity Aquifer or Waco include: Lake Belton via Bluebonnet WSC, the Brazos River, the Brazos River Alluvium, and reuse of wastewater effluent. Waco's development of wastewater reuse supplies for non-potable uses will free up and extend existing potable supplies. The FHLM WSC and Tri-County SUD may also be able to meet some of the future demands for utilities that are located near their distribution systems.

1.0 Introduction

1.1 Purpose of Study

The Brazos G Regional Water Plan (2006 Plan) identified the City of Waco (Waco) as the primary regional water provider in McLennan County. However, Waco's supplies are limited and would be nearly fully utilized by Year 2060. This report documents a study to identify additional water management strategies for McLennan County Water User Groups (WUGs) that may be feasible alternatives to Waco. This study supports regional water planning by identifying local preferences for future water supplies for WUGs in McLennan County.

1.2 Methodology

Tasks completed including the following:

- Compile estimated and projected water demands for each WUG,
- Compile primary and secondary water supplies for each WUG,
- Compile Trinity Aquifer well information,
- Estimate pumpage from the Trinity Aquifer,
- Summarize results of interviews with representatives of each WUG,
- Review updates to groundwater availability from the Trinity Aquifer, and
- Identify and discuss potential water management strategies.

2.0 Results

2.1 Water Demands

According the 2006 Plan, there are about 20 municipal WUGs in McLennan County. The list of WUGs, the past water demands from Texas Water Development Board (TWDB) water use surveys, and projected demands from the 2006 Plan are presented in Table 1. As shown in the table, there are several notable inconsistencies in the estimates of recent water use and projected demands. Cases where the past use estimates are noticeably greater than the projected demands include: Crawford, Lorena and Robinson. Cases where the past use is noticeably less than the projected demands include: Bellmead, Chalk Bluff Water Supply Corporation (WSC), Gholson WSC and Western Hills Water System (WS). Accounting procedures, such as purchasing or selling water to other utilities, may explain some or all of the inconsistencies.

Based on the TWDB water use surveys of the water utilities, the maximum annual water demand from 2001-2005 for the WUGs and other public water supplies was 14,642 and 3,510 acre-feet (acft), respectively, for a total of 18,152 acft. In comparison, the Brazos G 2010 estimates of demand for the WUGs and County-Other are 16,702 and 6,635 acft, respectively, for a total of 23,337 acft. In summary, the 2010 Brazos G demand estimates were about 14 percent higher than the maximum annual use between 2001 and 2005. Long-term estimates in demand suggest a growth of about 37 percent by 2060.

Table 1.
Water Use and Projected Demands for Brazos G Water User Groups in McLennan County

Brazos G Water User Group	*Maximum Annual Water Use (acft/yr) (TWDB)*	*Annual Demand (acft/yr) (Brazos G Table 4A-20)*			
	2001-2005	*2010*	*2020*	*2040*	*2060*
Bellmead	1,341	2,622	2,751	2,984	3,202
Beverly Hills	567	414	416	414	424
Bruceville-Eddy	766	825	961	1,195	1,383
Chalk Bluff WSC	355	1,160	1,766	2,881	2,955
Crawford	195	65	67	69	73
Cross County WSC	425	445	497	585	661
Gholson WSC	129	956	1,462	2,574	2,647
Hewitt	1,930	2,029	2,237	2,571	2,877
Lacy-Lakeview	629	835	989	1,256	1,477
Lorena	660	369	408	475	533
Mart	360	335	354	383	415
McGregor	966	933	923	902	899
Moody	347	202	203	204	212
North Bosque WSC	395	367	454	608	730
Riesel	178	109	116	126	137
Robinson	1,743	1,110	1,153	1,210	1,291
West	469	459	467	482	506
Western Hills WS	258	384	458	588	694
Woodway	2,861	2,944	2,925	2,882	2,874
TOTAL	14,642	16,702	18,757	22,555	24,172
County-Other Public Water Suppliers (TWDB)	3,510				
County-Other (Brazos G)		6,635	6,904	7,399	7,881
TOTAL	18,152	23,337	25,661	29,954	32,053

2.2 Water Supplies

Water supply information from the WUGs is available from Texas Commission on Environmental Quality (TCEQ) water utility reports, the 2006 Plan, and interviews with water utility managers. A summary of the supplies is presented in Table 2.

As shown in Table 2, the Trinity Aquifer is the primary supply for about 75 percent of the WUGs. In several cases, the primary supply is considered to be a combination of Trinity Aquifer wells and surface water from Lake Belton, the Brazos River or nearby streams and lakes. Two of the Trinity Aquifer users have supplemental supplies from Waco. Several of the utilities have interconnects that can either provide a substantial amount of their water or emergency supplies. Two of the utilities rely completely on Waco for water.

A summary description of the water supplies provided by Trinity Aquifer wells is presented in Table 3. A typical well is about 1,750 feet deep and yields 250 gallons per minute (gpm). A very good well would yield over 400 gpm. Large wells will commonly have 11 to 16 inch diameter screens. A common screen diameter for medium size wells is 9 inches. A few small municipal wells have screens as small as 5 inches in diameter. The deepest well is nearly 3,200 feet deep, yields about 270 gallons per minute and is located on the east side of the county. The shallow wells are about 1,100 feet deep and on the west side of the county.

Estimates of groundwater supplies that were derived from the Trinity Aquifer were made for each of the WUGs and for other groundwater uses in McLennan County (Table 4). The estimates for the WUGs are based on the maximum water demand for 2001-2005 and the percent of the demand that was derived from groundwater in year 2000, which is the only year for which such data are available. Groundwater use for categories other than public supply is based on Brazos G and TWDB data. This compilation shows about 10,100 acft/yr was being pumped from the Trinity Aquifer by the WUGs in the early 2000s. Pumpage for other uses from the Trinity Aquifer totals about 7,500 acft/yr. These data and analyses suggest about 17,600 acft/yr of pumpage from the Trinity Aquifer during the early 2000s.

