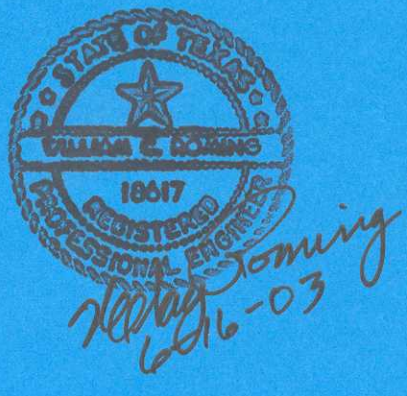
BRAZOS RIVER AUTHORITY OF TEXAS

CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY

Phase II

System Infrastructure Improvements and Capital Improvements Plan

Report



Prepared By

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TEMPLE, TEXAS

May 2003

ABBREVIATIONS, DEFINITIONS AND CONVERSION FACTORS

Abbreviations:

mgd	million gallons per day
ac-ft	acre foot
gpd	gallons per day
gpcd	gallons per capita per day
gfd	gallons per square foot per day
ntu	nephelometric turbidity units

Definitions:

Water:

Average Daily Demand -- Rate expressed as gpcd, mgd or ac-ft/year. When expressed as gpcd it represents the average daily water consumption for each person over a given year. When expressed as mgd, it represents the average daily water used by the entire system over a given year. When expressed as ac-ft/year, it represents the volume of water required per year for supply purposes.

Maximum Daily Demand -- Total amount of water used on the day of the heaviest consumption in any given year. The water treatment and water pumping facilities must be capable of supplying this amount of water for that day.

Peak Hourly Demand -- Rate of water consumption during the peak hour of the maximum day of a given year. This water usage is most economically supplied through a combination of elevated storage and high service pumps. The distribution system must be capable of satisfying this demand.

Turbidity -- Measured in nephelometric turbidity units (ntu), is suspended matter in water that scatters or otherwise interferes with the passage of light through the water. Turbidity is indicative of the quality of the water. Potable water usually falls in the range of 0.10 to 0.30 ntu. Raw water turbidities vary from very low (1-5 ntu) to very high (>200 ntu).

Flux Rate -- Measured in gallons per square foot per day (gfd), is the rate at which feed water can be passed through a membrane filtration module. Membrane modules have a given surface area, and as such the flux rate determines the number of modules required to achieve a desired filtrate flow rate.

Conversion Factors:

1 ac-ft = 325,851 gallons

1 ac-ft/year= 893 gallons per day

1,000 ac-ft/year = 0.893 mgd

1 mgd = 1,120 ac-ft per year

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May 30, 2003

Mr. David Collinsworth
Brazos River Authority
P. O. Box 7555
Waco, Texas 76714-7555

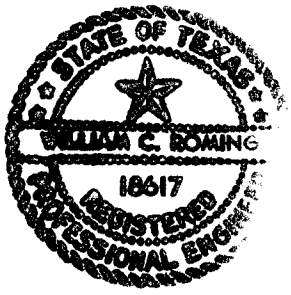
Re: Central Texas Regional Water Supply Study
Phase II Report

Dear Mr. Collinsworth:

This report summarizes our findings for Phase II of the Central Texas Regional Water Supply Study. Phase II of the Study evaluated alternative facilities and established a capital improvement plan for the Central Texas region as necessary to meet existing and future demands identified in Phase I. This completes the two phases of the Study that began in February 2000.

Sincerely,

W. Clay Roming, P.E.



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SUMMARY

The following comments summarize the primary findings which are discussed in greater detail in various sections of the report:

- The study area encompasses portions of seven central Texas counties (Bell, Burnet, Coryell, Falls, Lampasas, Milam and Williamson) and includes twenty-two water suppliers.

- Four sources of water supply the study area. Stillhouse Hollow Reservoir and Lake Belton are sources of surface water while the Edwards and Trinity aquifers are sources of ground water.

- The major obstacle facing the study participants is not the quantity of water, but rather the allocation of that water and the system capacity to treat and distribute water.

- None of the participants who use ground water can supply the projected maximum day demand from their existing well capacity. Improvements are sized to augment existing ground water and to supply treated surface water as a sole source (denoted with *).

- The main area of concern regarding pipeline capacity deficiencies within the Central Texas Water Supply Corporation system is in the far east extremities.

- The existing CTWSC water treatment plants 1 and 2 (WTP No. 1 and No. 2) and the pipelines that serve the western service area are adequate through the year 2040.

- A new water treatment plant on the east side of Lake Stillhouse Hollow is required to supply the CTWSC customers to the east of the existing treatment facility. CTWSC refers to this treatment facility as WTP No. 3 and is currently under design.

- The additional systems, Belton, Salado, Chisholm Trail, Jarrell-Schwertner and Bartlett (not currently supplied by CTWSC) will require additional treated surface water from either CTWSC WTP No. 3 or an alternate Brazos River Authority treatment facility located on the Lampasas River.

- Membrane filtration has been chosen as the primary treatment option due to its decreasing capital cost, quality of filtrate independent of feed water quality, decreased operation and maintenance costs and ease of expansion.

- Improvements to supply existing CTWSC customers through upgrading existing facilities and construction of required facilities and supplying additional customers through CTWSC facilities total $54,370,000 (*$60,760,000 to meet maximum day demand with treated surface water only).

- Improvements to supply existing CTWSC customers through upgrading existing facilities and construction of proposed facilities total $39,960,000 and will be required within the next 25 years.

- Improvements to create the BRA water supply system that will serve Belton, Salado, Chisholm Trail, Jarrell-Schwertner and Bartlett total $25,440,000 (*$31,996,000 to meet maximum day demand with treated surface water only).

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PHASE II – ALTERNATIVES AND CAPITAL IMPROVEMENT PLAN

1. Introduction

Phase I noted that the major problem facing the area was not the supply of water, but the allocation of that water and limitations in distributing the required amount of potable water. Phase II of the Central Texas Regional Water Supply Study describes the infrastructure required to supply treated water to meet the projected maximum day demand of each of the study participants through the year 2050. Phase I of this study concluded there was an adequate supply of water currently under contract to supply the study area through the year 2050. This phase of the study will address those improvements required for production and distribution of adequate potable water to meet the participants' projected demands. Proposed improvements will include additional pipelines, elevated and/or ground storage, booster pump stations and water treatment facilities.

There are twenty-two (22) water supply entities within the study area as tabulated below. Sixteen of these entities currently purchase treated water from the Central Texas Water Supply Corporation (CTWSC). The six remaining entities are currently served by another water wholesaler, ground water or a combination of both.

Bartlett, City of
Belton, City of
Chisholm Trail Special Utility District (SUD)
Harker Heights, City of
Jarrell-Schwertner Water Supply Corporation (WSC)
Salado WSC

Central Texas Water Supply Corporation Members (CTWSC)
- Armstrong WSC
- Bell-Milam-Falls (B-M-F) WSC
- Bell County Water Control and Improvement District (WCID) No. 5
- Buckholts, Town of
- Dog Ridge WSC
- East Bell WSC

Holland, City of
Kempner WSC
Lampasas, City of
Little Elm WSC
Lott, City of
Oenaville and Belfalls (O&B) WSC
Rogers, City of
Rosebud, City of
West Bell County WSC
Westphalia WSC

Several factors were taken into account while evaluating proposed system improvements. The first factor was which wholesaler would supply treated water to each of the study participants in the future. Exhibit 1, located on Page 7 of this report, shows current CTWSC customers in blue and the customers not currently served from CTWSC in red.

It was assumed that all current CTWSC customers would be served by CTWSC in the future. Therefore, Alternative 1 corresponds to upgrading CTWSC facilities and pipelines to meet the projected demand of only current CTWSC customers. Alternative 1 is a baseline for the improvements that will be required by CTWSC to meet projected demands of the system's current customers. However, given the proximity of the proposed CTWSC Treatment Plant No. 3 to Belton, Salado, Chisholm Trail and Jarrell-Schwertner, it is possible that the new CTWSC plant could be used to supplement the existing supply of potable water to these entities. It is also possible that Bartlett and Harker Heights could receive treated water from CTWSC. Therefore, Alternative 2 describes the infrastructure improvements necessary for CTWSC to supply its current customers and additional customers through the year 2050.

Alternative 3 assumes that CTWSC upgrades its infrastructure to meet the future demands of its current customers and that no new customers are added. The six entities that do not currently purchase treated water from CTWSC would be supplied from a new water treatment plant and distribution system owned and operated by the Brazos River Authority (BRA). Instead of each entity purchasing raw water rights, the BRA would hold the water rights and would sell treated water to each entity.

The second factor, in addition to where the entities would purchase treated surface water, was the quantity of treated surface water that Belton, Bartlett, Chisholm Trail, Harker Heights, Jarrell-Schwertner and Salado would require.

Belton currently receives treated surface water from Bell County Water Control and Improvement District (WCID) No. 1, located on the south side of Lake Belton. The majority of the Belton populace is located north of the Lampasas River. It was assumed that the area north of the Lampasas River would continue to be served by WCID No. 1. However, it would be difficult and expensive to supply distribution system capacity to serve the area south of the Lampasas River from WCID No. 1. For this reason, it was assumed that a new water treatment facility would supply treated water to that portion of the Belton Certificate of Convenience and Necessity (CCN) south of the Lampasas River.

Harker Heights currently has an exclusive contract to purchase treated surface water from Bell County Water Control and Improvement District No. 1 (WCID No. 1). Harker Heights currently has 9.0 million gallons per day capacity from WCID No. 1. Based on the projections included in Phase I of this Study, this capacity is adequate to supply maximum day water demands through the year 2012. Therefore, Harker Heights is not currently in immediate need of treated water and as such has time to fully investigate all of its options.

Harker Heights' options would include negotiating with WCID No.1 for additional capacity, contracting to purchase treated surface water from CTWSC or possibly constructing its own treatment facility. While the first option is viable, it is unlikely that another water treatment plant will be built on the western end of Lake Stillhouse Hollow. Due to its proximity to the existing CTWSC treatment plant, it is logical that Harker Heights may be able to purchase treated water from CTWSC. However, the existing capacity of the CTWSC treatment plant is accounted for by existing CTWSC customers. Thus, in order to supply Harker Heights, an expansion of the existing CTWSC plant would be required. This is not likely due to the limitations of the location and depth of the existing raw water intake structure. Therefore, it is not prudent to make recommendations and prepare opinions of probable cost prior to Harker Heights determining what its options are.

Bartlett, Jarrell-Schwertner WSC and Salado WSC currently operate groundwater wells that supply all of their potable water. This report assumes that each of these entities will continue to use its groundwater supply well into the future. Therefore, improvements were sized to meet projected maximum day demands through the conjunctive use of both ground and surface water. This conjunctive use allows the demands to be met in the most cost-effective manner. However, given the questionable future reliability of ground water and the minimal impact of existing wells on infrastructure, the proposed pipeline improvements were also sized to provide treated surface water to meet projected maximum day water demands from the year 2005 through 2050 as defined in Phase I of this study. The increased pipeline diameters associated with supplying surface water to meet maximum day demands are denoted by an asterisk in the accompanying exhibits.

Chisholm Trail Special Utility District's (SUD) main supply of potable water is from groundwater wells located in the Edwards Aquifer. However, Chisholm Trail augments this groundwater with treated surface water from the City of Georgetown in the amount of 1.5 million gallons per day at non-peak times. Therefore, improvements were sized assuming that portion of Chisholm Trail within the study area would be supplied. As with the three entities listed above, improvements have been sized for supplying the maximum day demand by the conjunctive use of ground and surface water and solely through surface water.

The remaining sections of this report will describe the manner each entity utilizes to supply its customers, examine existing infrastructure, identify those sections of the existing infrastructure that will be deficient and require upgrades, determine sizes, routes and alternatives to correct these deficiencies, prepare capital and operation and maintenance costs for these improvements and prepare a capital improvements plan outlining the actions required to supply the study area for the next fifty years.

Meetings

Meetings were held throughout the Study process to inform the participants of the purpose of the Study, solicit particpants' input on viable routes, anticipated demands and operating procedures,

and finally to detail the recommendations included in the draft report. Prior to each of the meetings listed below, a meeting was held with Mr. Denis Qualls of the Brazos River Authority to discuss the scope of work, the recommendations to be included in the report (locations, routes, etc.) and the general progress of the Study. The following lists the date, location and purpose of each meeting held (additional information, including letters inviting participants, agendas and attendance sheets are included at the end of this report in Appndix F):

1. September 6, 2000 at the Bell County Commissioners' Courtroom, Bell County Courthouse at 101 East Central Avenue in Belton, Texas. Phase I was reviewed and Phase II was introduced. All participants were invited.

2. September 26, 2000 at the Central Texas Water Supply Corporation Board Meeting, CTWSC Offices, 4020 Lakecliffe Drive in Harker Heights, Texas. CTWSC requested that the information presented at the September 6 meeting be presented at their board meeting.

3. April 10, 2001 at the Bell County Commissioners' Courtroom, Bell County Courthouse at 101 East Central Avenue in Belton, Texas. This was the first meeting after each of the entities had signed the agreement and served as the Phase II "Kickoff Meeting".

4. May 22, 2001 at the Central Texas Water Supply Corporation Board Meeting, Rogers Civic Center, 2 West Mesquite in Rogers, Texas. Discussion of proposed infrastructure requirements as they relate to CTWSC system. Addressed SD Kallman planning currently underway and how it related to Phase II of this Study.

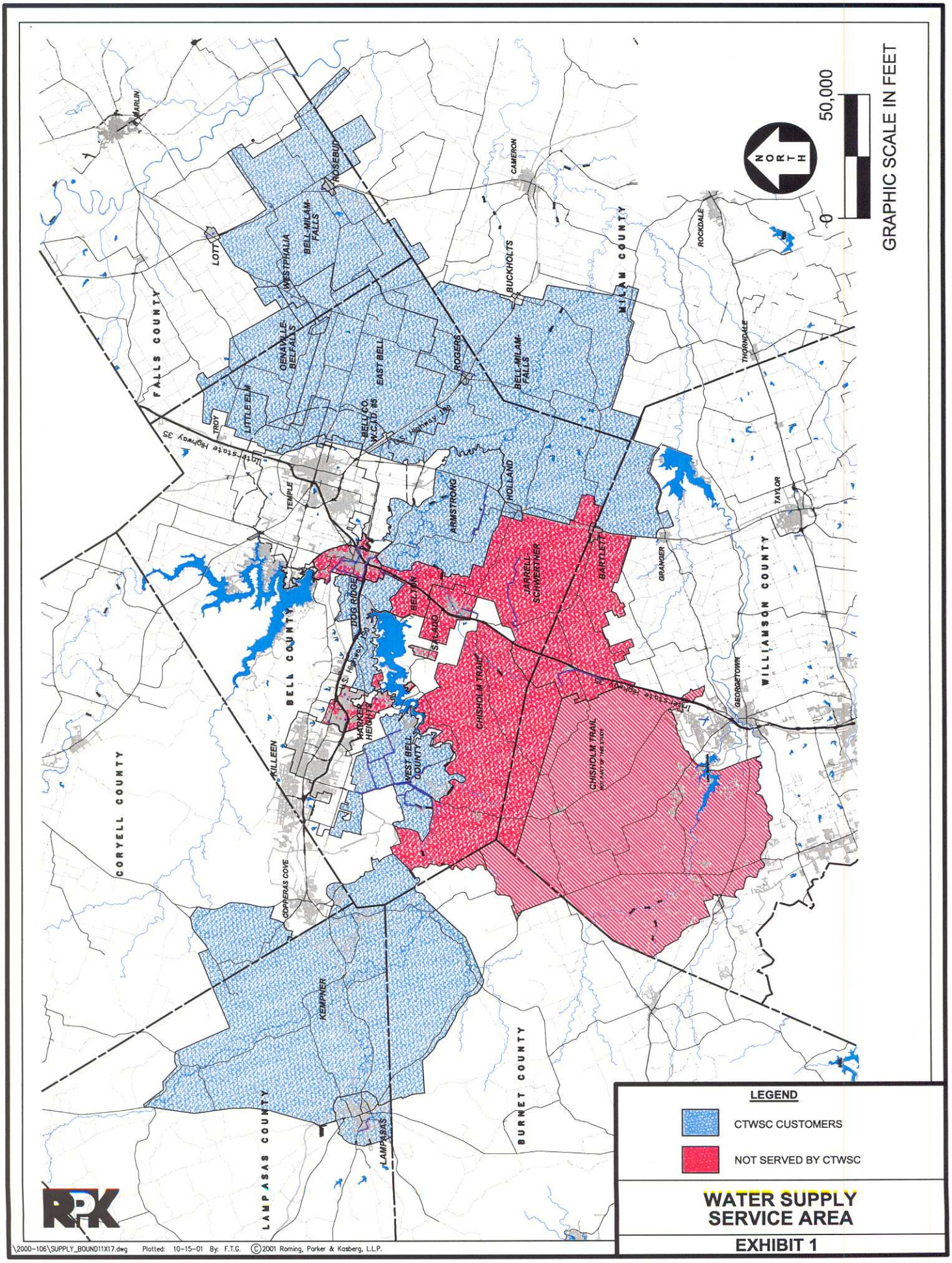
5. August 13, 2001 at the Bell County Commissioners' Courtroom, Bell County Courthouse at 101 East Central Avenue in Belton, Texas. Discussion included initial pipeline routes for proposed improvements, treatment facility types and location and role of ground water in the future.

6. April 4, 2002 at the Bell County Commissioners' Courtroom, Bell County Courthouse at 101 East Central Avenue in Belton, Texas. Presented findings of Phase II Draft Report. Requested questions and/or comments for inclusion in Final Report.

In addition to the meetings listed above, meetings were held with several of the entities to discuss their current operational procedures and items of specific interest to that entity. Two of these meetings were held as follows:

1. June 12, 2001 at the Bartlett Electric Co-op with Arnold Oliver to discuss Jarrell-Schwertner's existing operations. Items discussed included the quality of J-S's wells, the reliability of those wells and the projected demand.

2. August 28, 2001 at Harker Heights Municipal Offices with Steve Carpenter and Jerry Atkinson to discuss Harker Heights' options concerning treated surface water.


NORTH
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GRAPHIC SCALE IN FEET
FALLS COUNTY
BELL COUNTY
CORYELL COUNTY
LAMPASAS COUNTY
BURNET COUNTY
MILAM COUNTY
WILLIAMSON COUNTY
MARLIN
ROSEBUD
LOTT
WESTPHALIA
BELL-MILAM-FALLS
CAMERON
BUCKHOLTS
ROCKDALE
THORNDALE
TAYLOR
OENAVILLE
BELFALLS
EAST BELL
ROGERS
BELL-MILAM-FALLS
TROY
LITTLE ELM
BELL CO. W.C.I.D. #3
Interstate Highway 35
TEMPLE
ARMSTRONG
HOLLAND
GRANGER
JARRELL-SCHWERTNER
BARTLETT
DOG RIDGE
BELTON
SALADO
CHISHOLM TRAIL
GEORGETOWN
MARKET HEIGHTS
KILLEEN
WEST BELL COUNTY
ODDERAS COVE
KEMPNER
LAMPASAS
LEGEND
CTWSC CUSTOMERS
NOT SERVED BY CTWSC
WATER SUPPLY SERVICE AREA
EXHIBIT 1
RPK
\2000-106\SUPPLY_BOUND11X17.dwg Plotted: 10-15-01 By: F.T.G.
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2. System Operation

Phase I of this Study indicated that several Central Texas Water Supply Corporation customers currently augment the treated surface water from Lake Stillhouse Hollow with ground water from the Trinity Aquifer. Phase I also indicated that Bartlett, Jarrell-Schwertner WSC and Salado WSC rely solely on ground water. Chisholm Trail SUD currently augments ground water from the Edwards Aquifer with treated surface water supplied through the City of Georgetown. Phase II of this Study investigated the existing well capacities of each ground water source relative to the projected average day and maximum day water demands for each entity.

In order to accurately predict the amount of treated water required for each entity in the future, it was necessary to first investigate each ground water user's current ground water capabilities. Therefore, information concerning the pumping capacity of each ground water well was collected from the study participants. The complete listing of each well and its capacity is included as Exhibit A-1 located in Appendix A at the end of this report. The "reliable well capacity" for each entity was then calculated. The "reliable well capacity" is the total ground water available if the largest well were unavailable or out of service. Table 1 summarizes the total and reliable pumping capacity of the wells operated by each entity.

Table 1

Ground Water Well Capacities

Study Participant	# of Wells	Pumping Capacity (gpm)	
		Total	Reliable
Bell-Milam-Falls WSC	2	480	240
Bell County WCID #5	1	50	0
Little Elm WSC	1	140	0
East Bell WSC	1	210	0
Oenaville & Belfalls WSC	1	135	0
Bartlett, City of	2	600	200
Chisholm Trail SUD	4	2,688	1,198
Jarrell-Schwertner WSC	7	955	770
***Salado WSC**	6	1,905	1,475

* Salado currently has two (2) wells drilled, but not yet approved. It is anticipated these wells will be rated at 200 and 500 gpm, respectively. When these wells are put into service, the total well capacity will be 2605 gpm and the reliable well capacity will be 2105 gpm.

Table 2

Reliable Well Capacity

Study Participant	Reliable Well Capacity	Year Capacity is Exceeded:		
		Average Day	Maximum Day	[3]0.6 Rule
Bell-Milam-Falls WSC	240	2000	2000	2000
Bell County WCID #5	0	2000	2000	2000
Little Elm WSC	0	2000	2000	2000
East Bell WSC	0	2000	2000	2000
Oenaville & Belfalls WSC	0	2000	2000	2000
Bartlett, City of	200	2000	2000	2000
[1]Chisholm Trail SUD	1,198	>2050	2044	2038
Jarrell-Schwertner WSC	770	2033	2000	2037
[2]Salado WSC	1,475	2028	<2005	2014

[1] Chisholm Trail's reliable well capacity is for the entire system, not just the area included in the Study Area. Therefore, the reliable well capacity will actually be exceeded well before the dates in this table.

[2] Using capacity of the two additional wells drilled by Salado, the years that average day, maximum day and the 0.6 Rule exceed reliable well capacity are >2050, 2014 and 2028, respectively.

[3] 0.6 Rule is the capacity required by TCEQ Rule §290.45 to meet maximum day demands.

Table 2 summarizes the year that projected demands exceed the reliable well capacity for each of the entities that currently use ground water. Inspection of Table 2 indicates that neither the Central Texas Water Supply Corporation (Bell-Milam-Falls WSC, Bell County WCID #5, Little Elm WSC, East Bell WSC and Oenaville & Belfalls WSC) customers nor Bartlett has the ability to supply the projected average day demand with their largest well out of service. Chisholm Trail SUD, Jarrell-Schwertner WSC and Salado WSC currently have adequate capacity to supply average day water demands through the next twenty-five to thirty years, based on Phase I projections.

While Table 2 indicates that Chisholm Trail has adequate capacity to supply both projected average day and maximum day demands, this does not take into account the remainder of Chisholm Trail's service area. Phase I projections were for the 82,840 acres of the Chisholm Trail service area considered in this study and do not take into account the additional 176,808 acres not included in this study. Chisholm Trail currently augments ground water with treated water to meet maximum day demand. Therefore, it is logical to assume that when Chisholm

Trail's entire service area is considered, the well capacity shown will not be adequate to meet maximum day demand and appropriate actions should be taken to supply treated surface water to Chisholm Trail.

Jarrell-Schwertner WSC currently has adequate ground water capacity to meet current annual average day demand but not current maximum day demand. In addition to not meeting maximum day demand, Jarrell-Schwertner has indicated occasional problems with the quality of its wells. It is recommended that Jarrell-Schwertner make plans to purchase treated surface water from one of the area suppliers and use its groundwater only to augment maximum day demands and/or as a backup system. However, for planning purposes, the pipeline improvements have been sized both with and without the use of ground water.

Salado is the only entity currently supplied solely by groundwater that is able to meet projected demands in the next ten years. The additional two wells will allow Salado to supply its customers maximum day demands through the year 2014. While Salado has adequate groundwater capacity to supply its current customers, it should be noted that groundwater from the Edwards Aquifer is not a source without limits. Salado should take steps to add an alternate source of treated water to its system as the substantial growth in the area will eventually necessitate an alternate water source. Likewise, plans for an alternate water source should be in place in the event that regulations severely limit the amount of water taken from the Edwards. While this may seem premature since the Clearwater Underground Conservation District has yet to enact rules, it is the belief of this study that Salado will eventually be limited even without rules due to the substantial growth anticipated and the limited supply of ground water.

Table 3

Total Well Capacity

Study Participant	Total Well Capacity (gpm)	Year Capacity is Exceeded:		
		Average Day	Maximum Day	[3]0.6 Rule
Bell-Milam-Falls WSC	480	2000	2000	2000
Bell County WCID #5	50	2014	2000	2000
Little Elm WSC	140	2005	2000	2000
East Bell WSC	210	2000	2000	2000
Oenaville & Belfalls WSC	135	>2050	>2050	>2050
Bartlett, City of	600	>2050	2011	>2050
[1]Chisholm Trail SUD	2,688	>2050	>2050	>2050
Jarrell-Schwertner WSC	955	>2050	2000	>2050
[2]Salado WSC	1,905	>2050	2012	2023

[1] Chisholm Trail's reliable well capacity is for the entire system, not just the area included in the Study Area. Therefore, the reliable well capacity will actually be exceeded well before the dates shown in this table.

[2] Using capacity of the two additional wells drilled by Salado, the years that average day, maximum day and the 0.6 Rule exceed reliable well capacity are >2050, 2014 and 2028, respectively.

[3] 0.6 Rule is the capacity required by TCEQ Rule §290.45 to meet maximum day demands.

Table 3 summarizes the year that projected demands exceed the total well capacity for each of the entities that currently use ground water and is included for reference purposes but was not used when deciding need of treated water.

In summary, while several entities have firm well capacities capable of supplying adequate groundwater to meet average day demands, only Salado is capable of supplying maximum day demand to their customers. The CTWSC customers that use groundwater should continue the use of groundwater to augment maximum day demand and as an alternate water source. However, inspection of Table 3 (Total Well Capacity) indicates that only Oenaville and Belfalls WSC has adequate well capacity to meet average day demands. Therefore, all proposed infrastructure improvements to the existing CTWSC system will be sized to provide treated surface water to meet maximum day demands and discussion of ground water use (in terms of system operation) will be limited to augmenting maximum day and as a backup source.

Bartlett, Chisholm Trail, Jarrell-Schwertner and Salado have adequate total well capacity to meet average day demands through the study period. However, each entity does not have existing capacity adequate to meet maximum day demands. As such, these four entities should investigate the accessibility of treated surface water. Several entities currently mix treated surface water with ground water with no ill effects. However, it is recommended that compatibility tests be performed by an appropriate research laboratory as one of the first steps in obtaining surface treated water. It is logical that two sources are better than one and that using ground water to augment treated surface water reduces both the risk associated with a sole source and the impact on each source.

Operationally, it has been determined that Bartlett, Chisholm Trail, Jarrell-Schwertner and Salado can meet base demands with existing well capacities. Therefore, improvements will be sized with two operational scenarios:

- Groundwater capacity to meet average day demands. Infrastructure improvements sized to supply adequate surface water to augment ground water to meet maximum day demand.
- Infrastructure improvements sized to supply projected maximum day demands solely through treated surface water. Due to questions surrounding the future use of groundwater and the desirability of higher quality drinking water, it would be irresponsible to not include provisions for supplying treated surface water to meet maximum day demands.

3. System Infrastructure Improvements

The goal of this study and accompanying report is to evaluate and recommend those improvements necessary to meet the projected maximum day demand of each of the study participants through the year 2050 in the most cost effective manner possible. The first step in evaluating the necessary infrastructure was accomplished in Phase I of this study by projecting the average and maximum day water demands of each study participant. The steps taken in this phase of the report were to investigate the existing facilities, determine where deficiencies in the system were projected and to determine the improvements and alternatives that would correct the deficiencies in a cost-effective manner. This section focuses on the pipelines, booster pump stations and storage facilities that will be required to supply the projected maximum day demand to each of the participants. Treatment facilities will be discussed in Sections 4 and 5 of this report.

Existing Facilities

The Central Texas Water Supply Corporation's distribution system capacity was analyzed in "The Evaluation and Analysis of Central Texas Water Supply Corporation Facilities", prepared by Roming, Parker & Kasberg, L.L.P (RPK) and dated February 1999. The population and maximum day water projections from the "Central Texas Water Supply Study" Phase I report along with the line capacities from the 1999 Report provided the basis for determining where system capacity deficiencies would occur. Additionally, information concerning each of CTWSC's booster pump stations was obtained from Mr. R. David Cole, CTWSC General Manager. Exhibit 2, located in Appendix E at the end of this report, shows both the existing infrastructure and the proposed improvements.

Pipelines

The main area of concern when discussing pipeline capacity within the CTWSC system is north and east of the North Pump Station. This area includes the following lines and capacities as shown in Table 4:

Table 4
Existing CTWSC Pipeline Deficiencies
(North Pump Station to Rosebud)

Beginning	End	Pipe Diameter	Existing Capacity	Maximum Required Capacity
North Pump Station	East Bell Junction	12”	1.85 mgd	3.03 mgd
East Bell Junction	Little Elm Junction	12”	1.29 mgd	2.07 mgd
Little Elm Junction	O&B Pump Station	10”	1.06 mgd	1.62 mgd
O&B Pump Station	Westphalia Junction	10”	0.91 mgd	1.44 mgd
Westphalia Junction	Lott Pump Station	8”	0.83 mgd	1.36 mgd
Lott Pump Station	Rosebud Tank	8”	0.59 mgd	0.99 mgd

Table 5
Existing CTWSC Pipeline Deficiencies
(Various)

Beginning	End	Pipe Diameter	Existing Capacity	Maximum Required Capacity
System Split P.S.	Knob Hill Tank	12’/18”	0.97 mgd	2.15 mgd
Knob Hill Tank	Rogers Tank	10”	0.65 mgd	0.77 mgd
South Branch	Armstrong P.S.	12”	0.72 mgd	3.02 mgd
Armstrong P.S.	Holland Tank	10”	0.46 mgd	2.07 mgd
Holland Tank	B-M-F Station No. 2	6”	0.14 mgd	1.40 mgd
Little Elm Junction	First Service Point	8”	0.24 mgd	0.43 mgd
Highway 195 P.S.	Ivy Mountain Tank	24”	10.08 mgd	10.26 mgd

The preceding Table 5 shows the existing pipelines and the ultimate capacity required for the remaining system deficiencies. The areas of concern are from the System Split Pump Station to Rogers, the Armstrong Branch to the south, from Little Elm Junction to Little Elm First Service Point and from Highway 195 Pump Station to Ivy Mountain Tank.

The maximum required capacity shown in Tables 4 and 5 is the pipeline capacity required to supply treated surface water to meet the projected maximum day demand of each customer supplied by that pipeline. This study assumes that several of the water supply corporations will continue to augment treated surface water with ground water as described in Section 1. However, at some point in the future, it is assumed that the water suppliers that augment with ground water from the Trinity Aquifer will become dependent on surface water due to the marginal drinking water quality of the Trinity Aquifer. Generally, waters of the Trinity Aquifer are characterized by high total dissolved solids (TDS) concentrations. High TDS concentrations are generally more of an aesthetics problem than a health hazard. However, while not necessarily a health risk, waters with high TDS concentrations can also contain elevated levels of nitrate, arsenic, aluminum, copper and lead that are above the Primary or Secondary Drinking Water Standards. Review of the "Chemical Analyses of Public Water Systems" compiled by the Texas Department of Health and dated 1983 indicates that active wells (in 1983) in Armstrong, Bartlett, WCID No. 5, Bell-Milam-Falls, Dog Ridge, East Bell, Holland, Jarrell-Schwertner, Little Elm, Oenaville and Belfalls and Rogers had water qualities that were above the Secondary Drinking Water Standards for either one, some or all of the following:

- iron ($>$ 0.3 mg/L)
- sulfates ($>$ 250 mg/L)
- fluoride ($>$ 2.0 mg/L)
- total dissolved solids ($>$ 500 mg/L)
- temperature (While not a secondary standard, increased temperature is a concern which could require cooling towers.)

The applicable wells and corresponding chemical analysis has been included in as Exhibit A-2 in Appendix A. Various treatment applications are available to treat ground water to

remove the ions named above, however, these treatment alternatives are generally not cost effective when considering the pumping rates of 50 to 200 gpm. Therefore, when pipeline capacities for the existing CTWSC customers are discussed, these are the capacities required to supply treated surface water to meet maximum day demand.

