TurnerCollie&Braden Inc.

in association with
LBG-Guyton Associates

REGIONAL WATER COMMITTEE 50

BRAZOS COUNTY AREA REGIONAL WATER SUPPLY SYSTEM FEASIBILITY STUDY

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November 1997

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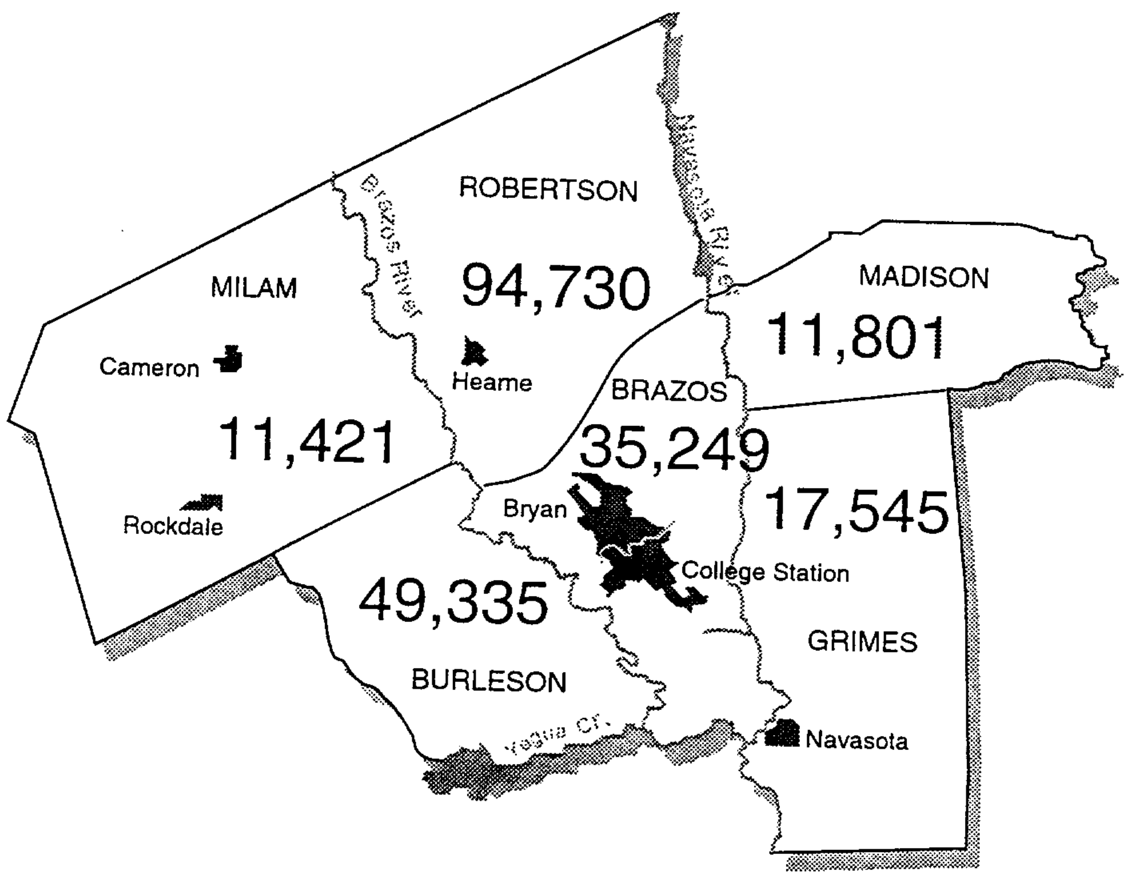
SECTION I - EXECUTIVE SUMMARY

Brazos and western Grimes counties are anticipated to experience a population increase of 77 percent over the planning period 2000 - 2050. To accommodate this growth, water demand is expected to increase by 61 percent. Potable water to the study region is supplied by nine individual entities: cities of Bryan, College Station, and Navasota; Texas A&M University; Wellborn Water Supply Corporation (WSC); Wickson Creek Special Utilities District; Brushy Creek WSC; OSR (formerly Fairview-Smetana) WSC; and Carlos WSC. These entities, together with Brazos County, have formed a committee, referred to as the Regional Water Committee-50 (RWC-50), to look into the long-term solutions to water supply for the region. In 1996, the RWC-50 worked with the Brazos River Authority to obtain a planning grant from the Texas Water Development Board (TWDB) to examine the issues relating to the long-term water needs. This final report summarizes the findings of that effort.

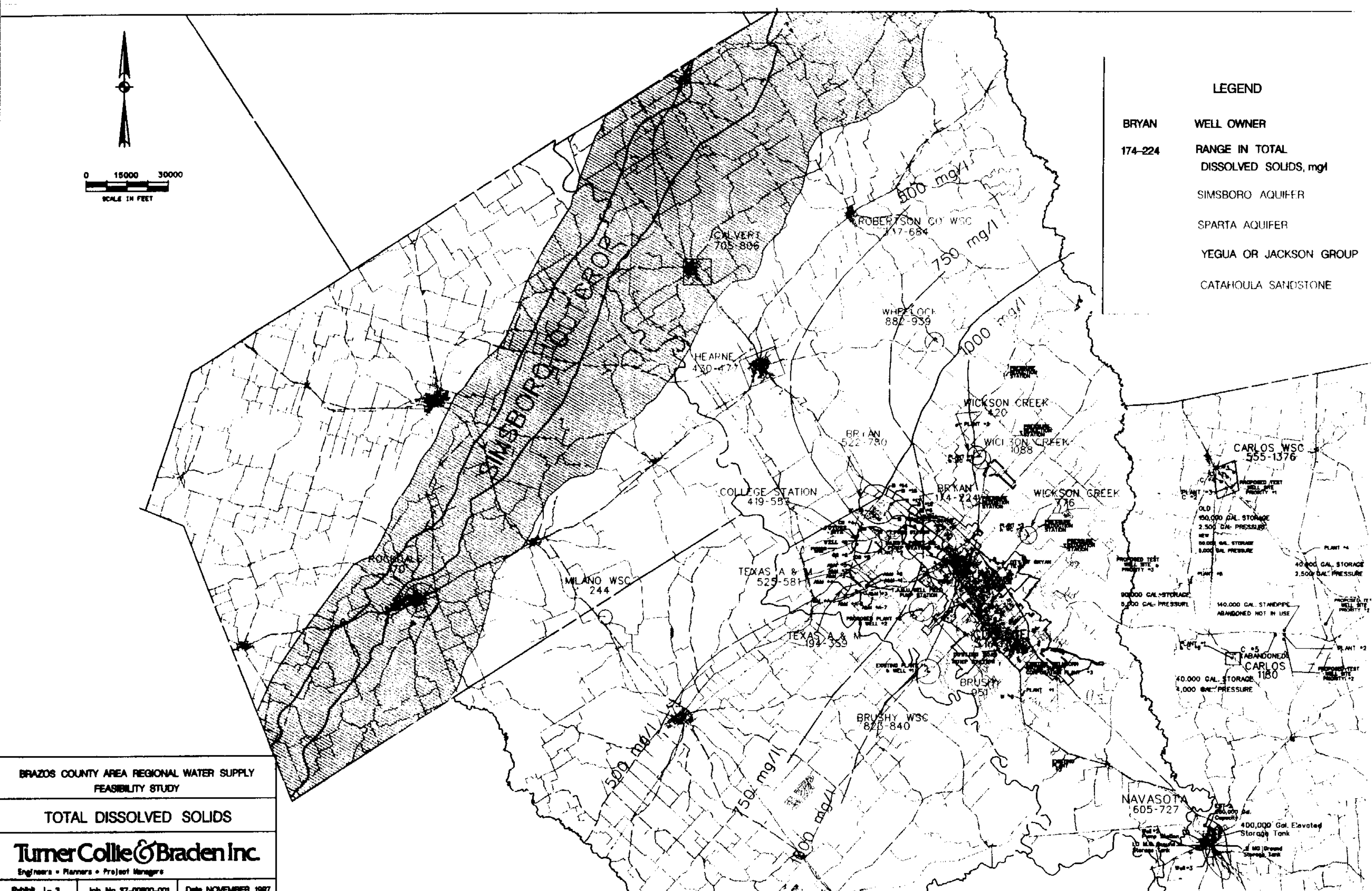
During the planning period 2000 - 2050, average daily municipal water demands are expected to increase from a current 29.9 MGD to 48.1 MGD. Simultaneously, non-municipal demands are expected to increase from 28 MGD to 41.2 MGD. Total average daily water demand is projected to approximate 89.3 MGD (100,000 acre-feet/year). Currently, the RWC-50 members rely solely on groundwater as a source of supply. The most prolific of the aquifers used is the Simsboro Sands. Although detailed modeling of the aquifer has not been accomplished, groundwater availability modeling performed by the TWDB indicates that sufficient resources exist within the region to supply this demand. The results of the TWDB analysis, summarized by *Exhibit I-1*, indicate that future supplies of groundwater will require access to the resources in Robertson or Milam counties.

Current groundwater quality meets or exceeds all of the recommended minimum standards for safe drinking water established by the USEPA. However, future groundwater withdrawal could have impacts on levels of dissolved solids and sodium content. Data acquired from existing wells show a trend toward higher quality water towards the north and west, approaching the outcropping areas, as indicated on *Exhibits I-2* and *I-3*.

Exhibit I-1 Groundwater Sources



Texas Water Development Board estimate of groundwater availability in acre-feet-per-year



BRAZOS COUNTY AREA REGIONAL WATER SUPPLY FEASIBILITY STUDY

TOTAL DISSOLVED SOLIDS

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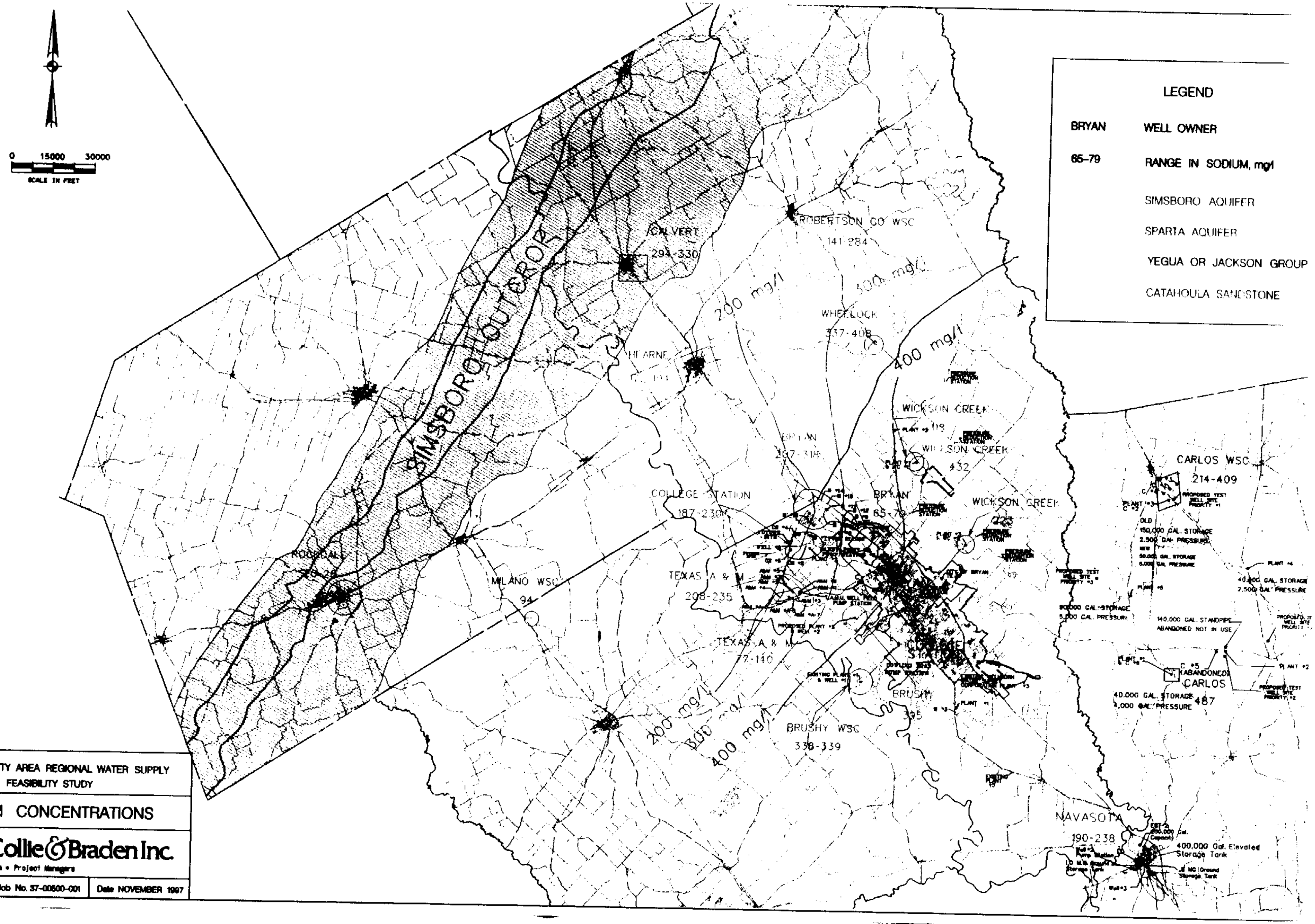
Exhibit I-3	Job No. 37-00800-001	Date NOVEMBER 1997