Table 2.
Water Supplies for Water User Groups

WUG	*Primary Water Supply*	*Supplemental/ Backup Water Supply (Brazos G)*	*Supplemental/ Backup Water Supply (TCEQ)*	*Water Supply (Interview with Utility)*
Bellmead	Trinity	Possibly from Waco	Waco	Trinity, with emergency from Waco
Beverly Hills	Waco			
Bruceville-Eddy	Trinity	Lake Belton, via Bluebonnet WSC	Lake Cypress Springs	Trinity Plan to stay independent of Waco
Chalk Bluff WSC	Trinity			Trinity
Crawford	Trinity			Trinity, with local surface water when available
Cross Country WSC	Trinity			Trinity
Gholson WSC	Trinity			Trinity, with emergency interconnect to other, local utilities
Hewitt	Trinity	Waco	Waco	Trinity, with supplement from Waco
Lacy-Lakeview	Waco			Waco
Lorena	Trinity	Brazos River	City of Robinson and Levi WSC	Trinity, City of Robinson, and Levi WSC.
Mart	Trinity and Lake Mart			Trinity and Lake Mart
McGregor	Trinity, Lake Belton and Run of River		Bluebonnet WSC (Lake Cypress Springs), Waco	Trinity, with supplies originating from Lake Belton via Bluebonnet WSC and Woodway distribution system
Moody	Trinity	Lake Belton, via Bluebonnet WSC	Bluebonnet WSC	Trinity and Bluebonnet WSC
North Bosque WSC	Trinity			Trinity
Riesel	Trinity		RMS WSC (Trinity) and SW from Tri-County SUD	RMS WSC (Trinity) and emergency from Tri-County SUD (surface water)
Robinson	Trinity and Brazos River		Brazos River (off-channel reservoir)	Trinity and Brazos River via off-channel reservoir
West	Trinity		Waco, Cottonwood WSC, Hill Top WSC, Bold Springs WSC	Trinity and Waco
Western Hills WS	Trinity			Trinity
Woodway	Trinity		Waco and Bluebonnet WSC	Trinity, with supplemental from Waco and Bluebonnet WSC

Table 3.
Trinity Aquifer Wells Operated by Water User Groups in McLennan County

Water User Group	Number of Wells	Range in Well Depths (feet)		Range in Well Yields (gpm)		Cumulative Rated Well Capacity		Annual Supply*
		Minimum	Maximum	Minimum	Maximum	gpm	MGD	acft/yr
Bellmead	4	2,310	2,464	470	600	2,040	2.94	1,645
Bruceville-Eddy	4	1,550	1,810	50	402	660	0.95	533
Chalk Bluff WSC	3	2,120	2,130	250	450	960	1.38	774
Crawford	2	965	1,005	61	105	165	0.24	133
Cross County WSC	6	1,234	1,322	110	205	925	1.33	746
Gholson WSC	5	1,180	1,515	200	325	1,215	1.75	980
Hewitt	6	1,768	2,007	110	550	2,390	3.44	1,928
Lorena	2	2,000	2,028	250	350	600	0.86	484
Mart	1		3,181		270	270	0.39	218
McGregor	1		1,050		325	325	0.47	262
Moody	2	1,494	1,561	135	140	275	0.40	222
North Bosque WSC	3	1,179	1,320	175	440	815	1.17	658
Robinson	5	2,184	2,550	200	400	1,460	2.10	1,178
West	2	1,940	2,008	120	350	470	0.68	379
Western Hills WS	4	1,135	1,360	60	400	945	1.36	762
Woodway	5	1,790	1,934	130	1,120	3,400	4.90	2,742
Total	**55**					**16,915**	**24.36**	**13,642**

* Note: Annual supply estimated by dividing cumulative rated well capacity in half to account for reserve capacity required to meet peak day demands, which are typically twice average day demands.

Table 4.
Estimates of Pumpage from the Trinity Aquifer in McLennan County

Water User Group	*Max Year (2001-2005) Demands (acft)*	*2000 Supply from Groundwater (percent)*	*Max Year (2001-2005) Demands from Groundwater (acft)*
Bellmead	1,341	100	1,341
Beverly Hills	567	0	0
Bruceville-Eddy	766	34	259
Chalk Bluff WSC	355	100	355
Crawford	195	100	195
Cross County WSC	425	100	425
Gholson WSC	129	100	129
Hewitt	1,930	68	1,320
Lacy-Lakeview	629	0	0
Lorena	660	100	660
Mart	360	36	131
McGregor	966	17	168
Moody	347	13	47
North Bosque WSC	395	100	395
Riesel	178		0
Robinson	1,743	100	1,743
West	469	100	469
Western Hills WS	258	100	258
Woodway	2,861	77	2,207
TOTAL	**14,642**	**69**	**10,101**
Other Groundwater Uses			
Small Public Water Suppliers[1]			2,400
Rural Domestic[2]			2,000
Manufacturing[3]			938
Steam Electric[3]			1,708
Irrigation[3]			0
Mining[3]			0
Livestock[3]			495
TOTAL			**7,541**
GRAND TOTAL			**17,642**

[1]Uses TWDB water demands with an average SW-GW split for WUGs
[2]Brazos G County-Other estimates, less the Small Public Water Suppliers
[3]TWDB data base, average of 2000-2003 values

2.3 Water Supply Plans of Water User Groups

With the goal of integrating the actual plans of water utilities into the water management strategies as much as possible, interviews were conducted with an official from each WUG to get first hand information on their plans. Responses in the interview are presented in Table 5.