In addition to the pipeline capacity problems in the Central Texas System noted above, there also lies the problem of supplying treated surface water to the entities that do not currently purchase treated surface water from CTWSC. The major issues facing these entities are:

1. Adequate raw water available under contract
2. Water treatment facilities to treat raw water (Contract with water supplier)
3. Transmission pipelines to deliver treated surface water
4. Adequately sized distribution lines within each entity's system

This report will investigate only improvements associated with issues 2 and 3 above. Alternate treatment facilities and pipelines will be designed based on the following options:

1. CTWSC upgrades its facilities to supply its current customers and constructs new pipelines and facilities to supply those entities they do not currently supply.
2. CTWSC supplies only its current customers and an alternate BRA treatment facility and pipeline system is built to supply those entities not currently members of CTWSC.

The pipelines that currently supply those entities located to the west of the existing water treatment plants No. 1 and 2 are generally adequate to supply the projected maximum day demand through the next thirty to forty years. The only deficiency in the area noted in Table 5 is the stretch of 24-inch line from the Highway 195 Pump Station to Ivy Mountain Tank. The 24-inch line is adequate to supply the projected maximum day demands through the year 2040. Improvements that are not required until after 2040 have not been sized or costed given the uncertainty with projections that distant in the

future. However, proposed improvements and alternate solutions for remedying the capacity problems for each of the remaining scenarios described above are included at the end of this Section.

Booster Pump Stations

The Corporation currently operates four booster pump stations that aid in the distribution of water from the System Split to Rosebud, including the System Split Pump Station, the North Pump Station, the Oenaville and Belfalls (O&B) Pump Station and the Lott Pump Station. Table 6 summarizes the firm pumping capacity of each of these pump stations.

Table 6
Existing CTWSC Booster Pump Stations
Firm Pumping Capacity

Pump Station	Pump No.1	Pump No. 2	Pump No. 3	Firm Capacity
System Split	1000 gpm	1000 gpm	-----	1000 gpm
North	1300 gpm	920 gpm	920 gpm	1840 gpm
O&B	600 gpm	600 gpm	-----	600 gpm
Lott	400 gpm	400 gpm	-----	400 gpm

Storage

The Corporation currently owns and operates nine water storage facilities in its distribution system. The location, type and capacity of each storage facility is listed in Table 7.

Table 7
Existing CTWSC Storage Facilities

Location	Type of Storage	Capacity
Highway 195 Pump Station	Ground	2,000,000 gallons
Dog Ridge	Standpipe	1,000,000 gallons
System Split	Ground	1,000,000 gallons
Knob Hill	Standpipe	2,000,000 gallons (200,000 gallons as Elevated)
North Pump Station	Standpipe Standpipe	157,450 gallons 354,260 gallons
O & B Pump Station	Standpipe	500,000 gallons
Lott Pump Station	Ground	500,000 gallons
Ivy Mountain	Standpipe	2,000,000 gallons (2,000,000 gallons as Elevated)

In addition to the nine tanks listed above, each of the customers in the CTWSC system have numerous ground and elevated storage tanks. These individual suppliers (members of CTWSC) must meet the requirements set forth in Chapter 290 of the TNRCC requirements. TNRCC 290.45 (b)(2) states that "all surface water supplies must provide the following:

(E) a total storage capacity of 200 gallons per connection

(G) an elevated storage capacity of 100 gallons per connection"

Since this study was not intended to analyze the operations of each individual entity, only those storage facilities required to operate the CTWSC transmission system were investigated.

Proposed System Improvements

The following sections will describe the improvements and alternates that were investigated for this report. The system improvements described in this section can be described according to the particular system to which they belong. Therefore, each improvement is considered either a CTWSC or a BRA improvement. CTWSC improvements include the following designations:

- Preliminary improvements designed by the engineering firm S.D. Kallman, Inc (SDK) for the Central Texas Water Supply Corporation. A draft copy of the Preliminary Engineering Report for these improvements was provided by Mr. Doug Tune, P.E., in August 2001. These improvements have been investigated and this report accepts their validity. As such, these improvements have been included in this report and attributed to SDK. These improvements were sized to meet the demands of current CTWSC customers only. However, this study investigated the magnitude of these improvements if the five additional study participants were also to be served by CTWSC. These improvements are discussed later in this section.
- Sizing and alignment of improvements to supply only those study participants that are currently members of CTWSC.
- Sizing and alignment of improvements to supply not only those study participants that are currently customers of CTWSC but those participants that could likely be customers (Salado WSC, Chisholm Trail SUD, Jarrell-Schwertner WSC, and the cities of Bartlett and Belton). Improvements to supply the additional customers were sized in two separate manners, including the use of surface water to augment existing ground water supplies to meet maximum day and also the sole use of surface water to meet maximum day demands.

The improvements attributed to the BRA system have been sized and aligned to supply the five participants listed above assuming they do not reach an agreement to purchase treated water from CTWSC. Note that Harker Heights has not been included in either of these scenarios. A brief discussion of Harker Heights' situation is included on Page 3 of this report.

A 20-foot permanent easement was assumed for the length of each pipeline improvement. It is possible that in many instances the pipeline may be aligned in existing right-of-way and the easement will not have to be acquired. However, at this early stage the more conservative (costly) option was assumed.

CTWSC System Improvements

The CTWSC system stretches from Kempner and Lampasas in the West to Rosebud and Buckholts in the East. This extraordinarily large service area is currently served from the existing Water Treatment Plants No. 1 and 2 located near Harker Heights on Lake Stillhouse Hollow. Section 4 of this report discusses the addition of Water Treatment Plant No. 3 on the eastern side of Lake Stillhouse Hollow. The additional treatment capacity along with the following system improvements will allow the CTWSC system to supply the required maximum day flows well into the future. This report investigated the following types of improvements in order to provide the required capacity:

- Modifications to existing booster pump stations (increase pumping capacity) to increase capacity within existing pipelines
- Parallel existing pipelines with new pipelines for additional capacity
- Supply entities in extremities of system via new pipeline, i.e., Rosebud supplied through proposed pipeline from Rogers to Rosebud

As was noted earlier in this section, the proposed CTWSC improvements can be broken into three categories: SDK proposed improvements, improvements to supply existing customers only and improvements to supply existing and future customers. Therefore, these three categories of improvements will be discussed separately.

S.D. Kallman Proposed Improvements

The initial improvements proposed by this study, made prior to the informational meeting, concerned augmenting the capacity to the System Split booster Pump Station, aligning pipelines to serve the entities to the south and east and to augment CTWSC's existing system to Rosebud. It was learned that the engineering firm of S.D. Kallman,

Inc. had begun the planning of the new CTWSC treatment plant and additional improvements to the system. These improvements consisted of pipelines to the east that terminated at the System Split Pump Station and pipelines to the north that would connect to the 14-inch line that currently supplies the customers east of Dog Ridge WSC. These improvements mirrored the initial improvements presented at the informational meeting for the most part. After reviewing the general alignment and capacities of these improvements, which indicated a general agreement with the proposals of this study, it was decided to include these improvements as they appear in the Preliminary Engineering Design Report for CTWSC Improvements prepared by SDK. The SDK proposed improvements are illustrated in both Exhibit 2 and Exhibits 3-A1 and 3-A2 located in Appendix E of this report.

The following improvements will allow the increased treatment capacity to be distributed to the customers east of the existing water treatment plant. Initially, the FM 1670 Pump Station will supply a portion of the Dog Ridge WSC demand. Eventually, this pump station will supply the entire Dog Ridge WSC demand. The improvements listed below were sized to meet the ultimate 2050 demand of current CTWSC customers. Alternatives will be presented later in this section that will utilize portions of these improvements for supplying additional customers. The following is a summary of the improvements proposed by SDK:

Table 8
CTWSC Proposed System Improvements
(SD Kallman, Inc.)

Beginning	End	Pipe Diameter	Length	Comments
WTP No. 3	FM 1670 Standpipe	24”	31,500’	Supply Dog Ridge WSC from New WTP.
WTP No. 3	IH 35	30”	10,100’	Augment Armstrong WSC/System Split
IH 35	Armstrong Standpipe	24”	28,800’	Augment to east
Armstrong Standpipe	System Split Pump Station	20”	69,000’	Gravity flow from Standpipe to Pump Station

Table 8
(continued)

Improvement	Comments
FM 1670 Pump Station	Supply Dog Ridge WSC from new WTP
FM 1670 Standpipe (1.0 Million Gallon)	Gravity flow to east (Armstrong Pump Station)
Armstrong Pump Station Upgrade	Required to accept flows from FM 1670 (TBA after construction of 20" line to east)
Armstrong Standpipe (2.0 Million Gallon)	Gravity flow to existing tanks and pump stations to the north, east and south

Additional (Future) Improvements to Existing CTWSC System

The improvements to the existing CTWSC system were developed to tie into the proposed SDK improvements and increase the capacity of the system to meet the projected 2050 maximum day demands. The areas noted in the Existing Facilities paragraph of this section are the areas that will require additional infrastructure to meet these demands.

Major deficiencies noted earlier were the far eastern and southern extremities of the CTWSC system. These include the City of Rosebud and B-M-F WSC near Travis (Travis is located between Lott and Rosebud in the B-M-F WSC service area) in the east and the City of Holland and B-M-F WSC in the south. Initially, three options were investigated to supply additional capacity to the City of Rosebud. They consisted of the three following scenarios:

1. Construct additional pipelines that would parallel existing pipelines that did not have adequate capacity and upgrade the capacity of the associated pump stations.
2. Parallel the existing line from the System Split Pump Station (upgrade pump station) to East Bell WSC and construct an additional line from East Bell WSC to the City of Rosebud. In addition, either a parallel pipeline

from System Split Pump Station to the City of Rogers or pump modifications would be required.

3. Parallel existing alignment from System Split Pump Station to the City of Rogers with additional capacity built into the line to supply the City of Rosebud. Construct a new pipeline that would tie into the existing system at East Bell WSC and eventually at the City of Rosebud.

Options 2 and 3 provided the additional advantage of completing a looping of the CTWSC system. As such, Option 1 was the least advantageous of the alternatives and will not be discussed in this report. The following Tables 9 and 10 list the proposed improvements and alternate routes and sizes that were investigated to supply the system east and north of the System Split Pump Station. Exhibits 2, 3-B1 and 3-B4, located in Appendix E, illustrate these improvements.

Table 9
CTWSC Proposed System Improvements
(Additional Capacity North and East of System Split Pump Station)

Beginning	**End**	**Pipe Diameter**	**Length**	**Comments**
System Split Pump Station	North Pump Station	14”	43,500’	Supply B-M-F and Bell Co. WCID #5 to East Bell WSC
North Pump Station	East Bell WSC	12”	22,500’	Supply all of East Bell WSC
East Bell Junction	Rosebud	12”	77,000’	Supply City of Rosebud and B-M-F-Travis
Improvement	**Comments**			
Modifications to System Split Pump Station (Alternate 1)	Construct Pump Station adjacent to existing Pump Station to house additional pumps to supply Bell Co. WCID #5 to B-M-F-Travis through these improvements. Upgrade pumps to City of Rogers.			
Modifications to System Split Pump Station (Alternate 2)	Construct Pump Station adjacent to existing Pump Station to house additional pumps to supply B-M-F WSC, Bell Co. WCID #5, East Bell WSC, City of Rosebud, B-M-F WSC (Travis area), and the cities of Rogers and Buckholts.			

The proposed improvements to supply the northern and eastern extremities of the CTWSC system consist of modifying the existing System Split Pump Station, constructing new pipelines that parallel the existing CTWSC transmission system from the System Split Pump Station to the East Bell Pump Station on Highway 53 and constructing new pipelines along Highway 53 to the City of Rosebud. Pump upgrades at the System Split Pump Station will allow flow along the proposed route to Rosebud (or B-M-F-Travis Tank) without the aid of a booster pump station. The increased pipeline diameters and total length of proposed pipeline allowed required pump horsepower to remain in an acceptable range. Two alternatives were investigated to upgrade the System Split Pump Station to utilize the additional capacity of the pipeline improvements.

The first alternative consisted of constructing an additional pump station adjacent to the existing System Split Pump Station. This new pump station would be equipped with three (3) 100-HP pumps capable of pumping 1650 gpm with the largest pump out of service. These pumps would supply B-M-F WSC, Bell Co. WCID #5, East Bell WSC and the City of Rosebud through the proposed pipelines. In addition to the new pump station, the existing pumps to the cities of Rogers and Buckholts would be retrofitted with three (3) 75-HP pumps capable of pumping 1500 gpm with the largest pump out of service. While this alternative was investigated, it was not chosen due to the increased capital cost of providing six additional pumps.

The second alternative consisted of constructing an additional pump station adjacent to the existing System Split P.S. This new pump station would be equipped with three (3) 175-HP pumps with a firm capacity of 1750 gpm. This pump station would supply the maximum day demand to the same entities along the proposed pipeline to the City of Rosebud and also the B-M-F WSC in the area of Travis. This pump station will also supply B-M-F WSC and the cities of Rogers and Buckholts to the east. Essentially, the horsepower and capacity of the three pumps was upgraded to meet the demand requirements of the entities listed above.

Construction of the proposed water line improvements and Alternate 2 for upgrading the System Split Pump Station will allow the existing pumps at System Split to supply the remaining entities from North Pump Station to the City of Lott.

Table 10
CTWSC Alternate System Improvements
(Additional Capacity North and East of System Split Pump Station)

Beginning	End	Pipe Diameter	Length	Comments
System Split Pump Station	Knob Hill Tank	16”	22,000’	Augment B-M-F WSC, City of Rogers and East Bell WSC to City of Rosebud.
Knob Hill Tank	City of Rogers	14”	22,000’	Additional capacity to the City of Rogers.
City of Rogers	East Bell Junction (FM 439 and HW 53)	12”	38,000’	Additional Supply Point for East Bell WSC.
East Bell Junction	City of Rosebud	10”	68,000’	Provide additional capacity to the City of Rosebud.
Improvement		**Comments**		
Modifications to System Split Pump Station		Construct Pump Station adjacent to existing Pump Station to house additional pumps to augment B-M-F WSC, City of Rogers, East Bell WSC and the City of Rosebud through these improvements.		

Future investigations should look into the storage capacity at System Split. The existing 1,000,000 gallon ground storage tank is currently adequate. However, future growth and system operation may require additional storage capacity.

The alternate improvements to supply the northern and eastern extremities of the CTWSC system consist of modifying the existing System Split Pump Station, constructing new pipelines that parallel the existing CTWSC transmission system from the System Split Pump Station to the City of Rogers and constructing new pipelines along FM 437 and Highway 53 to the City of Rosebud. Upgrades at the System Split Pump

Station, consisting of three (3) 100-HP pumps with a firm pumping capacity of 2100 gpm, will allow flow to the City of Rosebud via the City of Rogers without the aid of a booster pump station. However, the alternate improvements described above only allow water to reach the Rosebud Tank via this route. If the need for increased capacity from the City of Rosebud to the B-M-F tank near Travis arises, it would necessitate the construction of a booster pump station near the intersection of FM 437 and Highway 53 and possibly another booster pump station in the City of Rosebud.

In addition to the areas beyond the System Split Pump Station, another area of concern is the Armstrong Branch to the City of Holland and the 60,000 gallon tank that serves the B-M-F WSC's southwestern area. The construction of the Armstrong Road Standpipe, with a high water level of approximately 800 feet above mean sea level, will increase the capacity of the 10-inch line to the City of Holland to from 500,000 gallons per day (0.5 mgd) to approximately 1.3 million gallons per day. This additional capacity was computed using the high water level of the proposed Armstrong Tank and the allowable head loss to the Holland Tank, which has a high water level of approximately 660 feet above mean sea level. However, the 6-inch line to the 60,000 gallon B-M-F tank will still be inadequate. Dependent on the actual growth experienced in the southern B-M-F WSC service area, the actual construction of a parallel line (6 to 8 inches in diameter) from the City of Holland to the 60,000 gallon B-M-F tank may not be required for some fifteen to twenty years in the future.

Improvements to CTWSC System to Serve Additional Customers

The two previous sections focused on those improvements necessary to increase the capacity of the Central Texas system to meet the projected 2050 maximum day demands of its existing customers. The following improvements are those that are necessary to supply those entities that do not currently purchase treated water from CTWSC. Improvements to serve additional customers (Belton, Bartlett, Chisholm Trail, Jarrell-Schwertner and Salado) have been sized to supply treated surface water to augment

ground water to meet maximum day demand or to supply treated surface water solely to meet maximum day demand.

The most logical and cost effective method of adding Belton, Salado, Chisholm Trail and Jarrell-Schwertner to the CTWSC system is to allow these entities to purchase capacity in the 30-inch line from the Water Treatment Plant No.3 to IH 35. A new transmission line paralleling IH-35 would then supply Salado and terminate in the proposed FM 2843 Pump Station. The FM 2843 Pump Station would then pump water to the northern portion of Jarrell-Schwertner WSC. This pump station could be built with a separate bank of pumps to supply Chisholm Trail SUD. These improvements are illustrated in Exhibit 3C-1 located in Appendix E at the end of this report.

Several alternatives were investigated to supply the City of Bartlett. The first of which was the continuation of the line from Jarrell-Schwertner WSC to the City of Bartlett. However, this resulted in an excessive length of new pipeline. Due to the proximity of the southern B-M-F WSC Tank and the City of Bartlett, the second alternative investigated was to construct a new pipeline from the 20-inch line proposed by SDK to a point where it would split to supply both the southern portion of B-M-F WSC and the City of Bartlett. The second alternative was found to be most cost-effective. However, if the City of Bartlett is not to be supplied by CTWSC, then a parallel line from the City of Holland to the B-M-F WSC Tank is the most cost-effective method of augmenting the supply of B-M-F WSC's southern service area.

Treated Surface Water to Augment Existing Ground Water

The following improvements are required to supply the treated surface water required in excess of existing well capacities to meet maximum day demands. The total well capacities of Salado, Chisholm-Trail, Jarrell-Schwertner and Bartlett have been considered in the sizing of these improvements.

Table 11
CTWSC Proposed System Improvements
(Augment Ground Water To Serve Additional Customers)

Beginning	End	Pipe Diameter	Length	Comments
CTWSC WTP No.3	IH 35 Junction	30”	9,500’	Supply City of Belton Service area south of Lampasas River
IH 35 Junction	Salado WSC	18”	11,500	Supplement Salado WSC
Salado WSC	FM 2843 P.S.	12”	10,500	Supply Chisholm-Trail SUD
FM 2843 P.S.	Jarrell-Schwertner WSC	8”	16,000	Supply Jarrell-Schwertner
20” SDK Line	City of Bartlett	10”/6”	51,500	Supply City of Bartlett through existing system from North.
Improvement		**Comments**		
FM 2843 Pump Station		Construct new pump station with three (3) 60-HP pumps with firm capacity of 1000 gpm		

Treated Surface Water to Supply Maximum Day Demand

The following improvements were sized to deliver treated surface water to meet maximum day demands without taking ground water into account. This is a prudent step to consider given the precarious nature of ground water. While previous discussions have proven these additional entities will require a treated surface water source to augment existing groundwater, inspection of Tables 11 and 12 indicates the entire maximum day demand can be supplied in surface water by increasing pipe one to two pipe diameters (2-4 inches). The additional cost for increasing the pipe diameters will be relatively small compared to placing a parallel line of smaller diameter in the future. Therefore, it is recommended that in depth cost analysis studies be performed prior to any decisions concerning the capacity of these improvements. Please note these improvements are denoted with an asterisk (*) on the attached Exhibits.

Table 12
CTWSC Proposed System Improvements
(Solely Treated Surface Water To Serve Additional Customers)

Beginning	End	Pipe Diameter	Length	Comments
CTWSC WTP No.3	IH 35 Junction	*30”	9,500’	Supply City of Belton Service area south of Lampasas River
IH 35 Junction	Salado WSC	*20”	11,500	Supplement Salado WSC
Salado WSC	FM 2843 P.S.	*16”	10,500	Supply Chisholm-Trail SUD
FM 2843 P.S.	Jarrell-Schwertner WSC	*12”	16,000	Supply Jarrell-Schwertner
20” SDK Line	City of Bartlett	10”/*8”	51,500	Supply City of Bartlett through existing system from North.
Improvement		**Comments**		
FM 2843 Pump Station		Construct new pump station with three (3) 125-HP pumps with firm capacity of 2000 gpm		

BRA Water System Development

The earlier discussion of the entities that do not currently receive treated surface water from CTWSC noted several obstacles that would hinder these entities in their attempt to purchase treated surface water from either CTWSC or another water supplier. Several of the issues facing these entities are:

1. Adequate raw water available under contract
2. Water treatment facilities to treat raw water (Contract with water supplier)
3. Transmission pipelines to deliver treated surface water

The first solution investigated only dealt with items 2 and 3. Contracting with CTWSC to purchase treated surface water and the associated improvements would alleviate the problems of treatment facilities and transmission pipelines. However, prior to purchasing treated surface water, each entity would be responsible for acquiring a raw water contract at Lake Stillhouse Hollow. While the improvements proposed above may

seem logical, it is possible that the five entities in question may not be able to reach the appropriate agreement(s) with CTWSC to construct the improvements and supply treated surface water.

Therefore, a second supply system was investigated. This system would be owned and operated by the Brazos River Authority. This system would consist of a water treatment facility on the Lampasas River and the associated transmission pipelines, booster pump stations and storage facilities necessary to supply the required amount of treated surface water. As with the first solution, these improvements address items 2 and 3 from above. However, the BRA system would operate differently from the CTWSC system. Instead of each customer acquiring raw water rights, the BRA would hold all raw water rights and would sell treated water capacity directly to each entity. Not only does this address Item 1 from above, but it also addresses the fundamental problem stated in Phase I of this Study. Phase I noted that the fundamental problem facing the study area was not an adequate supply of raw water but rather the distribution of raw water rights among the participants. Several alternatives were investigated to achieve the goal of supplying treated surface water to the cities of Belton, Salado and Bartlett, Chisholm Trail SUD and Jarrell-Schwertner WSC.

The following Tables 13 and 14 describe those improvements and alternatives necessary to create the BRA Water Supply System. Table 13 corresponds to augmenting ground water with treated surface water while Table 14 details those improvements necessary to meet maximum day demand solely through treated surface water. The following improvements and alternatives are illustrated in Exhibits 3-C1 and 3-C2 located in Appendix E at the end of this report.

Table 13
BRA Proposed System Improvements
Treated Surface Water to Augment Existing Ground Water Supplies To Meet Maximum Day Demands

Beginning	End	Pipe Diameter	Length	Comments
BRA WTP on Lampasas River	City of Belton Distribution Point	24”	5,000’	Supply City of Belton South of Lampasas River
Belton Dist. Point	Salado WSC	18”	18,000’	Supply Salado WSC
Salado WSC	FM 2843 P.S.	12”	13,000’	Supply Chisholm Trail SUD
FM 2843 P.S.	Jarrell-Schwertner WSC	10”	13,000’	Supply northern service area of Jarrell-Schwertner WSC
Jarrell-Schwertner WSC	City of Bartlett	8”	69,000’	Gravity Flow from Jarrell-Schwertner WSC
Improvement		**Comments**		
FM 2843 Pump Station and 1.0 MG Ground Storage Tank		Required to Supply Jarrell-Schwertner WSC and the City of Bartlett		

Table 14
BRA Proposed System Improvements
Treated Surface Water to Meet Maximum Day Demands (No Ground Water)

Beginning	End	Pipe Diameter	Length	Comments
BRA WTP on Lampasas River	City of Belton Distribution Point	*30”	5,000’	Supply City of Belton South of Lampasas River
Belton Dist. Point	Salado WSC	*24”	18,000’	Supply Salado WSC
Salado WSC	FM 2843 P.S.	*18”	13,000’	Supply Chisholm Trail SUD
FM 2843 P.S.	Jarrell-Schwertner WSC	*14”	13,000’	Supply northern service area of Jarrell-Schwertner WSC
Jarrell-Schwertner WSC	City of Bartlett	*8”	69,000’	Gravity Flow from Jarrell-Schwertner WSC
Improvement		**Comments**		
FM 2843 Pump Station and 1.0 MG Ground Storage Tank		Required to Supply Jarrell-Schwertner WSC and the City of Bartlett		

The proposed BRA system consists of approximately twenty-two (22) miles of pipeline. As was stated earlier, the FM 2843 Pump Station could be designed with an additional bank of pumps designated solely for Chisholm Trail SUD. Currently, the pump station design consists of three (3) 70-HP (*150-HP) pumps with a firm capacity of 1200 (*2600 gpm) to supply Jarrell-Schwertner WSC and the City of Bartlett through the year 2050.

The alignment of the proposed BRA improvements, shown in Exhibits 3-C1 and 3-C2, allows a single distribution point in the northeastern extremity of Chisholm Trail SUD. The alternative considered paralleling IH-35 to the City of Jarrell and then across to the City of Bartlett. This alternative would provide a more centralized distribution point for Chisholm Trail SUD and would also provide a broader coverage for Jarrell-Schwertner WSC. However, there are substantial problems associated with this alternative. This route requires approximately four additional miles of pipeline at an increased diameter from that proposed. The second major obstacle is the elevation difference by proceeding further south to the City of Jarrell. While the pump flow rates remained the same, the total dynamic head (TDH) increased dramatically. The significant increase in TDH resulted in either pumps with dramatically increased horsepower requirements or the addition of another booster pump station in addition to the FM 2843 Pump Station. While it may be beneficial to provide alternate distribution points to Chisholm Trail SUD in the future, it currently appears to be cost prohibitive.

Conclusion

The improvements outlined in this section represent the minimum system improvements required to supply the projected maximum day demand through the year 2050. The associated Opinion of Probable Cost sheets are located in Appendix B, Appendix C and Appendix D at the end of this report. The proposed pipeline alignments and sizes are illustrated in Exhibit 2 (pullout map) and the 11" x 17" Exhibits 3-A1 through 3-C2.

4. Treatment Process

There are essentially four methods of filtration. The following lists these four methods along with a brief summary of acceptable influent water quality:

- Conventional rapid sand filtration – raw waters with high turbidity.
- Slow sand and diatomaceous earth (DE) filtration – considered for particulate removal of almost any source water of five (5) nephelometric turbidity units (ntu) or less.
- Slow sand or DE filtration – depending on the nature of the particles, may be used in raw waters of up to 10 ntu.
- Membrane filtration – consistent effluent quality independent of raw water turbidity.

The two sources of surface water considered in this study are Lake Stillhouse Hollow and the Lampasas River downstream from Lake Stillhouse Hollow. Each of these sources is located within the Lampasas River Watershed. The 2001 Water Quality Report, prepared by the Brazos River Authority (BRA), recognizes Lake Stillhouse Hollow as having "excellent water quality". Both of these sources are subject to variations in turbidity. While average turbidities are relatively low, instances of high turbidity are occasionally seen.

Given the source water qualities and the process limitations given above, only conventional rapid sand filtration and membrane filtration were considered as viable treatment options at the proposed plants.

Conventional Rapid Sand Filtration

Conventional rapid sand filtration (Conventional) refers to the process by which most municipal water has been processed in the past. The process consists of chemical pre-treatment, rapid mixing, coagulation, flocculation, clarification, filtration and disinfection.

The main advantage to conventional treatment is that it is a proven process. The main disadvantage to conventional treatment is that it is not always able to keep pace with stricter water quality regulations. This inability to meet stricter requirements requires costly

modifications to update the treatment process. One such regulation is the "filter-to-waste" proposal which states that each individual filter effluent turbidity must be less than 0.5 ntu and the combined filter effluent cannot exceed 0.3 ntu. The filtrate that does not meet these requirements would have to be "wasted". That is, it could not be distributed as drinking water. While many conventional plants consistently produce filtrate of this quality, there are instances when normal plant processes or natural events occur that will disrupt this ability. For instance, after a conventional filter is backwashed and placed online, the turbidity will occasionally spike (a brief period of high values) until the filter media settles back to its original location. In addition, major rain events increase the turbidity of the raw water a significant amount which limits the effectiveness of the conventional filter. The capital cost of a conventional treatment facility would be substantially impacted by the additional valves, piping and lagoons required to "waste" this filtrate.

Membrane Filtration

Membranes for the production of potable water are becoming an increasingly viable alternative to the conventional treatment process. Membranes provide an absolute barrier to microorganisms and produce water at a quality equal to or better than that currently provided by conventional treatment processes. The physical barrier provided by the membrane reduces the amount of chemicals that must be added to the raw water, which results in a decrease in disinfection by-products associated with those chemicals. In addition to decreased chemical costs, membrane facilities do not usually require settling basins prior to the filters.

Membrane filtration refers to several systems which use a "physical barrier" that will not allow particles over a certain size to pass. The four most common types of membrane filtration are reverse osmosis (RO), nano-filtration (NF), ultra-filtration (UF) and micro-filtration (MF). The most noticeable difference between the four processes above is the nominal size of the membrane pores. Reverse osmosis has the smallest pores while micro-filtration has the largest pores. Conversely, the cost of each system is related inversely to the nominal pore size. Currently, ultra-filtration and micro-filtration are the most common choices for municipal water applications. In addition to cost, reverse-osmosis and nano-filtration are not well suited to the

municipal water sector due to the high variances in surface water quality. For the remainder of this report, membrane technologies will refer to either ultra-filtration of micro-filtration.

Micro-filtration refers to membranes having a nominal pore size of 0.1 micron while ultra-filtration membranes have a molecular weight cut off (MWCO) of 13K to 80K. Both MF and UF systems provide a dependable barrier against *Cryptosporidium* and *Giardia Lamblia,* while UF also provides protection against many viruses. A "true" ultra-filtration system must be capable of a 4-log (99.99 %) virus removal. The following table compares micro-filtration with ultra-filtration:

Table 15
Comparison of Micro-Filtration and Ultra-Filtration

Category	Micro-Filtration	Ultra-Filtration
Nominal Pore Size	app. 0.1 micron	MWCO (13K to 80K) 0.002-0.1 micron
Flow Direction	Outside-In	Inside-Out
Removes	*Cryptosporidium* and *Giardia Lamblia,*	*Cryptosporidium, Giardia Lamblia* and virus,
Backwash Flow Rate	app. 65% of Filtrate	200 – 300% of Filtrate
Membrane Strength	7-10 Year Warranty	3-5 Year Warranty
Capital Cost of Membrane Equipment	$400 to $600 1,000 gallons	$460 to $690 1,000 gallons
Operation and Maintenance Cost	$0.011 1,000 gallons	Increased power consumption due to higher operating pressure and increased backwash frequency

While the ultra-filtration provides a higher quality filtrate, it currently has more limitations than a similar micro-filtration plant. Currently, the capital cost of a UF plant is approximately 15% greater than that of a MF plant. Since the pore size of the UF membrane is smaller than the MF membrane, it also follows that the UF will require more frequent backwashes for the same quality influent. In addition, power and chemical costs associated with more frequent backwashes increase the operation and maintenance costs of the UF plant. One alternative is to build sedimentation basins prior to the ultra-filtration membrane equipment. Thus controlling

the quality of influent the membranes are exposed to. This option increases the initial capital cost and chemical cost related to coagulants, but reduces the O&M costs associated with the frequency of backwashes.

In addition to providing exceptional water quality, the compactness of membrane technology also allows for the construction of a full-scale water treatment plant in less space than is required for a conventional plant. Modular design of membrane trains allows additional capacity to be easily added. One added benefit of some MF and UF systems is that they share the same footprint. Therefore, a municipality could construct a MF plant in order to decrease upfront capital costs. In the future, when either funds were available or regulations warranted, the municipality could retrofit the racks containing MF membranes with UF membranes without constructing additional treatment buildings. The following is a summary of the benefits of membrane systems:

- Modular Construction (easy to add additional treatment units, capacity)
- Compatibility between MF and UF footprints.
- High permeability and throughput
- Removes turbidity, oxidized iron and manganese
- Consistent filtrate quality regardless of feed water quality
- Dependable barrier against *Cryptosporidium, Giardia Lamblia, Legionella* and other bacteria.
- Resistant to chlorine and other oxidants.
- Reduced cost of ownership including labor, chemicals, energy and replacement.
- Maximum recovery rates (typically $>95\%$).
- Minimal waste produced by minimizing chemical use and maximizing recovery.
- Low re-circulation flow rates minimize power consumption.
- Minimal pre-filtration required.