BRAZOS COUNTY AREA REGIONAL WATER SUPPLY FEASIBILITY STUDY

SODIUM CONCENTRATIONS

Turner Collie & Braden Inc.
Engineers • Planners • Project Managers

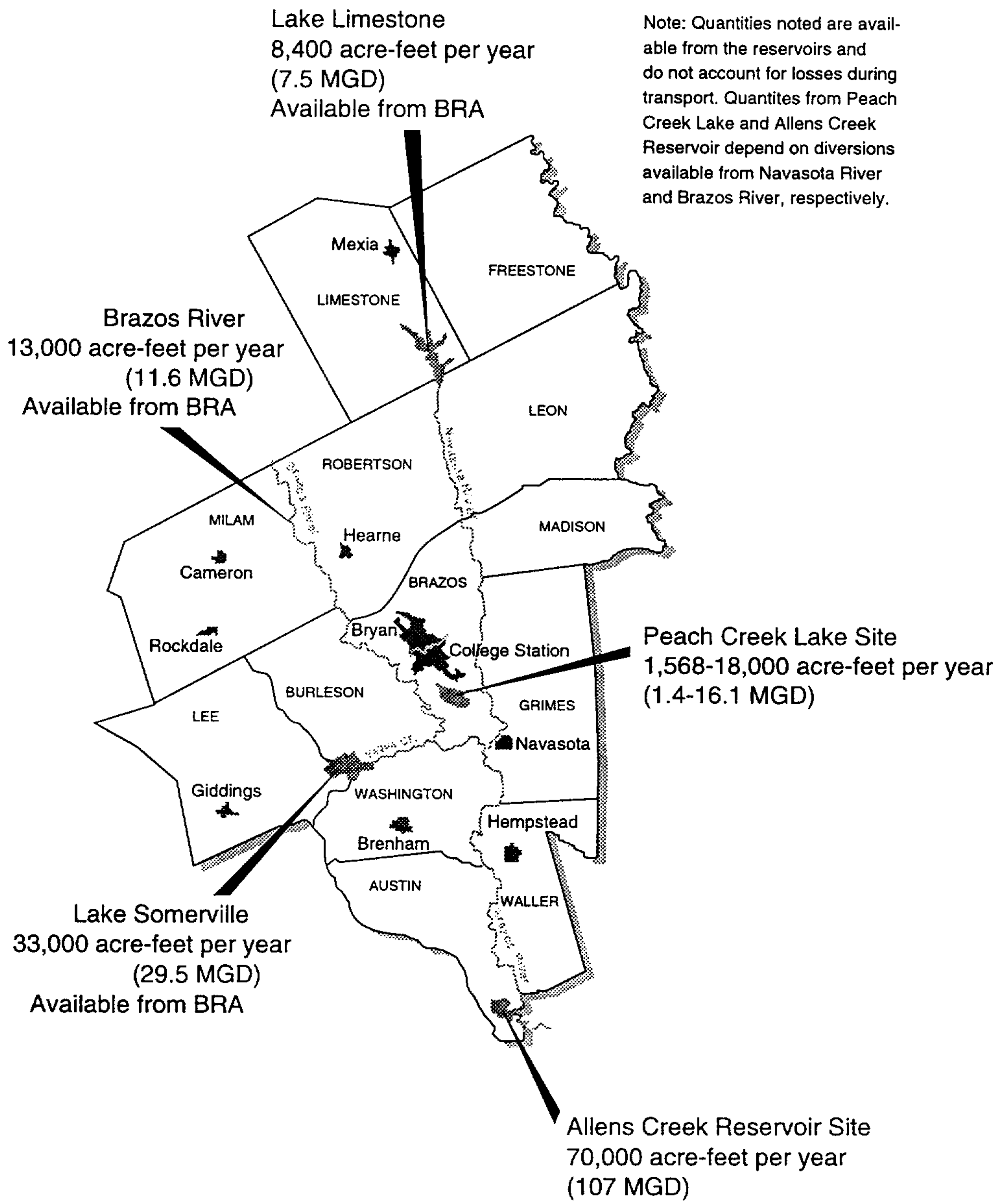
Exhibit I-2	Job No. 37-00500-001	Date NOVEMBER 1997

Supplementing groundwater resources are those currently existing surface water resources available from the Brazos River basin. *Exhibit I-4* depicts the location of nearby reservoir sites and the river itself that may be used as potential sources for additional water supply. At the current time, approximately 8,400 acre-feet of water is available annually from Lake Limestone; approximately 33,000 acre-feet is available annually from Lake Somerville; and 13,000 acre-feet is available in the Brazos River itself. These sources of water represent water that is not currently committed to another user. The availability of surface water changes as contracts for water in the Brazos River are subsequently purchased by new users, or released by existing users. Contracts for the purchase of surface water can be acquired on an annual basis from the Brazos River Authority (BRA). The fee for this water is dependent on the operating costs for the water supply system, as determined by the BRA. Annual cost for surface water available through the BRA has recently dropped from $20.21 per acre-foot to $20.01 per acre-foot, effective September 1, 1997. The BRA Board of Directors, on an annual basis, determines the annual cost-per-acre-foot of raw water. Surface water currently available through the BRA is sufficient to meet demands in the study area through 2050.

Surface water in the Brazos River has a relatively high salinity. Statistically, the water quality is such that it exceeds the Maximum Contaminant Levels established for Salinity by USEPA approximately 5 percent of the time. Offsetting this limitation is accomplished by constructing either a terminal storage or a reservoir. When water is withdrawn directly from either Lake Limestone or Lake Somerville, the statistical problem of high salinity is not a factor.

Two proposed reservoirs could affect the project. The first of these, Allens Creek, is being considered by Fort Bend County Surface Water Supply Corporation, and it will have a yield of 70,000 acre-feet. Allens Creek, located in Austin County approximately 70 miles from the study area, was considered too remote for consideration as an option for direct supply in this study. Although Allens Creek could potentially benefit the project area by providing downstream users with a source of supply other than water currently available from the BRA, it has not been considered as a viable alternative for this region to consider because the area served by Fort Bend County Surface Water Supply Corporation will require quantities of water greater than the

Exhibit I-4 Surface Water Sources



projected yield from Allens Creek and the surface water currently available through the BRA, combined. Peach Creek Lake, currently being considered by Wellborn Water Supply Corporation and Texas A & M University, is a small reservoir site with a yield of 1,600 to 18,000 acre-feet per year. The wide range of yield occurs because Peach Creek captures runoff from a small watershed, and also relies on diversion of unappropriated water from the Navasota River. It is located in close proximity to the major users in the study area, as depicted on *Exhibit I-4*. Peach Creek was considered as an option for supply in this study.

Adequate water resources exist to supply the long-term needs of the study area through the year 2050. Several options exist on how to secure these resources. Four options were considered in this study, including:

1) Continued development of groundwater individually by the separate water entities.
2) Continued development of groundwater by the entities operating on a regional basis, sharing supply and transmission facilities.
3) Development of surface water to provide average day demands to the operating entities functioning on a regional basis, and each entity augmenting this supply during peak periods by individually using groundwater systems currently in place.
4) Development of surface water to provide average day demands to the operating entities, and augmenting this supply with a regional groundwater system to use during peak demand periods.

Each of these alternatives is discussed in *Section VI* of the report. The implementation costs for each alternative are discussed in detail in *Section VI,* and are summarized by the following table.

Table I-1. Implementation Costs for Water Supply Alternatives

Alternative	Cost*
Alternative 1	$137,015,000
Alternative 2	$125,190,000
Alternative 3	$316,000,000
Alternative 4	$257,949,000

* All costs are reported in total present worth cost over the study period.

Each of the alternatives requires certain considerations, some of which the RWC-50 should begin to consider in the immediate future. Alternatives 1 and 2, which propose the development of new groundwater resources, will require that the Brazos County populace gain access to groundwater from adjacent counties. Some consideration as to a legal vehicle that promotes the regional use of this resource, through development of an underground water conservation district, should be considered. Alternatives 3 and 4, which require use of surface water, will require the RWC-50 to balance the cost of obtaining surface water contracts in the near future to allow them to build a treatment plant in the year 2010. Acquisition of the surface water is a consideration, since other municipalities, most notably those in Fort Bend County, are in the process of making similar considerations.

SECTION II - INTRODUCTION AND BACKGROUND

Purpose and Study Objectives

Brazos County and the western portion of Grimes County currently rely entirely upon groundwater to meet municipal water demands. The area has exhibited rapid growth rates in the past, and is expected to grow in the future because the area has gained national recognition for its high quality of life. Because of both this expected growth and the area's dependence on groundwater, it is important to know how the aquifer will respond to future increases in pumping and what other supply options are available to meet future water demands. The regional water supply planning study focuses on answering three questions:

1) How much water is actually available from the area's sources?,
2) What is the quality of each source?, and
3) How much does it cost to develop these sources?

The RWC-50 was initiated to investigate how water resources of Brazos and western Grimes County can best be optimized. The committee consists of several large and small water supply utilities and other agencies concerned with the water supply of the region. The committee itself consists of representatives of the cities of Bryan and College Station, Texas A&M University, Brazos County Commissioners Court, Wellborn Water Supply Corporation (WSC), and Wickson Creek Special Utilities District (SUD). It represents a region that includes the service areas of water systems serving Bryan, College Station, Texas A&M University, the City of Navasota, Wellborn WSC, Wickson Creek SUD, Carlos WSC, Fairview-Smetana WSC (now OSR Water Supply Corporation), and Brushy WSC. The Brazos River Authority, at the request of the RWC-50, served as the financial manager of the project.

The following scope of services was performed for this study:

1) Determine future water needs for the area, including information on adequacy of existing systems, population growth, and water demands.
2) Determine groundwater availability, including any previous reports on groundwater availability in the area, the safe yield of the aquifer, potential drawdown associated with

continued pumping, and steps necessary to incorporate the groundwater supply into a regional water supply entity.

3) Determine surface water availability, including potentially available sources, raw water costs, regulatory and legislative issues concerning surface water, and potential systems to treat and deliver surface water to the existing supply entities.
4) Analyze the water quality concerns associated with potential surface water and ground water sources.
5) Determine costs for future development of groundwater supply, including costs to develop a regional groundwater system.
6) Determine costs for development of surface water supply sources, including raw water costs, cost for treatment works, and transmission lines to the region's existing water supply utilities.
7) Determine costs for a regional combined groundwater/surface water system.

Study Area

The planning area for this study includes all of Brazos and western Grimes counties. The area encompasses approximately 792 square miles, and contains the cities of Bryan, College Station, and Navasota. The region is represented by two distinctly different areas from a water use perspective.

The area's population and water demands are centered around the cities of Bryan and College Station (located in central Brazos County). The economy of these cities relies heavily on Texas A&M University, and has been primarily composed of industries associated with the university and a service sector directed toward serving the university population. The area is making a concerted effort to diversify and attract new industries, such as light manufacturing facilities, that are not dependent upon Texas A&M University, as well. The three largest municipal water systems serve this populous area of the region. The cities of College Station and Bryan, together with Texas A&M University, currently supply approximately 27.4 MGD of water to a service area of approximately 73 square miles. This represents about 92 percent of the water demand in the region, but only nine percent of the region's land area.

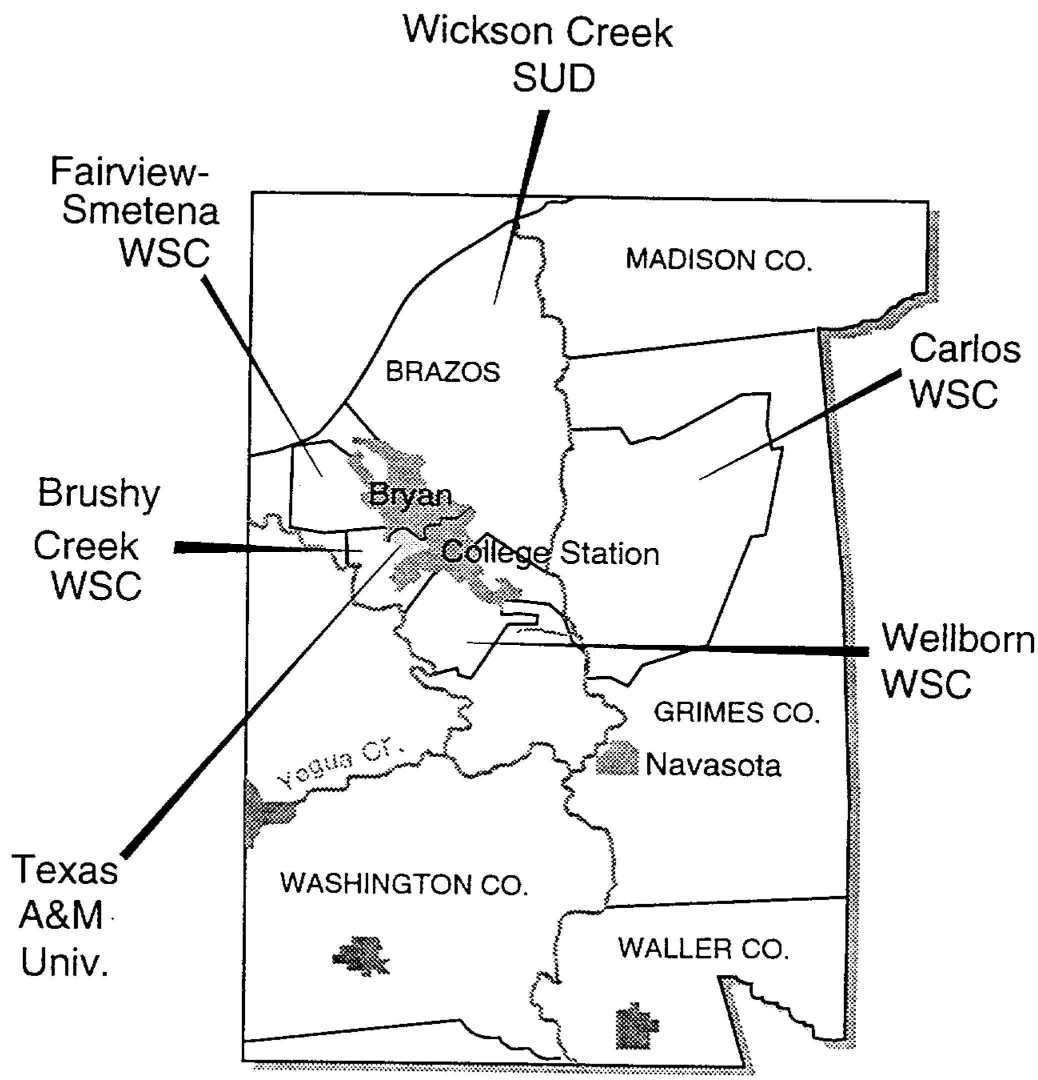
The rest of the planning area, with the exception of the City of Navasota, is largely rural. Its economy is supported primarily by agriculture, and potable water demand in the area is provided by rural water utilities. Wickson Creek SUD supplies water to the northern and eastern portions of Brazos County. Wellborn WSC supplies municipal water to the areas of Brazos County located south of College Station. Brushy Creek WSC and OSR WSC supply water to areas west of College Station and Bryan, respectively. The City of Navasota supplies water within its corporate limits in southwestern Grimes County. Carlos WSC supplies water in western and central Grimes County. These small water utilities serve approximately 719 square miles, representing approximately 91 percent of the total study area, but supply only approximately 2.5 MGD, or eight percent, of the area's total water demand.

Exhibit II-1 shows the study area and approximate service areas for the region's water supply entities.

Previous Water Supply Studies

Several previous water supply studies and master plans were consulted during the development of this report. A list of these references is available at the end of this report.

Exhibit II-1 Study Area and Existing Water Utilities



Predicting future water needs requires an investigation of population growth in the area of concern. Population data for this study was collected from the TWDB, area master planning studies, and from water utilities themselves. Annual growth rates were collected from each of these sources and compared, to ensure the best possible population projections would be used to determine the area's future water needs.