With a wide variety of water utilities, most of the representatives have relatively short-term plans to continue with their past practices. In general, these practices are to: (1) install new Trinity Aquifer wells as needed, of which several have immediate plans to construct new wells,

Table 5.
Summary of Interviews with Water User Group Representatives

WUG	*Name of Contact*	*Present Water Supply*	*Planned Future Supply*	*Connection to Waco, Present and Future*	*Comments*
Bellmead	Scooter Radcliffe, City Manager	Trinity wells, with emergency contract with Waco	Trinity. Install two new Trinity wells in near future. Rely totally on Trinity for future supplies.	Currently has a Waco emergency contract, but plans to not renew it.	They are not using Waco water now, and have no plans to do so in the future.
Beverly Hills	N/A	Waco	Waco	Yes	Did not contact
Bruceville-Eddy	Monte Harris, Mayor Pro Tem	Trinity .	Trinity. Has approval for a new Trinity well.	No	Plan to stay independent of Waco
Chalk Bluff WSC	Barry Holle, General Manager	Trinity	Trinity. Considering installing another well. Member of FHLM WSC for future supplies.	No	May be tying into Tri-County SUD in near future
Crawford	David Posten, Mayor/General Manager	Trinity, Surface Water supply, which is Run of River diversion from Tonk Creek to local Quarry for off-channel storage.	Trinity. The supply from the creek and off-channel reservoir is unreliable.	No. Waco requires a very high reservation fee and high charges for water delivered. Also, Waco is too far away.	Near capacity now. Plans to install new Trinity well. They have a few very high water users that complicate the system operation.
Cross Country WSC	Brad Berry, General Manager	Trinity	Trinity. May have to connect to Waco.	Maybe	One of several utilities operated by the same general manager and staff.
Gholson WSC	Brandy Dyer, General Manager	Trinity. Interconnect with other water utilities for emergency supplies.	Stay on Trinity as long as they can. Member of FHLM WSC for future supplies.	No	Continue with current arrangement.
Hewitt	Paul Holly, Manager	Trinity, with supplemental supplies from Waco during summer.	Trinity, with supplemental supplies from Waco during summer.	Yes	Considering a new Trinity well.
Lacy-Lakeview		Waco	Waco	Yes	Conveyed wells, easements, etc. to Waco.

Table 5.
Summary of Interviews with Water User Group Representatives (Continued)

WUG	*Name of Contact*	*Present Water Supply*	*Planned Future Supply*	*Connection to Waco, Present and Future*	*Comments*
Lorena	John Moran	Trinity, City of Robinson, and Levi WSC	Trinity, City of Robinson and Levi WSC. Planning for Wastewater Reuse.	No	
Mart	Jerald Flippin, Dir Public Works	Trinity and Lake Mart	Trinity, Lake Mart, and restore surface water right to Tradinghouse Creek Reservoir. Member of FHLM WSC for future supplies.	Unknown	Concerned about Lake Mart being inadequate. Water right was not renewed, so it was lost.
McGregor	Don Carnes, Dir Public Works	Trinity, Interconnect to Woodway, which gets water from Bluebonnet WSC	Trinity, Interconnect to Woodway, which gets water from Bluebonnet WSC. Improve the system operation with new pipeline.	No	Complicated. Other than Trinity, water source is Lake Belton via Bluebonnet , which also provides treatment. Pipelines are being upgraded for direct connection to Bluebonnet.
Moody	David Culpepper, Water Supt.	Bluebonnet WSC (primary supply) and Trinity	Bluebonnet WSC and Trinity. Rehab old Trinity wells and/or increase take from Bluebonnet WSC.	No	
North Bosque WSC	Brad Berry, General Manager	Trinity	Trinity. May have to connect to Waco	Maybe	One of several utilities operated by the same general manager and staff.
Riesel	Barry Holle, General Manager	Groundwater from RMS WSC, emergency from Tri-County SUD	Groundwater from RMS WSC, emergency from Tri-County SUD, regional interconnections. Member of FHLM WSC for future supplies.	No	Co-managed with Chalk Bluff WSC.
Robinson	Greg Hobbs, General Manager	Trinity and Brazos River (about equal use)	Trinity and Brazos River. Expand water rights from Brazos River.	No	Brazos water is diverted to an off-channel reservoir and treated by RO.

Table 5.
Summary of Interviews with Water User Group Representatives (Concluded)

WUG	*Name of Contact*	*Present Water Supply*	*Planned Future Supply*	*Connection to Waco, Present and Future*	*Comments*
West	Kenneth Kubala, City Secretary	Trinity and Waco	Trinity and Waco. Probably will rely more and more on Waco.	Yes	Has one relatively new Trinity well.
Western Hills WS	Mark Kosian, Field Supervisor for Aqua Texas	Trinity	Trinity	No	Concerned about restrictions from groundwater district. Experiencing slow growth.
Woodway	Randall Riggs	Trinity (primary), Waco and Bluebonnet (supplemental)	Trinity and current interconnection	Yes	In process of installing two new wells.

and (2) rely or expand interconnects with other neighboring water utilities for emergencies. Notably, only 3 of the 17 WUGs who rely on Trinity Aquifer wells to some degree expressed an opinion that they may need to connect to Waco or rely more and more on Waco for their water supply. Several expressed an interest in either remaining or becoming independent of Waco.

Several of the utilities have successfully diversified their water supplies. Some examples include:

- Bruceville-Eddy, McGregor, Moody and Woodway are interconnected to Bluebonnet WSC, which provides wholesale surface water from Lake Belton. McGregor and Woodway also have an interconnect to Waco.
- Gholson WSC, Mart, and Riesel were identified as members of the FHLM WSC for interconnections and future supplies.
- Crawford, Mart and Robinson have independent surface water supplies.

2.4 Potential Strategies for Additional Water Supplies

2.4.1 Trinity Aquifer

The availability of water from the Trinity Aquifer in McLennan County is in the process of undergoing a major revision. Previously, Brazos G in their 2001 and 2006 Plans, adopted a TWDB groundwater availability estimate of 1,718 acft/yr. The current procedure for estimating

groundwater availability has been formalized with HB 1763 that was passed by the 79th Texas Legislature. This bill requires several major actions, including:

- Groundwater Management Areas (GMA) are to be delineated by the TWDB.
- Using a required process for each GMA, groundwater districts are to establish Future Desired Conditions (DFC) for each of the aquifers in the GMA.
- The TWDB is to make iterative runs with the Groundwater Availability Model (GAM) by adjusting pumping until the DFC is met. The resulting pumpage from the groundwater model within a groundwater district would be known as Managed Available Groundwater (MAG).
- Groundwater Districts are to issue permits up to the MAG.
- Regional water planning groups are to use the MAG in the development their plans.