Membrane filtration systems are currently classified as “alternative treatment technologies” under the Surface Water Treatment Rule (SWTR). As such, each proposed installation must be approved by the state regulatory agency based on individual site conditions. However, the past two years have seen a significant increase in the number of membrane filtration plants in the municipal water field in Texas. The increased number of installations has allowed the TNRCC to somewhat relax their requirements concerning piloting schedules. While the current cost of the membrane equipment is substantially higher than the cost of a conventional media filter, this

cost is offset by the decreased chemical costs and the capital savings of not constructing settling basins.

Existing and Proposed Treatment Facilities

Central Texas Water Supply Corporation currently operates a 14.35 mgd conventional water treatment plant located on the northwest end of Lake Stillhouse Hollow. The 14.35 mgd capacity is the total capacity of CTWSC Water Treatment Plants No. 1 and No.2. While they were constructed at different times, hence the terminology of Plant No.1 and No.2, the plants do not operate independently of each other. This existing plant (No. 1 and No. 2 combined) will eventually supply only those customers located to the west of the water treatment plant. Exhibit 4-A, located in Appendix E at the conclusion of this report, illustrates the projected maximum day demand versus treatment capacity for the next fifty years. Exhibit 4-A indicates that there is adequate capacity to serve these customers.

CTWSC is currently designing a membrane filtration facility that will be located near the dam on Lake Stillhouse Hollow. As currently designed, the plant (WTP No. 3) will have an initial capacity of 6.0 mgd and an ultimate capacity of 18.0 mgd. WTP No. 3 will eventually supply all of the CTWSC customers east of the existing water treatment plant. Exhibit 4-B1, located in Appendix E, illustrates the projected maximum day demand versus treatment capacity for the next fifty years. Inspection of Exhibit 4-B1 indicates that the initial 6.0 mgd capacity is not adequate to supply treated surface water to meet the existing maximum day demand of the existing CTWSC customers. However, several of the entities that are being supplied from the new treatment plant supplement the treated surface water with ground water. The projected demands are based on providing treated surface water to meet projected maximum day demands and do not take ground water use into account. The use of ground water and surplus from the existing plant will provide an adequate supply of potable water until 2010.

Exhibit 4-B2, located in Appendix E, illustrates the projected maximum day demand and associated treatment capacity to supply existing CTWSC customers to the east and possible future customers. The initial plant capacity required to supply treated surface water to each of these entities is 10.0 mgd (*16.0 mgd to supply solely treated surface water) through the year

2010. The 19.0 mgd (*25.0 mgd) ultimate capacity of this plant is adequate through the year 2050 (*2045). However, the current BRA contract with the CTWSC for the intake structure limits the firm raw water pumping capacity to 11,200 gpm (16.1 mgd). Currently, these additional customers either receive treated water from another supplier or rely on groundwater. These projections were based on these entities using groundwater from the Edwards Aquifer to supplement treated surface water to meet maximum day demands (improvements with an * are sized to supply maximum day demand solely through treated surface water.

Exhibit 4-C, found in Appendix E, illustrates the projected maximum day demand and associated treatment capacity to supply the cities of Belton and Bartlett, Salado WSC, Jarrell-Schwertner WSC and Chisholm Trail SUD from a proposed BRA water treatment plant. The BRA plant would have an initial capacity of 5.0 mgd (*9.0 mgd) and an ultimate capacity of 10.0 mgd (*15.0 mgd). The majority of the capacity in this plant would be used to augment ground water to meet maximum day demand (*alleviate the current reliance on ground water) and is a viable option if the entities listed above are unable to reach agreement with CTWSC.

Exhibit 4-D illustrates a typical process flow schematic for a membrane filtration plant. Sedimentation basins were not included in the Opinion of Probable Cost for each of the treatment plants. The quality of the water in Lake Stillhouse Hollow and the Lampasas River is of quality that sedimentation basins will not be required. However, the site layout of a prospective membrane facility should include provisions for sedimentation prior to the membrane filters. The sedimentation basins provide the membranes with a stable, quality influent that will allow either increased flux rates (loading rates) through the membrane or increased filter run time between backwashes. While sedimentation basins will allow an increased flux rate, capital saved in membrane modules will not offset the increased capital cost of constructing the basins.

Annual Costs Associated with Treatment Facilities

Annual costs associated with treatment plants consist of debt costs related to the infrastructure and operation and maintenance costs related to the production of treated surface water. Operation and Maintenance (O&M) costs can vary greatly from treatment

plant to treatment plant depending on the number of employees required, the treatment process and the size of the facility. For instance, a conventional water treatment facility will have relatively low electrical costs and higher chemical costs due to coagulants for the clarifiers and media for filters. A membrane facility will have lower chemical costs (no coagulants or filter media) but substantially higher electrical costs related to increased pump sizes to "force" raw water through the membranes.

Generally, the major O&M costs consist of salaries, raw water, electricity, testing facilities and chemicals. Since the actual annual cost will vary dependent on plant size, this report will address annual costs in cost per one thousand gallons of treated water for comparison purposes. Likewise, the proposed CTWSC and BRA plants will have relatively similar O&M costs, therefore, annual costs will be presented for a typical 15 million gallon per day membrane facility. The annual costs are approximately $0.45/1000 gallons of treated water. This corresponds to an annual cost of approximately $2,500,000 for a 15 mgd facility. The annual operation and maintenance costs for the 5.0 mgd, 6.0 mgd and 10.0 mgd facilities are $900,000, $1,000,000 and $1,650,000, respectively. Support documentation outlining the typical annual costs for a 15.0 mgd plant are included in Appendix G.

Conclusion

The conventional water treatment plant is currently able to produce filtrate that meets TNRCC guidelines. However, in a world of "disappearing zeroes", this may not always be the case. Regulations and guidelines likely will continue to restrict the level of particulates in our drinking water and the current answer to these future regulations is the "physical barrier" of membrane filtration. Currently, micro-filtration is more cost-effective than ultra-filtration. The capital cost, operation and maintenance costs and expected life span of the micro-filtration plants offer the most economic choice. However, the interchangeability of the micro-filtration and ultra-filtration racks allow a micro-filtration plant to be built and then retro-fitted at some point in the future with ultra-filtration by simply replacing the membrane modules and feed pumps.

5. Treatment Facility Location(s)

This study describes the required infrastructure to supply treated water to meet the projected maximum day demand of each of the study participants. As stated in the System Infrastructure Improvements section of this report, this study investigated the possibility of two separate treatment plants being constructed in the area south and east of Lake Stillhouse Hollow Reservoir (LSHR).

Project Description

The Central Texas Study Area is located in an area that is experiencing tremendous growth. Three major factors account for this growth:

1. Interstate Highway 35 (IH 35) divides the Study Area in half. IH 35 has been impacted greatly by the North American Free Trade Agreement (NAFTA) and the increased traffic along the highway has led to increased business in the study area.
2. Fort Hood, located outside of the study area to the north, is the largest military base in the free world. The military brings a great number of people to this area. Very often these people remain in the area after their military service is complete.
3. The increase in technological related firms in the Austin area has created an innumerable number of jobs. The southern study area has experienced increased population as these workers have discovered lower realty prices and cost of living within an hour drive of Austin.

In addition to the three factors listed above, the joint-use airfield at Fort Hood's Robert Gray Army Airfield is expected to increase the number of people traveling through the study area. The population growth described above, accompanied by industrial growth has dictated that existing facilities and infrastructure be upgraded and additional facilities be built in order to meet the increased demands projected for the area. Failure to plan for the increased water demands will likely impede the growth and economic well being of the area. Implementation of the Capital Improvements Plan included in Section 6 of this report will allow the study area to continue to grow and prosper without the limitation of an adequate supply of potable water.

Construction of the CTWSC Water Treatment Plant No. 3 and possibly the BRA Water Treatment Plant will benefit the entire study area. The capacity of the existing CTWSC treatment plants will be exhausted prior to 2005. Numerous areas in the CTWSC distribution system are approaching their design capacities. Several of the entities currently are not able to supply water to new customers living in their service area due to TNRCC regulations concerning the minimum amount of water the system can pump per connection. Therefore, some rural customers are forced to drill their own ground water wells in order to supply water to their homes. While construction of the proposed improvements will allow adequate water to be treated and distributed to the study participants, this study focuses only on the primary distribution system. Each entity within the system will need to address the improvements necessary to distribute the water within their system. This analysis is beyond the scope of this study.

Many of the CTWSC customers augment the surface water being supplied with ground water from the Trinity Aquifer. Also, several of the entities, namely Salado WSC, the City of Bartlett and Jarrell-Schwertner WSC are currently operating solely on ground water from the Edwards and Trinity Aquifers. While the Edwards Aquifer is adequate for drinking water, the Trinity Aquifer is considered to have marginal quality for drinking water. Construction of the proposed water treatment facilities and associated infrastructure will increase the amount of treated surface water delivered to the participants which will lessen the amount of ground water required to meet maximum day water demands.

Site Requirements

Potential site locations for the proposed water treatment facilities were based on the following criteria:

1. Proximity of plant site to source water and to customers being served.
2. Consideration of finished water transmission requirements to interconnect plant to water distribution system.
3. Environmental and land use concerns.

4. Subsurface and geotechnical considerations.
5. Land availability, cost and zoning.
6. Compatibility with surrounding developments.
7. Potential for flooding.
8. Availability of utilities.
9. Site topography and accessibility.

In addition to meeting the requirements listed above, each site will also have to meet the following agencies' requirements:

- Texas Historical Commission
- U.S. Fish and Wildlife
- U.S. Corps of Engineers
- Texas Natural Resource Conservation Commission

The Texas Historical Commission (THC) requires that a professional archeological survey of the project area be conducted in conformance with Chapter 41 Rules of the Texas Antiquities Code. This law provides for the location, discovery, study and protection of cultural resources. It also requires the issuance of an Antiquities Permit for the purpose of completing archeological and historical investigations.

The U.S. Fish and Wildlife Department must be contacted regarding the impact of these projects upon wetlands. Based on a review of the proposed improvements, the likelihood of impact on federally listed species or other important fish and wildlife resources would be determined. This determination should be obtained prior to the final design.

Approval letters from both the THC and the U.S. Fish and Wildlife Department should be submitted to the U.S. Army Corps of Engineers in order to obtain a Section 404 permit that will allow the construction of the proposed improvements.

The Texas Commission on Environmental Quality (TCEQ) will require a permit to operate each water treatment plant. The permit will define the capacity of the plant. Conventional plants are rated based on theoretical calculations. However, since membrane technology is currently classified as an "alternate treatment technology" under the Surface Water Treatment Rule (SWTR), the permitting process is slightly different. Since membrane systems are site specific, the TNRCC requires a "piloting" period to determine the operating parameters based on the actual feed water encountered. Initially the piloting process was conducted prior to the design phase and pre-qualified the piloted systems. However, the increase in number of membrane plants has allowed the TNRCC to alter the piloting process. Currently, the piloting process takes place during the first year of operation of the membrane plant. The TNRCC issued the PDW Program Staff Guidance document entitled Pilot Study Process for Hollow-Fiber Ultrafiltration and Hollow-Fiber Microfiltration Membranes that outlines the procedures that must be followed during the "pilot" period. Upon completion of the "pilot" period, the TNRCC permit will specify the capacity of the plant.

Site Location and Alternatives

Initial planning for the construction of Treatment Plant No. 3 by CTWSC led to the purchase of 78 acres of land on West Amity Road, west of FM 1670 (See Exhibit 5-A1 in Appendix E). The raw water intake structure and raw waterline for this plant are currently being constructed south of the dam on Lake Stillhouse Hollow. Following a site visit in which a visual inspection of the area was made, it was determined that the location met those criteria that can be observed without field investigations. Due to the considerable planning of CTWSC and related infrastructure improvements currently underway, no other locations for this plant were investigated. Exhibit 5-A2, located in Appendix E, shows a preliminary site layout of CTWSC WTP No.3 provided by SD Kallman, Inc.

Initial discussions with the BRA indicated that the scope of this Study should include investigation into the possibility of constructing a water treatment plant in addition to the CTWSC Plant. This new plant would supply those entities that would require treated surface water in the future and were not currently supplied by CTWSC, i.e., the City of Belton (south

of the Lampasas River), Chisholm Trail SUD, Jarrell-Schwertner WSC, the City of Bartlett, Salado WSC and possibly the City of Harker Heights. Due to the proximity of the first five entities listed above, it was decided that the optimal location for the new plant would be within the City of Belton CCN on the Lampasas River.

Two locations were chosen from the topography of a USGS topographic map and are shown in Figure 5-B1 located at the end of this report in Appendix E. The first location was north of the Lampasas River on a gravel road south of Shanklin Road. However, a site visit to the location excluded the site due to a variety of reasons. The second location, which is the proposed site, is south of the Lampasas River on the east side of Camp Tahuaya Rd. The initial site is adjacent to the Camp Tahuaya Boy Scout Camp and is composed of approximately 24 acres. This site was more logical for several reasons:

- Five of the six potential customers are located south of the Lampasas River, which would minimize distribution pipeline length.
- The east side of Camp Tahuaya Road is relatively undeveloped.
- Camp Tahuaya Road provides access to the proposed plant.
- Proximity of the site to the Lampasas River
- The topography of this site is relatively flat which would be beneficial in construction (no major cuts or fills).
- The geography of the river in this area is conducive to the construction of a low water dam.

Exhibit 5-B2, found in Appendix E, shows the proposed site layout for the BRA water treatment facility.

Environmental, Social and Cultural Impacts

The effects of additional water treatment capacity in the area are numerous. They include better quality of living, population expansion and expansion of industry. The increases in population and industry associated with the growth of an area will obviously have an affect on the

environment. These effects include the numerous problems associated with population growth; increased motor vehicle emissions, increased refuse and an increase in the amount of resources required to sustain that growth.

Air Quality

The air quality of the area is good. The proposed membrane filtration plants, along with any piping, storage and/or pump stations will not affect the air quality directly. That is, normal operation of the plant will not lead to a degradation of air quality.

Water Quality

An earlier section of this report stated that the water quality of Lake Stillhouse Hollow was excellent. Likewise, the quality of the Lampasas River downstream of Lake Stillhouse Hollow is also very good. The normal operation of the proposed water treatment plants will not have an affect on the quality of water found in these two bodies of water. However, the proposed BRA water treatment plant will require the construction of a low water dam on the Lampasas River downstream from the raw water intake structure. The construction of this dam will have some affect on the normal flow patterns of the Lampasas River during low-flow conditions. A more extensive study should be prepared to determine the effects this dam will have on the river and aquatic life downstream of the dam as part of the preliminary design of the plant.

Surrounding Lands / Wildlife of the Area

The two tracts of land designated for construction of the CTWSC and BRA water plants are each located in a rural setting. The areas surrounding each are sparsely inhabited. The CTWSC tract is approximately 78 acres, while the BRA tract is approximately 25 acres. The size and location of each treatment plant will allow

for minimal disturbance of the surrounding inhabitants both during construction and once the plants are in operation. The proposed BRA water treatment facility is located near the Camp Tahuaya Boy Scout Facility. The BRA facility should have a minimal effect on the Boy Scout facility after construction. Since the proposed BRA facility and Camp Tahuaya share a common road, it is likely there will be some minor conflicts during construction. The CTWSC plant is located some distance from Lake Stillhouse Hollow and as such should have no effect on the Lake wildlife. Likewise, the BRA site is not located within a wetland. The BRA plant is located near the Lampasas River and Lake Boyd Callan, however, the actual treatment facility should have no impact on the surrounding area or the wildlife found in the area. The preliminary design study should address what affects can be expected from construction of the low water dam.

Historic and Religious/Ethnic Considerations

The proposed treatment plant locations do not encroach on known historic or religious sites. The construction of these facilities will result in a greater amount of potable water being supplied to the area and will not have historical, religious or ethnic impacts.

Conclusion

The CTWSC treatment facility will be located on a 78-acre tract near Lake Stillhouse Hollow while the BRA facility would be located on a 25-acre facility near the Lampasas River. The location of each plant is in relatively close proximity to its proposed customers and is in a rural area that is sparsely populated. The construction of either one or both of these plants will benefit the study area with minimal affects on the existing surroundings.

6. Capital Improvements Plan

CTWSC Improvements to Supply Existing Customers

The following Tables 16 through 20 demonstrate the magnitude and sequencing of those projects required to upgrade the existing CTWSC system to meet the projected demands of its current customers through the year 2050. The values found in Table 16 were taken from SDK's preliminary engineering report prepared for CTWSC. Each of the exhibits identified in Tables 16 through 20 can be found in Appendix B at the end of this report.

Table 16

Phase I Improvements
Supply Existing Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
B-1	Water Treatment Plant No. 3 (6.0 MGD)	$ 10,400,000
B-2	Raw Water Intake Structure	$ 2,500,000
B-3	Recommended Improvements including:	$ 9,100,000
	30" and 24" Lines to Armstrong Tank	
	24" Line to FM 1670	
	2.0 MG Armstrong Road Standpipe	
	1.0 MG FM 1670 Standpipe	
	Modifications to Armstrong Pump Station	
	FM 1670 Pump Station	
	Total Phase I Improvements Cost	$ 22,000,000

Phase I improvements include the SDK proposed improvements that are currently under design. These improvements should be constructed within the next two years.

Table 17

Phase II Improvements
Supply Existing Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
B-4	20" Line -- Armstrong to System Split	$ 3,900,000
B-9a	Modifications to System Split	$ 460,000
	Total Phase II Improvements Cost	$ 4,360,000

Phase II improvements supply additional water to the System Split pump station and should be constructed within the next five to seven years. Exhibits B-10 (alt) through B-15 (alt), found in Appendix B, show the opinion of probable cost for those alternate improvements that were not selected.

Table 18

Phase III Improvements
Supply Existing Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
B-16	WTP No. 3 Expansion # 1 (3.0 mgd)	$ 4,500,000
B-5	10" Line from Holland to B-M-F	$ 1,400,000
B-6	14" Line – System Split to North Pump Station	$ 1,950,000
B-7	12" Line – North Pump Station to East Bell	$ 900,000
	Total Phase III Improvements Cost	$ 8,750,000

Phase III improvements will be required within the next ten to twelve years and consist of beginning the pipeline improvements to supply additional treated water to Rosebud.

Table 19

Phase IV Improvements
Supply Existing Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
B-17	WTP No. 3 Expansion # 2 (2.0 mgd)	$ 2,200,000
B-8	12" – East Bell to Rosebud	$ 2,650,000
	Total Phase IV Improvements Cost	$ 4,850,000

Phase IV improvements will be required within the next twenty to twenty-five years. Construction of the line to Rosebud not only supplies additional water to Rosebud, but also creates redundancy in the far extremities of the CTWSC system. The pipelines and System Split pump station improvements have been sized to supply treated water to the B-M-F tank near Travis through the City of Rosebud. However, complete redundancy cannot be realized without the construction of a booster pump station either near East Bell WSC or at the City of Rosebud tank to allow the treated water to reach the City of Lott. This study did not size or locate this pump station because it is not necessary to supply the maximum day demand to the study area, however, it may be an advantage from an operational standpoint in the future.

Table 20

Summary of Phased Improvements
To Supply Existing CTWSC Customers

Improvement	Cost
Phase I	22,000,000
Phase II	4,360,000
Phase III	8,750,000
Phase IV	$ 4,850,000
Total Improvements Cost	$ 39,960,000

The total cost of improvements to supply the existing CTWSC customers through the year 2050 is $39,960,000.

CTWSC Improvements to Supply Existing and Additional Customers

The improvements outlined in the following tables are those necessary to supply existing CTWSC customers and additional customers. It was noted earlier that several of the additional customers rely heavily on ground water. Therefore, two separate opinions of probable cost are included. The first assumes each of the additional entities will continue to use ground water and the treated surface water will be used to augment the existing ground water supplies. These are the minimum improvements that will be required. However, opinions of probable cost have also been included to demonstrate the additional cost associated with supplying only treated surface water to meet maximum day demands.

Augment Existing Ground Water with Treated Surface Water

The following Tables 21 through 25 demonstrate the magnitude and sequencing of those projects required to upgrade the existing CTWSC system to meet the projected demands of its current customers and future customers through the year 2050. Those improvements from Tables 16 through 19 that are essential in supplying existing customers have been included in this section for comparison purposes. Each of the exhibits identified in Tables 21 through 24 is located in Appendix D at the end of this report unless otherwise noted.

Table 21

Phase I Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-1	Water Treatment Plant No. 3 (10.0 MGD)	$ 16,500,000
[a]B-2	Raw Water Intake Structure	$ 2,500,000
[a]B-3	Recommended Improvements including:	$ 9,100,000
	30" and 24" Lines to Armstrong Tank	
	24" Line to FM 1670	
	2.0 MG Armstrong Road Standpipe	
	1.0 MG FM 1670 Standpipe	
	Modifications to Armstrong Pump Station	
	FM 1670 Pump Station	
	Total Phase I Improvements Cost	$ 28,100,000

[a] Exhibits B-2 and B-3 are found in Appendix B.

Phase I improvements include the SDK proposed improvements that are currently under design. The majority of which are to supply the existing CTWSC customers. However, the initial 6.0 mgd plant is not sufficient to supply both the existing customers and the proposed customers. Therefore, costs have been generated for a 10.0 mgd plant. The 30-inch line from the water treatment plant to IH-35 was initially sized with adequate capacity to supply not only the existing CTWSC customers but also the proposed customers. These improvements should be constructed within the next two years.

Table 22

Phase II Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-2	18" Line to Salado	$ 700,000
D-3	12" Line to FM 2843	$ 500,000
D-8	FM 2843 Booster Pump Station	$ 1,000,000
D-4	8" Line to Jarrell-Schwertner	$ 560,000
[a]B-4	20" Line -- Armstrong to System Split	$ 3,900,000
[a]B-9a	Modifications to System Split	$ 460,000
	Total Phase II Improvements Cost	$ 7,120,000

[a] Exhibits B-4 and B-9a are found in Appendix B.

Phase II improvements should be constructed in the same general time frame as Phase I improvements. They have been broken into Phase II to illustrate that these improvements are primarily to supply the proposed customers, i.e., Salado WSC, Jarrell-Schwertner WSC, Chisholm Trail SUD, and the cities of Bartlett and Belton.

Table 23

Phase III Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-10	WTP No. 3 Expansion (5.0 mgd)	$ 6,900,000
D-5	10" Line towards Holland/B-M-F	$ 1,450,000
D-6	8" Line to B-M-F	$ 775,000
D-7	6" Line to Bartlett	$ 425,000
[a]B-6	14" Line – System Split to North Pump Station	$ 1,950,000
[a]B-7	12" Line – North Pump Station to East Bell	$ 900,000
	Total Phase III Improvements Cost	$ 12,400,000

[a] Exhibits B-6 and B-7 are found in Appendix B.

Phase III improvements include those improvements that will eventually create an alternate route to Rosebud. The preferred option for supplying the City of Bartlett consists of sharing capacity from the 20" SDK pipeline to a point where the line will split

between City of Bartlett and the B-M-F WSC Tank. Phase III improvements are estimated to be required in the year 2010.

Table 24

Phase IV Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-11	WTP No. 3 Expansion (4.0 mgd)	$ 4,100,000
[a]B-8	12" – East Bell to Rosebud	$ 2,650,000
	Total Phase IV Improvements Cost	$ 6,750,000

[a] Exhibit B-8 can be found in Appendix B.

Phase IV improvements include those improvements that complete the alternate route to the City of Rosebud. Phase IV improvements are estimated to be required prior to the year 2020. In addition to supplying an adequate amount of treated surface water to existing customers, the improvements shown in Tables 19-24 will provide additional customers that currently either rely on ground water or will require an additional source in the future.

Table 25

Summary of Phased Improvements
To Supply Existing and Future CTWSC Customers

Improvement	Cost
Phase I	$ 28,100,000
Phase II	$ 7,120,000
Phase III	$ 12,400,000
Phase IV	$ 6,750,000
Total Improvements Cost	$ 54,370,000

The required improvements to supply treated surface water to augment existing ground water supplies to the five additional customers totals $54,370,000. This is an additional $14,410,000 in improvements over those improvements required to supply the existing CTWSC customers.

Supply Maximum Day Demand Solely Through Treated Surface Water

The following Tables 26 through 30 demonstrate the magnitude and sequencing of those projects required to upgrade the existing CTWSC system to meet the projected demands of its current customers and future customers through the year 2050. Those improvements from Tables 16 through 19 that are essential in supplying existing customers have been included in this section for comparison purposes. Each of the exhibits identified in Tables 26 through 29 can be found in Appendix D at the end of this report unless otherwise noted. These improvements are sized to provide maximum day demand and are shown for reference. The sequencing and observations are similar to those in the Tables 21 through 24.

Table 26

Phase I Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-1*	Water Treatment Plant No. 3 (16.0 MGD)	$ 22,300,000
[a]B-2	Raw Water Intake Structure	$ 2,500,000
[a]B-3	Recommended Improvements including:	$ 9,100,000
	30" and 24" Lines to Armstrong Tank	
	24" Line to FM 1670	
	2.0 MG Armstrong Road Standpipe	
	1.0 MG FM 1670 Standpipe	
	Modifications to Armstrong Pump Station	
	FM 1670 Pump Station	
	Total Phase I Improvements Cost	$ 33,900,000

[a] Exhibits B-2 and B-3 are found in Appendix B.

Table 27

Phase II Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-2*	20" Line to Salado	$ 900,000
D-3*	16" Line to FM 2843	$ 600,000
D-8*	FM 2843 Booster Pump Station	$ 1,100,000
D-4*	12" Line to Jarrell-Schwertner	$ 650,000
[a]B-4	20" Line -- Armstrong to System Split	$ 3,900,000
[a]B-9a	Modifications to System Split	$ 460,000
	Total Phase II Improvements Cost	$ 7,610,000

[a] Exhibits B-4 and B-9a are found in Appendix B.

Table 28

Phase III Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-10*	WTP No. 3 Expansion (5.0 mgd)	$ 6,900,000
D-5*	10" Line towards Holland/B-M-F	$ 1,450,000
D-6*	8" Line to B-M-F	$ 775,000
D-7*	8" Line to Bartlett	$ 475,000
[a]B-6	14" Line – System Split to North Pump Station	$ 1,950,000
[a]B-7	12" Line – North Pump Station to East Bell	$ 900,000
	Total Phase III Improvements Cost	$ 12,450,000

[a] Exhibits B-6 and B-7 are found in Appendix B.

Table 29

Phase IV Improvements
Supply Existing and Future Customers from CTWSC WTP No.3
Opinion of Probable Cost

Exhibit	Improvement	Cost
D-11*	WTP No. 3 Expansion (4.0 mgd)	$ 4,100,000
[a]B-8	12" – East Bell to Rosebud	$ 2,650,000
	Total Phase IV Improvements Cost	$ 6,800,000

[a] Exhibit B-8 can be found in Appendix B.

In addition to supplying an adequate amount of treated surface water to existing customers, the improvements shown in Tables 26 through 29 will supply treated surface water to meet maximum day demands for additional customers that currently either rely on ground water or will require an additional source in the future.

Table 30

Summary of Phased Improvements
To Supply Existing and Future CTWSC Customers

Improvement	Cost
Phase I	$ 33,900,000
Phase II	$ 7,610,000
Phase III	$ 12,450,000
Phase IV	$ 6,800,000
Total Improvements Cost	$ 60,760,000

The required improvements, with increased capacities and sizes to deliver treated surface water to meet maximum day demands, totals $60,760,000. This is an additional $20,800,000 in improvements over those improvements required to supply the existing CTWSC customers and $6,390,000 greater than the improvements required when ground water is taken into account.

BRA Improvements

The improvements outlined in the following tables are those necessary to create the BRA Water System. The BRA Water System will serve those entities that are not currently members of CTWSC. It was noted earlier that several of these entities rely heavily on ground water. Therefore, two separate opinions of probable cost are included. The first assumes each of the additional entities will continue to use ground water and the treated surface water will be used to augment the existing ground water supplies. These are the minimum improvements that will be required. However, opinions of probable cost have also been included to demonstrate the additional cost associated with supplying only treated surface water to meet maximum day demands.

Augment Existing Ground Water with Treated Surface Water

The following Tables 31 through 33 demonstrate the magnitude and sequencing of those projects required to develop the BRA system to treat surface water from the Lampasas River and distribute it to those water suppliers that are currently utilizing ground water, solely, or require additional treated surface water. These improvements are designed to supply an adequate amount of treated surface water (in addition to existing ground water sources) to meet the projected maximum day demands of its customers through the year 2050. Each of the exhibits identified in Tables 31 through 34 is located in Appendix C at the end of this report.

Table 31

Phase I Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-1	Raw Water Intake Structure	$ 4,750,000
C-2	Water Treatment Plant (5.0 MGD)	$ 9,500,000
	Total Phase I Improvements Cost	$ 14,250,000

Phase I improvements consist of the raw water intake structure and treatment facilities that will initially be required to supply Salado WSC, Chisholm Trail SUD, Jarrell-Schwertner WSC and the cities of Belton and Bartlett from the proposed BRA treatment facility. There is currently a need for these facilities and as such should be constructed in the near future if these entities are unable to acquire treated surface water from another source.

Table 32

Phase II Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-5	24" Line – WTP to Belton	$ 420,000
C-6	18" Line – Belton to Salado	$ 1,100,000
C-7	112" Line – Salado to FM 2843 Pump Station	$ 550,000
C-10	FM 2843 Pump Station and 1.0 MG Storage	$ 1,120,000
C-8	10" Line – FM 2843 P.S. to Jarrell-Schwertner	$ 500,000
C-9	8" Line – Jarrell-Schwertner to Bartlett	$ 1,900,000
	Total Phase II Improvements Cost	$ 5,590,000

Phase II improvements consist of the transmission pipelines and booster pump station necessary to create the BRA water system. These improvements should be constructed simultaneously with the treatment facilities shown in Table 31.

Table 33

Phase III Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-3	Water Treatment Plant Expansion (2.5 mgd)	$ 2,900,000
C-4	Water Treatment Plant Expansion (2.5 mgd)	$ 2,700,000
	Total Phase III Improvements Cost	$ 5,600,000

Phase III improvements consist of only the two 2.5 mgd expansions that are projected in the years 2015 and 2025 since the pipelines in Phase II were sized to supply the projected maximum day demand in 2050.

Table 34

Summary of Phased Improvements
To Develop BRA Distribution System

Improvement	Cost
Phase I	$ 14,250,000
Phase II	$ 5,590,000
Phase III	$ 5,600,000
Total Improvements Cost	$ 25,440,000

The total capital cost to create the BRA water system is approximately $20,000,000 with a total cost of approximately $25,440,000 through the year 2050. This compares to a total cost of approximately $14,410,000 for the infrastructure required for CTWSC to serve the additional customers. This is due to CTWSC being an established system and already having an existing infrastructure.

Supply Maximum Day Demand Solely Through Treated Surface Water

The following Tables 35 through 37 demonstrate the magnitude and sequencing of those projects required to develop the BRA system to treat surface water from the Lampasas River and distribute it to those water suppliers that are currently utilizing ground water, solely, or require additional treated surface water. These improvements are sized to provide maximum day demand and are shown for reference. The sequencing and observations are similar to those in the Tables 21 through 24. Each of the exhibits identified in Tables 35 through 37 can be found in Appendix at the end of this report.

Table 35

Phase I Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-1*	Raw Water Intake Structure	$ 5,000,000
C-2*	Water Treatment Plant (9.0 MGD)	$ 12,000,000
	Total Phase I Improvements Cost	$ 17,000,000

Table 36

Phase II Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-5*	30” Line – WTP to Belton	$ 600,000
C-6*	24” Line – Belton to Salado	$ 1,400,000
C-7*	18” Line – Salado to FM 2843 Pump Station	$ 800,000
C-10*	FM 2843 Pump Station and 1.0 MG Storage	$ 1,200,000
C-8*	14” Line – FM 2843 P.S. to Jarrell-Schwertner	$ 625,000
C-9*	12” Line – Jarrell-Schwertner to Bartlett	$ 2,200,000
	Total Phase II Improvements Cost	$ 6,825,000

Table 37

Phase III Improvements
Supply Possible Customers from BRA Lampasas River WTP
Opinion of Probable Cost

Exhibit	Improvement	Cost
C-3*	Water Treatment Plant Expansion (3.0 mgd)	$ 4,771,000
C-4*	Water Treatment Plant Expansion (3.0 mgd)	$ 3,400,000
	Total Phase III Improvements Cost	$ 8,171,000

Table 38

Summary of Phased Improvements
To Develop BRA Distribution System

Improvement	Cost
Phase I	$ 17,000,000
Phase II	$ 6,825,000
Phase III	$ 8,171,000
Total Improvements Cost	$ 31,996,000

The total capital cost to create the BRA water system to supply treated surface water to meet maximum day demand is approximately $24,000,000 with a total cost of approximately $32,000,000 through the year 2050. This compares to a total cost of approximately $20,800,000 for the infrastructure required for CTWSC to supply treated surface water to meet maximum day demands to additional customers and is approximately $8,000,000 greater than the cost to construct the BRA infrastructure to augment existing ground water.