TWDB Projections

The TWDB provides population data for counties, municipalities with population greater than 1000, and unincorporated portions of counties. TWDB population projections for Brazos County estimate that growth during the period from 1990 to 2050 will range from 0.67 percent to 1.27 percent. Estimated growth rates for Bryan, College Station, and Navasota are presented in *Table III-1.*

Table III-1. TWDB Growth Rates from 1990 to 2050 (percent per year)

	High	Medium	Low
Bryan	1.28	1.12*	0.68
College Station	1.16	0.99*	0.56
Navasota	0.58	0.40*	0.23
Brazos County	1.27	1.09*	0.67
Brazos County (other)	1.58	1.33*	0.97
Grimes County	0.96	0.88*	0.54

* Indicates most likely series

Master Planning Projections

Estimates of future growth for Bryan, College Station, and Wickson Creek SUD were provided in master planning studies, and projections for Navasota were provided by City personnel. *The Bryan Comprehensive Plan* (August 1993), includes population projections through 2020. Annual growth rates used for these projections range from 0.98 percent to 1.78 percent, and suggest that high end growth rates are the most likely. Population growth is projected through 2010 in *The College Station Comprehensive Plan* (August 1996). Growth rates predicted by the College Station Comprehensive Plan range from a low growth scenario of two percent annually to a high growth rate of four percent per year. Growth rates from the *Wickson Creek Special Utility District Update of Master Plan* (January 1994) and the City of Navasota population projections are 1.83 percent and 1.05 percent per year, respectively. The growth rates for these entities are summarized in *Table III-2*.

Table III-2. Growth Rates from Master Planning Documents (percent per year)

	High	Medium	Low
Bryan	1.78*	1.54	0.98
College Station	4.0	3.0*	2.0
Wickson Creek SUD	1.83	NA	NA
Navasota	1.05	NA	NA

* Indicates most likely series

Comparison of Population Projections

A direct comparison can be made between TWDB most likely series growth rates and growth rates reported in master planning documents for Bryan, College Station, and Navasota; and growth rates for Wickson Creek SUD can be compared to growth rates from the TWDB Brazos County (other) projections. *Table III-3* compares growth rates for each of these entities.

Table III-3. Comparison of Growth Rates from TWDB Most Likely Series and Master Planning Documents (percent per year)

	TWDB	Master Planning Documents
Bryan	1.12	1.78
College Station	0.99	3.0
Navasota	0.40	1.05
Wickson Creek SUD	1.33*	1.83

* Based on TWDB County-Other Projections

Although discrepancies exist in each of these estimated growth rates, those for College Station and Bryan were brought to the attention of the TWDB. It was TWDB's opinion that the TWDB population projections underestimate the area's population growth in the short term, but that the higher growth rates reported by the College Station and Bryan comprehensive plans were not sustainable through the entire duration of the planning period. The letters explaining TWDB's position concerning the population projections, and Turner Collie & Braden's response, are included in *Appendix A*.

To meet the TWDB's concerns, a hybrid projection was developed using growth rates consistent with the cities' master planning projections for an initial period of time, and then tapering to a lower rate of growth through the remainder of the study period. These projections will be described more fully in the following section.

The low growth rate shown by the TWDB population projections for Navasota is most likely due to the Board's projection of slow growth through 2030, followed by a decrease in population through 2050. This has been considered unlikely, and a growth rate that reflects slightly slower than historical growth is probably more accurate. The population projections used for Navasota in this study are included in the following section.

Population Projections for the Study Area

<u>Population Centers</u>

Population projections developed for Bryan and College Station are based on the TWDB's suggestion that the current rapid growth rates the cities are experiencing will likely taper off in the later years of the planning study. It has been assumed that the growth experienced by College Station between 1990 and 1996 (3.12 percent annually) will last through 2010, at which time growth will slow to the 0.90-percent-per-year rate predicted between 2010, and 2050 by the original TWDB "most-likely" series projections. The 1990 to 1996 annual growth of Bryan was smaller than that of College Station, and has been assumed to be more sustainable. The historical growth rate of 1.59 percent for Bryan was projected through 2020, and the TWDB "most-likely" series growth rate of 1.02 percent from 2020 to 2050 was used for the remainder of the planning horizon. *Table III-4* shows population projections for College Station and Bryan based on these growth rates. TWDB concurred in the use of these projections for this study.

Smaller Entities

Population projections were developed for smaller entities by estimating their current population and then projecting the current population through the planning period. With the exception of the City of Navasota and Wickson Creek SUD, neither population data nor projections were available for the smaller systems. Population for the smaller entities was determined based on the number of connections the system serves and the number of people per household reported by the 1990 census for block(s) in the system's service area. These populations were projected through the study area based on growth rates from TWDB population projections. Population projections for Carlos WSC were developed based on TWDB growth rates for Grimes County. Growth rates for Wickson Creek SUD, Wellborn WSC, Brushy Creek WSC, and Fairview-Smetana WSC were taken from the TWDB Brazos County-Other Projections. The growth rate used for the City of Navasota is based on the historical growth rate from 1980 to 1990, and TWDB projected growth from 1990 to 2000. *Table III-4* includes population projections through 2050 for the entire study area.

Table III-4. Population Projections Through 2050

	Year						
System	1990	2000	2010	2020	2030	2040	2050
City of Bryan	55,002	64,400	75,405	88,289	97,719	108,157	119,709
City of College Station	52,456	71,322	96,974	106,063	116,005	126,879	138,771
Texas A&M	43,000	43,000	43,000	43,000	43,000	43,000	43,000
Wellborn WSC [1]	5,086	5,787	6,585	7,493	8,526	9,701	11,039
Wickson Creek SUD [1]	3,420	5,355	6,093	6,933	7,889	8,976	10,214
Brushy Creek WSC [1]	1,047	1,191	1,356	1,543	1,755	1,997	2,273
Fairview-Smetana WSC [1]	1,028	1,170	1,331	1,515	1,724	1,962	2,232
City of Navasota	6,296	6,714	7,160	7,635	8,142	8,683	9,260
Carlos WSC [2]	1,692	1,847	2,016	2,201	2,402	2,622	2,863
AREA TOTALS	**169,027**	**200,786**	**239,919**	**264,672**	**287,162**	**311,977**	**339,361**

[1] Projections using growth rates from TWDB Brazos County-Other Projections
[2] Projections using growth rates from TWDB Grimes County Projections

Growth and New Development

It can be assumed that a certain level of growth, in the form of new development, where will be required to support the region's projected population growth. *Exhibit III-1* shows the areas this growth is most likely to occur.

The approximate acreage of new development required to support population growth for Bryan and College Station is based on existing land use patterns and population densities reported in the cities' respective comprehensive plans. Approximately one additional acre of residential, and 0.66 additional acres of commercial/industrial, development are required to support 13.6 new residents in College Station. One acre of new residential development and 0.3 acres of new commercial/industrial development are needed in Bryan for every 14-person increase in population. New development in other areas is based on a population density of 14-persons-per-acre of new development. Acreage of new development required for each entity is reported in *Table III-5.*

Table III-5. New Development Required to Support Population Growth (acres)

	Year						
System	1997-2,000	2001-2010	2011-2020	2021-2030	2031-2040	2041-2050	Total
City of Bryan	262	1,022	1,196	876	969	1,073	**5,398**
City of College Station	691	3,131	1,109	1,213	1,327	1,452	**8,924**
Texas A&M	0	0	0	0	0	0	**0**
Wellborn WSC	15	57	65	74	84	96	**390**
Wickson Creek SUD	41	53	60	68	78	88	**389**
Brushy Creek WSC	3	12	13	15	17	20	**80**
Fairview-Smetana WSC	3	12	13	15	17	19	**79**
City of Navasota	9	32	34	36	39	41	**191**
Carlos WSC	3	12	13	14	16	17	**76**
Study Area Totals	**681**	**2,795**	**1,768**	**1,606**	**1,772**	**1,956**	**10,579**

The Bryan Comprehensive Plan predicts that most future development should occur to the north and west of existing development, with some development in undeveloped areas near the Texas A&M Campus. Two primary areas of likely growth are predicted in *The College Station Comprehensive Plan*. Undeveloped areas near the Texas A&M Campus will most likely see an increase in high-density residential development, and the areas to the south along State Highway 6 and its major crossroads will most likely be developed by medium- and low-density residential communities. It is assumed that new development in the City of Navasota will occur primarily along State Highway 6. Due to the large service areas and relatively small increases in population, no concentrated areas of development are expected within the rural water systems. Although those systems located adjacent to the population centers of Bryan and College Station may experience somewhat higher growth along the city limits, it has been assumed that new development in these systems will be interspersed with the existing development, and will represent an increase in density along existing service lines rather than an expansion of service area.

Water Demands

TWDB provides water demands for several water use types, including municipal, manufacturing, irrigation, power generation, mining, and livestock. Although this study is primarily concerned with municipal demands and supply to water utilities serving the public, it is important to understand competing uses when planning for future water supply. For the purposes of this study, TWDB "most likely" demand projections were used. The "most likely" scenario incorporates water conservation and below-average rainfall into municipal demand projections, and various economic factors deemed likely into non-municipal demand projections.

<u>Municipal Demands</u>

TWDB population and demand projections were used to determine per-capita water demand for Bryan, College Station, Navasota, Brazos County-Other, and Grimes County. TWDB per-capita demands were compared to per-capita demand reported by the corresponding water supply utilities' master plans and pumping information, and those that were similar were used. It should be noted that the only entity that showed a large difference between per-capita water demands reported by TWDB and those reported by the city was College Station. This difference is due largely to the fact that TWDB includes "institutional" water demands such as those incurred by Texas A&M University, as part of the College Station demand. When the water demands reported by the Texas A&M University Domestic Water System Master Plan and the College Station Comprehensive Plan are compared to TWDB municipal demand projections for College Station in 2000, they agree to within one percent (see *Table III-6*). *Table III-7* includes per capita demands used to estimate municipal water demands in this study.

Table III-6. Comparison of Per Capita Water Demands for College Station for Year 2000

Texas A&M University[1]	7.8 MGD
College Station[2]	8.34 MGD
Total	16.14 MGD
TWDB College Station[3]	16.27 MGD
Percent Difference	0.8%

[1] 7.8 MGD reported in Texas A&M University Domestic Water System Master Plan
[2] 143 gallons per capita reported in the College Station Comprehensive Plan * TWDB estimated population for 2000
[3] 18,224 acre-ft per year projected water demand for 2000 from TWDB projections

Table III-7. Per Capita Water Demand in Gallons per Day

System	Year 1990	2000	2010	2020	2030	2040	2050
Bryan [1]	161.3	167.0	158.0	150.0	146.0	143.0	143.0
College Station [2]	143.0	143.0	143.0	143.0	143.0	143.0	143.0
Texas A&M University [3]	*	*	*	*	*	*	*
Wellborn WSC [4]	114.8	108.3	100.2	93.2	90.2	87.2	86.1
Wickson Creek SUD [4]	114.8	108.3	100.2	93.2	90.2	87.2	86.1
Brushy WSC [4]	114.8	108.3	100.2	93.2	90.2	87.2	86.1
Fairview-Smetana WSC [4]	114.8	108.3	100.2	93.2	90.2	87.2	86.1
Navasota	171.6	118.9	111.0	104.0	100.0	97.0	96.0
Carlos WSC [5]	131.5	115.1	106.4	99.9	96.5	93.5	92.2

[1] Based on TWDB projections for Bryan
[2] Based on TWDB projections for College Station
[3] TAMU demands are not population-based
[4] Based on TWDB projections for Brazos County-Other
[5] Based on TWDB projections for Grimes County

Per-capita demands were multiplied by the population projections to determine the municipal water demand for each entity through the end of the planning study, with the exception of Texas A&M University. Demands through the planning period for TAMU were based on usage data and projected building construction and demolition. Data from these sources and information on potential reuse of wastewater effluent for non-potable uses resulted in no increased demands on the TAMU potable system throughout the study period. *Table III-8* shows municipal water demands for each entity and the total municipal demand for the region.

Table III-8. Municipal Water Demands for Brazos and Western Grimes Counties (MGD)

	Year						
System	1990	2000	2010	2020	2030	2040	2050
City of Bryan	8.87	10.75	11.91	13.24	14.27	15.47	17.12
City of College Station	7.50	10.20	13.87	15.17	16.59	18.14	19.84
Texas A&M	7.67	7.67	7.67	7.67	7.67	7.67	7.67
Wellborn WSC	0.58	0.63	0.66	0.70	0.77	0.85	0.95
Wickson Creek SUD	0.39	0.58	0.61	0.65	0.71	0.78	0.88
Brushy Creek WSC	0.12	0.13	0.14	0.14	0.16	0.17	0.20
Fairview-Smetana WSC	0.12	0.13	0.13	0.14	0.16	0.17	0.19
City of Navasota	1.08	0.80	0.80	0.79	0.81	0.84	0.89
Carlos WSC	0.22	0.21	0.21	0.22	0.23	0.25	0.26
AREA TOTALS	**26.56**	**31.10**	**36.00**	**38.72**	**41.36**	**44.34**	**48.00**

Non-Municipal Water Demands

Non-municipal water demands represent water usage within the region that may compete for the area's limited water resources. TWDB "most likely" water demand projections for Brazos and Grimes counties, for both municipal and non-municipal demands, are reported in *Table III-9*. *Exhibit III-2* compares current water demands for the area with projected demand in 2050.