Officials of GMA 8, which includes McLennan County, are considering adopting DFCs for the Trinity Aquifer in McLennan County that, in all likelihood, will produce a MAG of about 20,700 acft/yr. Thus, in the Brazos G regional planning process, the change in groundwater availability (an increase of about 19,000 acft/yr) substantially alters previously estimated shortages for those WUGs relying on the Trinity Aquifer.

A comparison of the MAG with the total pumpage from the Trinity Aquifer in the early 2000s (17,642 acft/yr in the early 2000s, as shown in Table 4) suggests that there is sufficient groundwater available from the Trinity Aquifer to continue with the current water management practices of the WUGs in the short-term. A projection of future demands with current management practices shows the demands to be 19,730; 21,450; 24,710; and 25,820 acft/yr in years 2010, 2020, 2040 and 2060, respectively. This projection is based on: (1) Brazos G demand estimates in Table 1, (2) percentage of the total demand in year 2000 coming from groundwater, and (3) groundwater demands by users in other categories remaining constant. This analysis shows that the groundwater demand from the Trinity Aquifer will exceed the MAG between years 2010 and 2020. Continuing with the management practices in the early part of this decade, the year 2060 demands on the Trinity Aquifer will be about 25,800 acft/yr, which would exceed the MAG by about 5,100 acft/yr.

One of the consequences of pumping the Trinity Aquifer at the full MAG is a very significant drawdown in groundwater levels, as shown by the TWDB. The result of the simulations for this and other specified pumpage across the model shows water levels in the lower Trinity Aquifer (Hosston Formation) to be at an elevation of about 600 feet below mean

sea level (msl) after 50 years. Prior to groundwater development, the estimated groundwater levels in the lower Trinity Aquifer in the vicinity of Waco were about 650 feet above msl. Thus, the cumulative drawdown would be over 1,200 feet. The average drawdown for McLennan County for the 50-year period in the GAM simulation was calculated to be 527 feet. In the central and eastern part of the county, the drawdown was shown to be about 650 feet. Assuming a typical land surface elevation of 500 feet-msl and additional drawdown within a pumping well to be about 100 feet, the pumping lifts will be about 1,200 feet. To allow for pump submergence, the pump's intake would have to be set at about 1,250 feet below land surface. These drawdown values were computed assuming full pumpage of the MAG for the entire 50-year test period. While McLennan County pumping is approaching the MAG level, in perspective, it probably will take several years before the projected pumpage would reach the MAG level throughout the entire GMA 8 area. With this in mind, the actual drawdown could be slightly less than the values calculated by the GAM for this scenario.

Another consequence of the very significant drawdown is cost to the well users. Additional cost would be incurred for: (1) increasing power to lift the water higher, (2) lowering and/or replacing pumps, and (3) possibly replacing small wells with large wells to accommodate bigger pumps that would have to be set deeper in the well. Well replacement will be required if a pump needs to be lowered inside a small diameter section of the well and the required pump's diameter is too large to fit inside this section. If a well has a casing or screen diameter of less than 9 inches in diameter and is shallower than 600 feet deep, well replacement is very likely necessary. High capacity 9-inch wells probably will be marginal because of pump size constraints and may also have to be replaced. With a relatively high capacity Trinity Aquifer well costing $800,000 to $1,200,000, many of the small water utilities may have difficulty affording a new well.

2.4.2 City of Waco

According to Waco officials, the city has water supply contracts with the following utilities:

- Cities of Lacy Lakeview, McGregor, Hewitt, and Woodway
- Bold Springs WSC.

An expression of interest in a contract has been received from the following small water utilities:

- Central Bosque WSC
- Hilltop WSC
- North Bosque Estate
- South Bosque Estates
- China Springs Water Company.

These utilities are not classified as WUGs for regional planning purposes.

Due to remoteness from outside water supplies, additional candidates for connecting to Waco's water system are North Bosque WSC and West.

2.4.3 Options other than Waco and the Trinity Aquifer

In the compilation and study of future water supplies for WUGs other than Waco and the Trinity Aquifer, four water supplies were identified. They include: Bluebonnet WSC, the Brazos River, the Brazos River Alluvium, and reuse. In support of regionalization, the FHLM WSC is a consortium of water utilities. Two of their objectives are to support water system interconnects and to secure, treat and deliver water to member utilities. Tri-County SUD is located to the east of McLennan County and may be able to meet some of the future demands for utilities that are located near their distribution system.

Bluebonnet WSC is located in Bell County and currently provides treated wholesale water to water utilities in the southwest part of McLennan County. The source of Bluebonnet's water is Lake Belton. TCEQ's water system report states that Bluebonnet has a production capacity of 8.64 MGD and an average daily demand of 2.738 MGD. Wholesale customers in McLennan County include the cities of Bruceville-Eddy, McGregor, Moody and Woodway. Other potential major water utilities in this part of the county include Crawford, Hewitt, Lorena, and Western Hills WS.

The availability of water from the Brazos River (BRA System Operation water) is limited. However, there are potential options to develop water management strategies with this supply. One is a conjunctive use approach where most of the treated water would come from the Brazos River during normal and high flow conditions and either off-channel storage or Trinity Aquifer wells during low flow conditions. The relatively high capital cost of the project, which

probably will require advanced water treatment, suggests a regional water approach instead of small utilities working independently. Water utilities in the vicinity of the Brazos River include: Bellmead, Chalk Bluff WSC, Cross Country WSC, Gholson WSC, Lacy-Lakeview, Riesel, and Robinson.