7. Conclusion

The twenty-three participants in the Central Texas Regional Water Supply Study are in an advantageous position. There are two exceptional surface water supplies in Lake Belton and Lake Stillhouse Hollow in the area. In addition to these two surface water supplies, several of the entities also have access to the ground water from the Edwards and/or Trinity Aquifers. Therefore, it is logical that the major problem facing these study participants is not an adequate supply of water, but rather the distribution, treatment and transmission of that water.

While several study participants currently rely on groundwater, this Study found that none of the participants could supply the projected maximum day demand with their current well capacity for a significant period in the future. System infrastructure improvements were designed to supply each of the participants through a combination of the existing CTWSC water treatment plant and CTWSC water treatment plant No. 3 or a combination of the two facilities previously listed and an additional BRA water treatment facility located on the Lampasas River. The BRA facility was investigated as an alternative in the instance CTWSC was unable to supply one or more of the entities that currently require an additional supply of treated surface water. It is recommended that all entities that currently possess groundwater capabilities retain at least a portion of those capabilities for emergency back up once improvements are constructed to supply treated surface water.

The Central Texas Regional Water Supply Study was conducted to preliminarily size and align those improvements necessary to supply treated surface water to meet the projected maximum day demand of each of the participants through the year 2050. The improvements included in this phase of the study were designed to meet those projected demands determined in Phase I. It is advised that both the projections and proposed improvements be reviewed every five to ten years and adjustments made for actual population growth and system requirements.

Appendix A

Ground Water Data

EXHIBIT A-1

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Existing Well Capacity

Water Supplier	Existing Well			Comments
	Qty.	Capacity	Source	
Bartlett	2	400	Trinity	Possible to pump from both wells at once. Waters do mix. Have not experienced any precipitant. Aquifers are compatible.
		200	Edwards	
	Total	600		
Chisholm Trail	4	1,490		N/A
		890		
		210		
		98		
	Total	2,688		
Jarrell-Schwertner	7	185	Edwards	N/A
		185		
		140		
		50		
		135		
		125		
		135		
		955		
Salado	6	120	Edwards	2 wells drilled, but not yet approved. 200 and 500 gpm, respectively. Put total well capacity at 2605 gpm and reliable well capacity at 2105 gpm.
		225		
		390		
		390		
		430		
		350		
	Total	1,905		

EXHIBIT A-2

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

****Historical Well Quality**

Name of System	Date	CA	MG	NA	CO3	HCO3	MN	FE	SO4	CL	F	NO3 as N	TDS	Partial Alk.	Total Alk.	T.H.	pH
Armstrong WSC	4/8/1980	10	4	397	0	461	< .02	0.20	311	150	4.5	0.11	1107	0	378	42	8.3
Bell County WCID No. 5	10/1/1980	9	1	386	5	405	< .02	0.27	213	219	1.8	0.09	1030	4	340	29	8.4
B-M-F WSC #1	6/7/1983	45	10	90	0	224	< .02	0.06	61	78	0.5	0.18	399	0	184	155	8.1
B-M-F WSC #2	6/7/1983	32	7	246	0	306	0.02	0.14	134	182	1.2	0.13	757	0	251	110	8.3
Buckholts, Town of	3/5/1981	62	11	567	1	315	< .02	0.66	952	155	2.0	0.19	1922	1	260	200	8.4
CTWSC	8/16/1982	44	16	30	0	152	< .02	< .02	23	65	0.3	0.07	256	0	125	175	8.2
Dog Ridge WSC	4/8/1980	11	4	446	0	478	< .02	0.95	424	136	6.1	0.05	1262	0	392	46	8.2
East Bell WSC	4/7/1980	8	1	365	2	468	< .02	0.12	203	141	2.7	0.05	954	2	388	24	8.4
Holland, City of	3/5/1980	10	4	436	6	466	< .02	0.35	253	221	3.2	0.4	1160	5	392	41	8.5
Kempner WSC	11/20/1980	84	34	16	0	353	< .02	0.06	39	29	0.4	2.93	390	0	289	349	8.0
Lampasas, City of	10/19/1997	114	40	215	0	364	< .02	< .02	21	439	0.2	0.27	1019	0	298	464	7.9
Lott, City of	9/8/1980	88	13	422	5	302	< .02	0.10	799	96	2.3	0.8	1592	4	256	272	8.4
O&B WSC	4/7/1980	6	1	320	5	472	< .02	0.28	222	71	2.5	0.03	863	4	395	21	8.4
Rogers, City of	3/5/1980	149	54	997	0	365	< .02	0.10	1859	436	2.7	0.57	3690	0	299	594	8.1
Rosebud, City of	2/9/1983	59	8	148	0	178	< .02	0.03	155	147	0.5	0.26	613	0	146	181	8.2
West Bell WSC	11/18/1975	51	9	21	0	160	< .02	0.12	20	38	0.8	< .01	300	0	131	163	7.9
Westphalia WSC	7/27/1982	16	7	518	7	405	< .02	0.15	688	91	2.8	0.05	1536	6	344	70	8.5
Bartlett, City of	1/26/1982	10	3	442	3	453	< .02	0.10	246	278	2.8	0.1	1212	3	377	37	8.4
Jarrell-Schwertner WSC	5/18/1983	81	19	12	0	312	< .02	0.03	18	16	0.3	3.54	316	0	256	283	8.0
Salado WSC	10/30/1980	76	12	12	0	259	< .02	0.03	21	17	1.0	3.46	280	0	212	240	8.2
Secondary Drinking Water Standards	n/a	n/a	n/a	n/a	n/a	n/a	0.05	0.3	250	250	2	n/a	500	n/a	n/a	n/a	6.5-8.5

* Values shown in red exceed recommended Secondary Drinking Water Standards.

* Values taken from "Chemical Analyses of Public Water Systems", Texas Department of Health.

Appendix B

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers

Opinion of Probable Cost

EXHIBIT B

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Summary of All Proposed Improvements

Item No.	Description	Total Cost
	Proposed Improvements (Parallel from System Split to East Bell and to Rogers)	
B-1	[1]CTWSC WTP No. 3	$ 10,400,000.00
B-2	[1]CTWSC Raw Water Intake Structure	$ 2,500,000.00
B-3	[1]CTWSC Recommended Improvements	$ 9,100,000.00
B-4	[2]20" Line from Armstrong to System Split	$ 3,900,000.00
B-5	10" Line from Proposed 20" Line to B-M-F/Bartlett Junction	$ 1,400,000.00
B-6	14" Line from System Split to North Pump Station	$ 1,950,000.00
B-7	12" Line from North Pump Station to East Bell	$ 900,000.00
B-8	12" Line from East Bell to Rosebud	$ 2,650,000.00
B-9a	Modifications to System Split Pump Station (Proposed)	$ 460,000.00
B-9b	Modifications to System Split Pump Station (Alternate)	$ 570,000.00
	Alternate Improvements (New Line from System Split to Rosebud via Rogers)	
B-10 (alt)	16" Line from System Split to Knob Hill	$ 1,200,000.00
B-11 (alt)	14" Line from Knob Hill to Rogers	$ 1,100,000.00
B-12 (alt)	12" Line from Rogers to East Bell Junction	$ 1,500,000.00
B-13 (alt)	10" Line from East Bell Junction to Rosebud	$ 2,300,000.00
B-14 (alt)	8" Line from East Bell Junction to East Bell	$ 300,000.00
B-15 (alt)	Modifications to System Split Pump Station	$ 400,000.00
	Proposed WTP No. 3 Expansions	
B-16	CTWSC WTP No. 3 Expansion #1	$ 4,500,000.00
B-17	CTWSC WTP No. 3 Expansion #2	$ 2,200,000.00

[1]Improvement and Opinion of Probable Cost taken from SD Kallman report for CTWSC.

[2]Improvement taken from SD Kallman Report, Opinion of Probable Cost developed for this Study.

RPK

EXHIBIT B-1

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

[1]Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Water Treatment Plant No. 3

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	6.0 MGD Membrane Filtration Plant	1	LS	$ 6,000,000.00	$ 6,000,000.00
2	36-inch Potable Transfer Line to Clearwell	3,700	LF	$ 67.57	$ 250,000.00
3	Sludge Dewatering Facility and Equipment	1	LS	$ 150,000.00	$ 150,000.00
4	60,000 gallon Backwash Water Holding Tank	1	LS	$ 125,000.00	$ 125,000.00
5	1.0 Million gallon Clearwell	1	LS	$ 400,000.00	$ 400,000.00
6	Site Utiilies (including potable water lines, chlorine solution lines, electrical, lighting, fencing and related improvements	1	LS	$ 100,000.00	$ 100,000.00
7	"East" High Service Pump Station	1	LS	$ 200,000.00	$ 200,000.00
8	"North" High Service Pump Station	1	LS	$ 200,000.00	$ 200,000.00
9	Ashpalt Roadways and Parking at Plant Site	1	LS	$ 250,000.00	$ 250,000.00

Subtotal	$ 7,675,000.00
Sales Tax	$ 633,187.50
Construction Cost	$ 8,308,187.50
Site Acquisition (78 acres)	$ 201,000.00
Financial Services	$ 170,000.00
Engineering & Contingencies	$ 1,661,637.50
Total Project Cost	$10,340,825.00
Cost For Planning Purposes	$10,400,000.00

[1] Opinion of Probable Cost broken out from S.D. Kallman, Inc. Preliminary Engineering Report prepared for Central Texas Water Supply Corporation.

EXHIBIT B-2

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

[1]Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Raw Water Intake Structure and Raw Water Line

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	6,250 GPM Vertical Turbine Raw Water Pump	2	EA	$ 375,000.00	$ 750,000.00
2	Raw Water Pump Control Building at Intake	1	LS	$ 200,000.00	$ 200,000.00
3	Standby Electrical Generator	1	LS	$ 100,000.00	$ 100,000.00
4	30-inch Raw Water Line	2,780	LF	$ 80.94	$ 225,000.00
		Subtotal			$ 1,275,000.00
		Sales Tax			$ 105,187.50
		Construction Cost			$ 1,380,187.50
	CTWSC Cost Participation in BRA's Joint Use Raw Water Intake Structure				$ 730,000.00
		Financial Services			$ 30,000.00
		Engineering & Contingencies			$ 276,037.50
		Total Project Cost			$ 2,416,225.00
		Cost For Planning Purposes			$ 2,500,000.00

[1] Opinion of Probable Cost broken out from S.D. Kallman, Inc. Preliminary Engineering Report prepared for Central Texas Water Supply Corporation.

EXHIBIT B-3

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

[1]Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Recommended Improvements

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	30-inch Potable Water Line in Rock Excavation	10,100	LS	----	$ 2,850,000.00
2	24-inch Potable Water Line in Dirt Excavation	31,500	LF		
3	24-inch Potable Water Line in Rock Excavation	28,800	LS	$ 62.50	$ 1,800,000.00
4	2.0 Million gallon Armstrong Road Standpipe	1	LS	$ 900,000.00	$ 900,000.00
5	1.0 Million gallon F.M. 1670 Standpipe	1	LS	$ 600,000.00	$ 600,000.00
6	Armstrong Pump Station	1	LS	$ 150,000.00	$ 150,000.00
7	F.M. 1670 Pump Station	1	LS	$ 225,000.00	$ 225,000.00
8	Distribution System Facility	1	LS	$ 140,000.00	$ 140,000.00
	Subtotal				$ 6,665,000.00
	Sales Tax				$ 549,862.50
	Construction Cost				$ 7,214,862.50
	Easements & Site Acquisition				$ 200,000.00
	Financial Services				$ 150,000.00
	Engineering & Contingencies				$ 1,442,972.50
	Total Project Cost				$ 9,007,835.00
	Cost For Planning Purposes				$ 9,100,000.00

[1] Opinion of Probable Cost broken out from S.D. Kallman, Inc. Preliminary Engineering Report prepared for Central Texas Water Supply Corporation.

EXHIBIT B-4

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
20-Inch Potable Water Line from Armstrong Tank to System Split

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	20-inch Potable Water Line	69,000	LS	$ 35.00	$ 2,415,000.00
2	Valves and Fittings	1	LS	$ 300,000.00	$ 300,000.00
3	Miscellaneous	1	LS	$ 100,000.00	$ 100,000.00
4	Pressure Testing	69,000	LF	$ 0.50	$ 34,500.00
5	Trench Safety	69,000	LF	$ 1.00	$ 69,000.00
	Construction Cost				$ 2,918,500.00
	Easement				$ 96,000.00
	Engineering, Legal, Environmental & Contingencies				$ 875,550.00
	Total Project Cost				$ 3,890,050.00
	Cost For Planning Purposes				$ 3,900,000.00

EXHIBIT B-5

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
10-Inch Potable Water Line from Proposed 20" Line to B-M-F/Bartlett Junction

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	10-inch Potable Water Line	39,000	LF	$ 20.00	$ 780,000.00
2	Valves and Fittings	1	LS	$ 110,000.00	$ 110,000.00
3	Miscellaneous	1	LS	$ 50,000.00	$ 50,000.00
4	Pressure Testing	39,000	LF	$ 0.50	$ 19,500.00
5	Trench Safety	39,000	LF	$ 1.00	$ 39,000.00
	Construction Cost				$ 998,500.00
	Easement				$ 54,000.00
	Engineering, Legal, Environmental & Contingencies				$ 299,550.00
	Total Project Cost				$ 1,352,050.00
	Cost For Planning Purposes				$ 1,400,000.00

EXHIBIT B-6

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
14-Inch Potable Water Line from System Split P.S. to North P.S.

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	14-inch Potable Water Line	43,500	LF	$ 25.50	$ 1,109,250.00
2	Valves and Fittings	1	LS	$ 150,000.00	$ 150,000.00
3	Miscellaneous	1	LS	$ 90,000.00	$ 90,000.00
4	Pressure Testing	43,500	LF	$ 0.50	$ 21,750.00
5	Trench Safety	43,500	LF	$ 1.00	$ 43,500.00

Construction Cost	$ 1,414,500.00
Easement	$ 60,000.00
Engineering, Legal, Environmental & Contingencies	$ 424,350.00
Total Project Cost	$ 1,898,850.00
Cost For Planning Purposes	$ 1,950,000.00

EXHIBIT B-7

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
12-Inch Potable Water Line from North P.S. to East Bell

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	22,500	LF	$ 22.00	$ 495,000.00
2	Valves and Fittings	1	LS	$ 80,000.00	$ 80,000.00
3	Miscellaneous	1	LS	$ 30,000.00	$ 30,000.00
4	Pressure Testing	22,500	LF	$ 0.50	$ 11,250.00
5	Trench Safety	22,500	LF	$ 1.00	$ 22,500.00
	Construction Cost				$ 638,750.00
	Easement				$ 31,000.00
	Engineering, Legal, Environmental & Contingencies				$ 191,625.00
	Total Project Cost				$ 861,375.00
	Cost For Planning Purposes				$ 900,000.00

EXHIBIT B-8

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
12-Inch Potable Water Line from East Bell to Rosebud

Item No.	Description	Estimated Quantity			Unit Cost		Total Cost
1	12-inch Potable Water Line	77,000	LF	$	21.50	$	1,655,500.00
2	Valves and Fittings	1	LS	$	200,000.00	$	200,000.00
3	Miscellaneous	1	LS	$	100,000.00	$	100,000.00
4	Pressure Testing	77,000	LF	$	0.50	$	38,500.00
5	Trench Safety	77,000	LF	$	1.00	$	77,000.00
	Construction Cost					$	2,071,000.00
	Easement					$	107,000.00
	Engineering, Legal, Environmental & Contingencies					$	414,200.00
	Total Project Cost					$	2,592,200.00
	Cost For Planning Purposes					$	2,650,000.00

EXHIBIT B-9a

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Modifications to System Split Booster Pump Station for Alternate Route

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
	To Supply Rosebud/BMF via Heidenheimer/East Bell and Rogers through Same Pumps				
1	3 - 175 HP Pumps	1	LS	$ 125,000.00	$ 125,000.00
2	Piping and Valves	1	LS	$ 60,000.00	$ 60,000.00
3	Concrete Masonry Unit (CMU) Building	1	LS	$ 60,000.00	$ 60,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
5	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00

Construction Cost	$ 370,000.00
Site Acquisition (2 acres)	$ 10,000.00
Engineering, Legal, Environmental & Contingencies	$ 74,000.00
Total Project Cost	$ 454,000.00
Cost For Planning Purposes	$ 460,000.00

EXHIBIT B-9b

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Modifications to System Split Booster Pump Station for Alternate Route

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
	To Supply Rosebud via Heidenheimer/East Bell				
1	3 - 100 HP Pumps	1	LS	$ 70,000.00	$ 70,000.00
2	Piping and Valves	1	LS	$ 50,000.00	$ 50,000.00
3	Concrete Masonry Unit (CMU) Building	1	LS	$ 50,000.00	$ 50,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
5	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
	To Supply Rogers (Replace Existing Pumps)				
1	3 - 75 HP Pumps	1	LS	$ 50,000.00	$ 50,000.00
2	Piping and Valves	1	LS	$ 30,000.00	$ 30,000.00
3	Electrical	1	LS	$ 50,000.00	$ 50,000.00

Construction Cost	$ 425,000.00
Site Acquisition (2 acres)	$ 10,000.00
Engineering, Legal, Environmental & Contingencies	$ 127,500.00
Total Project Cost	$ 562,500.00
Cost For Planning Purposes	$ 570,000.00

EXHIBIT B-10 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
16-Inch Potable Water Line from System Split to Knob Hill Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	16-inch Potable Water Line	22,000	LF	$ 31.50	$ 693,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 40,000.00	$ 40,000.00
4	Pressure Testing	22,000	LF	$ 0.50	$ 11,000.00
5	Trench Safety	22,000	LF	$ 1.00	$ 22,000.00
	Construction Cost				$ 866,000.00
	Easement				$ 31,000.00
	Engineering, Legal, Environmental & Contingencies				$ 259,800.00
	Total Project Cost				$ 1,156,800.00
	Cost For Planning Purposes				$ 1,200,000.00

EXHIBIT B-11 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
14-Inch Potable Water Line from Knob Hill Tank to Rogers

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	14-inch Potable Water Line	22,000	LF	$ 26.00	$ 572,000.00
2	Valves and Fittings	1	LS	$ 95,000.00	$ 95,000.00
3	Miscellaneous	1	LS	$ 35,000.00	$ 35,000.00
4	Pressure Testing	22,000	LF	$ 0.50	$ 11,000.00
5	Trench Safety	22,000	LF	$ 1.00	$ 22,000.00
	Construction Cost				$ 735,000.00
	BNSF Railroad Permit				$ 50,000.00
	Easement				$ 31,000.00
	Engineering, Legal, Environmental & Contingencies				$ 220,500.00
	Total Project Cost				$ 1,036,500.00
	Cost For Planning Purposes				$ 1,100,000.00

EXHIBIT B-12 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
12-Inch Potable Water Line from Rogers to East Bell Junction

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	38,000	LF	$ 22.00	$ 836,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 55,000.00	$ 55,000.00
4	Pressure Testing	38,000	LF	$ 0.50	$ 19,000.00
5	Trench Safety	38,000	LF	$ 1.00	$ 38,000.00

Construction Cost	$ 1,048,000.00
Easement	$ 53,000.00
Engineering, Legal, Environmental & Contingencies	$ 314,400.00
Total Project Cost	$ 1,415,400.00
Cost For Planning Purposes	$ 1,500,000.00

EXHIBIT B-13 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
10-Inch Potable Water Line from East Bell Junction to Rosebud

Item No.	Description	Estimated Quantity			Unit Cost		Total Cost
1	10-inch Potable Water Line	68,000	LF	$	20.00	$	1,360,000.00
2	Valves and Fittings	1	LS	$	100,000.00	$	100,000.00
3	Miscellaneous	1	LS	$	60,000.00	$	60,000.00
4	Pressure Testing	68,000	LF	$	0.50	$	34,000.00
5	Trench Safety	68,000	LF	$	1.00	$	68,000.00
	Construction Cost					$	1,622,000.00
	Easement					$	94,000.00
	Engineering, Legal, Environmental & Contingencies					$	486,600.00
	Total Project Cost					$	2,202,600.00
	Cost For Planning Purposes					$	2,300,000.00

EXHIBIT B-14 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
8-Inch Potable Water Line from East Bell Junction to East Bell Pump Station

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	9,000	LF	$ 18.00	$ 162,000.00
2	Valves and Fittings	1	LS	$ 30,000.00	$ 30,000.00
3	Miscellaneous	1	LS	$ 10,000.00	$ 10,000.00
4	Pressure Testing	9,000	LF	$ 0.50	$ 4,500.00
5	Trench Safety	9,000	LF	$ 1.00	$ 9,000.00
	Construction Cost				$ 215,500.00
	Easement				$ 13,000.00
	Engineering, Legal, Environmental & Contingencies				$ 64,650.00
	Total Project Cost				$ 293,150.00
	Cost For Planning Purposes				$ 300,000.00

EXHIBIT B-15 (alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Modifications to System Split Pump Station (Rosebud via Rogers)

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3 - 100 HP Pumps	1	LS	$ 70,000.00	$ 70,000.00
2	Piping and Valves	1	LS	$ 50,000.00	$ 50,000.00
3	Concrete Masonry Unit (CMU) Building	1	LS	$ 50,000.00	$ 50,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
5	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
	Construction Cost				$ 295,000.00
	Site Acquisition (2 acres)				$ 10,000.00
	Engineering, Legal, Environmental & Contingencies				$ 88,500.00
	Total Project Cost				$ 393,500.00
	Cost For Planning Purposes				$ 400,000.00

EXHIBIT B-16

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Water Treatment Plant No. 3 Expansion #1

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3.0 MGD Water Treatment Plant	1	LS	$ 2,000,000.00	$ 2,000,000.00
2	Backwash Lagoon (150,000 gallons)	1	LS	$ 150,000.00	$ 150,000.00
3	1.7 Million gallon Clearwell	1	LS	$ 1,250,000.00	$ 1,250,000.00
4	High Service Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
5	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
6	Electrical	1	LS	$ 100,000.00	$ 100,000.00
				Construction Cost	$ 3,750,000.00
				Engineering & Contingencies	$ 750,000.00
				Total Project Cost	$ 4,500,000.00
				Cost For Planning Purposes	$ 4,500,000.00

EXHIBIT B-17

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing Customers
Water Treatment Plant No. 3 Expansion #2

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	2.0 MGD Water Treatment Plant	1	LS	$ 1,500,000.00	$ 1,500,000.00
2	High Service Pump Station Modifications	1	LS	$ 150,000.00	$ 150,000.00
3	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
				Construction Cost	$ 1,800,000.00
				Engineering & Contingencies	$ 360,000.00
				Total Project Cost	$ 2,160,000.00
				Cost For Planning Purposes	$ 2,200,000.00

Appendix C

Brazos River Authority
Improvements to Create Water Supply System

Opinion of Probable Cost

EXHIBIT C

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Summary of All Proposed Improvements

Item No.	Description	Total Cost
	Proposed Improvements	
	Treated Surface Water To Augment Existing Ground Water	
C-1	BRA Raw Water Intake Structure	$ 4,750,000.00
C-2	BRA WTP	$ 9,500,000.00
C-3	BRA WTP Expansion No.1	$ 2,900,000.00
C-4	BRA WTP Expansion No.2	$ 2,700,000.00
C-5	30" Line from WTP to Belton	$ 420,000.00
C-6	24" Line from Belton to Salado	$ 1,100,000.00
C-7	18" Line from Salado to F.M. 2843 Booster Pump Station	$ 550,000.00
C-8	14" Line from F.M. 2843 Booster Pump Station to Jarrell-Schwertner	$ 500,000.00
C-9	12" Line from Jarrell-Schwertner to Bartlett Tank	$ 1,900,000.00
C-10	F.M. 2843 Booster Pump Station and Ground Storage	$ 1,120,000.00
	***Treated Surface Water to Meet Maximum Day Demands**	
C-1*	BRA Raw Water Intake Structure	$ 5,000,000.00
C-2*	BRA WTP	$ 12,000,000.00
C-3*	BRA WTP Expansion No.1	$ 4,771,000.00
C-4*	BRA WTP Expansion No.2	$ 3,400,000.00
C-5*	30" Line from WTP to Belton	$ 600,000.00
C-6*	24" Line from Belton to Salado	$ 1,400,000.00
C-7*	18" Line from Salado to F.M. 2843 Booster Pump Station	$ 800,000.00
C-8*	14" Line from F.M. 2843 Booster Pump Station to Jarrell-Schwertner	$ 625,000.00
C-9*	12" Line from Jarrell-Schwertner to Bartlett Tank	$ 2,200,000.00
C-10*	F.M. 2843 Booster Pump Station and Ground Storage	$ 1,200,000.00

EXHIBIT C-1

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Raw Water Intake Structure on Lampasas River

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Cofferdam	1	LS	$ 300,000.00	$ 300,000.00
2	Low Water Dam	1	LS	$ 2,000,000.00	$ 2,000,000.00
3	Raw Water Pump Station (incl. pumps, screens, header piping,etc.)	1	LS	$ 850,000.00	$ 850,000.00
4	24" Raw Water Line	2,500	LF	$ 80.00	$ 200,000.00
5	Chain Link Fence	1	LS	$ 5,000.00	$ 5,000.00
6	Sitework	1	LS	$ 15,000.00	$ 15,000.00
7	Electrical	1	LS	$ 150,000.00	$ 150,000.00

Construction Cost	$ 3,520,000.00
Site Acquisition (5 acres)	$ 20,000.00
Engineering, Legal, Environmental & Contingencies	$ 1,056,000.00
Total Project Cost	$ 4,596,000.00
Cost For Planning Purposes	$ 4,750,000.00

EXHIBIT C-2

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Membrane Filtration (5.0 MGD)	1	LS	$ 4,500,000.00	$ 4,500,000.00
2	Building to House Membrane Filtration/Office	1	LS	$ 250,000.00	$ 250,000.00
3	Backwash Lagoon	1	LS	$ 100,000.00	$ 100,000.00
4	24" Yard Piping	1	LS	$ 50,000.00	$ 50,000.00
5	500,000 Gallon Clearwell	1	LS	$ 450,000.00	$ 450,000.00
6	Supernatant Recycle Pump Station and Pumps	1	LS	$ 60,000.00	$ 60,000.00
7	Sludge Thickener	1	LS	$ 80,000.00	$ 80,000.00
8	Sludge Building	1	LS	$ 60,000.00	$ 60,000.00
9	Sludge Recirculation Pump Station and Pumps	1	LS	$ 40,000.00	$ 40,000.00
10	Chemical Storage Facilities (Building)	1	LS	$ 80,000.00	$ 80,000.00
11	Scrubber (adjacent to chlorine storage)	1	LS	$ 150,000.00	$ 150,000.00
12	Chemical Feed Pumps	1	LS	$ 150,000.00	$ 150,000.00
13	High Service Pump Station and Pumps	1	LS	$ 650,000.00	$ 650,000.00
14	Ashpalt Roadways/Parking at Plant Site	5,000	SY	$ 20.00	$ 100,000.00
15	Chain Link Fence	1	LS	$ 50,000.00	$ 50,000.00
16	Sitework	1	LS	$ 50,000.00	$ 50,000.00
17	Electrical	1	LS	$ 250,000.00	$ 250,000.00

Construction Cost	$ 7,070,000.00
Site Acquisition (25 acres)	$ 250,000.00
Engineering, Legal, Environmental & Contingencies	$ 2,121,000.00
Total Project Cost	$ 9,441,000.00
Cost For Planning Purposes	$ 9,500,000.00

EXHIBIT C-3

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River
Expansion No. 1

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Raw Water Pump Station Modifications	1	LS	$ 150,000.00	$ 150,000.00
2	Membrane Filtration (2.5 MGD)	1	LS	$ 1,500,000.00	$ 1,500,000.00
3	Backwash Lagoon	1	LS	$ 150,000.00	$ 150,000.00
4	High Service Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
5	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
6	Sitework	1	LS	$ 20,000.00	$ 20,000.00
7	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 2,170,000.00
	Engineering, Legal, Environmental & Contingencies				$ 651,000.00
	Total Project Cost				$ 2,821,000.00
	Cost For Planning Purposes				$ 2,900,000.00

EXHIBIT C-4

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River
Expansion No. 2

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Raw Water Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
2	Membrane Filtration (2.5 MGD)	1	LS	$ 1,500,000.00	$ 1,500,000.00
3	High Service Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
4	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
5	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 2,050,000.00
	Engineering, Legal, Environmental & Contingencies				$ 615,000.00
	Total Project Cost				$ 2,665,000.00
	Cost For Planning Purposes				$ 2,700,000.00

EXHIBIT C-5

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
24-Inch Potable Water Line from BRA Water Treatment Plant to Belton Distribution Point

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	24-inch Potable Water Line	5,000	LF	$ 46.00	$ 230,000.00
2	Valves and Fittings	1	LS	$ 50,000.00	$ 50,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	5,000	LS	$ 0.50	$ 2,500.00
5	Trench Safety	5,000	LF	$ 1.00	$ 5,000.00
	Construction Cost				$ 312,500.00
	Easements				$ 7,000.00
	Engineering, Legal, Environmental & Contingencies				$ 93,750.00
	Total Project Cost				$ 413,250.00
	Cost For Planning Purposes				$ 420,000.00

EXHIBIT C-6

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
18-Inch Potable Water Line from Belton to Salado

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	18-inch Potable Water Line	18,000	LF	$ 34.00	$ 612,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
4	Pressure Testing	18,000	LS	$ 0.50	$ 9,000.00
5	Trench Safety	18,000	LF	$ 1.00	$ 18,000.00
	Construction Cost				$ 814,000.00
	Easements				$ 25,000.00
	Engineering, Legal, Environmental & Contingencies				$ 244,200.00
	Total Project Cost				$ 1,083,200.00
	Cost For Planning Purposes				$ 1,100,000.00

EXHIBIT C-7

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
12-Inch Potable Water Line from Salado to F.M. 2843 BPS

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	13,000	LF	$ 22.50	$ 292,500.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 30,000.00	$ 30,000.00
4	Pressure Testing	13,000	LS	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00

Construction Cost	$ 402,000.00
Easements	$ 18,000.00
Engineering, Legal, Environmental & Contingencies	$ 120,600.00
Total Project Cost	$ 540,600.00
Cost For Planning Purposes	$ 550,000.00

EXHIBIT C-8

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
10-Inch Potable Water Line from F.M. 2843 BPS to Jarrell-Schwertner

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	10-inch Potable Water Line	13,000	LF	$ 20.00	$ 260,000.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 17,000.00	$ 17,000.00
4	Pressure Testing	13,000	LS	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00
	Construction Cost				$ 356,500.00
	Easements				$ 18,000.00
	Engineering, Legal, Environmental & Contingencies				$ 106,950.00
	Total Project Cost				$ 481,450.00
	Cost For Planning Purposes				$ 500,000.00

EXHIBIT C-9

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
8-Inch Potable Water Line from Jarrell-Schwertner to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	58,000	LF	$ 18.00	$ 1,044,000.00
2	Valves and Fittings	1	LS	$ 150,000.00	$ 150,000.00
3	Miscellaneous	1	LS	$ 80,000.00	$ 80,000.00
4	Pressure Testing	58,000	LS	$ 0.50	$ 29,000.00
5	Trench Safety	58,000	LF	$ 1.00	$ 58,000.00
	Construction Cost				$ 1,361,000.00
	Easements				$ 80,000.00
	Engineering, Legal, Environmental & Contingencies				$ 408,300.00
	Total Project Cost				$ 1,849,300.00
	Cost For Planning Purposes				$ 1,900,000.00

EXHIBIT C-10

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
F.M. 2843 Booster Pump Station and Ground Storage

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3 - 60 HP Pumps	1	LS	$ 50,000.00	$ 50,000.00
2	Piping and Valves	1	LS	$ 70,000.00	$ 70,000.00
3	Electrical	1	LS	$ 100,000.00	$ 100,000.00
4	Concrete Masonry Unit (CMU) Building	1	LS	$ 60,000.00	$ 60,000.00
5	1.0 MG Ground Storage Tank	1	LS	$ 500,000.00	$ 500,000.00
6	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
	Construction Cost				$ 855,000.00
	Easements				
	Engineering, Legal, Environmental & Contingencies				$ 256,500.00
	Total Project Cost				$ 1,111,500.00
	Cost For Planning Purposes				$ 1,120,000.00