Table III-9. Non-Municipal Water Demands (MGD)

	Year						
Brazos County	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
Manufacturing	0.16	0.17	0.20	0.22	0.23	0.26	0.29
Power	9.37	4.46	4.46	4.46	4.46	4.46	4.46
Irrigation	9.18	8.39	7.99	7.60	7.23	6.88	6.55
Mining	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Livestock	1.49	1.38	1.38	1.38	1.38	1.38	1.38
Brazos Total	**20.21**	**14.43**	**14.05**	**13.69**	**13.34**	**13.02**	**12.71**
Grimes County							
Manufacturing	0.23	0.25	0.28	0.31	0.35	0.39	0.43
Power	10.31	8.93	8.93	8.93	8.93	8.93	8.93
Irrigation	0.12	0.11	0.11	0.11	0.11	0.11	0.11
Mining	1.61	2.73	2.55	2.36	2.19	2.83	2.12
Livestock	-	1.73	1.73	1.73	1.73	1.73	1.73
Grimes Total	**12.27**	**11.14**	**11.12**	**13.78**	**17.24**	**21.48**	**28.41**
Total Non-Municipal	**32.48**	**25.57**	**25.17**	**27.47**	**30.58**	**34.50**	**41.12**
Total Municipal	**26.56**	**31.10**	**36.00**	**38.72**	**41.36**	**44.34**	**48.00**
REGIONAL TOTAL	**59.04**	**56.67**	**61.17**	**66.19**	**71.94**	**78.84**	**89.13**

Exhibit III-2. Estimated Water Use in 1997

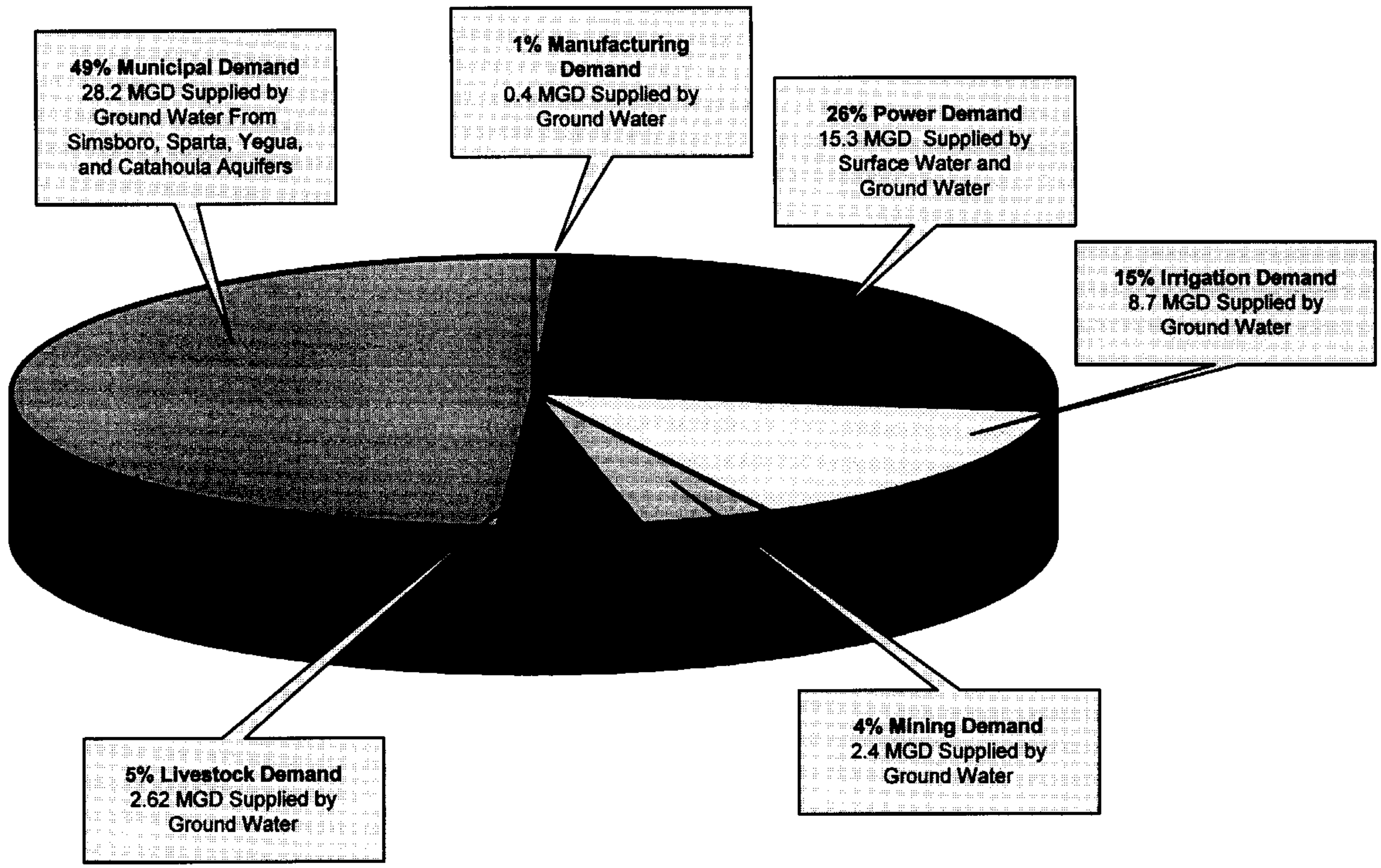
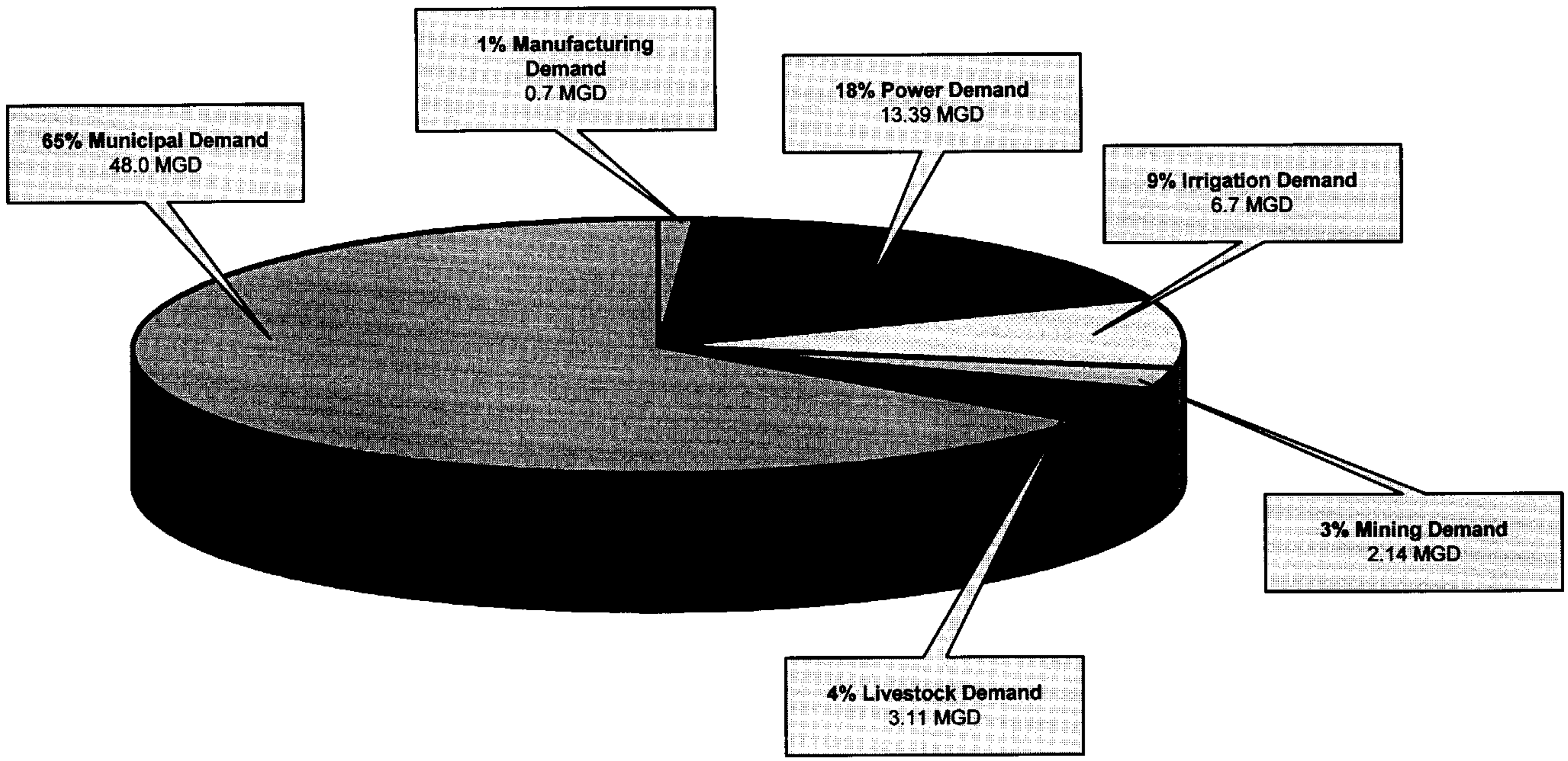


Exhibit III-2(cont.). Projected Water Use in 2050



Nine water entities currently supply water in the study area. An understanding of the existing supply sources, well fields, well field storage, well field pump stations, and transmission lines is necessary to adequately identify and propose future water sources, and to develop alternatives for incorporating these sources into the existing distribution systems. The following section discusses the sources and system facilities for each of the nine water systems in the region.

Supply Sources

The nine existing suppliers currently rely exclusively on groundwater to meet the study area's supply needs. Five distinct water formations—the Simsboro, Sparta, Jackson, Yegua, and Catahoula—are currently used for groundwater supply.

Currently, all but two of the existing systems provide their water supply from their own well fields. The cities of Bryan and College Station, as well as Texas A&M University, obtain the majority of their supply from large Simsboro wells in northern and western Brazos County. Brushy WSC uses the Simsboro for water supply, and a Simsboro well is planned for OSR WSC. Wickson Creek SUD uses both the Simsboro and Sparta for water supply, and has an interconnection with the City of Bryan for emergency supply. Wellborn WSC currently purchases approximately 55 percent of its entire supply from Texas A&M University and the remaining 45 percent from the City of College Station.

Systems in the eastern portion of the study area are limited to the Jackson, Yegua, and Catahoula formations. Carlos WSC has wells in the Jackson and Yegua, and the City of Navasota currently uses the Jackson and Catahoula for its entire supply. The location of each system's well fields, as well as the individual distribution systems, can be seen in *Exhibit IV-1*. The area currently has 22 wells in the Simsboro formations, with a total estimated combined capacity of 47,710 gpm. Eight Sparta wells are capable of pumping a total estimated combined capacity of 2,695 gpm. Two existing wells in the Jackson formation provide a combined 560 gpm of supply for Carlos and Navasota, and six existing wells in the Catahoula formation are capable of providing a combined 2,560 gpm. Seven wells in the Yegua formation are capable of providing a total of 330 gpm.

Existing Supply Facilities

Planning future water supply in an area requires an understanding of existing supply facilities. The existing wells, transmission lines, well field pump stations, and well field storage facilities were cataloged and compared to TNRCC supply requirements to determine future needs for each system included in the study area and for the region as a whole. A list of the region's wells and other water system facilities is provided in *Appendix B.*

City of Bryan

The City of Bryan currently uses eight wells located north of the City for its primary water supply. Wells 10 through 17 have estimated capacities ranging from 2,300 gpm to 2,400 gpm, and pump water from the Simsboro sands. Wells 10, 11, 12, 13, and 14 are located along State Highway 6 north of Bryan. Wells 15, 16, and 17 are located on Dansby Power Plant Road, which branches west from SH 6 toward Bryan Lake. Although not used, or at the very least, used infrequently, five additional wells are reported for the City of Bryan: wells 5, 6, 7, 8, and 9 are rated at 500 gpm each, and pump from the Sparta.

Approximately 28,000 linear feet of collection line, ranging from 14-inch to 36-inch in diameter, transport water from the wells to the well field pump station. The well field pump station has a firm capacity of 2,400 gpm, and pumps water along two existing 27-inch-diameter transmission lines to the City of Bryan's High Service Station, located between 17th and 18th Streets east of Tabor Road. Bryan has approximately 2.5 million gallons of storage at the well field pump station, and 8.0 million gallons of ground storage at the high service pump station. Three million gallons of elevated storage are part of the Bryan distribution system.

Proposed improvements to the City of Bryan system between 1997 and 2000 include a 1,000,000-gallon elevated storage tank between the well field pump station and the high service station, and a 42-inch-diameter line to replace the aging 27-inch-diameter transmission lines. Wells in the City of Bryan range on age from 43 to 11 years old, and have been refurnished within the past 11 years. The City of Bryan Transmission lines are approximately 40 years old and are approaching the end of their useful lifespan.

City of College Station

College Station's water supply consists of five wells located approximately 12 miles northwest of the City. The five existing Simsboro wells have capacities between 2,400 gpm and 2,800 gpm each, and a proposed sixth well, with 2,400 gpm capacity, has been recommended for the City of College Station. The demand analysis for College Station indicates that this well will be needed prior to the year 2000. The well field collection lines for College Station consist of approximately 21,500 linear feet of 30-inch-diameter water line, and convey flows to the Sandy Point pump station. A 62,000 linear foot 30-inch-diameter transmission line conveys flow from Sandy Point pump station to the Dowling Road Pump station. Dowling Road Pump station has two ground storage reservoirs with eight million gallons combined storage capacity. The College Station distribution system also includes two elevated storage tanks with a combined capacity of three million gallons. The City of College Station's supply facilities are relatively new. Wells range in age from 22 to one year old, and all w ells have been refurbrished in the last five years. The College Station Transmission line is approximately 18 years old.

Texas A&M University

The main well field for Texas A&M University has a total of seven wells, ranging from 200 gpm to 2,400 gpm in the Sparta and Simsboro formations. The flow from these wells is conveyed to two 0.5-million gallon ground storage tanks and the 11,475-gpm well field pumping station via approximately 20,000 linear feet of well collection line, ranging from 16 to 24 inches in diameter. The well field pump station has two distinct pump houses, with 4,000 and 3,675 gpm firm capacities. The pump station transmits flow through two parallel transmission lines of 18 and 24-inch diameters along approximately 36,000 linear feet to the F&B pump station. The well field pump station has two 0.5-million gallon ground storage tanks, and the F&B pump station contains two 2-million gallon ground storage tanks. The distribution system also includes a single 2-million gallon elevated storage tank.

Two primary short-term improvements have been recommended for the Texas A&M water system. A new well with a capacity of 2,400 gpm has been recommended (with an uncertain timeframe), and a new 30-inch-diameter transmission line has been recommended to replace the existing 24-inch transmission line (in the near future). The water supply facilities for the Texas A&M community were constructed between 1959 and 1972, and several of the facilities, including the 24-inch diameter transmisison line are in need of replacement.

Wellborn WSC

Wellborn WSC purchases its water supply from College Station and Texas A&M University. The water is supplied through direct interconnections to the Texas A&M and City of College Station distribution systems.

Wickson Creek SUD

Wickson Creek SUD currently pumps 1,200 gpm from two wells in the Simsboro Sands and Sparta formations, and a new 500-gpm Sparta well is planned for the immediate future. The Wickson Creek distribution system includes three plants, each with storage and pumping capabilities. The system has a total storage capacity of 835,000 gallons, including a new 250,000-gallon elevated storage tank and 35,000 gallons of pressure storage distributed among the three plants.

Brushy Creek WSC

Brushy Creek WSC has two supply wells and production plants. Well One is in the Sparta formation and has a capacity of approximately 60 gpm. Well Two is capable of pumping approximately 400 gpm from the Simsboro Sands.

OSR (Fairview-Smetana) WSC

Historically, Fairview-Smetana purchased water from the City of Bryan. However, when Fairview-Smetana merged with Lower Robertson WSC, it became OSR WSC, and plans have been made to construct a 500-gpm well into the Simsboro formation in late 1997 or early 1998.

City of Navasota

Navasota currently pumps water from four wells in the Jackson and Catahoula formations. The wells range in capacity from 240 gpm to 500 gpm, and two new 500-gpm wells have been proposed for late 1997 and 2000. The system includes 1.5 million gallons of ground storage, and 4.25 million gallons of elevated storage. Approximately 20,000 linear feet of well field collection line, ranging from 8 to 16 inches in diameter, convey flow from the wells to the high service pump station.

Carlos WSC

Carlos WSC currently uses four wells in the Jackson and Yegua formations. Existing well capacities range from 70 to 110 gpm, and a proposed new well with a capacity of 80 gpm has been proposed for the near future. The Carlos distribution system includes approximately 370,000 gallons of ground storage, and 16,500 gallons of pressure tank capacity among its three operating plants.