The Brazos River Alluvium is in the vicinity of some reaches of the Brazos River. In McLennan County, the alluvium is most extensive in a reach north of Lake Waco and in the reach downstream of downtown Waco. The water-bearing zone is typically gravels and rather shallow, less than 75 feet. The alluvium is recharged from local precipitation and possibly indirect leakage from the Brazos River in areas of high pumpage or during drought conditions. Well yields are highly variable, but may reach several hundred gallons per minute. Typically, the quality of the water in the alluvium is slightly saline, which would require desalination to be used for public supplies. The alluvium offers several benefits, including: (1) not requiring Brazos River diversion facilities and, possibly, off-channel storage, (2) providing an opportunity for a new water supply for relatively small utilities located in the vicinity of the Brazos River, and (3) providing opportunities for a regional system for several small utilities in the vicinity of the Brazos River. Potential water utilities include: Bellmead, Chalk Bluff WSC, Cross Country WSC, Gholson WSC, Lacy-Lakeview, Riesel, and Robinson.

Reuse is a potential supply for a utility or a group of utilities who own and operate a wastewater treatment plant. Use of the reuse water would most likely be for nonpotable purposes, such as irrigation and industry. The 2006 Plan includes direct reuse of wastewater from the Waco Metropolitan Area Regional Sewage System (WMARSS) as a water management strategy to meet some future water demands. This strategy could be expanded to the 2011 Plan. The City of Waco is pursuing projects to enable use of available reuse supplies from WMARSS. Increased use of WMARSS effluent for irrigation and industrial uses will offset needs for potable water that Waco is currently supplying. This is projected to free up potable supply for Waco to provide to uses more appropriate for potable supply, both inside Waco and to wholesale customers.

FHLM WSC is an organization comprised of about 15 water supply corporations and cities in Falls, Hill, Limestone, and McLennan Counties. The members of FHLM are to the east of Waco. They have hired a consultant and are working toward acquiring additional water supplies for its members and facilitating interconnection of member utilities. Water sources

under consideration are the Carrizo-Wilcox Aquifer and additional Trinity Aquifer wells. Based on the discussion above, water from the Brazos River and the Brazos River Alluvium would also be potential water supplies. Gholson WSC, Riesel, and Mart are members and potential recipients of water from FHLM WSC.

Tri-County SUD is located to the east of McLennan County and may have the potential to provide supplemental water to customers near their distributions system, including Mart and Riesel.

3.0 Summary and Recommendations

3.1 Summary

A study has been conducted to identify potential water management strategies for WUGs in McLennan County. Elements of the study included:

- Compilation of estimated and projected water demands for each WUG
- Compilation of primary and secondary water supplies for each WUG
- Compilation of the Trinity Aquifer well information
- Estimates of pumpage from the Trinity Aquifer
- Summary if interview with representatives of each WUG
- Review of the update to groundwater availability from the Trinity Aquifer
- Identification and discussion potential water management strategies

The estimated annual water demands of all the WUGs from the 2006 Brazos G Regional Water Plan range from about 16,700 acft in 2010 to about 24,200 acft in 2060. Adding in the County-Other demands, the range is from about 23,300 acft in 2010 to about 32,100 acft in 2060. The total pumpage from the Trinity Aquifer is estimated to range from about 17,642 acft/yr in the early 2000s to about 25,820 acft/yr in year 2060.

Of the 20 WUGs, 18 have all or part of their primary water supply coming from the Trinity Aquifer and 2 have all their supply coming from Waco. Five of the WUGs have a supplemental supply from Waco; and, seven have a supplemental supply from a surface water source other than Waco. One utility gets some water from the Brazos River. Three utilities have a supplemental supply from Bluebonnet WSC, which gets its water from Lake Belton. One utility gets some surface water from Tri-County SUD, which is east of McLennan County.

TCEQ data show that there are about 55 Trinity Aquifer wells owned and operated by the municipal WUGs in McLennan County. A typical well is about 1,750 feet deep and yields 250 gallons per minute (gpm). A very good well yields over 400 gpm.

Based on interviews with representatives of WUGs, most have relatively short-term plans to continue with their past practices. In general, these practices are to install new Trinity Aquifer wells as needed, of which several have immediate plans to construct new wells, and to rely or expand interconnects with other neighboring water utilities for emergencies. Three of the 17 WUGs who rely on Trinity Aquifer wells expressed an opinion that they may need to connect to Waco or rely more and more on Waco for their water supply. Several expressed an interest in either remaining independent of Waco or becoming independent of Waco.

The availability of water from the Trinity Aquifer in McLennan County is in the process of undergoing a major revision. Previously, Brazos G in their 2001 and 2006 Plans, adopted a TWDB groundwater availability estimate of 1,718 acft/yr. Now, representatives of groundwater districts within Groundwater Management Area 8 have formulated Desired Future Conditions, which will be processed by the TWDB to provide revised groundwater availability estimates, called Managed Available Groundwater (MAG). The preliminary estimate of the MAG for McLennan County is about 20,700 acft/yr.

Potential new water supply strategies for McLennan County that do not include the Trinity Aquifer or Waco include: Lake Belton via Bluebonnet WSC, the Brazos River, the Brazos River Alluvium, and reuse of wastewater effluent. Waco's development of wastewater reuse supplies for non-potable uses will free up and extend existing potable supplies. The FHLM WSC and Tri-County SUD may also be able to meet some of the future demands for utilities that are located near their distribution systems.

3.2 Recommendations

The options identified in this report should be considered in greater detail during development of the 2011 Plan, when water management strategies are investigated to meet the needs of WUGs in McLennan County.

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Appendix A
Comments from the Texas Water Development Board Regarding Phase I Reports and Responses from the Brazos G Regional Water Planning Group

February 20, 2009

RECEIVED
MAR 2009
GENERAL MANAGER

A copy to Trey Burgher

Mr. Phillip J. Ford
General Manager/CEO
Brazos River Authority
P.O. Box 7555
Waco, Texas 76714-7555

Re: Region G, Region-Specific Studies Contract for Regional Water Planning between the Texas Water Development Board (TWDB) and the Brazos River Authority (BRA), TWDB Contract No. 0704830692, Draft Final Study Report Comments.