EXHIBIT C-1*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Raw Water Intake Structure on Lampasas River

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Cofferdam	1	LS	$ 300,000.00	$ 300,000.00
2	Low Water Dam	1	LS	$ 2,000,000.00	$ 2,000,000.00
3	Raw Water Pump Station (incl. pumps, screens, header piping,etc.)	1	LS	$ 1,100,000.00	$ 1,100,000.00
4	27" Raw Water Line	2,500	LF	$ 100.00	$ 250,000.00
5	Chain Link Fence	1	LS	$ 5,000.00	$ 5,000.00
6	Sitework	1	LS	$ 15,000.00	$ 15,000.00
7	Electrical	1	LS	$ 150,000.00	$ 150,000.00
	Construction Cost				$ 3,820,000.00
	Site Acquisition (5 acres)				$ 20,000.00
	Engineering, Legal, Environmental & Contingencies				$ 1,146,000.00
	Total Project Cost				$ 4,986,000.00
	Cost For Planning Purposes				$ 5,000,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-2*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Membrane Filtration (9.0 MGD)	1	LS	$ 6,000,000.00	$ 6,000,000.00
2	Building to House Membrane Filtration/Office	1	LS	$ 300,000.00	$ 300,000.00
3	Backwash Lagoon (150,000 Gallons)	1	LS	$ 125,000.00	$ 125,000.00
4	27" Yard Piping	1	LS	$ 100.00	$ 100.00
5	750,000 Gallon Clearwell	1	LS	$ 525,000.00	$ 525,000.00
6	Supernatant Recycle Pump Station and Pumps	1	LS	$ 70,000.00	$ 70,000.00
7	Sludge Thickener	1	LS	$ 100,000.00	$ 100,000.00
8	Sludge Building	1	LS	$ 60,000.00	$ 60,000.00
9	Sludge Recirculation Pump Station and Pumps	1	LS	$ 50,000.00	$ 50,000.00
10	Chemical Storage Facilities (Building)	1	LS	$ 100,000.00	$ 100,000.00
11	Scrubber (adjacent to chlorine storage)	1	LS	$ 200,000.00	$ 200,000.00
12	Chemical Feed Pumps	1	LS	$ 200,000.00	$ 200,000.00
13	High Service Pump Station and Pumps	1	LS	$ 800,000.00	$ 800,000.00
14	Ashpalt Roadways/Parking at Plant Site	5,000	SY	$ 20.00	$ 100,000.00
15	Chain Link Fence	1	LS	$ 50,000.00	$ 50,000.00
16	Sitework	1	LS	$ 50,000.00	$ 50,000.00
17	Electrical	1	LS	$ 250,000.00	$ 250,000.00

Construction Cost	$ 8,980,100.00
Site Acquisition (25 acres)	$ 250,000.00
Engineering, Legal, Environmental & Contingencies	$ 2,694,030.00
Total Project Cost	$11,924,130.00
Cost For Planning Purposes	$12,000,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-3*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River
Expansion No. 1

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Cofferdam	1	LS	$ 350,000.00	$ 350,000.00
2	Raw Water Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
3	Membrane Filtration (3.0 MGD)	1	LS	$ 2,000,000.00	$ 2,000,000.00
4	Backwash Lagoon (150,000 Gallons)	1	LS	$ 150,000.00	$ 150,000.00
5	750,000 Gallon Clearwell	1	LS	$ 600,000.00	$ 600,000.00
6	High Service Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
7	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
8	Sitework	1	LS	$ 20,000.00	$ 20,000.00
9	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 3,670,000.00
	Engineering, Legal, Environmental & Contingencies				$ 1,101,000.00
	Total Project Cost				$ 4,771,000.00
	Cost For Planning Purposes				$ 4,800,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-4*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
Water Treatment Plant on Lampasas River
Expansion No. 2

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Raw Water Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
2	Membrane Filtration (3.0 MGD)	1	LS	$ 2,000,000.00	$ 2,000,000.00
3	High Service Pump Station Modifications	1	LS	$ 200,000.00	$ 200,000.00
4	Supernatant Recycle Pump Station Modifications	1	LS	$ 50,000.00	$ 50,000.00
5	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 2,550,000.00
	Engineering, Legal, Environmental & Contingencies				$ 765,000.00
	Total Project Cost				$ 3,315,000.00
	Cost For Planning Purposes				$ 3,400,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-5*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
30-Inch Potable Water Line from BRA Water Treatment Plant to Belton Distribution Point

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	30-inch Potable Water Line	5,000	LF	$ 60.00	$ 300,000.00
2	Valves and Fittings	1	LS	$ 50,000.00	$ 50,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	5,000	LS	$ 0.50	$ 2,500.00
5	Trench Safety	5,000	LF	$ 1.00	$ 5,000.00
	Construction Cost				$ 382,500.00
	Easements				$ 7,000.00
	Engineering, Legal, Environmental & Contingencies				$ 114,750.00
	Total Project Cost				$ 504,250.00
	Cost For Planning Purposes				$ 600,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-6*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
24-Inch Potable Water Line from Belton to Salado

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	24-inch Potable Water Line	18,000	LF	$ 46.00	$ 828,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
4	Pressure Testing	18,000	LS	$ 0.50	$ 9,000.00
5	Trench Safety	18,000	LF	$ 1.00	$ 18,000.00
	Construction Cost				$ 1,030,000.00
	Easements				$ 25,000.00
	Engineering, Legal, Environmental & Contingencies				$ 309,000.00
	Total Project Cost				$ 1,364,000.00
	Cost For Planning Purposes				$ 1,400,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-7*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
18-Inch Potable Water Line from Salado to F.M. 2843 BPS

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	18-inch Potable Water Line	13,000	LF	$ 34.00	$ 442,000.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 30,000.00	$ 30,000.00
4	Pressure Testing	13,000	LS	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00
	Construction Cost				$ 551,500.00
	Easements				$ 18,000.00
	Engineering, Legal, Environmental & Contingencies				$ 165,450.00
	Total Project Cost				$ 734,950.00
	Cost For Planning Purposes				$ 800,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-8*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
14-Inch Potable Water Line from F.M. 2843 BPS to Jarrell-Schwertner

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	14-inch Potable Water Line	13,000	LF	$ 26.50	$ 344,500.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 17,000.00	$ 17,000.00
4	Pressure Testing	13,000	LS	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00
	Construction Cost				$ 441,000.00
	Easements				$ 18,000.00
	Engineering, Legal, Environmental & Contingencies				$ 132,300.00
	Total Project Cost				$ 591,300.00
	Cost For Planning Purposes				$ 625,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-9*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
12-Inch Potable Water Line from Jarrell-Schwertner to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	58,000	LF	$ 21.50	$ 1,247,000.00
2	Valves and Fittings	1	LS	$ 150,000.00	$ 150,000.00
3	Miscellaneous	1	LS	$ 80,000.00	$ 80,000.00
4	Pressure Testing	58,000	LS	$ 0.50	$ 29,000.00
5	Trench Safety	58,000	LF	$ 1.00	$ 58,000.00
	Construction Cost				$ 1,564,000.00
	Easements				$ 80,000.00
	Engineering, Legal, Environmental & Contingencies				$ 469,200.00
	Total Project Cost				$ 2,113,200.00
	Cost For Planning Purposes				$ 2,200,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT C-10*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Brazos River Authority
Improvements to Create Water Supply System
F.M. 2843 Booster Pump Station and Ground Storage

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3 - 150 HP Pumps	1	LS	$ 100,000.00	$ 100,000.00
2	Piping and Valves	1	LS	$ 70,000.00	$ 70,000.00
3	Electrical	1	LS	$ 100,000.00	$ 100,000.00
4	Concrete Masonry Unit (CMU) Building	1	LS	$ 60,000.00	$ 60,000.00
5	1.0 MG Ground Storage Tank	1	LS	$ 500,000.00	$ 500,000.00
6	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
	Construction Cost				$ 905,000.00
	Easements				
	Engineering, Legal, Environmental & Contingencies				$ 271,500.00
	Total Project Cost				$ 1,176,500.00
	Cost For Planning Purposes				$ 1,200,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

Appendix D

Central Texas Water Supply Corporation
Improvements to Supply Existing and Additional Customers

Opinion of Probable Cost

EXHIBIT D

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing and Additional Customers
Summary of All Proposed Improvements

Item No.	Description	Total Cost
	Proposed Improvements	
	Treated Surface Water To Augment Existing Ground Water	
D-1	CTWSC WTP No. 3	$ 16,500,000.00
D-2	18" Line from IH-35 to Salado	$ 700,000.00
D-3	12" Line from Salado to F.M. 2843 Booster Pump Station	$ 500,000.00
D-4	8" Line from F.M. 2843 Booster Pump Station to Jarrell-Schwertner	$ 560,000.00
D-5	10" Line from Proposed 20" Line to BMF/Bartlett	$ 1,450,000.00
D-6	8" Line from BMF/Bartlett Junction to BMF Tank	$ 775,000.00
D-7	6" Line from BMF/Bartlett Junction to Bartlett Tank	$ 425,000.00
D-8	F.M. 2843 Booster Pump Station and Ground Storage	$ 1,000,000.00
D-9 (alt)	8" Line from Jarrell-Schwertner to Bartlett Tank	$ 1,925,000.00
D-10	CTWSC WTP No. 3 Expansion #1	$ 6,900,000.00
D-11	CTWSC WTP No. 3 Expansion #2	$ 4,100,000.00
	***Treated Surface Water to Meet Maximum Day Demands**	
D-1*	CTWSC WTP No. 3	$ 22,300,000.00
D-2*	20" Line from IH-35 to Salado	$ 900,000.00
D-3*	18" Line from Salado to F.M. 2843 Booster Pump Station	$ 600,000.00
D-4*	12" Line from F.M. 2843 Booster Pump Station to Jarrell-Schwertner	$ 650,000.00
D-5*	10" Line from Proposed 20" Line to BMF/Bartlett	$ 1,450,000.00
D-6*	8" Line from BMF/Bartlett Junction to BMF Tank	$ 775,000.00
D-7*	8" Line from BMF/Bartlett Junction to Bartlett Tank	$ 475,000.00
D-8*	F.M. 2843 Booster Pump Station and Ground Storage	$ 1,100,000.00
D-9 (alt)*	12" Line from Jarrell-Schwertner to Bartlett Tank	$ 2,200,000.00
D-10*	CTWSC WTP No. 3 Expansion #1	$ 6,900,000.00
D-11*	CTWSC WTP No. 3 Expansion #2	$ 4,100,000.00

EXHIBIT D-1

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Membrane Filtration (10.0 MGD)	1	LS	$ 8,000,000.00	$ 8,000,000.00
2	Building to House Membrane Filtration/Office	1	LS	$ 400,000.00	$ 400,000.00
3	Backwash Lagoon	1	LS	$ 160,000.00	$ 160,000.00
4	39" Yard Piping	1	LS	$ 85,000.00	$ 85,000.00
5	1,500,000 Gallon Clearwell	1	LS	$ 1,000,000.00	$ 1,000,000.00
6	Supernatant Recycle Pump Station and Pumps	1	LS	$ 90,000.00	$ 90,000.00
7	Sludge Thickener	1	LS	$ 140,000.00	$ 140,000.00
8	Sludge Building	1	LS	$ 80,000.00	$ 80,000.00
9	Sludge Recirculation Pump Station and Pumps	1	LS	$ 65,000.00	$ 65,000.00
10	Chemical Storage Facilities (Building)	1	LS	$ 125,000.00	$ 125,000.00
11	Scrubber (adjacent to chlorine storage)	1	LS	$ 225,000.00	$ 225,000.00
12	Chemical Feed Pumps	1	LS	$ 225,000.00	$ 225,000.00
13	High Service Pump Station and Pumps	1	LS	$ 1,000,000.00	$ 1,000,000.00
14	Ashpalt Roadways/Parking at Plant Site	1	LS	$ 250,000.00	$ 250,000.00
15	Chain Link Fence	1	LS	$ 50,000.00	$ 50,000.00
16	Sitework	1	LS	$ 50,000.00	$ 50,000.00
17	Electrical	1	LS	$ 225,000.00	$ 225,000.00

Construction Cost	$12,170,000.00
Site Acquisition (78 acres)	$ 201,000.00
Engineering, Legal, Environmental & Contingencies	$ 3,651,000.00
Total Project Cost	$16,022,000.00
Cost For Planning Purposes	$16,500,000.00

EXHIBIT D-2

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
18-Inch Potable Water Line from IH-35 to Salado

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	18-inch Potable Water Line	11,500	LF	$ 28.00	$ 322,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 50,000.00	$ 50,000.00
4	Pressure Testing	11,500	LS	$ 0.50	$ 5,750.00
5	Trench Safety	11,500	LF	$ 1.00	$ 11,500.00
	Construction Cost				$ 489,250.00
	Easements				$ 16,000.00
	Engineering, Legal, Environmental & Contingencies				$ 146,775.00
	Total Project Cost				$ 652,025.00
	Cost For Planning Purposes				$ 700,000.00

EXHIBIT D-3

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
12-Inch Potable Water Line from Salado to F.M. 2843 BPS

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	10,500	LF	$ 23.00	$ 241,500.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	10,500	LS	$ 0.50	$ 5,250.00
5	Trench Safety	10,500	LF	$ 1.00	$ 10,500.00
	Construction Cost				$ 342,250.00
	Easements				$ 15,000.00
	Engineering, Legal, Environmental & Contingencies				$ 102,675.00
	Total Project Cost				$ 459,925.00
	Cost For Planning Purposes				$ 500,000.00

EXHIBIT D-4

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
8-Inch Potable Water Line from F.M. 2843 BPS to Jarrell-Schwertner

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	16,000	LF	$ 18.00	$ 288,000.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	16,000	LS	$ 0.50	$ 8,000.00
5	Trench Safety	16,000	LF	$ 1.00	$ 16,000.00
	Construction Cost				$ 397,000.00
	Easements				$ 23,000.00
	Engineering, Legal, Environmental & Contingencies				$ 119,100.00
	Total Project Cost				$ 539,100.00
	Cost For Planning Purposes				$ 560,000.00

EXHIBIT D-5

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
10-Inch Potable Water Line from Proposed 20" Line to B-M-F/Bartlett Junction

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	10-inch Potable Water Line	38,500	LF	$ 20.00	$ 770,000.00
2	Valves and Fittings	1	LS	$ 150,000.00	$ 150,000.00
3	Miscellaneous	1	LS	$ 50,000.00	$ 50,000.00
4	Pressure Testing	38,500	LF	$ 0.50	$ 19,250.00
5	Trench Safety	38,500	LF	$ 1.00	$ 38,500.00
	Construction Cost				$ 1,027,750.00
	Easement				$ 54,000.00
	Engineering, Legal, Environmental & Contingencies				$ 308,325.00
	Total Project Cost				$ 1,390,075.00
	Cost For Planning Purposes				$ 1,450,000.00

EXHIBIT D-6

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
8-Inch Potable Water Line from B-M-F/Bartlett Junction to B-M-F

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	21,500	LF	$ 18.00	$ 387,000.00
2	Valves and Fittings	1	LS	$ 85,000.00	$ 85,000.00
3	Miscellaneous	1	LS	$ 30,000.00	$ 30,000.00
4	Pressure Testing	21,500	LF	$ 0.50	$ 10,750.00
5	Trench Safety	21,500	LF	$ 1.00	$ 21,500.00
	Construction Cost				$ 534,250.00
	Easement				$ 30,000.00
	Engineering, Legal, Environmental & Contingencies				$ 160,275.00
	Total Project Cost				$ 724,525.00
	Cost For Planning Purposes				$ 775,000.00

EXHIBIT D-7

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
6-Inch Potable Water Line from B-M-F/Bartlett Junction to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	6-inch Potable Water Line	13,000	LF	$ 15.00	$ 195,000.00
2	Valves and Fittings	1	LS	$ 50,000.00	$ 50,000.00
3	Miscellaneous	1	LS	$ 15,000.00	$ 15,000.00
4	Pressure Testing	13,000	LF	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00
	Construction Cost				$ 279,500.00
	Easement				$ 18,000.00
	Engineering, Legal, Environmental & Contingencies				$ 83,850.00
	Total Project Cost				$ 381,350.00
	Cost For Planning Purposes				$ 425,000.00

EXHIBIT D-8

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
F.M. 2843 Booster Pump Station and Ground Storage

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3 - 60 HP Pumps	1	LS	$ 50,000.00	$ 50,000.00
2	Piping and Valves	1	LS	$ 70,000.00	$ 70,000.00
3	Electrical	1	LS	$ 100,000.00	$ 100,000.00
4	Concrete Masonry Unit (CMU) Building	1	LS	$ 60,000.00	$ 60,000.00
5	0.75 MG Ground Storage Tank	1	LS	$ 400,000.00	$ 400,000.00
6	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
	Construction Cost				$ 755,000.00
	Easements				
	Engineering, Legal, Environmental & Contingencies				$ 226,500.00
	Total Project Cost				$ 981,500.00
	Cost For Planning Purposes				$ 1,000,000.00

EXHIBIT D-9(alt)

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
8-Inch Potable Water Line from Jarrell-Schwertner to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	58,000	LF	$ 18.00	$ 1,044,000.00
2	Valves and Fittings	1	LS	$ 200,000.00	$ 200,000.00
3	Miscellaneous	1	LS	$ 65,000.00	$ 65,000.00
4	Pressure Testing	58,000	LS	$ 0.50	$ 29,000.00
5	Trench Safety	58,000	LF	$ 1.00	$ 58,000.00
	Construction Cost				$ 1,396,000.00
	Easements				$ 80,000.00
	Engineering, Legal, Environmental & Contingencies				$ 418,800.00
	Total Project Cost				$ 1,894,800.00
	Cost For Planning Purposes				$ 1,925,000.00

EXHIBIT D-10

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3 Expansion # 1

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	5.0 MGD Water Treatment Plant	1	LS	$ 3,500,000.00	$ 3,500,000.00
2	Backwash Lagoon	1	LS	$ 175,000.00	$ 175,000.00
3	1.5 Million gallon Clearwell	1	LS	$ 1,000,000.00	$ 1,000,000.00
4	High Service Pump Station Modifications	1	LS	$ 300,000.00	$ 300,000.00
5	Supernatant Recycle Pump Station Modifications	1	LS	$ 75,000.00	$ 75,000.00
6	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 5,150,000.00
	Engineering, Legal, Environmental & Contingencies				$ 1,545,000.00
	Total Project Cost				$ 6,695,000.00
	Cost For Planning Purposes				$ 6,900,000.00

EXHIBIT D-11

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3 Expansion # 2

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	4.0 MGD Water Treatment Plant	1	LS	$ 2,700,000.00	$ 2,700,000.00
2	High Service Pump Station Modifications	1	LS	$ 250,000.00	$ 250,000.00
3	Supernatant Recycle Pump Station Modifications	1	LS	$ 75,000.00	$ 75,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 3,125,000.00
	Engineering, Legal, Environmental & Contingencies				$ 937,500.00
	Total Project Cost				$ 4,062,500.00
	Cost For Planning Purposes				$ 4,100,000.00

EXHIBIT D-1*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	Membrane Filtration (16.0 MGD)	1	LS	$12,000,000.00	$12,000,000.00
2	Building to House Membrane Filtration/Office	1	LS	$ 500,000.00	$ 500,000.00
3	Backwash Lagoon (200,000 Gallons)	1	LS	$ 160,000.00	$ 160,000.00
4	42" Yard Piping	1	LS	$ 100,000.00	$ 100,000.00
5	1,500,000 Gallon Clearwell	1	LS	$ 1,000,000.00	$ 1,000,000.00
6	Supernatant Recycle Pump Station and Pumps	1	LS	$ 110,000.00	$ 110,000.00
7	Sludge Thickener	1	LS	$ 150,000.00	$ 150,000.00
8	Sludge Building	1	LS	$ 80,000.00	$ 80,000.00
9	Sludge Recirculation Pump Station and Pumps	1	LS	$ 75,000.00	$ 75,000.00
10	Chemical Storage Facilities (Building)	1	LS	$ 150,000.00	$ 150,000.00
11	Scrubber (adjacent to chlorine storage)	1	LS	$ 275,000.00	$ 275,000.00
12	Chemical Feed Pumps	1	LS	$ 250,000.00	$ 250,000.00
13	High Service Pump Station and Pumps	1	LS	$ 1,500,000.00	$ 1,500,000.00
14	Ashpalt Roadways/Parking at Plant Site	1	LS	$ 250,000.00	$ 250,000.00
15	Chain Link Fence	1	LS	$ 50,000.00	$ 50,000.00
16	Sitework	1	LS	$ 50,000.00	$ 50,000.00
17	Electrical	1	LS	$ 250,000.00	$ 250,000.00

Construction Cost	$16,950,000.00
Site Acquisition (78 acres)	$ 201,000.00
Engineering, Legal, Environmental & Contingencies	$ 5,085,000.00
Total Project Cost	$22,236,000.00
Cost For Planning Purposes	$22,300,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-2*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
20-Inch Potable Water Line from IH-35 to Salado

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	20-inch Potable Water Line	11,500	LF	$ 40.00	$ 460,000.00
2	Valves and Fittings	1	LS	$ 100,000.00	$ 100,000.00
3	Miscellaneous	1	LS	$ 50,000.00	$ 50,000.00
4	Pressure Testing	11,500	LS	$ 0.50	$ 5,750.00
5	Trench Safety	11,500	LF	$ 1.00	$ 11,500.00
	Construction Cost				$ 627,250.00
	Easements				$ 16,000.00
	Engineering, Legal, Environmental & Contingencies				$ 188,175.00
	Total Project Cost				$ 831,425.00
	Cost For Planning Purposes				$ 900,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-3*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
16-Inch Potable Water Line from Salado to F.M. 2843 BPS

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	16-inch Potable Water Line	10,500	LF	$ 32.00	$ 336,000.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	10,500	LS	$ 0.50	$ 5,250.00
5	Trench Safety	10,500	LF	$ 1.00	$ 10,500.00
	Construction Cost				$ 436,750.00
	Easements				$ 15,000.00
	Engineering, Legal, Environmental & Contingencies				$ 131,025.00
	Total Project Cost				$ 582,775.00
	Cost For Planning Purposes				$ 600,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-4*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
12-Inch Potable Water Line from F.M. 2843 BPS to Jarrell-Schwertner

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	16,000	LF	$ 22.50	$ 360,000.00
2	Valves and Fittings	1	LS	$ 60,000.00	$ 60,000.00
3	Miscellaneous	1	LS	$ 25,000.00	$ 25,000.00
4	Pressure Testing	16,000	LS	$ 0.50	$ 8,000.00
5	Trench Safety	16,000	LF	$ 1.00	$ 16,000.00

Construction Cost	$ 469,000.00
Easements	$ 23,000.00
Engineering, Legal, Environmental & Contingencies	$ 140,700.00
Total Project Cost	$ 632,700.00
Cost For Planning Purposes	$ 650,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-5*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
10-Inch Potable Water Line from Proposed 20" Line to B-M-F/Bartlett Junction

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	10-inch Potable Water Line	38,500	LF	$ 20.00	$ 770,000.00
2	Valves and Fittings	1	LS	$ 150,000.00	$ 150,000.00
3	Miscellaneous	1	LS	$ 50,000.00	$ 50,000.00
4	Pressure Testing	38,500	LF	$ 0.50	$ 19,250.00
5	Trench Safety	38,500	LF	$ 1.00	$ 38,500.00
	Construction Cost				$ 1,027,750.00
	Easement				$ 54,000.00
	Engineering, Legal, Environmental & Contingencies				$ 308,325.00
	Total Project Cost				$ 1,390,075.00
	Cost For Planning Purposes				$ 1,450,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-6*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
8-Inch Potable Water Line from B-M-F/Bartlett Junction to B-M-F

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	21,500	LF	$ 18.00	$ 387,000.00
2	Valves and Fittings	1	LS	$ 85,000.00	$ 85,000.00
3	Miscellaneous	1	LS	$ 30,000.00	$ 30,000.00
4	Pressure Testing	21,500	LF	$ 0.50	$ 10,750.00
5	Trench Safety	21,500	LF	$ 1.00	$ 21,500.00
	Construction Cost				$ 534,250.00
	Easement				$ 30,000.00
	Engineering, Legal, Environmental & Contingencies				$ 160,275.00
	Total Project Cost				$ 724,525.00
	Cost For Planning Purposes				$ 775,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-7*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
8-Inch Potable Water Line from B-M-F/Bartlett Junction to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	8-inch Potable Water Line	13,000	LF	$ 18.00	$ 234,000.00
2	Valves and Fittings	1	LS	$ 50,000.00	$ 50,000.00
3	Miscellaneous	1	LS	$ 15,000.00	$ 15,000.00
4	Pressure Testing	13,000	LF	$ 0.50	$ 6,500.00
5	Trench Safety	13,000	LF	$ 1.00	$ 13,000.00
	Construction Cost				$ 318,500.00
	Easement				$ 18,000.00
	Engineering, Legal, Environmental & Contingencies				$ 95,550.00
	Total Project Cost				$ 432,050.00
	Cost For Planning Purposes				$ 475,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-8*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
F.M. 2843 Booster Pump Station and Ground Storage

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	3 - 125 HP Pumps	1	LS	$ 90,000.00	$ 90,000.00
2	Piping and Valves	1	LS	$ 70,000.00	$ 70,000.00
3	Electrical	1	LS	$ 100,000.00	$ 100,000.00
4	Concrete Masonry Unit (CMU) Building	1	LS	$ 60,000.00	$ 60,000.00
5	0.75 MG Ground Storage Tank	1	LS	$ 400,000.00	$ 400,000.00
6	Miscellaneous	1	LS	$ 75,000.00	$ 75,000.00
	Construction Cost				$ 795,000.00
	Easements				
	Engineering, Legal, Environmental & Contingencies				$ 238,500.00
	Total Project Cost				$ 1,033,500.00
	Cost For Planning Purposes				$ 1,100,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-9(alt)*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
12-Inch Potable Water Line from Jarrell-Schwertner to Bartlett Tank

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	12-inch Potable Water Line	58,000	LF	$ 21.50	$ 1,247,000.00
2	Valves and Fittings	1	LS	$ 200,000.00	$ 200,000.00
3	Miscellaneous	1	LS	$ 65,000.00	$ 65,000.00
4	Pressure Testing	58,000	LS	$ 0.50	$ 29,000.00
5	Trench Safety	58,000	LF	$ 1.00	$ 58,000.00

Construction Cost	$ 1,599,000.00
Easements	$ 80,000.00
Engineering, Legal, Environmental & Contingencies	$ 479,700.00
Total Project Cost	$ 2,158,700.00
Cost For Planning Purposes	$ 2,200,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-10*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3 Expansion # 1

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	5.0 MGD Water Treatment Plant	1	LS	$ 3,500,000.00	$ 3,500,000.00
2	Backwash Lagoon (200,000 gallons)	1	LS	$ 175,000.00	$ 175,000.00
3	1.5 Million gallon Clearwell	1	LS	$ 1,000,000.00	$ 1,000,000.00
4	High Service Pump Station Modifications	1	LS	$ 300,000.00	$ 300,000.00
5	Supernatant Recycle Pump Station Modifications	1	LS	$ 75,000.00	$ 75,000.00
6	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 5,150,000.00
	Engineering, Legal, Environmental & Contingencies				$ 1,545,000.00
	Total Project Cost				$ 6,695,000.00
	Cost For Planning Purposes				$ 6,900,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

EXHIBIT D-11*

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Opinion of Probable Cost

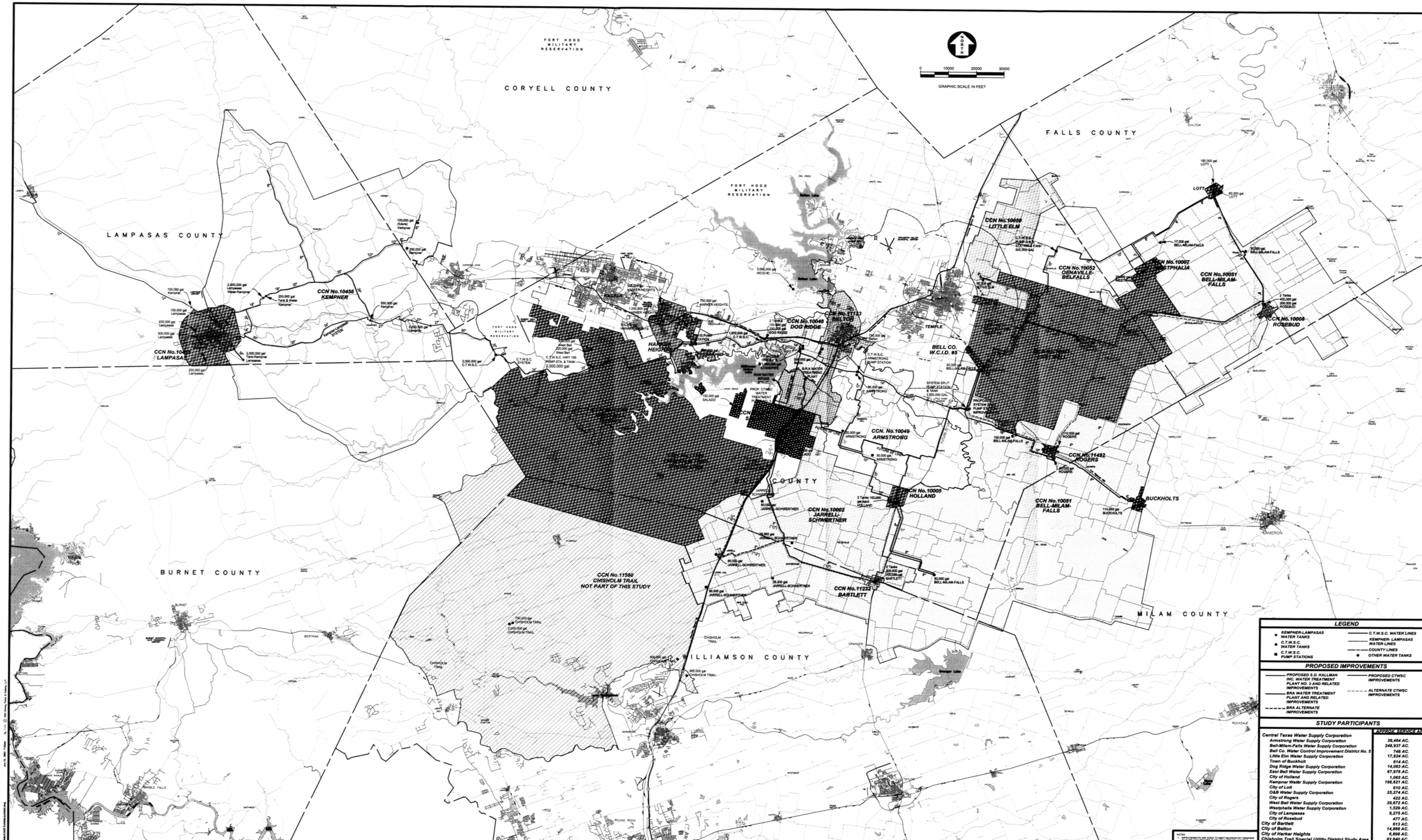
Central Texas Water Supply Corporation
Improvements to Supply Existing & Additional Customers
Water Treatment Plant No. 3 Expansion # 2

Item No.	Description	Estimated Quantity		Unit Cost	Total Cost
1	4.0 MGD Water Treatment Plant	1	LS	$ 2,700,000.00	$ 2,700,000.00
2	High Service Pump Station Modifications	1	LS	$ 250,000.00	$ 250,000.00
3	Supernatant Recycle Pump Station Modifications	1	LS	$ 75,000.00	$ 75,000.00
4	Electrical	1	LS	$ 100,000.00	$ 100,000.00
	Construction Cost				$ 3,125,000.00
	Engineering, Legal, Environmental & Contingencies				$ 937,500.00
	Total Project Cost				$ 4,062,500.00
	Cost For Planning Purposes				$ 4,100,000.00

* These improvements were sized to supply maximum day demand to all entities solely through the use of treated surface water.