Supply Requirements

TAC Title 30, Chapter 290, Subchapter D— Rules and Regulations for Public Water Systems requires that all public water supply systems using groundwater have sufficient well capacity to provide for maximum daily system demands, or 0.6 gpm per connection served by the system, whichever is greater. *Table IV-1* provides an estimate of the supply requirements for each water system included in this study, assuming planned facilities will be constructed prior to

2000. For entities where projected maximum daily demand exceeds the 0.6 gpm per connection, the maximum daily demand was used. Values shown are to meet miminum requirements only, and include all sources of supply. Systems are normally rated with the largest well out of service so that normal supply can continue if a well fails, but that was not done in this case, since it is not a specific requirement.

Table IV-1. Regional Supply Assessment 2000-2050

System		Year					
		2000	2010	2020	2030	2040	2050
Bryan	Required (gpm)	14,936	16,945	19,840	21,959	24,305	26,901
	Current wells (gpm)	18,700	18,700	18,700	4,400	0	0
	Needs (gpm)	0	0	1,140	17,559	24,305	26,901
	Surplus (gpm)	3,764	1,755	0	0	0	0
College Station	Required (gpm)	16,027	21,792	23,834	26,069	28,512	31,185
	Current wells (gpm)	15,650	15,650	13,250	5,200	0	0
	Needs (gpm)	377	6,142	10,584	20,869	28,512	31,185
	Surplus (gpm)	0	0	0	0	0	0
TAMU*	Required (gpm)	9,588	9,588	9,588	9,588	9,588	9,588
	Current wells(gpm)	9,945	9,310	9,110	2,400	0	0
	Needs (gpm)	0	278	478	7,188	9,588	9,588
	Surplus (gpm)	358	0	0	0	0	0
Wellborn WSC	Required (gpm)	1,300	1,480	1,684	1,916	2,180	2,481
	Current wells (gpm)	0	0	0	0	0	0
	Needs (gpm)	1,300	1,480	1,684	1,916	2,180	2,481
	Surplus (gpm)	0	0	0	0	0	0
Wickson Creek SUD	Required (gpm)	1,071	1,219	1,387	1,578	1,795	2,043
	Current wells(gpm)	1,700	1,700	1,700	800	0	0
	Needs (gpm)	0	0	0	778	1,795	2,043
	Surplus (gpm)	629	481	313	0	0	0
Brushy Creek WSC	Required (gpm)	325	370	421	479	545	620
	Current wells (gpm)	460	460	460	0	0	0
	Needs (gpm)	0	0	0	479	545	620
	Surplus (gpm)	135	90	39	0	0	0
OSR WSC	Required (gpm)	255	285	325	369	420	478
(Fairview-Smetana)	Current wells (gpm)	500	500	500	500	0	0
	Needs (gpm)	0	0	0	0	420	478
	Surplus (gpm)	245	215	175	131	0	0
Navasota	Required (gpm)	1,343	1,432	1,527	1,628	1,737	1,852
	Current wells (gpm)	3,010	3,010	3,010	1,500	0	0
	Needs (gpm)	0	0	0	128	1,737	1,852
	Surplus (gpm)	1,667	1,578	1,483	0	0	0
Carlos WSC	Required (gpm)	426	465	508	554	605	661
	Current wells (gpm)	360	360	360	110	0	0
	Needs (gpm)	66	105	148	444	605	661
	Surplus (gpm)	0	0	0	0	0	0

Table IV-1. Regional Supply Assessment 2000-2050

		Year					
System		2000	2010	2020	2030	2040	2050
AREA TOTALS	**Required (gpm)**	**45,271**	**53,575**	**59,113**	**64,140**	**69,687**	**75,807**
	Current wells (gpm)	**50,325**	**49,690**	**47,090**	**14,910**	**0**	**0**
	Needs (gpm)	**0**	**3,885**	**12,023**	**49,230**	**69,687**	**75,807**
	Surplus (gpm)	**5,054**	**0**	**0**	**0**	**0**	**0**

"Required" supply" is based on TNRCC requirements of 0.6 gpm per connection or maximum daily demand, whichever is greatest.
"Current wells" supply is the rated capacity of existing wells less the capacity of wells expected to go out of service.
"Needs" is the total additional supply required to meet requirements due to increased population and to replace supply from wells as they come to the end of their useful lifespan.
* Values for Texas A&M University are based on expected maximum daily demand.

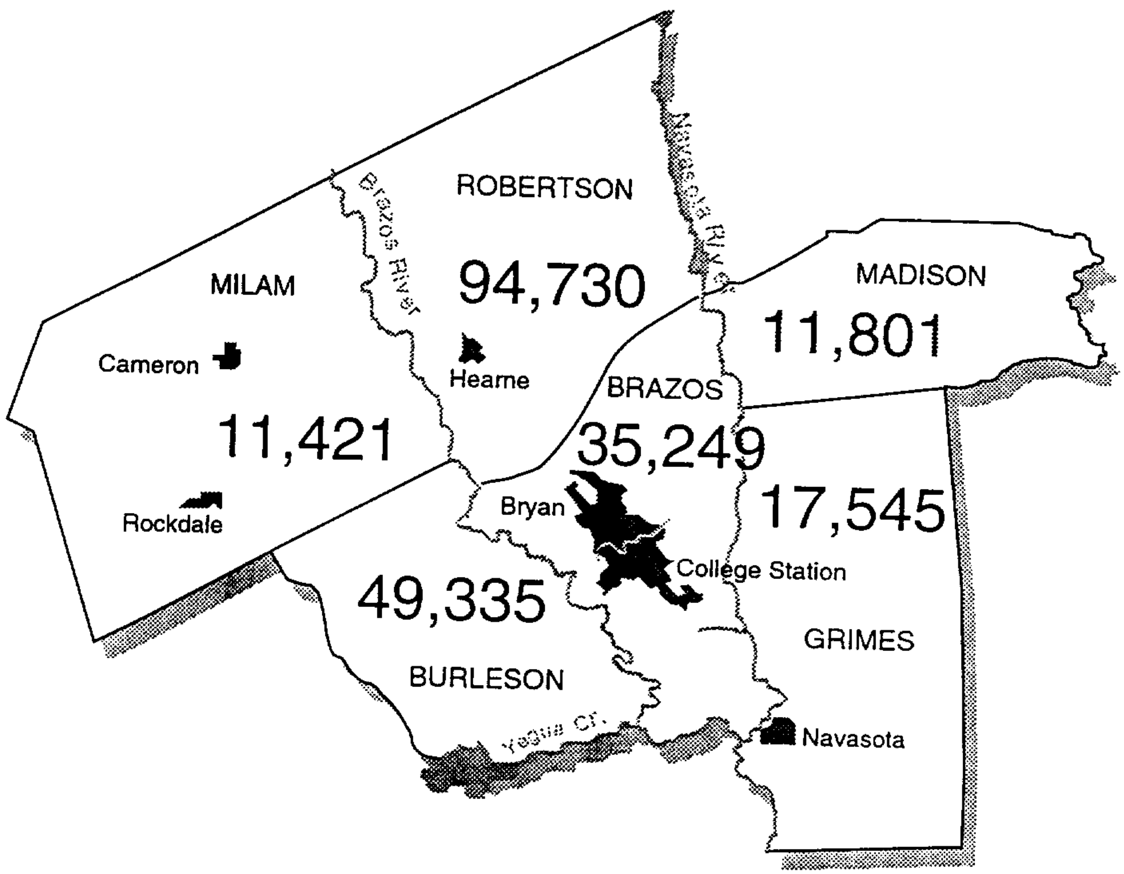
Groundwater Availability

The current supply of water for municipal/industrial use is almost entirely composed of groundwater from one or more of the aquifers in the area. According to TWDB estimates of groundwater availability in the area, there should be sufficient groundwater available in the Carrizzo-Wilcox formation to meet the region's future water supply requirements through 2050. *Exhibit IV-2* shows estimates of groundwater availability in Brazos and the surrounding counties.

Groundwater Quality

As noted previously, the majority of water used in the area comes from the Simsboro Sands of the Carrizo-Wilcox formation. Smaller amounts of water are supplied by the Sparta, Jackson, Yegua, and Catahoula aquifers. *Table IV-2* compares chemical analyses information from the wells and/or water distribution systems for each of the systems in the planning area to TNRCC requirements. All of the constituents present in the water are at or below the requirements of the National Primary Drinking Water Regulations (NPDWR). In addition, the water also meets the recommendations of the National Secondary Drinking Water Regulations (NSDWR) with the exception of Total Dissolved Solids (TDS). The NSDWR's recommend an upper limit on TDS of 500 mg/l. Texas requirements, however, contain an upper limit of 1000 mg/l for water delivered

Exhibit IV-2 Groundwater Sources



Texas Water Development Board
estimate of groundwater availability
in acre-feet-per-year

Table IV-2. Quality Data for Brazos County Area Groundwater

(all constituents reported as mg/l)

Metal Constituent Data

Well Owner	Laboratory or Data Source 1/	Entry Point 2/	Date Sampled	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Mercury	Nickel	Selenium	Thallium
City of Bryan	TWC	D	4/23/96	<0.002	<0.002	0.096	<0.001	<0.0002	<0.01	0.00016	<0.02	<0.004	<0.001
Brushy WSC	TWC	D	8/24/94	<0.002	<0.002	0.0734	<0.0008	<0.0001	<0.004	<0.00013	<0.005	<0.004	<0.0008
City of Calvert	TDH	D	3/13/97	<0.002	<0.002	0.073	<0.001	<0.0002	0.02	<0.00027	<0.02	0.0022	<0.001
Carlos WSC	TWC	D	9/20/94	<0.002	<0.002	0.0225	<0.0008	<0.0001	<0.004	<0.00013	<0.005	0.004	<0.0008
City of College Station	TWC	D	4/23/96	<0.002	<0.002	0.09	<0.001	<0.0002	<0.01	0.00013	<0.02	<0.004	<0.001
City of Hearne	TDH	D	8/07/96	<0.002	<0.002	0.039	<0.001	<0.0002	<0.01	<0.00017	<0.02	<0.002	<0.001
Milano WSC	TWC	D	8/16/94	<0.002	<0.001	0.0839	<0.0008	<0.0001	<0.004	<0.00013	<0.005	<0.004	<0.0008
City of Navasota	TWC	D	6/03/96	<0.004	0.0098	0.251	<0.001	<0.0002	<0.01	<0.00017	<0.02	<0.004	<0.001
Texas A&M University	TDH	W	5/14/97	<0.002	<0.002	0.079	<0.001	<0.0002	<0.01	<0.00027	<0.02	<0.002	<0.001
Wickson Creek SUD	TWC	D	7/16/96	<0.004	<0.002	0.092	<0.001	<0.0002	<0.01	0.0005	<0.02	<0.008	<0.001
Wellborn WSC 4/	—	—	—	—	—	—	—	—	—	—	—	—	—
TNRCC Recommende Upper Limit (MCL), mg/l	—	—	—	**0.006**	**0.05**	**2.0**	**0.004**	**0.005**	**0.1**	**0.002**	**0.1**	**0.05**	**0.002**

1/ TDH = Texas Department of Health.
TWC = Texas Water Commission, now Texas Natural Resource Conservation Commission (TNRCC).
TWDB = Texas Water Development Board.
2/ D = Distribution System.
W = Well.
3/ Texas A&M Well A-7 (BJ-59-21-714), screening the Simsboro sand.
4/ Wellborn WSC obtains its water from the City of College Station and/or Texas A&M University.

Table IV-2. Quality Data for Brazos County Area Groundwater

Volatile Organic Chemicals (VOCs)

Well Owner	Laboratory[1]	Test Date	Test Results[2]
City of Bryan	TDH	8/22/94	None Detected
City of Calvert	TDH	6/30/94	None Detected
Carlos WCS	TDH	9/24/94	None Detected
City of College Station	TDH	4/23/96	None Detected
City of Hearne	TDH	9/01/93	None Detected
Milano WSC	TDH	8/30/94	None Detected
City of Navasota	TDH	5/10/95	None Detected
Texas A&M University[3]			
Wickson Creek SUD	TDH	5/10/95	None Detected

The following maximum contaminant levels (MCL) for volatile organic contaminants apply to public supply water systems according to the TNRCC.

Contaminant	MCL (mg/l)	Contaminant	MCL (mg/l)
Monochlorobenzene	0.1	1,1-Dichloroethylene	0.007
o-Dichlorobenzene	0.06	1,1,1-Trichloroethane	0.2
para-Dichlorobenzene	0.075	1,1,2-Trichloroethane	0.005
Styrene	0.1	1,2-Dichloroethane	0.005
Tetrachloroethylene	0.005	1,2-Dichloropropane	0.005
Toluene	1.0	1,2,4-Trichlorobenzene	0.07
trans-1,2-Dichloroethylene	0.005	Benzene	0.005
Xylenes (total)	10	cis-1,2-Dichloroethylene	0.07
Vinyl chloride	0.002	Carbon tetrachloride	0.005

[1] Texas Department of Health
[2] Water Samples were analyzed for the VOCs listed
[3] Water sample scheduled to be collected for analysis by TNRCC in 1998

Table IV-2. Quality Data for Brazos County Area Groundwater

(all constituents reported as mg/l except specific conductance and pH)

Water Quality Data for Existing Wells

Well Owner & Well No./Name State Well No.	Screened Interval or Total Depth (feet)	Aquifer	Laboratory or Data Source 1/	Date Sample	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3) 2/	Dissolved Solids	Total Hardness (as $CaCO_3$)	Specific Conductance (micromhos/cm at 25°C)	pH
Brazos County																			
City of Bryan																			
Well 5 BJ-59-21-501	430-573	Sparta	TWDB	8/23/43	0.1	—	2	0	69	—	137	2	16	0.0	0.0	175	5	—	8.1
Well 6 BJ-59-21-201	389-479	Sparta	TWDB	7/08/47	0.6	—	2	1	71	—	164	4	18	0.1	0.4	203	9	—	8.2
Well 8 BJ-59-21-203	401-542	Sparta	TWDB	9/48	0.4	—	5	1	65	—	125	3	21	0.2	1.1	174	17	—	8.0
Well 9 BJ-59-21-306	710	Sparta	TWDB	9/18/52	0.1	—	1	1	79	—	161	0	15	—	—	195	6	—	—
Well 10	2670-2940	Simsboro	TWDB	3/23/54	0.1	—	4	1	314	—	659	0	74	—	—	747	14	—	8.3
BJ-59-21-303			TWDB	10/14/92	—	—	3	<1	318	3	735	5	63	1.0	<.0	780	12	1354	8.0
Well 11	2514-2904	Simsboro	TWDB	4/27/57	0.12	—	4	0	281	—	651	0	62	—	—	690	11	1126	7.0
BJ-59-21-202			TWDB	6/64	3.3	—	3	2	277	—	649	—	62	—	—	—	18	1108	7.0
Well 12	2480-2860	Simsboro	TWDB	6/10/64	0.02	—	2	1	258	2	624	0	53	0.7	0.0	645	10	1070	8.0
BJ-59-21-205			TWDB	7/28/87	—	—	3	<1	274	2	612	3	58	0.7	<.0	675	11	1200	8.5
Well 13	2320-2814	Simsboro	TWDB	9/64	—	—	3	1	231	—	532	0	54	0.4	—	550	12	935	8.0
BJ-59-21-208			TWDB	7/29/67	0.13	—	3	3	256	—	560	4	59	0.6	2.0	616	19	1112	8.6
Well 14	2225-2709	Simsboro	TWDB	5/13/68	0.08	—	4	0	226	—	503	0	51	0.0	0.0	557	10	917	8.5
BJ-59-21-207			TWDB	11/18/69	0.00	—	4	1	212	2	502	1	52	0.3	0.4	540	12	891	8.1
Well 15 BJ-59-21-107	2400-2830?	Simsboro	TWDB	10/13/92	—	—	3	<1	207	2	471	6	49	0.4	0.0	522	12	896	8.2
Well 16	2402-2852	Simsboro	TWDB	4/30/76	< 0.05	—	3	0	222	—	510	0	50	0.4	0.5	544	8	824	8.3
BJ-59-21-209			TWDB	7/28/87	—	—	2	<1	222	2	503	2	51	0.5	<.0	558	9	994	8.6