Dear Mr. Ford:

Staff members of TWDB have completed a review of the Draft Final Study Report under TWDB Contract No. 0704830692. As stated in the above-referenced contract, BRA will consider incorporating Draft Final Study Report comments, shown in Attachment 1, as well as other comments received, into the Final Study Report. In accordance with paragraph F, Article III, Section II of the contract, a copy of these TWDB Executive Administrator comments as well as a written summary of how the Draft Final Study Report was revised in response must be included in all the Final Study Report documents, for example, as an appendix.

TWDB looks forward to receiving one (1) electronic copy of all files, one electronic copy of each Final Study Report in Portable Document Format (PDF), and nine (9) bound double-sided copies of each Final Study Report to the TWDB Executive Administrator no later than the contract Final Study Report Deadline (April 30, 2009 for most reports). Please also transfer copies of all data and reports generated by the planning process and used in developing the Final Study Report to the TWDB Executive Administrator no later than the contract Final Study Report Deadline.

As a reminder, if any portion of the Final Study Report is to be included in a 2011 regional water plan it will be reviewed as part of the Initially Prepared Plan for meeting all statutory and agency rule requirements regarding the preparation of regional water plans.

If you have any questions concerning this contract, please contact Matt Nelson, TWDB's designated Contract Manager for this study at (512) 936-0829.

Sincerely,

for Dan Hardin
Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Enclosures
Attachment 1

c: Matt Nelson, TWDB

ATTACHMENT 1

TWDB Contract No. 0704830692

Region G, Region-Specific Studies 1-5:

TWDB Comments on Draft Final Region-Specific Study Reports:

1) Updated Drought of Record and Water Quality Implications for Reservoirs Upstream of Possum Kingdom Reservoir

2) Groundwater Availability Model of the Edwards-Trinity (Plateau) and Dockum Aquifer in Western Nolan and Eastern Mitchell Counties, Texas

3) Regionalization Strategies to Assist Small Water Systems in Meeting New SDWA Requirements

4) Brazos G Activities in Support of Region C's Water Supply Study for Ellis, Johnson, Southern Dallas, and Southern Tarrant Counties

5) Updated Water Management Strategies for Water User Groups in McLennan County

Region-Specific Study 1: Updated Drought of Record and Water Quality Implications for Reservoirs Upstream of Possum Kingdom Reservoir

1. Report does not present newly developed model input datasets developed under Task 1, for example, the raw numerical naturalized flow dataset (including from 1998) through June 2008 as used in the model. Please present these data as appendices in report.

2. Page 8, Table 2.1: Please clarify where the rating curves came from for elevation-content calculations.

Region-Specific Study 2: Groundwater Availability Model of the Edwards-Trinity (Plateau) and Dockum Aquifer in Western Nolan and Eastern Mitchell Counties, Texas

1. The data discussed on page 12 does not appear to match the data referred to in Appendix A. In the second to last paragraph, the report refers to the data showing 4,300 acre-feet of municipal pumpage in year 2005. The data in Appendix A do not appear to support this total. Please correct or clarify the basis of the 4,300 reference in the report.

2. Page 12, last paragraph discusses data in Appendix A and states that the total pumping in 2003 was 4,600 acre-feet. The value for 2003 in the Appendix A table however, appears to be 3,823 acre-feet. This paragraph also states the average is 3,240 acft/year, although the data as presented in the Appendix averages 2,851 acre-feet/year. Please correct

reference or clarify how numbers referred to in text were derived. Also, it appears that the totals for years 2001-2004 and 2007 are off by 1 acre-foot.

3. According to Task 1, subtask C in the contract Scope of Work, the report was to "estimate long-term supplies available from the well field." The report does not appear to directly provide estimates of long-term supplies. Please provide information regarding estimated long-term supplies in the report.

Region-Specific Study 3: Regionalization Strategies to Assist Small Water Systems in Meeting New SDWA Requirements

1. Page 58, paragraph 3 states that "the TWDB Regional Water Supply and Wastewater Facilities Planning Program could be used to provide up to 50 % of the cost of a detailed analysis of regionalization opportunities to encourage small water systems to actively consider and begin implementation of a regionalization strategy". Please clarify in the report that "TWDB can pay up to 50% of the study costs (75% in areas which have unemployment rates exceeding the state average by 50% or more and per-capita income is 65% or less than the state average for the last reporting period available)..."

Region-Specific Study 4: Brazos G Activities in Support of Region C's Water Supply Study for Ellis, Johnson, Southern Dallas, and Southern Tarrant Counties

TWDB's acceptance of the final report does not constitute approval of any revised population or water demand projections contained therein. The formal procedure for requesting revised projections is stated in TAC 357.5 (d) (2):

> *"Before requesting a revision to the population and water demand projections, the regional water planning group shall discuss the issue at a public meeting for which notice has been posted pursuant to the Open Meetings Act in addition to being published on the internet and mailed at least 14 days before the meeting to every person or entity that has requested notice of regional water planning group activities. The public will be able to submit oral or written comment at the meeting and written comments for 14 days following the meeting. The regional water planning group will summarize the public comments received in its request for projection revisions. Within 45 days of receipt of a request from a regional water planning group for revision of population or water demand projections, the executive administrator shall consult with the requesting regional water planning group and respond to their request."*

All requested revisions which receive a consensus recommendation from TWDB, the Texas Department of Agriculture, Texas Commission on Environmental Quality, and Texas Parks and Wildlife Department, will then be presented for consideration of Board approval at the next scheduled meeting.

1. Task 1 of the contract Scope of Work refers to reviewing recent studies. Please provide a general summary of findings regarding recent supply studies and activities in the area since the 2006 Brazos G Regional Water Plan was adopted.