Appendix E

Exhibits Referenced in Report



LEGEND

KEMPNER-LAMPASAS WATER TANKS	C.T.W.S.C. WATER LINES
C.T.W.S.C. WATER TANKS	KEMPNER- LAMPASAS WATER LINES
C.T.W.S.C. PUMP STATIONS	COUNTY LINES
	OTHER WATER TANKS

PROPOSED IMPROVEMENTS

PROPOSED S.D. KALLMAN INC. WATER TREATMENT PLANT NO. 3 AND RELATED IMPROVEMENTS	PROPOSED CTWSC IMPROVEMENTS
BRA WATER TREATMENT PLANT AND RELATED IMPROVEMENTS	ALTERNATE CTWSC IMPROVEMENTS
BRA ALTERNATE IMPROVEMENTS	

STUDY PARTICIPANTS

	APPROX. SERVICE AREA
Central Texas Water Supply Corporation	
Armstrong Water Supply Corporation	39,464 AC.
Bell-Milam-Falls Water Supply Corporation	248,937 AC.
Bell Co. Water Control Improvement District No. 5	748 AC.
Little Elm Water Supply Corporation	17,924 AC.
Town of Buckholt	614 AC.
Dog Ridge Water Supply Corporation	14,083 AC.
East Bell Water Supply Corporation	67,976 AC.
City of Holland	1,065 AC.
Kempner Water Supply Corporation	198,621 AC.
City of Lott	610 AC.
O&B Water Supply Corporation	25,274 AC.
City of Rogers	422 AC.
West Bell Water Supply Corporation	29,672 AC.
Westphalia Water Supply Corporation	1,529 AC.
City of Lampasas	9,275 AC.
City of Rosebud	477 AC.
City of Bartlett	613 AC.
City of Belton	14,868 AC.
City of Harker Heights	6,898 AC.
Chisholm Trail Special Utility District Study Area	82,840 AC.
Salado Water Supply Corporation	8,723 AC.
Jarrell-Schwertner Water Supply Corporation	79,219 AC.

ROMING, PARKER & KASBERG, L.L.P.
CONSULTING ENGINEERS
TEMPLE, TEXAS 76501

CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
ALTERNATE AND PROPOSED IMPROVEMENTS

STATE OF TEXAS ... C. ROMING 18617 REGISTERED ... ENGINEER

EXHIBIT 2

CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
ALTERNATE AND PROPOSED IMPROVEMENTS

EXISTING ARMSTRONG PUMP STATION

ARMSTRONG PUMP STATION UPGRADE

PROPOSED F.M. 1670 B.P.S.

PROPOSED 1670 STAND PIPE (1,000,000 gal)

RAW WATER INTAKE STRUCTURE

PROPOSED C.T.W.S.C. WATER TREATMENT PLANT NO. 3

20,000 gal. TANK ARMSTRONG

30,000 gal. TANK ARMSTRONG

2,000,000 gal. ARMSTRONG STANDPIPE

MATCH TO EXHIBIT 3 - A2 (TO SYSTEM SPLIT)

GRAPHIC SCALE IN FEET

0 4000

NORTH

LEGEND

EXISTING C.T.W.S.C. WATER LINE

PROPOSED C.T.W.S.C. IMPROVEMENTS (S.D. KALLMAN)

PROPOSED C.T.W.S.C.(S.D.KALLMAN) SYSTEM IMPROVEMENTS

WATER TREATMENT PLANT NO. 3 TO ARMSTRONG STANDPIPE AND 1670 STAND PIPE

EXHIBIT 3 - A1

MATCH TO EXHIBIT 3 - A1
(TO W.T.P. NO. 3)

MATCH TO EXHIBIT 3 - B4

MATCH TO EXHIBIT 3 - B1

MATCH TO EXHIBIT 3 - B5

PROPOSED SYSTEM SPLIT PUMP STATION IMPROVEMENTS

C.T.W.S.C. SYSTEM SPLIT PUMP STATION 1.0 MG TANK

20,000 gal. TANK ARMSTRONG

2,000,000 gal. ARMSTRONG STANDPIPE

30,000 gal. TANK ARMSTRONG

FM 436

FM 1123

SULPHER WELLS RD.

ARMSTRONG RD.

LANDFILL RD.

WALLACE RD.

CENTER LAKE RD.

BARNES RD.

KRAUSS RD.

ROMBERG RD.

PONDEROSA RD.

BERGER RD.

REED LAKE RD.

M.K.T. R.R.

Little River

Caney Creek

95 TEXAS

14"

10"

20"

16"

12"

0 4000

GRAPHIC SCALE IN FEET

NORTH

LEGEND

- EXISTING C.T.W.S.C. WATER LINE
- PROPOSED C.T.W.S.C. IMPROVEMENTS (S.D. KALLMAN)
- PROPOSED CTWSC (PHASE III)
- CTWSC ALTERNATE ROUTE

PROPOSED C.T.W.S.C.(S.D. KALLMAN) SYSTEM IMPROVEMENTS

ARMSTRONG STANDPIPE TO SYSTEM SPLIT

EXHIBIT 3 - A2

RPK

MATCH TO EXHIBIT 3 - B4
(TO NORTH PUMP STATION)

MATCH TO EXHIBIT 3 - B2
(TO PROPOSED EAST
BELL JUNCTION)

NORTH

0 4000

GRAPHIC SCALE IN FEET

12"

12" (ROSEBUD OPTION)
14" (BMF - TRAVIS OPTION)

Holtzheimer

FM 436

36
TEXAS

SN & FE RAILROAD

FM 437

BERGER RD.

C.T.W.S.C.
SYSTEM SPLIT
PUMP STATION
1.0 MG TANK

14"

PROPOSED
SYSTEM SPLIT
PUMP STATION
IMPROVEMENTS

16"

REED LAKE RD.

12"

2,000,000 gal
C.T.W.S.C
KNOB HILL
TANK

18"

100,000 gal
BELL-MILAM-FALLS

16"

14"

10"

110,000 gal
ROGERS

BURGESS CEMETERY RD.

8"

2,000,000 gal
C.T.W.S.C
ROGERS

LEGEND

- EXISTING CTWSC.WATER LINE
- PROPOSED CTWSC IMPROVEMENTS PHASE III)
- CTWSC ALTERNATE ROUTE

**PROPOSED C.T.W.S.C.
SYSTEM IMPROVEMENTS**

**SYSTEM SPLIT
TO ROGERS**

EXHIBIT 3 - B1

RPK

\2000-106\SYS EXHIBIT4000(1A).dwg Plotted: 9-6-01 By: F.T.G.

MATCH TO EXHIBIT 3 - B1
(TO SYSTEM SPLIT)

100,000 gal
BELL-MILAM-FALLS

2,000,000 gal
C.T.W.S.C.
KNOB HILL
TANK

10" 14"

REED LAKE RD.

36
TEXAS

BNI & FS RAILROAD

10" 14"

BURGES CEMETARY RD.

50,000 gal
ROGERS

110,000 gal
ROGERS

FM 2184

FM 437

FM 940

FM 495

12"

MATCH TO EXHIBIT 3 - B4
(TO EXISTING EAST
BELL JUCTION)

10" (ROSEBUD OPTION)
12" (BMF - TRAVIS OPTION)

53
TEXAS

50,000 gal
EAST BELL

10"

10" (ROSEBUD OPTION)
12" (BMF - TRAVIS OPTION)

10" (TO ROSEBUD)
12" (TO BMF - TRAVIS)

53
TEXAS

MATCH TO EXHIBIT 3 - B3
(TO ROSEBUD)

NORTH

0 4000

GRAPHIC SCALE IN FEET

LEGEND

- EXISTING CTWSC WATER LINE
- PROPOSED CTWSC IMPROVEMENTS (PHASE III)
- PROPOSED CTWSC IMPROVEMENTS (PHASE IV)
- CTWSC ALTERNATE ROUTE

**PROPOSED C.T.W.S.C.
SYSTEM IMPROVEMENTS**

**ROGERS TO
EAST BELL JUNCTION**

EXHIBIT 3 - B2

RPK

\2000-106\SYS EXHIBIT(2A).dwg Plotted: 9-6-01 By: F.T.G.

NORTH

0 4000

GRAPHIC SCALE IN FEET

77

320 TEXAS

53 TEXAS

FM 1772

FM 485

FM 437

FM 1963

FM 1963

10" TO ROSEBUD)

12" TO BMF - TRAVIS)

10" (ROSEBUD OPTION)

12" (BMF - TRAVIS OPTION)

400,000 gal
ROSEBUD

50,000 gal
EAST BELL

EAST BELL
JUNCTION

MATCH TO EXHIBIT 3 - B4
TO EAST BELL

MATCH TO EXHIBIT 3 - B2
TO ROGERS

SOUTHERN PACIFIC R.R.

LEGEND

PROPOSED CTWSC IMPROVEMENTS (PHASE IV)

CTWSC ALTERNATE ROUTE

EXISTING WATER LINE

PROPOSED C.T.W.S.C. SYSTEM IMPROVEMENTS

EAST BELL JUNCTION TO ROSEBUD

EXHIBIT 3 - B3

EXISTING EAST BELL JUNCTION

C.T.W.S.C. NORTH PUMP STATION & TANK 500,000 gal

FM 3117

53 TEXAS

10" (ROSEBUD OPTION)
12" (BMF - TRAVIS OPTION)

50,000 gal EAST BELL

8"

10" (ROSEBUD OPTION)
12" (BMF - TRAVIS OPTION)

PROPOSED EAST BELL JUNCTION

FM 485

FM 437

MATCH TO EXHIBIT 3 - B3 (TO ROSEBUD)

36 TEXAS

FM 436

12"
12" (ROSEBUD OPTION)
14" (BMF - TRAVIS OPTION)

50,000 gal W.C.I.D. #5

Heidenheimer

BN & FS RAILROAD

12"
12" (ROSEBUD OPTION)
14" (BMF - TRAVIS OPTION)

PROPOSED SYSTEM SPLIT PUMP STATION IMPROVEMENTS

C.T.W.S.C. SYSTEM SPLIT PUMP STATION 1.0 MG TANK

BERGER RD

Academy

FM 436

16"

MATCH TO EXHIBIT 3 - B1 (TO KNOB HILL)

NOTE:
PROPOSED IMPROVEMENT HAS TWO (2) OPTIONS.
OPTION 1 - PIPES AND PUMPS SIZED TO SUPPLY REQUIRED FLOWS TO ROSEBUD.
OPTION 2 - PIPES AND PUMPS SIZED TO SUPPLY REQUIRED FLOWS TO ROSEBUD AND MAJORITY OF FLOW TO BMF TRAVIS DISTRIBUTION POINT.

MATCH TO EXHIBIT 3 - B2 (TO ROGERS)

12"

FM 437

NORTH

0 4000

GRAPHIC SCALE IN FEET

ALTERNATE ROUTE FOLLOWS PROPOSED ROUTE FROM EAST BELL JUNCTION TO ROSEBUD

LEGEND

- EXISTING C.T.W.S.C. WATER LINE
- PROPOSED IMPROVEMENTS (PHASE III)
- PROPOSED IMPROVEMENTS (PHASE IV)
- ALTERNATE ROUTE

ALTERNATE C.T.W.S.C. SYSTEM IMPROVEMENTS

SYSTEM SPLIT TO EAST BELL JUNCTION

EXHIBIT 3 - B4

RPK

\2000-106\SYS EXHIBIT(3A).dwg Plotted: 9-6-01 By: F.T.G.

MATCH TO EXHIBIT 3 - A2
BELL-MILAM-FALLS

FM 301
FM 487
HAROLD CLARK RD.
M.K.T. R.R.
6" (*8")
95 TEXAS
500,000 gal
200,000 gal
BARTLETT
LUTHEREN CHURCH RD.
FM 487
8"
6"
INDIAN CREEK RD.
HOLT RD.
ROUNDHALL RD.
FM 2268
6"
10"
(2)100,000 gal
HOLLAND
FM 1123
10"
FM 1123
PONDEROSA RD.
95 TEXAS
ROBERTS RD.
MILLS RD.
LANDFILL RD.
20"
6"
8"
(2)100,000 gal
BELL-MILAM-FALLS

NORTH

0 4000

GRAPHIC SCALE IN FEET

LEGEND

- EXISTING C.T.W.S.C. WATER LINE
- PROPOSED BRA IMPROVEMENTS (S.D. KALLMAN)
- PROPOSED CTWSC IMPROVEMENTS

NOTES:

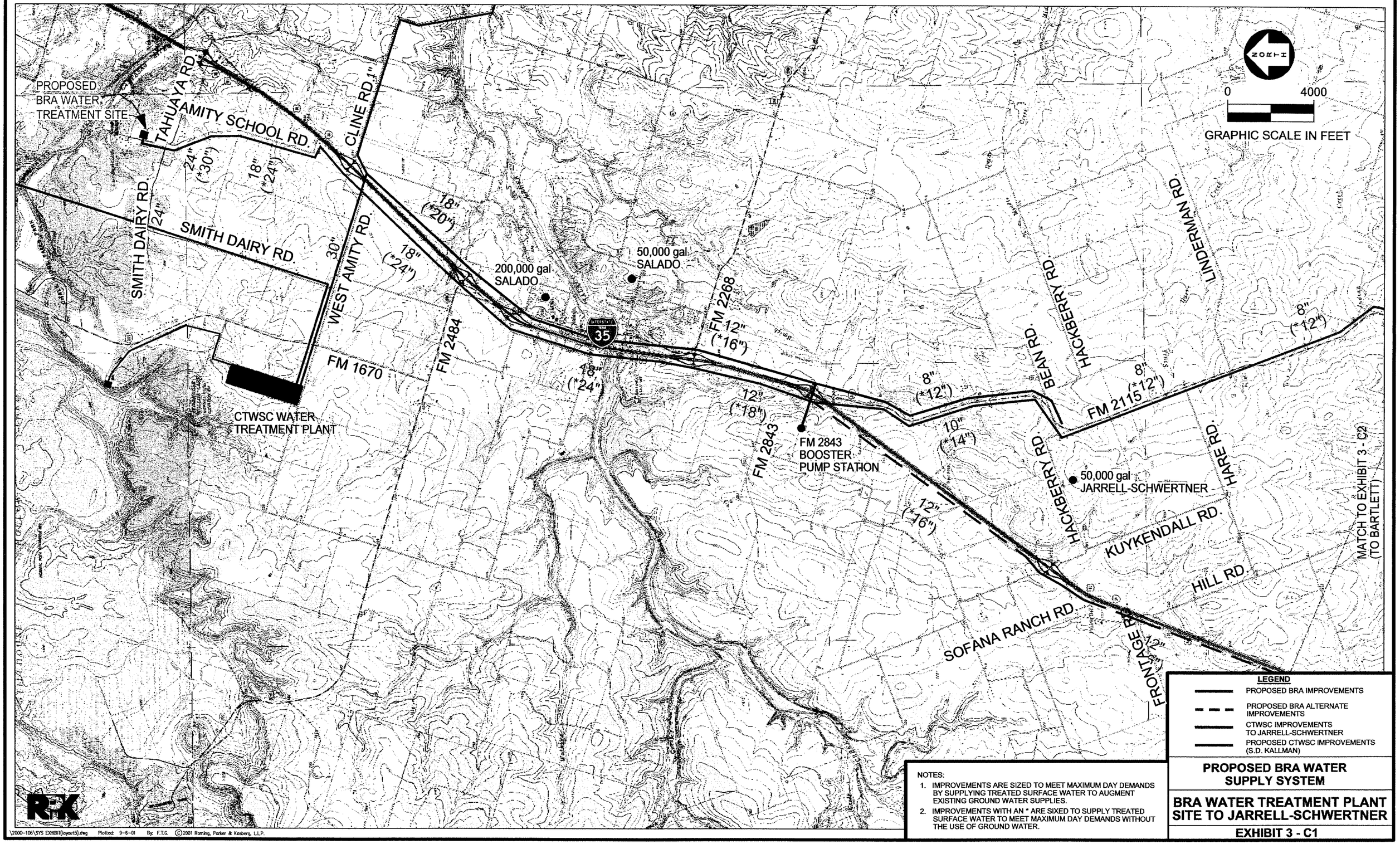
1. IMPROVEMENTS ARE SIZED TO MEET MAXIMUM DAY DEMANDS BY SUPPLYING TREATED SURFACE WATER TO AUGMENT EXISTING GROUND WATER SUPPLIES.
2. IMPROVEMENTS WITH AN * ARE SIXED TO SUPPLY TREATED SURFACE WATER TO MEET MAXIMUM DAY DEMANDS WITHOUT THE USE OF GROUND WATER.

PROPOSED C.T.W.S.C. SYSTEM IMPROVMENTS

LANDFILL ROAD (20" LINE) TO B-M-F / BARTLETT

EXHIBIT 3 - B5

RPK



LEGEND

- PROPOSED BRA IMPROVEMENTS
- PROPOSED BRA ALTERNATE IMPROVEMENTS
- CTWSC IMPROVEMENTS TO JARRELL-SCHWERTNER
- PROPOSED CTWSC IMPROVEMENTS (S.D. KALLMAN)

NOTES:

1. IMPROVEMENTS ARE SIZED TO MEET MAXIMUM DAY DEMANDS BY SUPPLYING TREATED SURFACE WATER TO AUGMENT EXISTING GROUND WATER SUPPLIES.
2. IMPROVEMENTS WITH AN * ARE SIZED TO SUPPLY TREATED SURFACE WATER TO MEET MAXIMUM DAY DEMANDS WITHOUT THE USE OF GROUND WATER.

PROPOSED BRA WATER SUPPLY SYSTEM

BRA WATER TREATMENT PLANT SITE TO JARRELL-SCHWERTNER

EXHIBIT 3 - C1

R.K

MATCH TO EXHIBIT 3 - C1
(TO B.R.A . W.T.P.)

NORTH

0 4000

GRAPHIC SCALE IN FEET

50,000 gal
JARRELL-
SCHWERTNER

26,560 gal
JARRELL-SCHWERTNER

500,000 gal
200,000 gal
BARTLETT

12" (*16")

8" (*12")

6" 12"

HARE RD.
LINDERMAN RD.
WILLIAMSON RD.
FM 304
HILL RD.
FM 2115
FM 305
FM 372
FM 303
HAROLD CLARK RD.
FM 487
CARR FM 724
MAIN ST.
M.K.T. R.R.
FM 332
FM 1105
FM 384
FM 301
95 TEXAS
Burlett
New Cox Hill

LEGEND

PROPOSED BRA IMPROVEMENTS

PROPOSED BRA ALTERNATE MPROVEMENTS

NOTES:

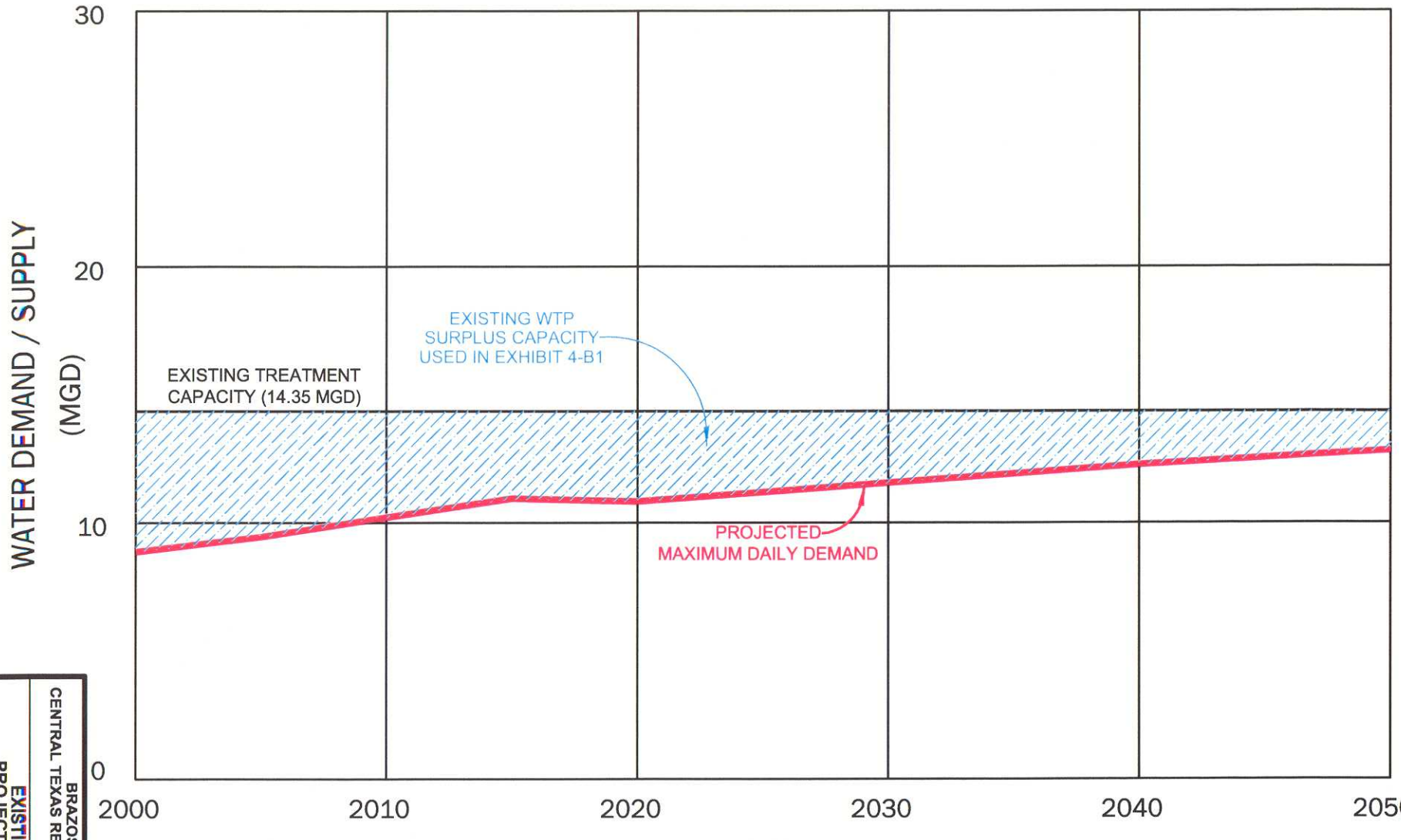
1. IMPROVEMENTS ARE SIZED TO MEET MAXIMUM DAY DEMANDS BY SUPPLYING TREATED SURFACE WATER TO AUGMENT EXISTING GROUND WATER SUPPLIES.
2. IMPROVEMENTS WITH AN * ARE SIZED TO SUPPLY TREATED SURFACE WATER TO MEET MAXIMUM DAY DEMANDS WITHOUT THE USE OF GROUND WATER.

PROPOSED BRA WATER SUPPLY SYSTEM

JARREL- SCHWERTNER TO BARTLETT

EXHIBIT 3 - C2

RPK



Existing C.T.W.S.C. Water Treatment Plant (14.35 MGD Capacity)
Serving: Dog Ridge (partial), Kempner, Lampasas and West Bell

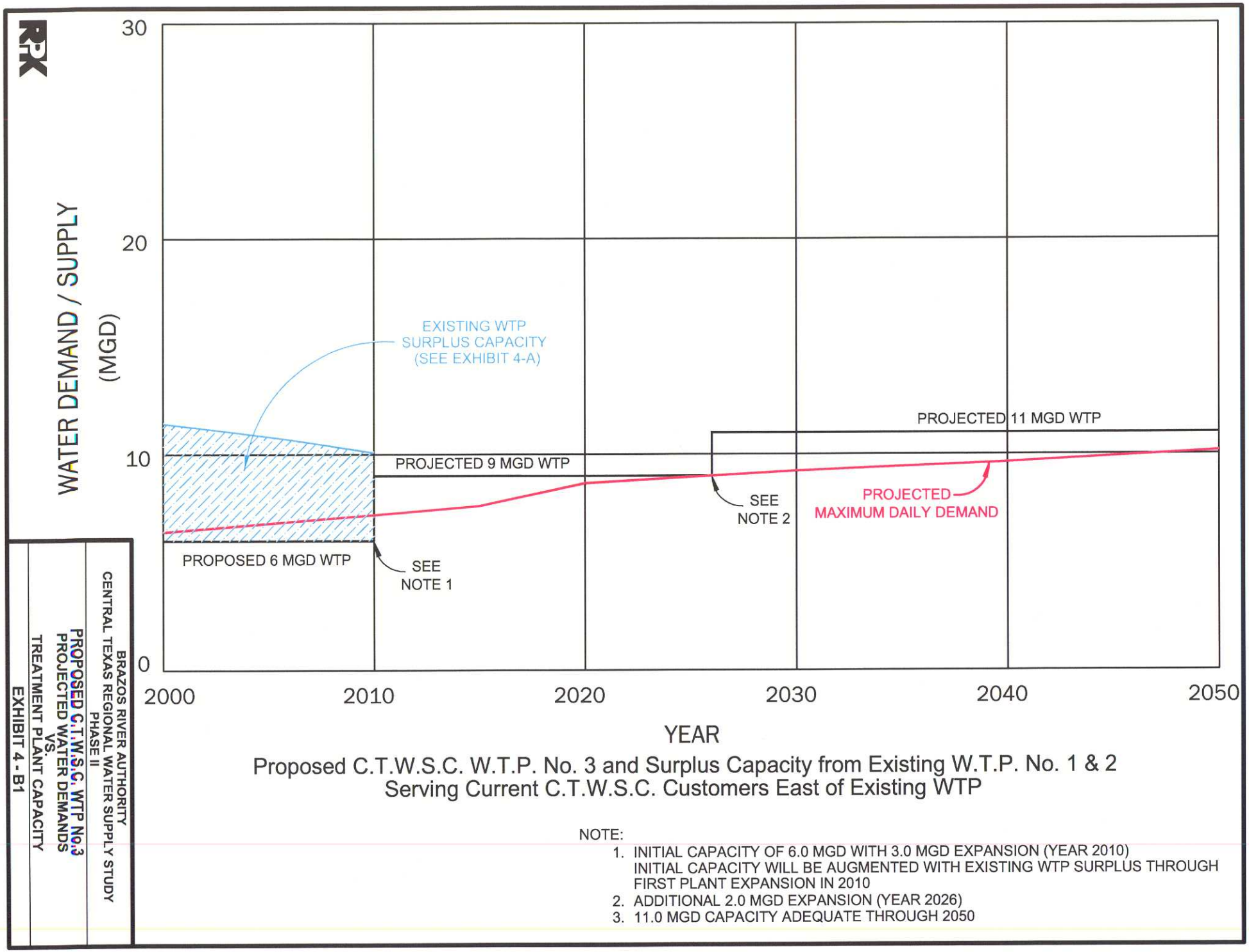
NOTE:

1. EXISTING CAPACITY OF 14.35 MGD IS ADEQUATE THROUGH 2050

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

EXISTING C.T.W.S.C. WTP
PROJECTED WATER DEMANDS
VS.
TREATMENT PLANT CAPACITY

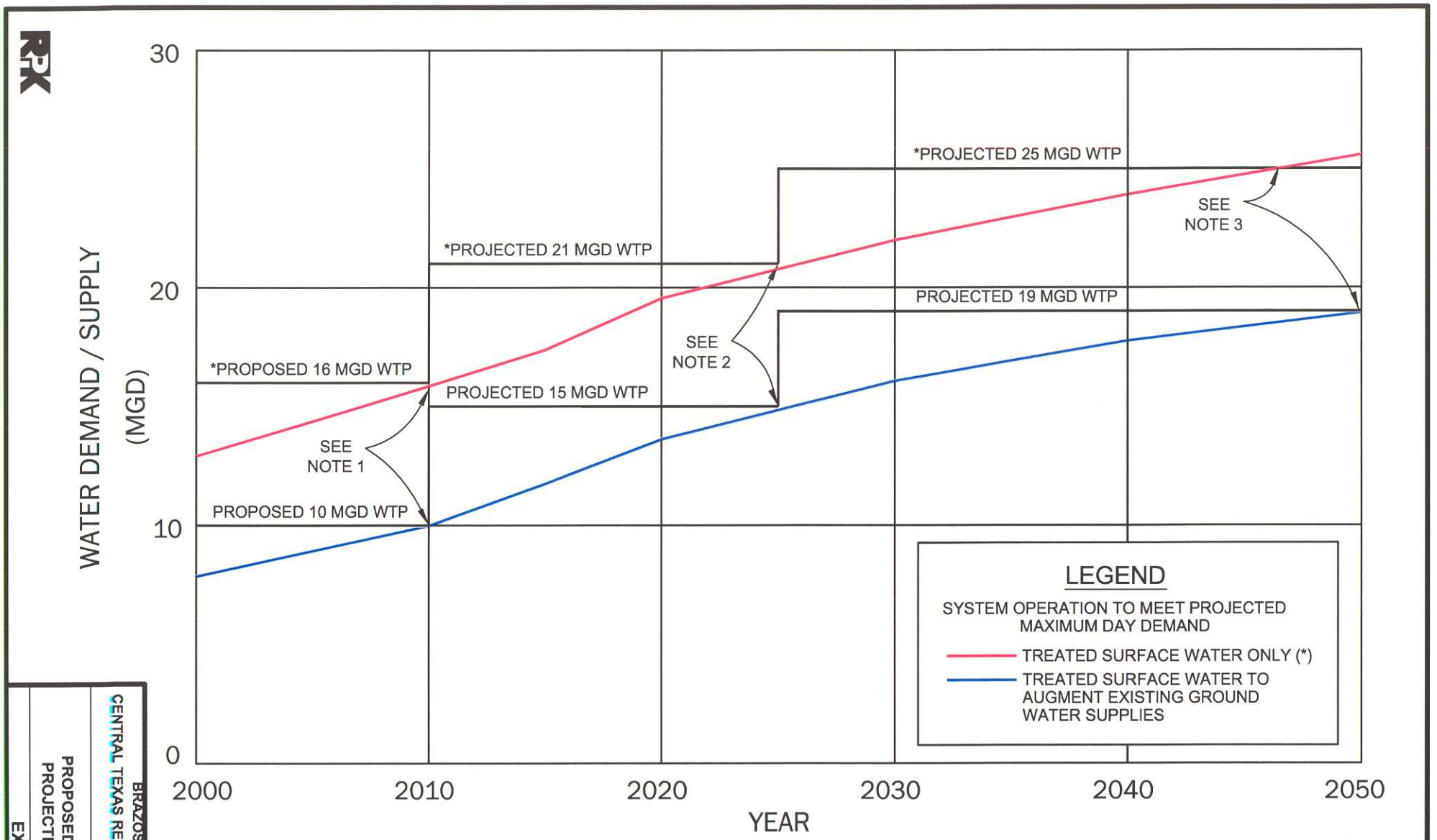
EXHIBIT 4 - A



Proposed C.T.W.S.C. W.T.P. No. 3 and Surplus Capacity from Existing W.T.P. No. 1 & 2
Serving Current C.T.W.S.C. Customers East of Existing WTP

NOTE:

1. INITIAL CAPACITY OF 6.0 MGD WITH 3.0 MGD EXPANSION (YEAR 2010)
   INITIAL CAPACITY WILL BE AUGMENTED WITH EXISTING WTP SURPLUS THROUGH FIRST PLANT EXPANSION IN 2010
2. ADDITIONAL 2.0 MGD EXPANSION (YEAR 2026)
3. 11.0 MGD CAPACITY ADEQUATE THROUGH 2050



Proposed C.T.W.S.C. W.T.P. No. 3
Serving: Current C.T.W.S.C. Customers East of Existing WTP and Bartlett, Belton, Chisholm Trail, Jarrell-Schwertner and Salado