Table IV-2. Quality Data for Brazos County Area Groundwater

Water Quality Data for Existing Wells

Well Owner & Well No./Name State Well No.	Screened Interval or Total Depth (feet)	Aquifer	Laboratory or Data Source 1/	Date Sample	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3) 2/	Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos/cm at 25°C)	pH
Brazos County																			
City of College Station																			
Well 1 BJ-59-21-410	2530-2960	Simsboro	ORL	9/10/79	0.01	< 0.05	3.6	0.7	230	—	534	1	48	0.44	—	553	12	—	8.4
Well 2 BJ-59-21-409	2520-2960	Simsboro	ORL	12/19/79	0.29	< 0.05	2.4	2.9	223	—	483	2.9	45	0.34	—	538	18	—	8.4
Well 3 BJ-59-21-411	2430-2920	Simsboro	CL	4/13/82	0.1	0.02	3.8	1	187	—	383	12.5	44	0.3	0.1	490	14	710	8.28
Well 4 BJ-59-21-412	2416-2918	Simsboro	EWL	9/18/87	0.06	0.02	3	1	188	1.4	395	17	47	0.5	2.2	467	11	810	8.27
Well 5	2364-2862	Simsboro	ENV	5/31/96	0.47	0.01	—	—	216	—	—	8.3	40.5	0.31	—	419	91	678	8.13
Texas A&M Universuty																			
Well 1 BJ-59-21-706	400-503	Sparta	TWDB	5/10/50	—	—	1	0	136	—	236	35	48	—	—	350	3	—	8.4
			TWDB	5/16/51	0.1	—	1	0	140	—	244	41	46	—	—	359	4	—	8.3
Well 2 BJ-59-21-705	373-473	Sparta	TWDB	4/18/50	0.1	—	1	0	113	—	218	21	34	—	—	291	3	—	8.7
			TWDB	5/16/51	0.1	—	1	0	111	—	211	23	33	—	—	285	3	—	8.5
Well 3 BJ-59-21-704	366-473	Sparta	TWDB	1/21/50	0.2	—	2	0	77	—	172	9	16	—	—	202	5	—	8.9
			TWDB	5/16/51	0.1	—	1	0	79	—	157	12	16	—	—	199	3	—	8.8
Well 4 BJ-59-20-920	292-412	Sparta	TWDB	2/25/50	0.2	—	1	0	77	—	147	9	17	—	—	194	4	—	8.7
Well 5 BJ-59-21-402	1120-2330	Carrizo/ Wilcox	TWDB	10/13/92	—	—	2	<1	315	2	682	6	68	0.8	<0.0	753	8	1279	8.3
Well 6 BJ-59-21-723	2600-2974	Simsboro	TWDB	10/14/60	0.5	—	4	1	208	—	461	1	54	—	—	525	13	820	8.4
Well A-7 BJ-59-21-714	2741-2990	Simsboro	TWDB	9/07/55	—	—	7	2	247	—	500	11	56	—	—	622	26	—	—
			TWDB	7/30/57	—	—	3	1	226	—	516	0	54	0.4	0.0	563	8	950	7.6

Table IV-2. Quality Data for Brazos County Area Groundwater

Water Quality Data for Existing Wells

Well Owner & Well No./Name State Well No.	Screened Interval or Total Depth (feet)	Aquifer	Laboratory or Data Source 1/	Date Sample	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3) 2/	Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos/ cm at 25°C)	pH
Brazos County																			
Brushy WSC																			
Well 1	1022-1100	Sparta	TWDB	9/19/66	0.3	0.004	3	0	338	—	732	36	72	0.6	0.1	823	7	1382	8.3
BJ-59-29-603			TWDB	3/09/94	—	—	4	1	339	3	744	11	82	0.8	0.0	840	12	1371	8.4
Well 2	3120-3360	Sparta	TWDB	7/15/81	0.16	< 0.05	2	1	395	—	922	0	77	1.8	<0.1	951	9	1530	8.3
BJ-59-21-909																			
Wickson Creek Special U																			
Well 1	2756-3056	Simsboro	TWDB	10/12/92	—	—	5	1	432	5	968	7	142	2.0	0.0	1,088	15	1,906	7.9
BJ-59-14-706			TWC	6/22/93	0.028	0.002	3	1	458	—	961	7	163	2.0	0.39 (N)	1,111	11	2,064	7.8
Well 2	805-1003	Sparta	POPE	4/82	0.82	0.01	1.6	0.3	223.2	—	488.1	4.0	38.4	0.6	0.0 (N)	776	5	825	8.6
BJ-59-22-6xx																			
Grimes County																			
Carlos WSC																			
Well 1A	296-336	Jackson	TDH	10/90	0.03	< 0.02	6	< 1	214	—	349	10	140	1.5	0.01 (N)	555	14	1,064	7.7
KW-59-32-503		Group?	IML	7/08/93	0.22	0.03	5	1	218	10	—	3	144	1.2	< 0.1 (N)	666	17	1,060	7.9
Well 3C	279-410?	Yegua?	POPE	8/82	0.3	0.06	20.8	2.9	408.6	—	405.0	375.5	163.0	0.4	0.0 (N)	1,377	64	1750	7.9
BJ-59-16-8xx			IML	7/08/93	1.78	0.07	20	2	381	7	—	382	167	0.2	< 0.1 (N)	1,210	58	2,000	7.9
Well 4D	286-386	Yegua?	POPE	7/82	0.12	0.14	29.6	3.4	286.8	—	344.0	224.5	139.0	0.3	0.0 (N)	1,028	88	1300	7.7
BJ-59-16-8xx			IML	7/08/93	0.48	0.15	25	3	270	8	—	199	145	< 0.1	< 0.1 (N)	854	75	1,430	7.1
Well 7G	880-976	Yegua?	IML	5/03/95	0.22	< 0.02	2	< 1	487	2	1,162	13	69	2.4	< 0.1 (N)	1,180	6	1,880	8.4
BJ-59-16-8xx																			

Table IV-2. Quality Data for Brazos County Area Groundwater

Water Quality Data for Existing Wells

Well Owner & Well No./Name State Well No.	Screened Interval or Total Depth (feet)	Aquifer	Laboratory or Data Source 1/	Date Sample	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3) 2/	Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos/cm at 25°C)	pH
Grimes County																			
City of Navasota																			
Well 1	178-270	Catahoula	TDH	9/12/42	0.40	—	23	3.4	238	—	556	2	93	0.3	—	669	72	—	7.8
KW-59-40-702			USGS	10/01/70	0.01	—	20	2.6	210	8.0	508	7.6	69	0.6	0.0	605	60	979	7.5
Well 2	660-755	Jackson	USGS	9/30/70	0.07	—	29	1.5	478	19	862	0.2	302	0.7	0.1	1,306	78	2,130	7.5
KW-59-40-708		Group	TWDB	4/14/92	—	—	28	1	469	29	898	8	280	0.7	0.1	1,308	75	2,110	7.1
Well 3	210-260	Catahoula	USGS	2/01/50	0.14	—	26	4	236	—	460	5	92	0.4	< 0.4	678	82	—	7.3
KW-59-40-707			USGS	9/30/70	0.02	—	27	3.2	222	8.6	552	0.6	88	0.6	0.1	649	80	1,070	7.4
Well 4	276-343	Catahoula	MSL	5/15/68	0.30	—	79	7	195	—	499	8	165	—	—	722	228	1,280	7.2
KW-59-48-106			USGS	10/01/70	0.52	—	75	8.0	190	9.9	480	8.8	170	0.4	0.0	727	220	1,270	7.1
Well 5	295-355	Catahoula	CL	11/13/81	0.1	0.01	30.7	3.8	229.1	—	575.8	—	84	0.5	0.1	702	92	1,013	7.68
KW-59-48-1xx			EWL	5/21/86	0.11	—	—	—	—	—	—	—	83	—	—	—	98	1,120	7.7
Well 6	356-420	Catahoula	EWL	3/28/88	0.08	0.02	30	4	236*	—	590	0	87	0.8	< 0.4	673	83	1,100	7.5
KW-59-48-2xx																			

EXPLANATION:

1/ CL = Curtis Laboratories.
EWL = Envirodyne Laboratories, Inc.
EWL = Edna Wood Laboratories.
IML = Inter-Mountain Laboratories, Inc.
MSL = Microbiology Service Laboratory.
ORL = Orlando Laboratories, Inc.
POPE = Pope Testing Laboratories, Inc.
TWC = Texas Water Commission, now TNRCC.
TWDB = Texas Water Development Board, laboratory unknown but the data source is from TWDB ground-water quality data for each county.
USGS = United States Geological Survey.

2/ To convert Nitrate as NO_3 value shown to nitrate as N (nitrogen), divide value shown by 4.43.

to the consumer, and all of the systems in the planning area are in compliance with that recommended upper limit. It is noted that some individual wells exceed the limit, but the blended water quality is still below the 1000 mg/l level.

Texas regulations contain requirements for well location with respect to sanitary hazards such as wastewater treatment plants and effluent, sanitary landfills, septic tank drainfield lines, and other sources of potential contamination. Texas also has an active program for assessing the degree of vulnerability of wells to surface water contamination. There has been an ongoing effort to identify those aquifers which are under the influence of surface water, and which are consequently variable in quality from a bacteriological and virological quality standpoint. Those wells which are not under the influence of surface water are normally those with interceded clay layers between land surface and the water sands, and the water is subject to long travel times through fine sand media. These factors provide an effective impediment to potential surface contamination which might enter the aquifer.

As a result of the above factors, water produced from the vast majority of wells in Texas is free of pathogens, and tests have reinforced this assumption in many areas. Properly protected groundwater sources, such as those in the study area, are not considered to be vulnerable to contamination by giardia, cryptosporidium, and other microbes of relatively recent interest. These pathogens are assumed to be prevented from entering the aquifers near the point of use, and those which do enter the aquifer at the outcrop area are filtered out of the water during its travel underground, while at the same time being deprived of ready supplies of organic material for reproduction. As a result, no treatment is needed for the removal of these entities.

Disinfection is required for all groundwater in Texas, but the purpose of disinfection is to provide a residual to protect the water in transit in the distribution system. Vulnerability assessments as noted above have been performed for wells in Texas and determinations made by the TNRCC concerning the potential for contamination of various aquifers, as well as to determine those aquifers that are under direct influence of surface water. None of the aquifers currently being used in the Brazos/western Grimes County areas is included as being under the influence of surface water. As a result, there is no treatment currently required by federal laws, and chlorination is required by state rules only for maintaining a residual in the distribution system.

One issue that has been raised during this process concerns the sodium content of the water. The level of sodium is not regulated by either the USEPA or the TNRCC. USEPA considered the regulation of sodium in meetings of the National Drinking Water Advisory Council, and concluded that the information available did not justify limits on sodium for either the Primary or Secondary Drinking Water Regulations. The information presented indicated that sodium does not appear to present a health risk to the general population, but is of considerable concern to persons on sodium-restricted diets imposed as a result of high blood pressure. Since sodium is present in many foods, restriction of sodium in the diet is more difficult if there is additional sodium in the water supply.

A review of records of water quality maintained by the TNRCC indicates that sodium levels in wells that screen the Simsboro Sands, Yegua formation, and Catahoula formation in the Brazos County and western Grimes County area are above the statewide average, and rank near the 85^{th} percentile in a group of approximately 3,200 water systems for which analyses were performed during the past two years. Where sodium levels are such that contributions from drinking two liters of water a day can have a severe impact on sodium-restricted diets, most communities have provided warning information to local physicians for use in counseling patients on sodium-restricted diets.

There are several treatment mechanisms that can be used to remove sodium from drinking water. These treatments include reverse osmosis, distillation, electrodialysis, and ion exchange. Of these technologies, electrodialysis and reverse osmosis are more widely used and have experienced decreases in cost within the last 10 years as technology improves and operational experience increases. While these treatments work most economically in large-scale facilities, they are also feasible for smaller installations. If one entity has a greater concern for sodium content, that entity could provide sodium removal treatment for the water it consumes prior to the ground storage facilities serving the distribution system. The treatment facilities could be employed to remove sodium to a very low level in the plant, and then the low-sodium water could be blended with the higher-sodium raw water to achieve a specific target level.

One of the significant cost aspects for the use of demineralization equipment is the disposal of the resulting reject water from the operation. The salts removed from the main plant flow are concentrated in the reject water, resulting in some loss of water as well as a disposal problem. The reject water can be evaporated in some areas, but the mean pan evaporation rate and total rainfall records indicate that the Brazos County area would be marginal for such an operation. Disposal in a brine injection well is another possible alternative, depending upon the location of the nearest such facility.

A second alternative for systems with sodium concerns is to provide demineralized water only for drinking purposes. Since only a very small portion of the water delivered to a consumer's residence is actually used for drinking and cooking purposes, it may be more cost-effective to provide treatment at a central location and make low-sodium water available on demand to all who are on sodium-restricted diets. This alternative would reduce the size of the plant needed, as well as the magnitude of the reject water disposal problem. It would also avoid providing treatment not needed for bathing and irrigation water. This alternative would not be allowed by TNRCC to meet a maximum contaminant level, but it would be available to an entity desiring to address a localized concern.

Interference Effects of Additional Groundwater Pumping

One of the primary effects that will be noted from increasing pumpage from the Simsboro to supply municipal needs is the increase in pumping levels in Simsboro wells. Future wells should be spaced similarly to existing wells to help limit interference drawdown, but some will still occur.