2. Tasks 1 and 4 of the contract Scope of Work refer to reviews of studies and reviews of population projection estimates. While Section 1.0 of the report summarizes the associated activities performed by date, it does not provide a general summary of the findings of these reviews or copies of or summaries of the comments that were provided by Region G consultant as a result of these reviews. Please provide a summary of findings or copies of written comments resulting from this work, for example, as an appendix in the report.

3. The report does not include or make specific reference to the raw population/water demand projections that were provided from individual water providers in the regional study area (e.g. Alvarado, Burleson, JCSUD, Mansfield, and Venus). Please provide copies of these water planning projections that are generally greater than TWDB population and/or water demand projections. If this raw data was included in another available report, please provide a reference.

4. Please consider adding clarifying language to the Executive Summary that more clearly sets forth the purpose and content of this specific report and that explains the need for a reader to also review the "Region C Water Supply Study for Johnson, Southern Dallas, and Southern Tarrant Counties". Consider including a copy of the associated Region C study Table of Contents for reference, for example, in an appendix.

5. Page B-3: Table B-2 is missing from report. Please include in final report.

Region-Specific Study 5: Updated Water Management Strategies for Water User Groups in McLennan County

1. Task 3 of the contract scope of work states that the following sections will be included in the draft and final report: "... purpose of study including how the study supports regional water planning, methodology, results, and recommendations, if applicable." These sections are not present in the draft report. Please include them in the final report.

HDR | ONE COMPANY *Many Solutions*℠

Memo

To: Brazos G Regional Water Planning Group	
From: David Dunn, PE	Project: Brazos G 2011 Regional Water Plan
CC: Trey Buzbee, Brazos River Authority	
Date: April 7, 2009	Job No: 00044257-001

RE: Suggested responses to TWDB comments regarding the five Phase I Reports

On December 29, 2008, HDR submitted to the Texas Water Development Board (TWDB) draft copies of the reports summarizing the five Phase I studies completed pursuant to the 2011 Brazos G Regional Water Plan. On February 20, 2009, the TWDB provided review comments on each draft report. Those review comments are repeated in this memorandum, followed by HDR's suggested response to each comment.

HDR recommends that the Brazos G RWPG accept these suggested responses to the TWDB comments, and direct HDR and the Brazos River Authority to incorporate the responses into the final versions of the reports, and submit the final reports to the TWDB prior to the report submission deadline of April 30, 2009. A copy of the TWDB review comments and the planning group's responses will be included as an appendix to each report.

Region-Specific Study 1: Updated Drought of Record and Water Quality Implications for Reservoirs Upstream of Possum Kingdom Reservoir

1. Report does not present newly developed model input datasets developed under Task 1, for example, the raw numerical naturalized flow dataset (including from 1998) through June 2008 as used in the model. Please present these data as appendices in report.

Suggested Response: The newly developed data sets have been printed and included as an appendix to the report.

2. Page 8, Table 2.1: Please clarify where the rating curves came from for elevation-content calculations.

Suggested Response: The reservoir elevation-area-capacity relations were obtained from the most recent bathymetric survey available for each reservoir. The last paragraph on page 7 has been updated to make the source of the data more clear.

Region-Specific Study 2: Groundwater Availability Model of the Edwards-Trinity (Plateau) and Dockum Aquifer in Western Nolan and Eastern Mitchell Counties, Texas

1. The data discussed on page 12 does not appear to match the data referred to in Appendix A. In the second to last paragraph, the report refers to the data showing 4,300 acre-feet of

municipal pumpage in year 2005. The data in Appendix A do not appear to support this total. Please correct or clarify the basis of the 4,300 reference in the report.

Suggested Response: The data shown in Table A-3 of Appendix A have been corrected.

2. Page 12, last paragraph discusses data in Appendix A and states that the total pumping in 2003 was 4,600 acre-feet. The value for 2003 in the Appendix A table however, appears to be 3,823 acre-feet. This paragraph also states the average is 3,240 acft/year, although the data as presented in the Appendix averages 2,851 acre-feet/year. Please correct reference or clarify how numbers referred to in text were derived. Also, it appears that the totals for years 2001-2004 and 2007 are off by 1 acre-foot.

Suggested Response: The numbers in the text have been corrected.

3. According to Task 1, subtask C in the contract Scope of Work, the report was to "estimate long-term supplies available from the well field." The report does not appear to directly provide estimates of long-term supplies. Please provide information regarding estimated long-term supplies in the report.

Suggested Response: The following text has been added to the report as a final paragraph in Section 7 Water Management Strategy for Sweetwater:

"If a groundwater only strategy is considered, the performance of the current Champion Well Field from 2001-2007 and the groundwater modeling suggests that the Edwards-Trinity and Dockum Aquifers could meet this average demand, which was about 2,850 acft/yr. If the well field was substantially expanded to the south-southwest, the modeling analysis suggests that it could meet the projected demand of 3,900 acft/yr for the planning period."

And the following text has been added to Section 9 Conclusions:

"If a groundwater only strategy is considered, the analysis suggests that the aquifers could meet 2001-2007 average demand of about 2,850 acft/yr. If the well field was substantially expanded to the south-southwest, the analysis suggests that the projected demand of 3,900 acft/yr for the planning period could be met."

Region-Specific Study 3: Regionalization Strategies to Assist Small Water Systems in Meeting New SDWA Requirements

1. Page 58, paragraph 3 states that "the TWDB Regional Water Supply and Wastewater Facilities Planning Program could be used to provide up to 50 % of the cost of a detailed analysis of regionalization opportunities to encourage small water systems to actively consider and begin implementation of a regionalization strategy". Please clarify in the report that "TWDB can pay up to 50% of the study costs (75% in areas which have unemployment rates exceeding the state average by 50% or more and per-capita income is 65% or less than the state average for the last reporting period available)..."

Suggested Response: The following text has been added as the second sentence of paragraph 3 on page 58:

"In some instances, the TWDB can pay for more than 50% of the study costs (75% in areas which have unemployment rates exceeding the state average by 50% or more and per-capita income is 65% or less than the state average for the last reporting period available)."