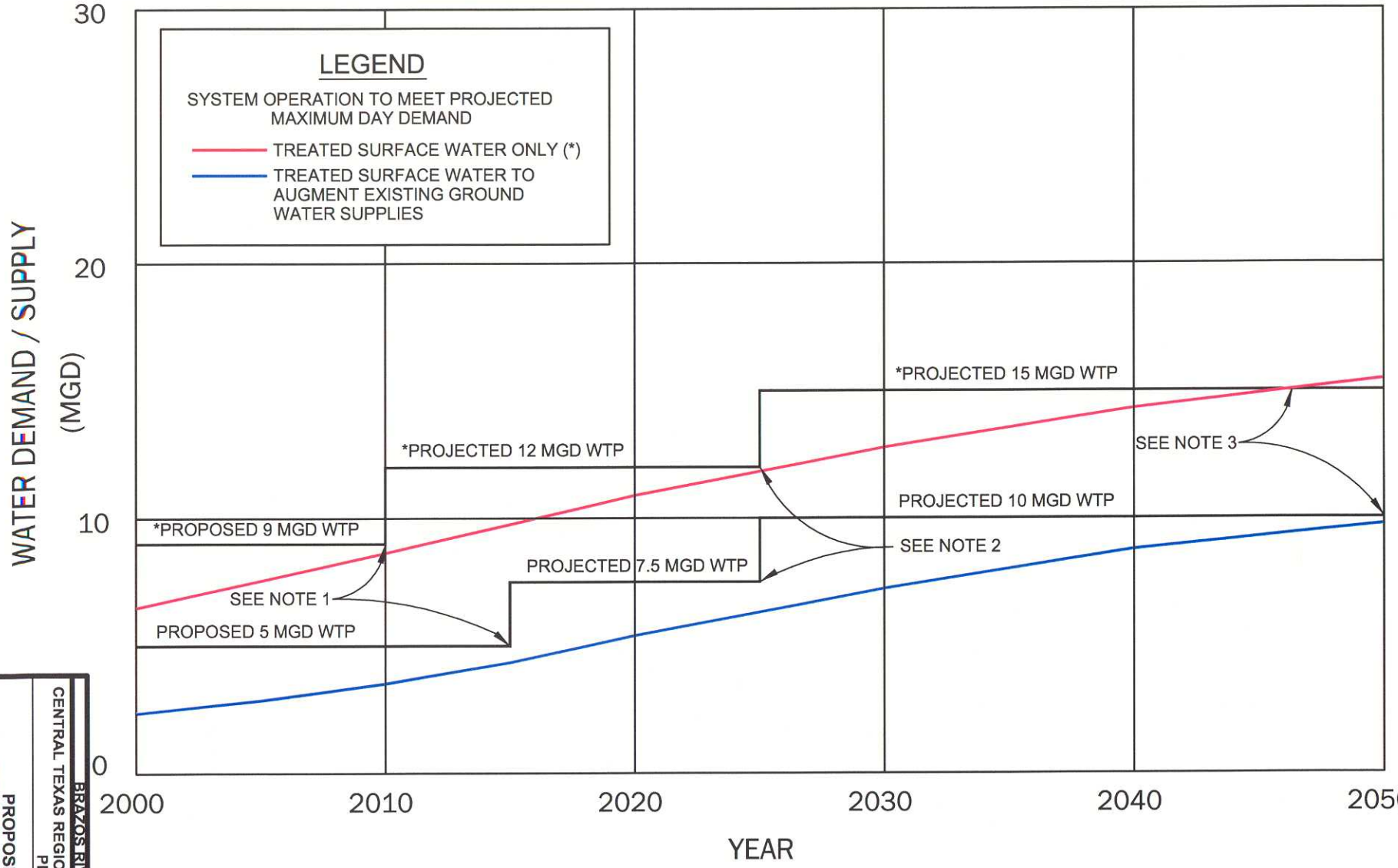
NOTE:
1. INITIAL CAPACITY OF 10.0 (*16.0) MGD WITH 5.0 MGD EXPANSION (YEAR 2010)
2. ADDITIONAL 4.0 MGD EXPANSION (YEAR 2025)
3. 19 (*25.0) MGD CAPACITY ADEQUATE THROUGH 2050 (*2045)

RPK

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

PROPOSED C.T.W.S.C. WTP No. 3
PROJECTED WATER DEMANDS

EXHIBIT 4 - B2



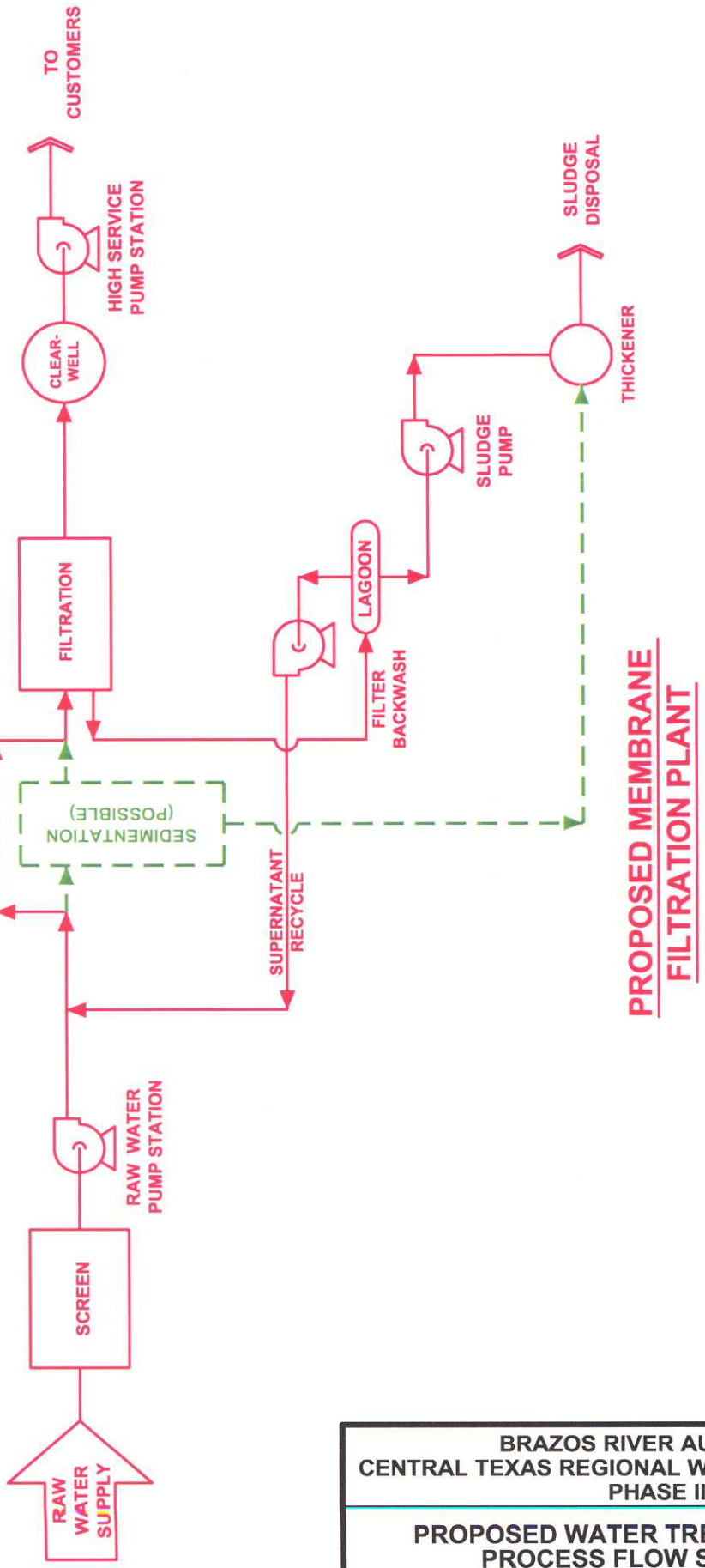
Proposed B.R.A. Water Treatment Plant
Serving: Bartlett, Belton, Chisholm Trail SUD, Jarrell-Schwertner and Salado

NOTE:

1. INITIAL CAPACITY OF 5.0 (*9.0) MGD WITH 2.5 (*3.0) MGD EXPANSION (YEAR 2015, *2010)
2. ADDITIONAL 2.5 (*3.0) MGD EXPANSION (YEAR 2025)
3. 10.0 (*15.0) MGD CAPACITY ADEQUATE THROUGH 2050 (*2045)
   (ADDITIONAL PLANNING WILL BE REQUIRED IN FUTURE)

RPK

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II
PROPOSED B.R.A. WTP
PROJECTED WATER DEMANDS
EXHIBIT 4 - C



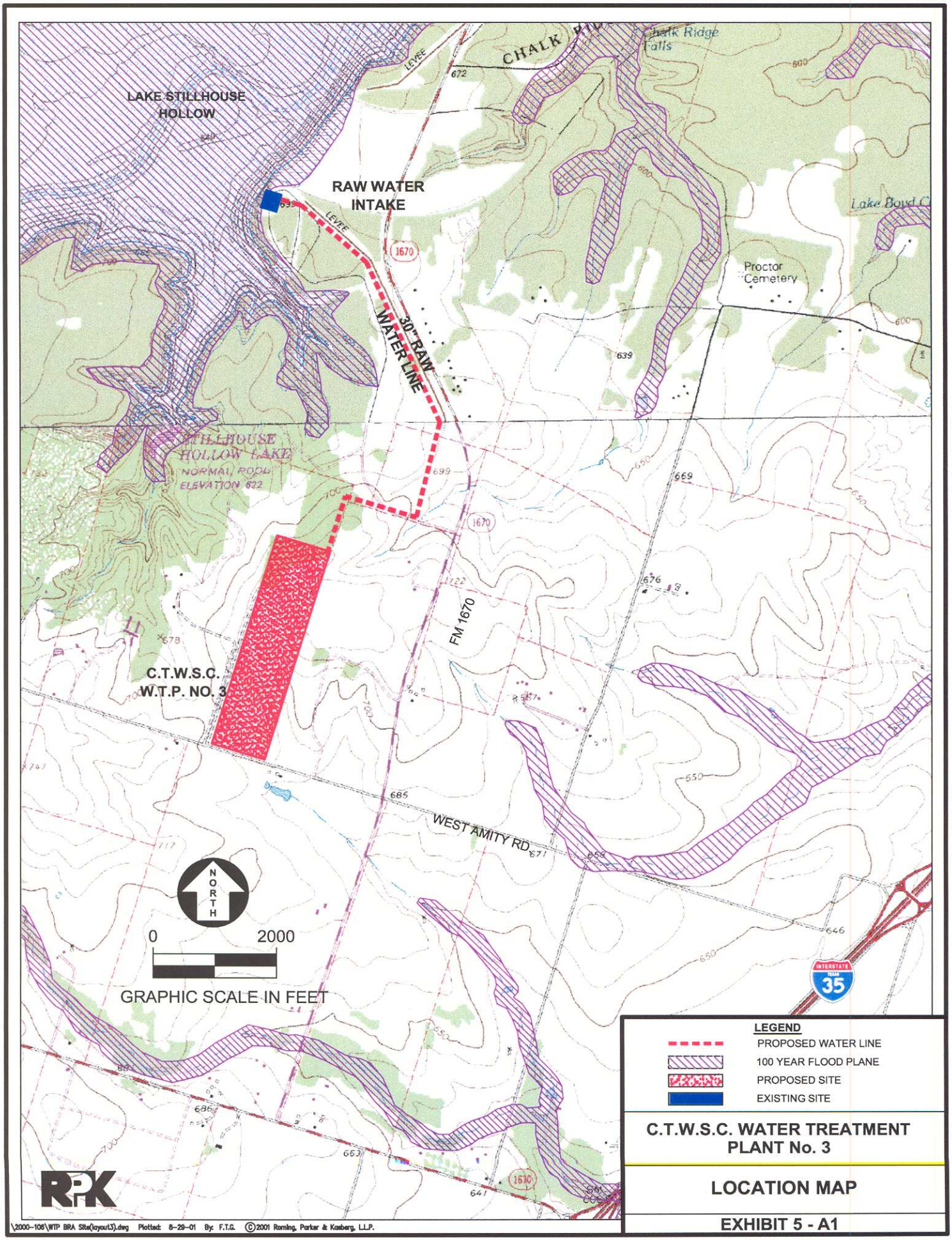
BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

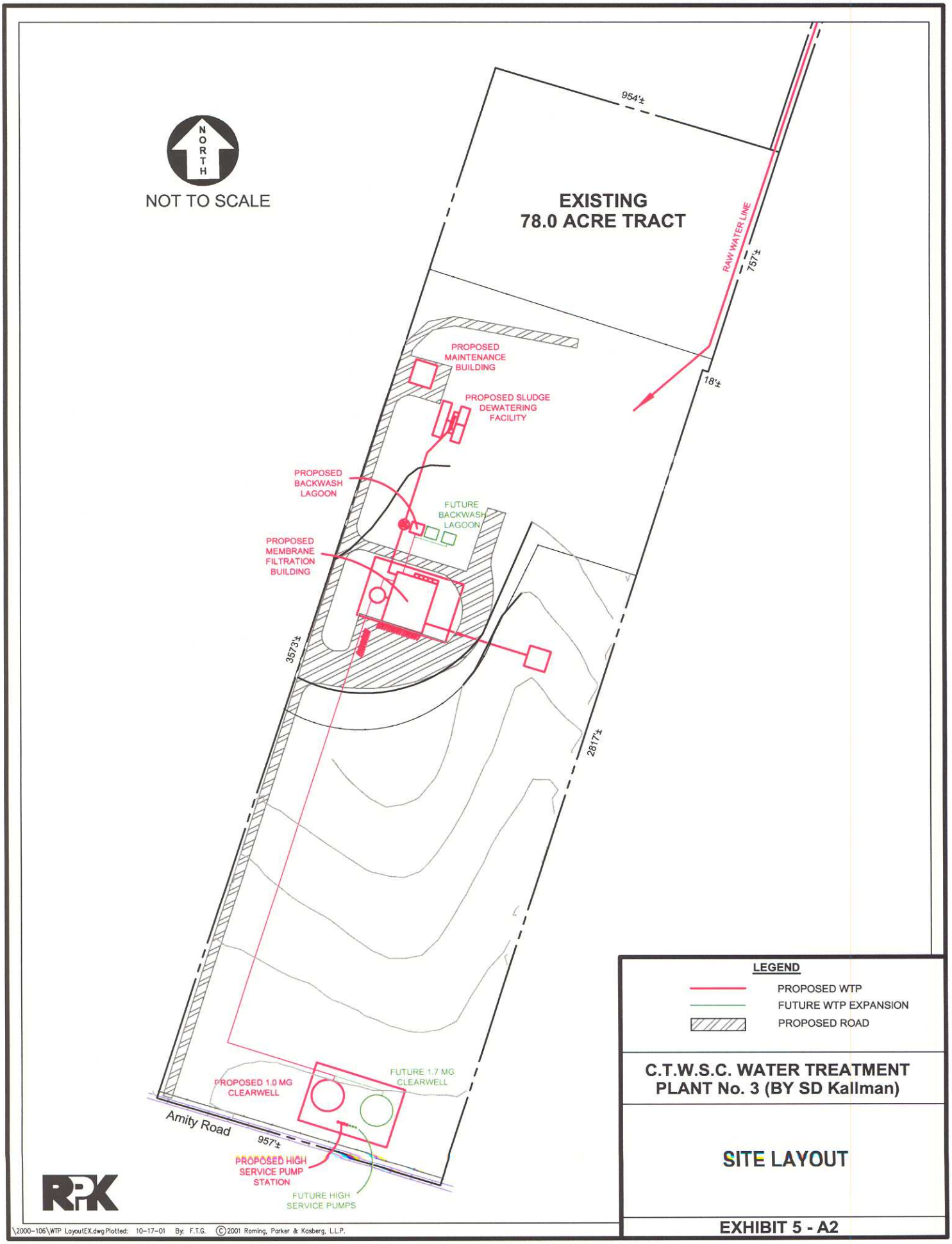
PROPOSED WATER TREATMENT PLANT PROCESS FLOW SCHEMATIC

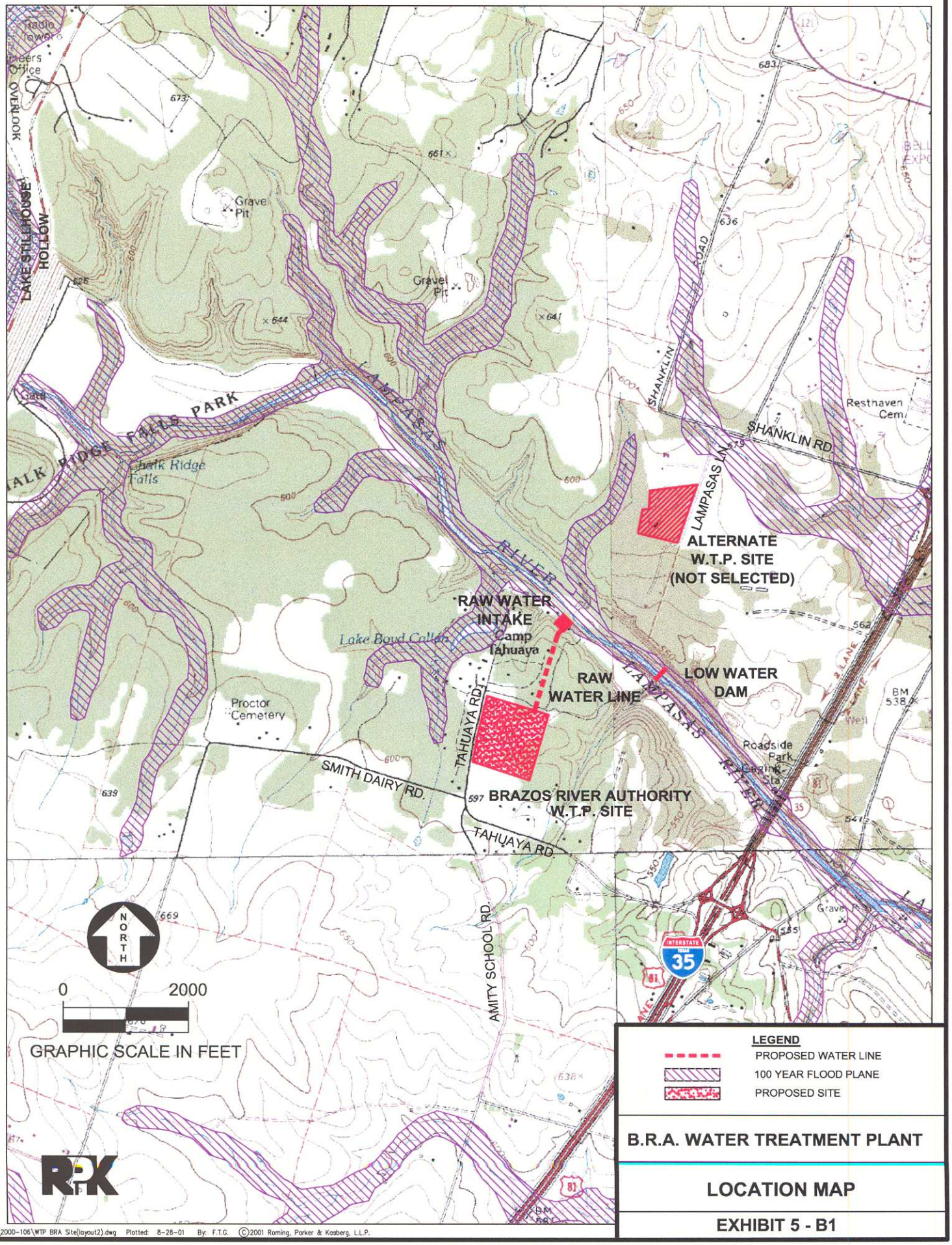
EXHIBIT 4-D

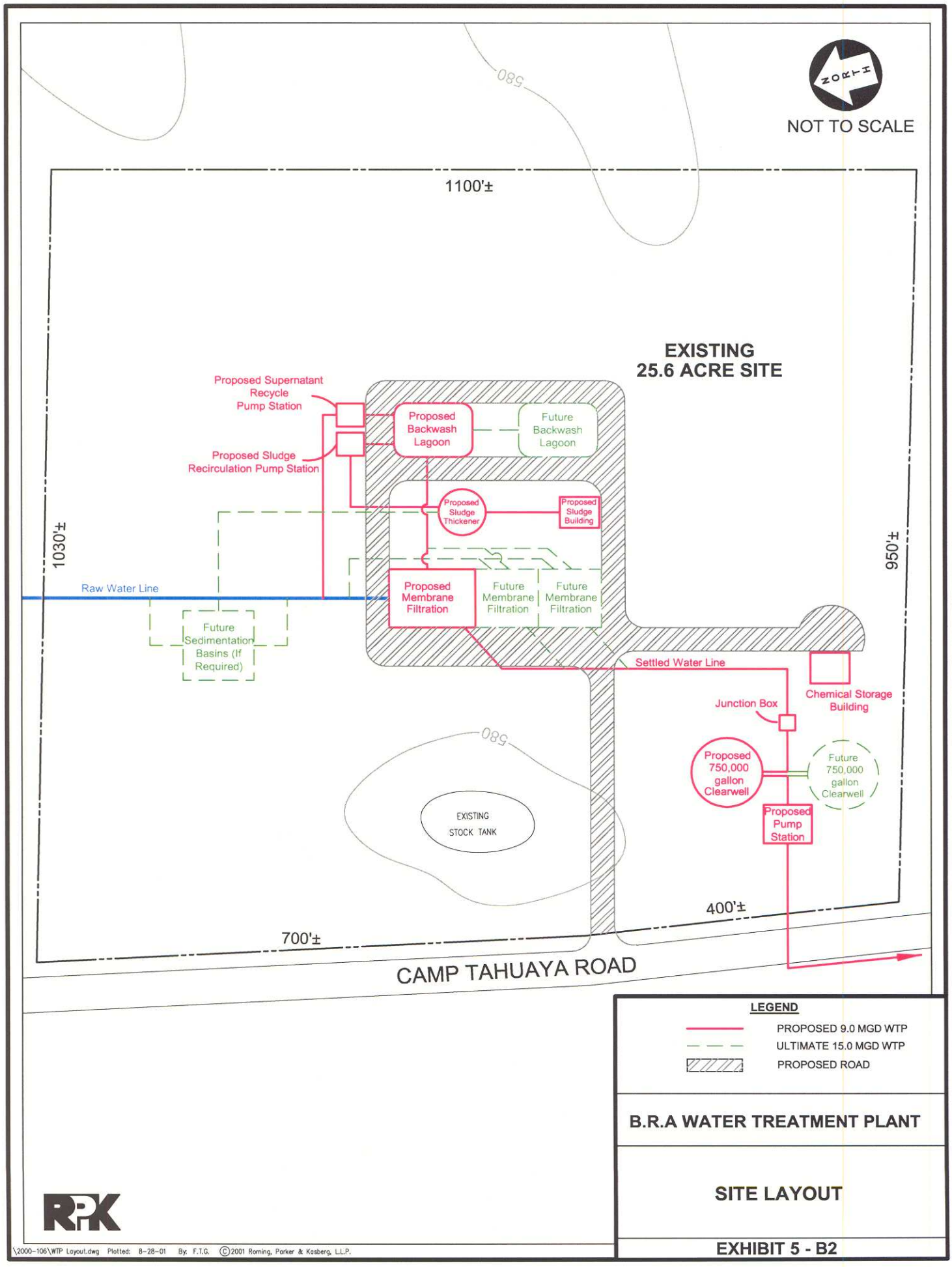
RPK

\2000-106\WTPSCHEMATIC.DWG


LAKE STILLHOUSE HOLLOW
RAW WATER INTAKE
LEVEE
30" RAW WATER LINE
1670
Proctor Cemetery
STILLHOUSE HOLLOW LAKE
NORMAL POOL ELEVATION 622
FM 1670
C.T.W.S.C. W.T.P. NO. 3
WEST AMITY RD
NORTH
0
2000
GRAPHIC SCALE IN FEET
INTERSTATE TEXAS 35
LEGEND
PROPOSED WATER LINE
100 YEAR FLOOD PLANE
PROPOSED SITE
EXISTING SITE
C.T.W.S.C. WATER TREATMENT PLANT No. 3
LOCATION MAP
EXHIBIT 5 - A1
\2000-108\WTP BRA Site(layout3).dwg Plotted: 8-29-01 By: F.T.G. ©2001 Raming, Parker & Kasberg, L.L.P.






NORTH
NOT TO SCALE
1100'±
580
EXISTING
25.6 ACRE SITE
Proposed Supernatant Recycle Pump Station
Proposed Sludge Recirculation Pump Station
Proposed Backwash Lagoon
Future Backwash Lagoon
Proposed Sludge Thickener
Proposed Sludge Building
1030'±
950'±
Raw Water Line
Proposed Membrane Filtration
Future Membrane Filtration
Future Membrane Filtration
Future Sedimentation Basins (If Required)
Settled Water Line
Chemical Storage Building
Junction Box
Proposed 750,000 gallon Clearwell
Future 750,000 gallon Clearwell
Proposed Pump Station
580
EXISTING STOCK TANK
400'±
700'±
CAMP TAHUAYA ROAD
LEGEND
PROPOSED 9.0 MGD WTP
ULTIMATE 15.0 MGD WTP
PROPOSED ROAD
B.R.A WATER TREATMENT PLANT
SITE LAYOUT
EXHIBIT 5 - B2
RPK
\2000-106\WTP Layout.dwg Plotted: 8-28-01 By: F.T.G. ©2001 Roming, Parker & Kasberg, L.L.P.

Appendix F

Meetings

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II
REPORT PRESENTATION

COMMISSIONERS COURT
APRIL 4, 2002

Organization	Contact Person	Contact Number
Roming Parker & Kasberg	Clay Roming	254-773-3731
RPK	Thomas Hale	254-773-3731
BRA	Trey Buzbee	254-761-3168
ARMSTRONG WSC	GLENDA Likes ~~Self~~	254-657-2429
Central Texas WSC	R. David Cole	254 698-2779
City of Belton	Jim Boecher	254-933-5816
Roming, Parker & Kasberg	Mack Parker	254-773-3731
City of Lampasas Public Works	Randy Clark	512 556 8315
City of Lampasas OMI INC.	Roger Bothof	512 556 3393
City of Belton Public Works	Les Hallbauer	254-933-5824
David Collingsworth	Brazos River Auth	254-776-1441
Ernest Rebuck	TX Water Development Board	512-936-2317
Bruce Butscher	City of Killeen	254 501 7620
Kempner WSC	Charles H. Stegar PE	(512) 930 9412
City of Belton	Sam Listi	254-933-5819

2000-106-11
4-4-2002

Brazos River Authority

QUALITY • CONSERVATION • SERVICE

August 29, 2000

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»
«City», «State» «PostalCode»

Re: Central Texas Regional Water Supply Study Meeting

Dear «Salutation»:

The Authority will conduct a meeting to review and discuss the findings of Phase I and to introduce Phase II of the Central Texas Regional Water Supply Study. The meeting will be held on Wednesday, September 6, 2000, at 10:00 a.m. at the Commissioners' Courtroom located on the 2nd floor of the Bell County Courthouse at 101 East Central Avenue in Belton, Texas.

If you have any questions regarding this meeting, please call Mr. Ron Anderson, the Authority's Senior Planning Manager at (512) 473-3572, or me at (254) 776-1441.

Sincerely,

DENIS QUALLS, P.E.
Regional Planning Director

DQ:rw
cc: Mr. Tommy Valle, EIT, Roming, Parker & Kasberg
x:\files\projects\central texas wss\central texas wss 29-aug-2000.doc

4400 Cobbs Drive • P.O. Box 7555 • Waco, Texas 76714-7555
254-776-1441 • FAX 254-772-5780

April 4, 2002

The attached letter has been sent to the following:

Honorable Ernestine Hill-Warren
Mayor
City of Rosebud
P.O. Box 657
Rosebud, Texas 76570

Mr. Sam Listi
City Manager
City of Belton
P.O. Box 120
Belton, Texas 76513

Mr. Ricky Preston
Operations Manager
Salado Water Supply Corporation
P.O. Box 128
Salado, Texas 76571

Mr. Dwayne Jekel
Bell Milam Falls Water Supply Corporation
P.O. Drawer 150
Cameron, Texas 76520

Mr. Thomas Frei
East Bell Water Supply Corporation
c/o Frei Enterprize, Inc.
Temple, Texas 76501

Mr. Wayne Newby
Public Works
City of Lott
P.O. Box 398
Lott, Texas 76656

Mr. Dwayne Jekel
Bell County WCID #5
P.O. Drawer 150
Cameron, Texas 76520

Mr. Larry Frei
Westphalia Water Supply Corporation
178 County Road 388
Lott, Texas 76656-3525

Mr. R. David Cole
General Manager
Central Texas WSC
4020 Lakecliff Drive
Harker Heights, Texas 76542-8607

Mr. Jerry Atkins
Public Works Director
City of Harker Heights
901 S. Ann Blvd.
Harker Heights, Texas 76543

Mr. Arnold Oliver
Jarrell Schwertner WSC
c/o Bartlett Electric Cooperative Inc.
P.O. Box 200
Bartlett, Texas 76511-0200

Mr. Ed Peeler
Town of Buckholtz
P.O. Box 117
Buckholtz, Texas 76518

Honorable Frank Horak
Mayor Pro Tem
City of Holland
P.O. Box 157
Holland, Texas 76534

Honorable Thomas Carter-Maddux
Mayor
City of Rogers
P.O. Drawer 250
Rogers, Texas 76569-0250

Mr. Dwayne Jekel
Little Elm Water Supply Corporation
P.O. Drawer 150
Cameron, Texas 76520

Mr. Michael H. Talbot
City Manager
City of Lampasas
312 E. Third Street
Lampasas, Texas 76550

Ms. Kathy Jones
City Secretary
City of Bartlett
P.O. Drawer H
Bartlett, Texas 76511

Ms. Patty Rodgers
General Manager
Chisholm Trail Special Utility District
P.O. Box 249
Florence, Texas 76527-0249

Mr. James Cargill
Armstrong Water Supply Corporation
P.O. Box 155
Holland, Texas 76534

Mr. Charles Shull
Dog Ridge Water Supply Corporation
P.O. Box 232
Belton, Texas 76513

Mr. Donald Guthrie
Kempner Water Supply Corporation
P.O. Box 103
Kempner, Texas 76539

Mr. John "Bob" Whitson
West Bell Water Supply Corporation
P.O. Box 1422
Killeen, Texas 76540

Mr. Thomas Frei
O&B Water Supply Corporation
c/o Frei Enterprize, Inc.
Temple, Texas 76501

Brazos River Authority

QUALITY • CONSERVATION • SERVICE

March 14, 2002

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»
«City», «State» «PostalCode»

Re: Central Texas Water Treatment and Distribution System Feasibility Study
Public Meeting

Dear «Salutation»:

The public meeting scheduled for Tuesday, March 26, 2002, at 2:00 p.m. has been changed to **Thursday, April 4, 2002, at 2:00 p.m.** in the Commissioners' Courtroom located on the 2nd floor of the Bell County Courthouse in Belton, Texas, to present the findings of the above-referenced report and to accept comments on the report.

If you have any questions, please call me at (254) 761-3158.

Sincerely,

DENIS QUALLS, P.E.
Regional Business Development Manager
Upper Basin

DQ:rw
cc: David Collinsworth, BRA, Regional Business Development Manager, Central Basin
Tommy Valle, EIT, Roming Parker and Kasberg, L.L.P.
\\pedeaipa\pe_shr_a\files\projects\central texas wss\public meeting revision letter 14-mar-2002.doc

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254-776-1441 • FAX 254-772-5780

COPY

The attached letter has been sent to the following:

Honorable Ernestine Hill-Warren
City of Rosebud
P.O. Box 657
Rosebud, Texas 76570
Copies - one

Mr. Sam Listi, City Manager
City of Belton
P.O. Box 120
Belton, Texas 76513
Copies – two

Mr. Ricky Preston, Operations Mgr
Salado WSC
P.O. Box 128
Salado, Texas 76571
Copies – one

Mr. Dwayne Jekel
Bell Milam Falls WSC
P.O. Drawer 150
Cameron, Texas 76520
Copies – one

Mr. Thomas Frei
East Bell WSC
c/o Frei Enterprize, Inc.
Temple, Texas 76501
Copies – one

Mr. Wayne Newby, Public Works
City of Lott
P.O. Box 398
Lott, Texas 76656
Copies – one

Mr. Dwayne Jekel
Bell County WCID #5
P.O. Drawer 150
Cameron, Texas 76520
Copies – one

Mr. Larry Frei
Westphalia WSC
178 County Road 388
Lott, Texas 76656-3525
Copies – one

Mr. R. David Cole, GM
Central Texas WSC
4020 Lakecliff Drive
Harker Heights, Texas 76542-8607
Copies - two

Mr. Jerry Atkins
City of Harker Heights
901 S. Ann Blvd.
Harker Heights, Texas 76543
Copies - two

Mr. Arnold Oliver
Jarrell Schwertner WSC
P.O. Box 200
Bartlett, Texas 76511-0200
Copies - one

Mr. Ed Peeler
Town of Buckholtz
P.O. Box 117
Buckholtz, Texas 76518
Copies - one

Honorable Frank Horak
City of Holland
P.O. Box 157
Holland, Texas 76534
Copies - one

Honorable Thomas Carter-Maddux
City of Rogers
P.O. Drawer 250
Rogers, Texas 76569-0250
Copies - one

Mr. Dwayne Jekel
Little Elm WSC
P.O. Drawer 150
Cameron, Texas 76520
Copies - one

Mr. Michael H. Talbot, City Manager
City of Lampasas
312 E. Third Street
Lampasas, Texas 76550
Copies - one

Ms. Kathy Jones, City Secretary
City of Bartlett
P.O. Drawer H
Bartlett, Texas 76511
Copies – one

Ms. Patty Rodgers, GM
Chisholm Trail SUD
P.O. Box 249
Florence, Texas 76527-0249
Copies - two

Mr. James Cargill
Armstrong WSC
P.O. Box 155
Holland, Texas 76534
Copies - one

Mr. Charles Shull
Dog Ridge WSC
P.O. Box 232
Belton, Texas 76513
Copies - one

Mr. Donald Guthrie
Kempner WSC
P.O. Box 103
Kempner, Texas 76539
Copies - one

Mr. John "Bob" Whitson
West Bell WSC
P.O. Box 1422
Killeen, Texas 76540
Copies - one

Mr. Thomas Frei
O&B WSC
c/o Frei Enterprize, Inc.
Temple, Texas 76501
Copies - one

- It is more feasible for the Cities of Belton and Bartlett, Salado WSC, Chisholm Trail SUD and Jerrell-Schwertner WSC to participate in Central Texas WSC's new water treatment plant; however if agreements cannot be reached, a Brazos River Authority water treatment plant should be considered.