The Simsboro is capable of providing large quantities of water to wells, but increasing the overall pumping rate in the area from a present 25 MGD to an average of 45 MGD, is estimated to cause an additional 125 to 165 feet of interference effects in existing Simsboro wells in the Bryan, College Station, and Texas A&M University wellfields. During periods of peak pumping, the interference effects in the three well fields could be an additional 25 to 55 feet. The additional pumping expense caused by the interference effects have been included in the cost analysis as increased operational costs. Interference drawndown effects vary directly with pumpage, thus if the pumping rate is less, the interference drawndown effects should be less. The water supply analysis further indicated that it would be possible to extend the wellfields to the northwest sufficiently to meet the 2050 water demand levels without supplemental treated surface water.

In addition to increased pumping lifts, there is a potential effect on the water quality from the wells by increasing overall pumpage and thus possibly causing water to the southeast that has higher amounts of total dissolved solids to move toward the well field areas. From the beginning of Simsboro pumpage by the City of Bryan in 1954 and through the development of the Texas A&M University and City of College Station Simsboro wells, water quality deterioration has not been observed in the Simsboro wells.

The Simsboro is abut 400 feet thick throughout the area, and with an assumed porosity of 30 percent, it contains about 76,800 acre-feet of water in storage per square mile. With this quantity of water in the aquifer per square mile, there is a vast amount of good quality water in storage in the approoxiamtely 15 square miles in and between the three well fields, and in the area outside the well fields.

The locations of the existing wells and proposed new wells increase the likelihood that these wells will continue providing water of good quality, due to the large amount of water in storage in the Simsboro, the substantial distance to the area of the aquifer that contains water with higher total dissolved solids, and because water moves radially to the centers of pumping, with the source of water coming from the Simsboro outcrop to the northwest. If there is any gradual change in quality, it should occur first in a well located furthest downdip in the Simsboro. Well 10, owned by the City of Bryan, is the furthest downdip Simsboro well in the area, and it has continued to show the same water quality from 1954 to the present; its water quality should continue to be monitored. Additional large-capacity wells are planned to the northwest of the three well fields, to obtain water of slightly better quality and to increase the buffer area between the new wells and the area of the aquifer to the southeast that contains water with higher concentrations of dissolved solids. With the proper location of future well fields, the threat of higher total dissolved solids water encroachment from the Southeast should not be a limiting factor to groundwater development.

SECTION V - DEVELOPMENT OF SURFACE WATER SOURCES

The purpose of this section is to discuss the potential development of surface water resources in the project area. A comprehensive study of future water use should investigate all available water resources, and should determine which ones are feasible for consideration as potential alternatives. Points considered during the analyses of surface water resources in the area includes the reasoning for development of surface water sources, the regulations governing the development of surface water, the availability of surface water in the Brazos County region, quality of surface water in the Brazos River Basin, and the treatment requirements for surface water sources.

There are three primary reasons to consider the use of surface water in the system at this time. The first reason is that there is a limited supply of surface water available and there is considerable interest in all of the water that is currently available in the Brazos River system. The Fort Bend County Surface Water Supply Corporation is conducting a study for the Fort Bend County Area which indicates that groundwater will be able to supply Fort Bend County's needs only through 2009, and that, after that time, surface water will be required for growth. The readily available supplies for the Fort Bend County area are the same ones that are being looked at in this study, with the exception of Peach Creek Reservoir. In addition, the Brazos River Authority has a policy that there is no option for water from their system. If water is needed in the future, the entity desiring the water must enter into surface water contracts with the BRA now in order to ensure that the water is there when the need arises. The BRA further requires that the need be demonstrated prior to the sale of surface water. This policy is intended to discourage the purchasing of surface water for speculative purposes.

The second primary reason for considering surface water is the potential for some improvement in chemical quality. Water from Lake Somerville is lower in dissolved solids and turbidity than water from the Brazos River itself, and water from Peach Creek Reservoir is also expected to be better in chemical quality than water from either the Brazos River or that from the existing wells. It should be noted here, however, that any desire for lower total dissolved solids and lower sodium levels is based on individual preferences. The levels of these constituents in the current supplies meet all regulatory requirements.

The third reason for development of surface water is to provide additional reliability by not relying solely on the development of groundwater. Development of surface water is subject to extensive review of water rights that are analyzed to ensure that if a right to water is granted there is every assurance that that amount of water is available during the drought of record. If no additional water is available, then no further rights are granted. In developing groundwater, the water is subject to the right of capture by the landowner above the aquifer. There is no system of allocating rights and ensuring that the aquifers are not overdrawn. Currently, anyone can come into the study area, drill a well into an aquifer, and use the water obtained, as long as the water is not determined to be wasted. It is also noted that, as the demands on the aquifer increase, the cost of producing water from the aquifer will also increase as a result of interference drawdown and increased pumping lifts. In addition, increased pumping and drawdown close to the higher dissolved solids and sodium areas could result in increased dissolved solids and sodium from some of the existing wells.

Regulatory Concerns Governing Surface Water

The development of surface water resources in the State of Texas requires compliance with requirements of the Texas Administrative Code with respect to surface water rights. For existing streams, the Texas Natural Resource Conservation Commission runs streamflow models to determine the amount of State water available to the system. For the study area, the Brazos River Authority is the entity charged with maintaining reservoirs and other facilities for storage and management of State waters, with the sale of water offsetting the BRA's cost for operation and management of the system.

The United States Army Corps of Engineers requires a Nationwide Permit for any project which will impact Navigable Water of the United States. Title 30, Section 330 of the Code of Federal

Regulations sets forth the mechanism by which a Nationwide Permit is obtained and under what conditions it must be obtained.

Before a surface water source can be developed for use by any entity in Texas, the rights to that water must be obtained or reserved in advance. Rights to unappropriated water must be obtained from the State subject to permitting by the TNRCC. Water rights can be purchased from current rights holders such as industrial users or utilities companies or contracts for surface water can be obtained from a regional water supply authority. As noted above, the RWC-50 study area lies within a region serviced by the Brazos River Authority (BRA).

Brazos River Authority

The BRA was established by the Texas Legislature in 1929 to conserve, develop, and put to beneficial use the surface water resources of the Brazos River Basin. The Brazos River Basin includes all or part of 65 counties, spanning a region from the New Mexico state line to the Gulf of Mexico.

The BRA owns and operates the dams and reservoirs at Possum Kingdom Lake, Lake Granbury, and Lake Limestone. In addition, the BRA contracts with the Corps of Engineers for water supply storage space in the Corps' nine multipurpose flood control and water conservation reservoirs. The combined capacity of these reservoirs is 210 billion gallons. The BRA contracts to supply water on a wholesale basis to municipal, industrial, and agricultural water customers throughout the basin. In addition to raw water sales, the BRA also owns production and treatment facilities for providing treated potable water to some customers, as well as regional facilities for treatment of wastewater produced within the basin. The BRA sells and supplies surface water contracts on a first-come-first-served basis. However, BRA reserves the right to refuse to sell water for which a specific need cannot be demonstrated. This provision prevents other entities from speculating in BRA water in the hopes of reselling for a profit at a later date.

Current Surface Water Sources

The current surface water sources which are analyzed as viable alternatives, or supplemental sources to groundwater, are the Brazos River, Lake Somerville, and Lake Limestone. The BRA oversees the Brazos River watershed and delivery of their water through the Brazos River. The water released by the BRA could come from any of the reservoirs they operate, including Lake Somerville. The BRA would also oversee the Navasota River watershed and delivery of water purchased from Lake Limestone, which would be released to the Navasota River. The price of BRA resources available in the Brazos River, Lake Somerville, and Lake Limestone is set annually by the Authority's Board of Directors. Any discussion of available surface water resources in this section of the report will refer to surface water that is currently available for sale at the time this report is written. As noted previously, changes in the BRA's commitments occur over time, as well as changes in the price for surface water sold by the system.

The Brazos River

The Brazos River is a readily accessible source of surface water which forms the border between Brazos and Burleson counties. It lies approximately 4.5 miles southwest of the cities of Bryan and College Station and is easily reached by traveling southwest on FM 60. The BRA estimates that 46,000 acre-feet/year (41 MGD) are available in the Brazos River System, below the confluence of Yegua Creek, which lies well south of College Station. If water is withdrawn from the Brazos near the FM 60 crossing, approximately 13,000 acre-feet (11.6 MGD) would be available. These estimates of availability are for surface water available through the BRA to any interested water entity at this time. This water would be supplied by the BRA's upstream reservoirs. It must be noted that stream losses during run of the river transit have not been taken into account for either of these yield estimates.

Lake Somerville

Lake Somerville is another readily available source of surface water which straddles the border between Burleson, Lee, and Washington counties. Lake Somerville is a multi-purpose reservoir that has a normal pool elevation of 238 ft MSL, a surface area of approximately 11,460 acres, and a total capacity of 160,110 acre-feet. The BRA estimates that 33,000 acre-feet are available for purchase. These estimates of availability are actual quantities of surface water available for sale by the BRA to any interested water entity at this time. If Lake Somerville were utilized as a surface water source, there would be negligible losses during transport, given that the water would be pumped directly from the reservoir to the delivery location via pipeline.

Lake Limestone

Lake Limestone is located on the Navasota River, approximately 45 miles north of the City of Bryan. The BRA estimates that the reservoir has a total capacity of 225,400 acre-feet, and an estimated yield of approximately 65,500 acre-feet per year. (58.5 MGD) . The Brazos River Authority estimates that it can make 8,400 acre-feet per year (7.5 MGD) available for release to the Navasota River from Lake Limestone. Given the large distances from Lake Limestone to the study area, direct transmission of surface water via pipeline is not economically feasible and, therefore, not recommended. However, water purchased from the BRA at Lake Limestone could be released to the Navasota River and diverted downstream to a suitable reservoir or detention facility. Thus, water purchased from Lake Limestone could be obtained indirectly after its release to the Navasota River. Once again, however, an allowance must be made for losses incurred during run of the river transit.

Purchase of Surface Water Contracts For Rights Held by Other Entities

Houston Lighting and Power Company (HL&P) has a contract with the BRA for an annual withdrawal average of 18,000 acre-feet, and the Texas Utilities (TU) Company has a contract with the BRA for an annual average of 25,000 acre-feet. Both of these contracts are for water rights in Lake Limestone. HL&P and TU Electric could theoretically sell their water to the water entities involved in this study or to any water entity that will exist in this region in the future. However, HL&P maintains that it currently has no water for sale. In addition, TU Electric has also stated that it currently has no water for sale; however, should it have water for sale in the future, it will negotiate through the BRA. It should be noted that any water negotiated from existing Lake Limestone contracts would most likely exceed the current system price established by the BRA. Given these factors, the purchase of surface water from the aforementioned entities, or any entity other than the BRA, is not included in alternative water supply scenarios presented in this study.

Unappropriated Water

Unappropriated water is defined as the amount of water remaining after existing water rights are taken into account. Unappropropriated water at a location along a river is termed run of the river water. This section discusses the potential availability of run of the river water in the project area.

A March 1994 Phase 1 report for the southeast study area of the Trans Texas Water Program contains a TWDB estimate of run-of-the-river yield for the Brazos River Basin of 211,000 acre-ft/year. This estimate is reported to be based on the historical 24-hour low flow recorded at the most downstream U.S.G.S. river gage. This flow record does not reflect upstream diversion, status of return flows, or optimization of yield through storage options. In addition, the most downstream U.S.G.S. stream gage is located near Richmond Texas. This location is over 100 miles downstream of any potential diversion site in the Brazos County region.

The TNRCC has also supplied run-of-the-river estimates for the Brazos and Navasota Rivers based on the Commission's Brazos River Basin Water Availability Model. The Brazos and Navasota River systems were modeled for the years 1940 through 1976 on a month-by-month basis. The Brazos River diversion point was assumed to be at the FM 60 crossing for this study. Unappropriated water estimates could be large at times; however, fourteen of the thirty-seven years modeled experienced at least three months in which there was zero unappropriated flow available for use. The Navasota River diversion point was assumed to be at the proposed Peach Creek Reservoir diversion point. Unappropriated water estimates for the Navasota can also be substantial; however, nineteen of the thirty-seven years modeled experienced at least three months in which there was zero unappropriated flow available for use.

Based on the above analysis, the run-of-the-river water from either the Brazos or the Navasota Rivers could not be used for either a primary or a peak source of supply without some means of storing the water during low flows. The proposed Peach Creek Reservoir represents such an operation by taking water from the Navasota River and storing it in a reservoir constructed for that purpose. This allows the use of water diverted from the Navasota River throughout the year, and the size of the reservoir determines the firm yield of the facility.

A similar alternative could have been developed for the Brazos River, but was not. There were several reasons for this decision, but the primary reason involved the cost of the raw water versus the cost of treatment and transmission facilities. Subsequent cost analysis showed that the cost of raw water is less than 5 percent of the total cost of water served under any of the options using surface water that were investigated. The primary cost advantage of storage construction would be that costs for the surface water to be used would not be incurred until design and construction of the storage and diversion facilities were begun. There would be no cost for water sales contracts to tie up existing supplies until they were needed. Since the cost of the raw water represented by the contract price is so small, in comparison to the overall cost of treatment and transmission, it was determined that there would not be sufficient cost advantage to justify a separate alternative. As an example, if the costs for the contract prices for the surface water for the Lake Somerville diversion of 33,000 acre-feet annually are allowed to accumulate for all of the years until surface water from that source begins to be used, the cumulative cost is approximately $24 million. If that cost is expensed in the same manner as the treatment plant facilities, it adds an additional $.175 per 1,000 gallons on an annual basis. While this is a significant amount, it is still only slightly over 10 percent of the total cost of the surface water from Lake Somerville. If surface water from Lake Somerville is used as the only source of Surface supply, and usage begins in 2010, the total amount of addtional cost would be $2.4 million dollars, on $.018/1000 gallons.

A second factor is the desire to use as much of the existing facilities as possible. The use of the groundwater for peaking purposes allows the surface water treatment plant to be operated under the most favorable scenario, i.e., steady state conditions of flow over long periods of time. The existing investment in wells and transmission lines is significant, and the use of average day surface water supplemented with well water to meet the necessary peak demands allows the reliability of two sources and the cost savings from not having to build an enlarged treatment plant to meet those peak demands. In addition, the cost of production of well water is so much less than for surface water that there is an economic advantage to using as much well water as possible.

A third factor is the reliability of the source. Water available for contract is firm yield supply, as proven by hydrological studies. Unappropriated water in the future may be significantly less due to increasing population and demand and increased streamflow for environmental needs. If a decision is made to pursue surface water, then the investment in securing available water should be considered a small price for the reliability when compared to the overall cost for surface water treatement.

Summary of Available Surface Water

Table V-1 below summarizes the availability and cost information for the currently available surface water sources which will be analyzed throughout this report as surface water alternatives for the study area. This information was contained in a letter received from the Brazos River Authority, dated May 12, 1997, and has been included in *Appendix C*. It should be noted that the price of $20.21 per acre-foot recorded in the BRA letter has since been changed to $20.01 per acre-foot, effective September 1, 1997.