Region-Specific Study 4: Brazos G Activities in Support of Region C's Water Supply Study for Ellis, Johnson, Southern Dallas, and Southern Tarrant Counties

1. Task 1 of the contract Scope of Work refers to reviewing recent studies. Please provide a general summary of findings regarding recent supply studies and activities in the area since the 2006 Brazos G Regional Water Plan was adopted.

Suggested Response: The following text will be added to Section 1.0:

"A review was conducted of recent water supply studies in the four-county area, with a primary emphasis on Johnson County entities. The overall message from the studies indicates that population and water demand projections are increasing at a faster pace than the Texas Water Development Board (TWDB) projections from the 2006 Plan. The City of Cleburne conducted a study[1] in May 2007 that showed that new industrial development and oil and gas exploration in the area have increased rapidly, which has led to increased water requirements. A study conducted by Johnson County Special Utility District (JCSUD)[2] showed substantially higher projected population and water demands in Year 2030 than TWDB estimates. The JCSUD study was used as a basis for recommending population and water demand updates, which show a 37% increase in projected population in Year 2030 and nearly 40% increase in projected Year 2030 water demands as compared to TWDB projections used in the 2006 Brazos G Plan. Since the 2006 Brazos G Plan, Johnson County Fresh Water Supply District No. 1 has merged with JCSUD and is shown accordingly in the Four County Study report. Additional studies in the area were reviewed and considered including: information from the City of Arlington regarding their wholesale water rate study, and a report developed jointly by the Brazos River Authority and Tarrant Regional Water District in April 2004 entitled "Regional Water Supply and Wastewater Service Study for Johnson and Parker County."

2. Tasks 1 and 4 of the contract Scope of Work refer to reviews of studies and reviews of population projection estimates. While Section 1.0 of the report summarizes the associated activities performed by date, it does not provide a general summary of the findings of these reviews or copies of or summaries of the comments that were provided by Region G consultant as a result of these reviews. Please provide a summary of findings or copies of written comments resulting from this work, for example, as an appendix in the report.

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[1] *City of Cleburne and Freese and Nichols, "Cleburne Long-Range Water Supply Study- Draft," May 2007.*

[2] *Johnson County Special Utility District and HDR Engineering, Inc, "Evaluation of Additional Water Supplies from the Trinity and Brazos River Basins," December 2006.*

Suggested Response: Copies of selected email correspondence with comments provided by Brazos G consultants have been added as Attachment B-1. An interim progress report update with proposed population and water demand projections was provided to the Brazos G RWPG on October 28, 2008 (as described in Section 1.0). A copy of this presentation has been added as Attachment B-2.

In addition, the following text will be added to Section 1:0:

"The population and water demand recommendations were reviewed for consistency with information provided by each of the Johnson County entities. In some cases, historical population and water use information was provided which was used to assess the reasonableness of extrapolating historical trends to future population and water demands projections. Due to the large number of entities over the study area, there were numerous review processes required to ensure that the recommended population and water demand projections used in the study were consistent with current trends that Johnson County entities are experiencing and their local plans. A copy of selected email correspondence from Brazos G consultants with comments and results of their reviews of Region C's interim analyses and reported results is presented in Attachment B-1."

3. The report does not include or make specific reference to the raw population/water demand projections that were provided from individual water providers in the regional study area (e.g. Alvarado, Burleson, JCSUD, Mansfield, and Venus). Please provide copies of these water planning projections that are generally greater than TWDB population and/or water demand projections. If this raw data was included in another available report, please provide a reference.

Suggested Response: The raw population and water demand projections provided by Johnson County water entities will be provided as Attachment A. Text will be added to Section 1.0 to reference Attachment A. For more information regarding how raw population and water demand projections were used to develop recommended projections, please consult Region C's report entitled "Water Supply Study for Ellis County, Johnson County, Southern Dallas County, and Southern Tarrant County."

4. Please consider adding clarifying language to the Executive Summary that more clearly sets forth the purpose and content of this specific report and that explains the need for a reader to also review the "Region C Water Supply Study for Johnson, Southern Dallas, and Southern Tarrant Counties". Consider including a copy of the associated Region C study Table of Contents for reference, for example, in an appendix.

Suggested Response: The purpose and content of the specific report was included in the draft report in the executive summary as follows:

"The purpose of this study is to review recent growth in the study area, make adjustments to population and demand projections to account for the growth, and update the current and future water plans of the water user groups and wholesale water providers in the study area. This study included conducting meetings and compiling survey data provided by water suppliers regarding their current and future water plans, determining revisions to population and demand projections, and developing a water supply plan for the study area. This report describes the

assistance provided by Brazos G to the study effort, and summarizes the information resulting from the study that is pertinent to the Brazos G Area."

The following additional text will be added to the Executive Summary:

"Those reading this summary should also consult the 'Region C Water Supply Study for Ellis County, Johnson County, Southern Dallas County, and Southern Tarrant County,' which provides the full report and results of the Four County study."

5. Page B-3: Table B-2 is missing from report. Please include in final report.

Suggested Response: Table B-2 (which has been relabeled as Table D-2 in response to renumbering attachments) will be included in the final report.

Region-Specific Study 5: Updated Water Management Strategies for Water User Groups in McLennan County

1. Task 3 of the contract scope of work states that the following sections will be included in the draft and final report: "… purpose of study including how the study supports regional water planning, methodology, results, and recommendations, if applicable." These sections are not present in the draft report. Please include them in the final report.

Suggested Response: The organization of the report has been restructured as follows:

Section 1.0 Introduction has been subdivided into Section 1.1 Purpose of Study and Section 1.2 Methodology. The text states how the study supports regional water planning. Sections 2.0 through 5.0 have been made subdivisions 2.1 through 2.4 of a new Section 2.0 Results, while retaining their original text and organization. Section 5.0 Summary has been titled Section 3.0 Summary and Recommendations with two new subdivisions 3.1 Summary and 3.2 Recommendations, while retaining its original text.

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