A public meeting is scheduled for Tuesday, March 26, 2002, at 2:00 p.m. in the Commissioners' Courtroom located on the 2nd floor of the Bell County Courthouse in Belton, Texas, to present the findings of the report and to accept comments on the report.

If you have any questions, please call me at (254) 761-3158.

Sincerely,

for DENIS QUALLS, P.E.
Regional Business Development Manager
Upper Basin

DQ:rw
Enclosures
cc: David Collinsworth, BRA, Regional Business Development Manager, Central Basin
Tommy Valle, EIT, Roming Parker and Kasberg, L.L.P.

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Brazos River Authority

QUALITY • CONSERVATION • SERVICE

February 28, 2002

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»
«City», «State» «PostalCode»

Re: Central Texas Water Treatment and Distribution System Feasibility Study

Dear «Salutation»:

Enclosed is a draft copy of the report entitled *Central Texas Regional Water Supply Study, Phase II, System Infrastructure Improvements and Capital Improvements Plan* for your review and comment.

The study identifies improvements needed to the Central Texas Water Supply Corporation's existing system to meet the needs of its existing customers and to extend service to potential customers within the study area. A summary of the study findings is listed below.

- The major obstacle facing the study participants is not the supply of water, but rather the allocation of that water and the system capacity to treat and distribute water.
- None of the participants who use groundwater can supply the projected maximum day demand from their existing well capacity.
- The main area of concern regarding pipeline capacity deficiencies within the Central Texas WSC system is in the far east extremities.
- The existing Central Texas WSC water treatment plants 1 and 2 and the pipelines that serve the western service area are adequate through 2040.
- A new water treatment plant on the east side of Lake Stillhouse Hollow is required to supply the Central Texas WSC customers east of the existing treatment facility.
- The additional systems, (i.e., Cities of Belton and Bartlett, Salado WSC, Chisholm Trail Special Utility District and Jerrell-Schwertner WSC) will need additional surface water in the future.

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WTP on the Lampasas River or from some other source not considered in this study.

2. Dog Ridge will initially be served by both the existing CTWSC WTP and proposed CTWSC WTP No. 3. Eventually, Dog Ridge will be supplied solely from WTP No. 3. A booster pump station along FM 1670 will be required to supply all of Dog Ridge from the East (WTP No.3)
3. Harker Heights can not easily be served from one of the proposed water treatment plants and the capacity of the existing CTWSC WTP is spoken for. An expansion of the existing WTP would be required for Harker Heights to purchase treated water from CTWSC.
4. The southern portion of Belton, south of the Lampasas River, will be served from the new CTWSC WTP No. 3 or from the Alternate WTP on the Lampasas River. The northern portion will continue to be served by WCID #1.

4. Treatment Facilities

a. Conventional

b. Membrane
- Ultrafiltration/Microfiltration
- Modular construction (easily expandable)
- filtrate able to meet proposed future regulations

c. Opinion of Probable Cost
- Opinion of probable construction costs will be prepared and analyzed.
- Operation and Maintenance costs will be prepared and analyzed.
- Recommendation on plant process and construction phasing will be prepared.

5. Treatment Facility Location(s)

a. CTWSC WTP No. 3
- Located south of dam at Lake Stillhouse Hollow
- Designed initially to serve current CTWSC customers east of existing CTWSC WTP.
- Additional capacity possibly added to serve new customers to the south and south Belton.

b. Alternate Location
- Located downstream of Camp Tahuaya on the Lampasas River.
- Designed to serve Barltett, south Belton, Chisholm Trail, Jarrell-Schwertner and Salado.

6. Questions

- 4 Study Participants (Bartlett, Chisholm-Trail, Jarrell-Schwertner and Salado) currently use ground water
- 2 Study Participants (Belton, Harker Heights) are currently served by WCID #1.
- The 6 participants that are not currently customers of CTWSC combine for a significant demand that will require a treated surface water supply in the future.

b. Existing pipelines reaching capacity
   - The existing CTWSC transmission lines are approaching capacity in the extremities of the system (From Lott to Rosebud, From Holland to BMF).

c. Alternate ways of supplying maximum day demand (expand pump stations, parallel existing pipelines, construct new pipelines)
   - This study concurs with the recommendations prepared by S.D. Kallman, Inc., for the CTWSC system.
   - In addition to these improvements, additional infrastructure will be required for the entire system to meet future water demands.
   - There are three alternatives to increase supply to Rosebud:
     1. Parallel from System Split to Rogers. Construct new line along F.M 437 from Rogers to East Bell Junction (at Highway 53). Construct new line along Highway 53 from East Bell Junction to Rosebud. An additional pump station will be required at the System Split. This alternative allows for redundancy within the system and more favorable hydraulic conditions.
     2. Parallel the entire stretch from the System Split to Rosebud and from System Split to Rogers and modify the necessary pump stations.
     3. Parallel the existing line from System Split to Rogers. Parallel the existing line from System Split to the North Pump Station. Then parallel the line to East Bell (out Highway 53) and then along Highway 53 to Rosebud.
   - An additional line that parallels the existing line from Holland to BMF will be required. This line could be designed with additional capacity to supply treated water to Bartlett.
   - A pipeline will be required from either the CTWSC or Alternate Plant site that will supply the entities in the southern portion of the study area. The proposed line is aligned along IH 35 and will supply Chisholm-Trail and Jarrell-Schwertner. From Jarrell-Schwertner, an additional line could be built to the south and east to supply Bartlett.
   - Projections indicate that the pipeline between 195 Pump Station and Ivy Mountain Tank will reach capacity towards the end of the study period (>2040). As such, this report makes note of this condition and will suggest that it be investigated in the future.
   - Cost Estimates (including present worth analysis) will be prepared for each of the alternatives and a recommendation of construction and phasing will be provided in the final report.

d. Use of treatment facilities to supply treated water (which plant will supply entities and how much)
   - This study assumes the following:
     1. Chisholm Trail, Jarrell-Schwertner, Salado and Bartlett will be supplied treated surface water from the new CTWSC WTP, from the Alternate

Brazos River Authority
Central Texas Regional Water Supply Study
Phase II

System Improvements Review

August 13, 2001
Commissioner's Courtroom
Belton, Texas
2:00 p.m.

Agenda & Notes

1. Introduction

- The area, as a whole, has adequate raw water supplies.
- However, the problem is the allocation of that raw water and limitations in distributing treated surface water.

2. System Operation

a. Use of ground water to supplement treated surface water to meet maximum day demands
   - Currently, several CTWSC customers use ground water to supplement treated surface water during peak demand periods
   - Study participants not currently members of CTWSC (Bartlett, Chisholm-Trail, Jarrell-Schwertner and Salado) depend solely on ground water.

b. Role of ground water in this Study
   - This study assumes that the amount of ground water used in 1999, will remain steady throughout the study period.
   - This study assumes that water supply entities that augment treated surface water with ground water will continue to do so.
   - However, when system infrastructure improvements are required, they will be sized to supply treated surface water to meet the maximum day water demand.
   - At that point, ground water will be utilized as an emergency backup/alternate water source.

3. System Operation

a. CTWSC and Non-CTWSC customers
   - CTWSC currently serves 16 customers

Brazos River Authority
Central Texas Regional Water Supply Study
Phase II

Informational Meeting

May 22, 2001
7:00 p.m.

Agenda

1. Introduction

2. Review of Phase I

   a. Adequate Supply of Raw Water
   b. Projected Maximum Day Demands vs. Existing Treatment Capacities
   c. Minimum Requirements to Satisfy 0.6 Rule vs. Projected Maximum Day Demand

3. Phase II Scope of Services

4. Phase II Schedule

5. Overview of Phase II

   a. Required Infrastructure Schematic
   b. Use Existing Pipeline Capacities, Supplement as Required
   c. Phased Construction

6. Questions

EXECUTIVE SESSION

NONE SCHEDULED

REGULAR SESSION

DISCUSSION AND POSSIBLE ACTION CONCERNING EXECUTIVE ITEMS — President

REPORTS	ORIGINATOR
♦ NEGOTIATING COMMITTEE REPORT	Mr. Whitson
♦ PERSONNEL COMMITTEE REPORT	Mr. Crow
♦ BY-LAWS COMMITTEE REPORT	Mrs. Dolan
♦ PRESIDENT'S REPORT	President
♦ DIRECTOR(S) REPORT	Director(s)
♦ GENERAL MANAGER'S REPORT	David Cole
♦ SYSTEM MANAGER'S REPORT	Lee Kelley

MEETINGS

NEXT REGULAR MONTHLY MEETING WILL BE SCHEDULED FOR JUNE 26, 2001 AT 7:00 P.M. AT THE CENTRAL TEXAS WATER SUPPLY CORPORATION CONFERENCE ROOM AT 4020 LAKECLIFFE DRIVE, HARKER HEIGHTS, TEXAS 254-698-2779.

NOTE

The General Manager would like to know if you are willing to host the meeting for the month(s) of September and November 2001.

ADJOURN

I, Donnette Davis, Receptionist, Central Texas Water Supply Corporation, Harker Heights, Texas, do hereby certify that this Notice of Meeting was posted on the bulletin board of Central Texas Water Supply Corporation, 4020 Lakecliffe Drive, Harker Heights, Texas, 76548-8607, at a place readily accessible to the general public at all times, the Bell County Courthouse Annex bulletin board, and with the State of Texas Register, on the 14 day of May, 2001 at 8:14 AM.

Donnette Davis

Donnette Davis, Receptionist

AGENDA	ORIGINATOR
I. REMOVE FROM TABLE CENTRAL TEXAS WATER SUPPLY CORPORATION STAFF MERIT AND COST OF LIVING INCREASES	David Cole
II. DISCUSSION AND POSSIBLE ACTION TO APPROVE AN AMENDMENT TO THE BUDGET OF $31,500 RETROACTIVE APRIL 25, 2001 FOR MERIT AND COST OF LIVING FOR CENTRAL TEXAS WATER SUPPLY CORPORATION STAFF	Mr. Crow
III. REMOVE FROM TABLE OPTIONS CONCERNING SALEM WSC AND NORTH MILAM WSC	David Cole
IV. DISCUSSION AND POSSIBLE ACTION CONCERNING SALEM WSC AND NORTH MILAM WSC	Mr. D. Jekel
V. REMOVE FROM TABLE DOG RIDGE WSC ABANDONED TANK SITE	David Cole
VI. DISCUSSION AND POSSIBLE ACTION CONCERNING DOG RIDGE WSC ABANDONED TANK SITE	Mr. Whitson

MINUTES	ORIGINATOR
♦ DISCUSSION AND POSSIBLE ACTION CONCERNING APPROVAL OF MINUTES OF THE REGULAR MONTHLY MEETING ON APRIL 24, 2001	David Cole

FINANCIAL	ORIGINATOR
♦ DISCUSSION AND POSSIBLE ACTION CONCERNING APPROVAL OF FINANCIAL STATEMENT FOR APRIL 2001, SUBJECT TO AUDIT	David Cole

NOTICE OF REGULAR MONTHLY MEETING OF THE BOARD OF DIRECTORS
CENTRAL TEXAS WATER SUPPLY CORPORATION
4020 LAKECLIFFE DRIVE
HARKER HEIGHTS, TX. 76548-8607

Notice is hereby given that a regular monthly meeting of the Board of Directors of Central Texas Water Supply Corporation will be held on Tuesday, May 22, 2001, at the Rogers Civic Center, 2 West Mesquite, Rogers, Texas 76570, 254-642-3312.

REGULAR SESSION
7:00 P.M.

ANNOUNCEMENTS	ORIGINATOR
I. CALL TO ORDER	President
II. NOTICE OF MEETING POSTED	President
III. CALL ROLL OF DIRECTORS	President
IV. PRESENTATION OF AWARDS AND RECOGNITION	President

OPEN SESSION	ORIGINATOR
OPEN TO THE PUBLIC FOR SUGGESTIONS, PROPOSALS, OR GRIEVANCES. EACH SESSION LIMITED TO THREE (3) MINUTES PER PERSON, SESSION NOT TO EXCEED THIRTY (30) MINUTES.	President

PRESENTATIONS	ORIGINATOR
BRIEFING ON CENTRAL TEXAS WATER TREATMENT AND FEASIBILITY STUDY PHASE II- ALTERNATIVES AND CAPITAL IMPROVEMENT PLAN	Dennis Qualls Clay Roming Tom Ray Tommie Valle

ENGINEER REPORT	ORIGINATOR
UPDATE ON PROJECTS	Steve Kallman

Brazos River Authority
Central Texas Regional Water Supply Study
Phase II

"Kick-Off" Meeting

April 10, 2001
2:00 p.m.

Agenda

1. Introduction

2. Review of Phase I

   a. Adequate Supply of Raw Water
   b. Projected Maximum Day Demands vs. Existing Treatment Capacities
   c. Minimum Requirements to Satisfy 0.6 Rule vs. Projected Maximum Day Demand

3. Phase II Scope of Services

4. Phase II Schedule

5. Overview of Phase II

   a. Required Infrastructure Schematic
   b. Use Existing Pipeline Capacities, Supplement as Required
   c. Phased Construction

6. Questions

CENTRAL TEXAS WATER TREATMENT AND DISTRIBUTION SYSTEM
FEASIBILITY STUDY
KICK-OFF MEETING

April 10, 2001, 2:00 p.m.
Commissioners Courtroom, Bell County Courthouse

NAME	AGENCY / ENTITY	MAILING ADDRESS	PHONE NUMBER	FAX NUMBER
Clay Tommy Jonny Valle	RPK Eng.	1 So Main Temple 76501	254 773-3731	773 6667
Sam Luttl	City of Belton	Belton City Hall	254 939- 5819	933-5822
Lee Kelley	CENTRAL TX WSC	4020 LAKECLIFFE DR HARKER HTS TX 76548	254. 698-3583	254 698-4405

Honorable Billy Ray Crow
Mayor
City of Rogers
P.O. Drawer 250
Rogers, Texas 76569-0250

Mr. John "Bob" Whitson
West Bell Water Supply Corporation
P.O. Box 1422
Killeen, Texas 76540

Mr. Dwayne Jekel
Bell County WCID #5
P.O. Drawer 150
Cameron, Texas 76520

Mr. Dwayne Jekel
Little Elm Water Supply Corporation
P.O. Drawer 150
Cameron, Texas 76520

Mr. Thomas Frei
O&B Water Supply Corporation
9130 FM 438
Troy, Texas 76579

Mr. Larry Frei
Westphalia Water Supply Corporation
178 County Road 388
Lott, Texas 76656-3525

Mr. Mike Talbot
City Manager
City of Lampasas
312 E. Third Street
Lampasas, Texas 76550

Honorable Ernestine Hill-Warren
Mayor
City of Rosebud
P.O. Box 657
Rosebud, Texas 76570

The attached letter has been sent to the following:

Mr. R. David Cole
General Manager
Central Texas Water Supply Corporation
4020 Lakecliff Drive
Harker Heights, Texas 76542-8607

Mr. Mike Williams
Utility Director
City of Bartlett
P.O. Drawer H
Bartlett, Texas 76511

Mr. Sam Listi
City Manager
City of Belton
P.O. Box 120
Belton, Texas 76513

Mr. Jerry Atkins
Public Works Director
City of Harker Heights
901 S. Ann Blvd.
Harker Heights, Texas 76543

Ms. Patty Rodgers
General Manager
Chisholm Trail Special Utility District
P.O. Box 249
Florence, Texas 76527-0249

Mr. Ricky Preston
Operations Manager
Salado Water Supply Corporation
P.O. Box 128
Salado, Texas 76571

Mr. Jerry David
President
Jarrell Schwertner Water Supply Corporation
P.O. Box 369
Jarrell, Texas 76537

Mr. James Cargill
Armstrong Water Supply Corporation
P.O. Box 155
Holland, Texas 76534

Mr. Dwayne Jekel
Bell Milam Falls Water Supply Corporation
P.O. Drawer 150
Cameron, Texas 76520

Mr. Ed Peeler
Town of Buckholtz
P.O. Box 117
Buckholtz, Texas 76518

Mr. Cal Kusler
Dog Ridge Water Supply Corporation
P.O. Box 232
Belton, Texas 76513

Mr. Thomas Frei
East Bell Water Supply Corporation
16483 Hwy 53
Temple, Texas 76501

Honorable Frank Horak
Mayor Pro Tem
City of Holland
P.O. Box 157
Holland, Texas 76534

Mr. Donald Guthrie
Kempner Water Supply Corporation
P.O. Box 103
Kempner, Texas 76539

Mr. Wayne Newby
Public Works
City of Lott
P.O. Box 398
Lott, Texas 76656

Brazos River Authority

QUALITY • CONSERVATION • SERVICE

March 29, 2001

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»
«City», «State» «PostalCode»

Re: Central Texas Regional Water Supply Study - Phase II Feasibility Study
"Kick-off" Meeting

Dear «Salutation»:

A public meeting will be held on Tuesday, April 10, 2001, at 2:00 p.m. in the Commissioners' Courtroom located on the 2nd floor of the Bell County Courthouse in Belton, Texas. This will be the "kick-off" meeting for the Central Texas Regional Water Supply System Phase II Feasibility Study.

This public meeting is a Texas Water Development Board planning grant requirement. The following information including the scope of the project, the anticipated project schedule, and a delineation of the study area will be presented at the meeting.

If you have any questions or need additional information, please call me.

Sincerely,

DENIS QUALLS, P.E.
Regional Planning Director

DQ:rw
cc: Honorable Jon Burrows, Bell County Judge
Tommy Valle, EIT, Roming Parker & Kasberg
\\pedealpa\pe_shr_a\files\projects\central texas wss\kick-off phase ii 29-mar-2001.doc

4400 Cobbs Drive • P.O. Box 7555 • Waco, Texas 76714-7555
254-776-1441 • FAX 254-772-5780

COPY

MEETINGS

NEXT REGULAR MONTHLY MEETING WILL BE SCHEDULED FOR OCTOBER 24, 2000 AT 7:00 P.M. AT THE HOSTESS HOUSE LOCATED AT 1406 HIGHWAY 281, LAMPASAS, TEXAS 76550.

ADJOURN

I, Cally Prockl, Office Secretary, Central Texas Water Supply Corporation, Harker Heights, Texas, do hereby certify that this Notice of Meeting was posted on the bulletin board of Central Texas Water Supply Corporation, 4020 Lakecliffe Drive, Harker Heights, Texas, 76548-8607, at a place readily accessible to the general public at all times, the Bell County Courthouse Annex bulletin board, and with the State of Texas Register, on the 14th **day of September, 2000 at** 9:30 AM.

Cally Prockl

Cally Prockl, Office Secretary

AGENDA	ORIGINATOR
I. DISCUSSION OF CENTRAL TEXAS REGIONAL WATER STUDY	David Cole Denis Qualls, BRA
II. DISCUSSION AND POSSIBLE ACTION TO APPROVE THE POLICY AND PROCEDURES FOR CONDUCTING THE ANNUAL MEMBERSHIP MEETING	David Cole Mr. McCoy

MINUTES	ORIGINATOR
◆ DISCUSSION AND POSSIBLE ACTION CONCERNING APPROVAL OF MINUTES OF THE REGULAR MONTHLY MEETING ON AUGUST 22, 2000	Mr. McCoy

FINANCIAL	ORIGINATOR
◆ DISCUSSION AND POSSIBLE ACTION CONCERNING APPROVAL OF FINANCIAL STATEMENT FOR AUGUST 2000, SUBJECT TO AUDIT	David Cole

EXECUTIVE SESSION

NONE SCHEDULED

REGULAR SESSION

DISCUSSION AND POSSIBLE ACTION CONCERNING EXECUTIVE ITEMS — President

REPORTS	ORIGINATOR
◆ NEGOTIATING COMMITTEE REPORT	Mr. Whitson
◆ PERSONNEL COMMITTEE REPORT	Mr. Crow
◆ BY-LAWS COMMITTEE REPORT	Mrs. Dolan
◆ PRESIDENT'S REPORT	President
◆ DIRECTOR(S) REPORT	Director(s)
◆ GENERAL MANAGER'S REPORT	David Cole
◆ SYSTEM MANAGER'S REPORT	Lee Kelley

NOTICE OF REGULAR MONTHLY MEETING OF THE BOARD OF DIRECTORS
CENTRAL TEXAS WATER SUPPLY CORPORATION
4020 LAKECLIFFE DRIVE
HARKER HEIGHTS, TX. 76548-8607

Notice is hereby given that a regular monthly meeting of the Board of Directors of Central Texas Water Supply Corporation will be held on Tuesday, September 26, 2000, at 7:00 p.m., in the Central Texas Water Supply Corporation meeting room located at 4020 Lakecliffe Drive, Harker Heights, Texas 76570. Telephone (254) 698-2779.

WORKSHOP

6:30 P.M.

REVIEW AND UPDATE BY-LAWS	Mrs. Dolan

REGULAR SESSION

7:00 P.M.

ANNOUNCEMENTS		ORIGINATOR
I.	CALL TO ORDER	Mr. McNeese
II.	NOTICE OF MEETING POSTED	Mr. McNeese
III.	CALL ROLL OF DIRECTORS	Mr. McNeese

AWARDS	ORIGINATOR
JAMES CHADWICK – 3 YEAR AWARD	President
ANDRE SANDERS – 3 YEAR AWARD	President
CLAUDE DALTON – 1 YEAR AWARD	President

ENGINEER REPORT	ORIGINATOR
UPDATE ON PROJECTS PLANT	Steven Kallman
TECHNOLOGY	James Lindsey

OPEN SESSION	ORIGINATOR
OPEN TO THE PUBLIC FOR SUGGESTIONS, PROPOSALS, OR GRIEVANCES. EACH SESSION LIMITED TO THREE (3) MINUTES PER PERSON, SESSION NOT TO EXCEED THIRTY (30) MINUTES.	President

ATTENDANCE SIGN-IN

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS WATER SUPPLY STUDY

Bell County Court House

Commissioners Court

September 6, 2000 10:00 a.m.

	NAME	ORGANIZATION	PHONE	FAX
12	DENIS QUALLS	BRA	254 776-1441	254 772-7935
13	THOMAS VALLE	RPK	254-773-3731	254-773-6667
14	CLAY ROMING	RPK	"	"
15				
16				
17				
18				
19				
20				
21				
22				

ATTENDANCE SIGN-IN

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS WATER SUPPLY STUDY

Bell County Court House

Commissioners Court

September 6, 2000 10:00 a.m.

	NAME	ORGANIZATION	PHONE	FAX
1	TOMMY FREE	EAST BELL WSC OPERATIONS MANAGER	254-585 2243	585 5698
2	WAYNE NEWBY	CITY OF LOTT	254-584-2681	254 584-2001
3	Mike Talbot	City of Lampasas	512-556-6831	512-556-2074
4	DON MACKIE	SALADO WATER Supply	254-947-5425	
5	BILL LUTZ	SALADO WATER Supply	254-947-5425	254-947-5430
6	Dwayne Jekel	Bell-Milam Falls	254-697-4016	254-697 2294
7	Robert Jekel	Bell Co WCID #5	254 697 4016	254 697 2294
8	R. David Cole	Central TX WSC	254 698-2779	254 698-4105
9	Louis Wharton	Day Ridge WSC	254-939-2[illegible]	
10	Jeff Holberg	City of Belton	254/ 933- 5819	933 - 5822
11	ANTHONY BEACH	BEACH ENGINEERS	774-9611	774-9676

Mr. Jerry David
President
Jarrell Schwertner Water Supply Corporation
P.O. Box 369
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Mr. James Cargill
Armstrong Water Supply Corporation
P.O. Box 155
Holland, Texas 76534

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P.O. Drawer 150
Cameron, Texas 76520

Mr. Ed Peeler
Town of Buckholtz
P.O. Box 117
Buckholtz, Texas 76518

Mr. Cal Kusler
Dog Ridge Water Supply Corporation
P.O. Box 232
Belton, Texas 76513

Mr. Thomas Frei
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16483 Hwy 53
Temple, Texas 76501

Mr. Fred Busby
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P.O. Box 157
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Mr. Donald Guthrie
Kempner Water Supply Corporation
P.O. Box 103
Kempner, Texas 76539

Mr. Wayne Newby
Public Works
City of Lott
P.O. Box 398
Lott, Texas 76656

Honorable Billy Ray Crow
Mayor
City of Rogers
P.O. Drawer 250
Rogers, Texas 76569-0250

Mr. John "Bob" Whitson
West Bell Water Supply Corporation
P.O. Box 1422
Killeen, Texas 76540

The attached letter has been sent to the following:

Mr. R. David Cole
General Manager
Central Texas Water Supply Corporation
4020 Lakecliff Drive
Harker Heights, Texas 76542-8607

Mr. Mike Williams
Utility Director
City of Bartlett
P.O. Drawer H
Bartlett, Texas 76511

Mr. Sam Listi
City Manager
City of Belton
P.O. Box 120
Belton, Texas 76513

Mr. Jerry Atkins
Public Works Director
City of Harker Heights
901 S. Ann Blvd.
Harker Heights, Texas 76543

Ms. Patty Rodgers
General Manager
Chisholm Trail Special Utility District
P.O. Box 249
Florence, Texas 76527-0249

Mr. Ricky Preston
Operations Manager
Salado Water Supply Corporation
P.O. Box 128
Salado, Texas 76571

Mr. Jerry David
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Mr. Dwayne Jekel
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Mr. Ed Peeler
Town of Buckholtz
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Honorable Frank Horak
Mayor Pro Tem
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Kempner Water Supply Corporation
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Kempner, Texas 76539

Mr. Wayne Newby
Public Works
City of Lott
P.O. Box 398
Lott, Texas 76656

The attached letter has been sent to the following:

Honorable John Burrows
Bell County
County Courthouse
Belton, Texas 76513

Mr. R. David Cole
General Manager
Central Texas Water Supply Corporation
4020 Lakecliff Drive
Harker Heights, Texas 76542-8607

Mr. Mike Williams
Utility Director
City of Bartlett
P.O. Drawer H
Bartlett, Texas 76511

Mr. Jeff Holberg
City Manager
City of Belton
P.O. Box 120
Belton, Texas 76513

Mr. Jerry Atkins
Public Works Director
City of Harker Heights
901 S. Ann Blvd.
Harker Heights, Texas 76543

Ms. Patty Rodgers
General Manager
Chisholm Trail Special Utility District
P.O. Box 249
Florence, Texas 76527-0249

Mr. Ricky Preston
Operations Manager
Salado Water Supply Corporation
P.O. Box 128
Salado, Texas 76571

Brazos River Authority
Central Texas Regional Water Supply Study
Phase II

Report Presentation

April 4, 2002
Bell County Commissioner's Courtroom
2:00 p.m.

Agenda

1. Introduction

2. Review of Phase I

   a. Adequate Supply of Raw Water
   b. Allocation of Water Rights does not necessarily match projected demand
   c. Treatment and Transmission Facilities not sized to deliver 2050 Maximum Day Demand of Potable Water.

3. Phase II Overview

4. Infrastructure Scenarios

   a. Expand CTWSC Infrastructure to meet demands of Current CTWSC Members.
   b. Upgrade CTWSC Infrastructure to meet demands of both Current CTWSC Members and Bartlett, Belton, Chisholm-Trail, Jarrell-Schwertner and Salado.
   c. Brazos River Authority constructs a Water Treatment Plant and Distribution System to serve Bartlett, Belton, Chisholm-Trail, Jarrell-Schwertner and Salado.

5. Recommended Infrastructure Improvements

6. Phased Construction & Cost

7. Conclusion & Questions

Appendix G

Annual Treatment Plant Costs

EXHIBIT G-1

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Annual Treatment Facility Costs

Typical 15.0 MGD Membrane Filtration Plant

Item	Description		Total Cost		Cost/1000 gallons
1	Personnel (Salaries, Benefits, etc.)	$	300,000.00	$	0.055
2	Raw Water Costs	$	640,000.00	$	0.117
3	Chemicals	$	300,000.00	$	0.055
4	Testing Facilities	$	15,000.00	$	0.003
5	Electricity	$	800,000.00	$	0.146
6	Miscellaneous (Maintenance, Fuel, Vehicle, Insurance, Administrative, etc.)	$	250,000.00	$	0.046
	Total O&M Costs	$	2,305,000.00	$	0.421
	For Planning Purposes	**$**	**2,450,000.00**	**$**	**0.45**

EXHIBIT G-1a

BRAZOS RIVER AUTHORITY
CENTRAL TEXAS REGIONAL WATER SUPPLY STUDY
PHASE II

Annual Treatment Facility Costs Breakdown

Typical 15.0 MGD Membrane Filtration Plant

Item	Description	*Salary*	*Fringe*		*Total*
1	**Personnel** (Salaries, Benefits, etc.)				
	1 Plant Manager	$40,000.00	$15,000.00	$	55,000.00
	1 Instrumentation (Testing, etc)	$28,000.00	$11,000.00	$	39,000.00
	2 Maintenance	$20,000.00	$ 8,000.00	$	56,000.00
	4 Plant Operators	$27,000.00	$10,000.00	$	148,000.00
	Item 1 Total Cost			**$**	**298,000.00**
2	**Raw Water Costs**				

$34.50/acre foot given 1 acre foot = 325,581 gallons

16.5 mg / day	365 days / year	1,000,000 gal / 1 mg	1 ac-ft / 325,581 gal	$34.50 / ac-ft	=	**$**	**640,000.00**

3 Chemicals

Caustic (200 gallons per day @ $.50/ gallon)

200 gal / day	$0.50 / gallon	365 days / year	=	$	36,500.00

Fluoride (35 gallons per day @ $.65/ gallon)

35 gal / day	$0.65 / gallon	365 days / year	=	$	8,300.00

Chlorine (1,000 pounds per day @ $460/ ton)

1,000 lbs / day	$460.00 / ton	1 ton / 2,000 lbs	365 days / year	=	$	170,000.00

Ammonium Sulfate (122 gallons per day @ $0.82/ gallons)

150 gals / day	$0.82 / gal	365 days / year	=	$	45,000.00

Membrane Cleaning Chemicals (Citric, Caustic, etc.)	$	25,000.00
Item 4 Total Cost	**$**	**284,800.00**

EXHIBIT G-1a
(continued)

Item	Description						
4	**Testing Facilities**						
	(Compliance with TCEQ Requirements)					**$**	**15,000.00**
5	**Electricity**						
	Raw Water Pumps						
	2- 300 HP Pumps (6000 gpm @ 150 TDH)						
	2 * 300 HP	.746 kW / HP	8760 hours / year	$0.065 / kWh	=	**$**	**255,000.00**
	Membrane Equipment						
	Recirculation Pumping Costs					$	3,500.00
	Backwash Pumping Costs					$	2,100.00
	CIP Heaters					$	500.00
	Miscellaneous Pumping Costs					$	1,000.00
	Air Compressors, Dryers, etc.					$	15,000.00
	Chemical Pumps						
	3- 1/2 HP Dosing Pumps						
	3 * 1/2 HP	.746 kW / HP	8760 hours / year	$0.065 / kWh	=	$	650.00
	Supernatant Recycle Pumps						
	1- 50 HP Pumps (1200 gpm @ 110 TDH)						
	1 * 50 HP	.746 kW / HP	8760 hours / year	$0.065 / kWh	=	$	21,500.00
	High Service Pumps						
	2- 450 HP Pumps (5200 gpm @ 250 TDH)						
	2 * 450 HP	.746 kW / HP	8760 hours / year	$0.065 / kWh	=	$	385,000.00
	Miscellaneous Plant Electricity					$	100,000.00
	Item 5 Total Cost					**$**	**784,250.00**