Table V-1. Surface Water Rights Availability and Cost

Source	Availability (acre-ft/yr)	Availability with Losses (acre-ft/yr)	Cost per Acre-Feet	Cost per 1000 Gal.
Brazos River*	13,000	11,050	$20.01	$.06
Lake Somerville	33,000	33,000	$20.01	$.06
Lake Limestone	8,400	7,140	$20.01	$.06

* The 1,300 acre feet from the Brazos River is available from upstream reservoirs.

As previously stated, transfer losses must be taken into account for water purchased from BRA reservoirs. The available water rights figure for the Brazos River listed in *Table V-1*, is for water available in upstream storage facilities such as Possum Kingdom Lake, and Lake Granbury for use downstream. The proposed withdrawal site for Brazos River water is at the FM 60 crossing. It will be assumed throughout this report that 15 percent of the water purchased would be lost during transit to this diversion point from the upstream reservoirs. The available water in Lake Limestone would be released to the Navasota River and intercepted downstream, as well. It will also be assumed that 15 percent losses would occur during transit down the Navasota to a proposed diversion point.

Potential Surface Water Sources

In addition to the currently available surface water resources discussed previously, there are two proposed water supply projects which could aid in meeting future water needs in the study area.

<u>Peach Creek Reservoir</u>

A 1992 report done by Global Natural Resources Corporation (GNRC) analyzed the feasibility of a proposed reservoir on Peach Creek in Brazos County as a surface water source for the Wellborn WSC. The proposal called for the construction of an earthen dam across Peach Creek, at a point approximately 7.56 miles upstream of the confluence of Peach Creek and the Navasota River. The proposed earthen dam would be 50 feet above the stream bed and have a crest length of 6,850 feet. The reservoir would inundate a region south of the City of College

Station with a surface area of 1,091 acres and a volume of 14,511 acre-feet, at a normal pool elevation of 240 feet mean sea level. However, the reservoir could supply anywhere in the range of 1,568 acre-feet per year (1.4 MGD) to 18,000-acre feet per year (16.1 MGD). It was estimated that the Peach Creek watershed could supply the minimum of 1,568 (1.4 MGD) acre-feet per year. It was proposed that the bulk of the remaining supply be diverted to the reservoir from the Navasota River. The GNRC report estimated that an additional 14.7 MGD could be obtained to supplement the Peach Creek reservoir.

The additional yields from the Navasota River, it was estimated, would be supplied by the portion of the Navasota River watershed originating at the Lake Limestone outfall region and terminating at the diversion point for Peach Creek lake. A 100 percent diversion of this portion of Navasota River flow stream would yield an additional 14.7 MGD. A 50 percent diversion would yield an additional 11.2 MGD to the Peach Creek reservoir. The estimates contained in the GNRC report were for run-of-the-river water, and did not include water which could be made available from Lake Limestone. For the purposes of this study, the only water which will be considered available from the Navasota river will be the water which is purchased from the Lake Limestone reservoir, due to the lack of reliability of run-of-the-river water as a stable source of surface water. In addition, the rights to this water may have been allocated by the BRA to communities downstream. The Brazos River Authority estimates that it can make 8,400 acre-feet/year (7.5 MGD) available for release to the Navasota River from Lake Limestone. It will be assumed throughout this report that only 85 percent of this flow will reach the diversion point for Peach Creek Lake , thus accounting for any losses.

Allens Creek Reservoir

The proposed Allens Creek Reservoir would be located approximately 3,000 feet above the confluence of Allens creek and the Brazos River. This location is in the southern tip of Austin County near Wallis. This reservoir would be supplied by most of the Allens Creek watershed and supplemented by flow diverted from the Brazos River. A 1,500 CFS diversion from the Brazos River would allow for a reservoir yield of 70,000 acre-feet per year. The original purpose for this reservoir was to provide a reliable source of cooling water for a proposed HL&P nuclear power plant. However, the nuclear power plant project was never developed. The proposed Allens Creek Reservoir has since been recognized as a potentially valuable component of the Trans Texas Water Program. It has been proposed that the reservoir could serve as regulating storage for water being transferred westward to areas in need in the central part of the state. However, the proposed reservoir site is, at a minimum, 80 miles from the study area. Given the cost associated with transmitting water over this distance, this proposed reservoir is not recommended as a potential direct source of surface water for the study area. The reservoir could potentially benefit the Brazos County region by deferring water demand in the Fort Bend Surface Water Supply Corporation's (FBSWSC) service area and limiting demands on water originating from rights held upstream. This scenario has not been fully developed as a surface water supply alternative in this study, however, because the FBSWSC is projected to need more than the projected yield of Allens Creek and available water from the BRA combined.

Exhibit V-1 shows the location and quantity of available surface water from each of the area's potential surface water sources.

Surface Water Quality

The available surface water in the region meets all raw water quality requirements with the potential exception of the Brazos River, which has been demonstrated to have high levels of chlorides during low-flow periods. *Table V-2* presents available raw water quality parameters measured in the Brazos River Basin.

Surface water from Lake Somerville and the Brazos River is currently being treated for municipal water use by the City of Brenham and Gulf Coast Water Authority, respectively. *Table V-3* compares quality of treated water from these two supply utilities to the primary and secondary drinking water standards.

Exhibit V-I Surface Water Sources

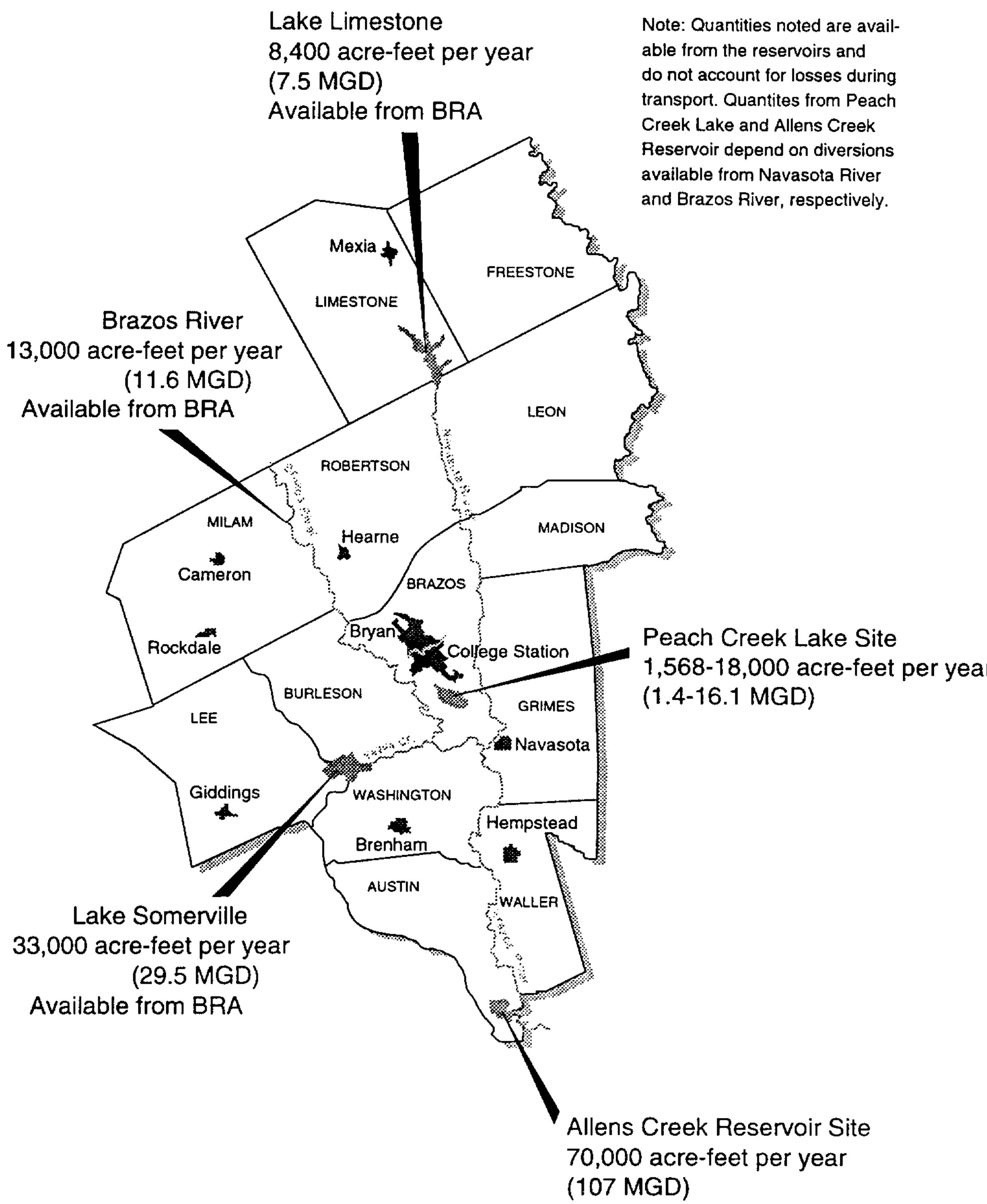


Table V-2. Surface Water Quality in the Brazos River Basin[1]

Parameter	Unit	Average Sample Summer[2]		Average Sample Winter[3]
DO	mg/l	6.88		10.71
PH	SU	7.75		8.18
Nitrogen as NO-3	mg/l	0.34		0.06
Nitrogen as NH-3	mg/l	0.05		0.17
Nitrogen as NO-2	mg/l	0.01	*	
PHOS-D	mg/l	0.01		0.01
PHOS-T	mg/l	0.04		0.02
Total Alkalinity	mg/l	122.00		82.00
Transparency	meters	0.51		48.00
Chloride	mg/l	486.00		645.00
Chlorophil	CorrectD	12.30		23.00
Conductivity	Micro-Ohm	2,322.00		2,868.46
Fecal Coliform	/100ml	10.00		3.00
Diazinon	µg/kg	3.75	*	
Dieldron	Dry weight	0.30	*	
Sulfate	mg/l	312.00		380.00
Total Organic Carbon	mg/l	1.00		6.00
Temperature	Cent.	26.07		11.30

[1] All samples are from Lake Granbury near dam

[2] Summer samples were taken on 6-16-92

[3] Winter samples were taken on 1-11-89

* Diazinon and Dieldron samples were taken on 6-10-82, no winter data was available for these constituents

Table V-3. Water Quality Data for Treated Sufrace Water

Constituent	Unit	TNRCC Standards		City of Brenham, Tx		Galveston Co. Water Authority- Texas City
Mandatory Contaminants Levels						
Antimony	mg/l	0.006	<	0.002	<	0.005
Arsenic	mg/l	0.05	<	0.002	<	0.002
Asbestos	fibers>10 mm per Liter	7000000		nr		nr
Barium	mg/l	2		0.078		0.123
Berryllium	mg/l	0.004	<	0.001	<	0.001
Cadmium	mg/l	0.005	<	0.0002	<	0.0002
Chromium	mg/l	0.1	<	0.01	<	0.01
Cyanide	mg/l	0.2		nr		nr
Flouride	mg/l	4		0.5		0.3
Mercury	mg/l	0.002	<	0.00027		0.00015
Nickel	mg/l	0.1	<	0.02	<	0.02
Nitrate	mg/l	10		0.11		0.1
Selenium	mg/l	0.05		0.0038	<	0.004
Thallium	mg/l	0.002	<	0.001		nr
Recomended Constituent Levels						
Aluminum	mg/l	.05-.2		0.13		0.04
Chloride	mg/l	300		53		91
Color	unit	15		nr		nr
Copper	mg/l	1	<	0.006	<	0.006
Corrosivity		non-corrosive		nr		nr
Flouride	mg/l	2		0.5		0.3
Foaming Agents	mg/l	0.5		nr		nr
Hydrogen Sulfide	mg/l	0.005		nr		nr
Iron	mg/l	0.3	<	0.01	<	0.01
Manganese	mg/l	0.05	<	0.008	<	0.008
Odor		3 threshold odor no.		nr		nr
pH		7		7.5		7.9
silver	mg/l	0.1	<	0.01	<	0.01
Sulfate	mg/l	300		75		66
TDS	mg/l	1000		241		388
Other Reported Data						
Lead			<	0.001	<	0.001
Zinc				0.02		0.168
P. Alkalinity as CaCO3				0		0
Carbonate				0		0
Bicarbonate				52		178
Total Alkalinity as CaCO3				43		146
Dil.Conductivity				480		792
Total Hardness as CaCO3				110		213
Sodium				38		62
Magnesium				5		15
Calcium				36		60
Sodium				39		nr

"<" notes quantities are below detectable limits

"nr" notes constituents for which no recorded data was provided

Existing Surface Water Treatment Requirements

The minimum requirements for the treatment of surface water were first delineated in Article 4477-1 of Vernon's Texas Civil Statutes, known as the Sanitation and Health Protection Law. This law was originally passed in 1945, and required that all surface water be provided treatment consisting of pre-chlorination, coagulation, clarification, filtration through acceptable media, post-chlorination, and covered clear well storage prior to the distribution system. This combination of treatment schemes was devised to ensure that those particles that were small enough to potentially pass through the filter bed were amassed into large enough particles to settle out by gravity after the coagulation and during the clarification processes. In later years, the law was amended to read pre- and post-treatment disinfection, in deference to ozone and chlorine dioxide, and particularly in recognition of the potential for formation of Total Trihalomethanes when free chlorine is used at the entrance to the treatment facilities.

Water quality prior to the advent of the Safe Drinking Water Act was established by the United States Public Health Service Drinking Water Standards, and treatment for surface water was aimed primarily at producing a water with few or no organisms of the coliform group. Testing was performed using the multiple tube fermentation technique initially, and later expanded to include the membrane filter technique, which simplified the testing regimen and provided direct evidence of individual colonies on the filter plate.

The majority of rivers and streams in Texas are recipients of wastewater treatment plant discharges, first flush stormwater discharges, and other municipal events that contribute a considerable load of viruses and bacteria to the water. As population growth has occurred, these waste load components of the surface streams have become a larger and larger portion of the dry weather flow, and contribute a higher fecal coliform and Biochemical Oxygen Demand (BOD) loading. For these reasons, Texas has not seen the interest in direct filtration and other treatments which fall short of the complete treatment specified by the Sanitation and Health Protection Law. These same conditions, coupled with outbreaks of Cryptosporidium and giardia at various locations throughout the United States, have also resulted in the recent increases in regulations at the federal level.

Current USEPA requirements for the treatment of surface water were developed under the Safe Drinking Water Act, and are included in the Surface Water Treatment Rule. This rule emphasizes the role of disinfection and contact time in meeting the requirements for pathogen removal/inactivation. Tables of required contact time for each disinfectant used are included, and these contact time requirements have an effect on plant unit sizing. Most facilities in Texas were not significantly affected by these rules because of the long history of use of complete treatment for surface water, and the existing requirements for covered clear well storage following treatment and prior to the first customer.

Potential Future Treatment Requirements

As the 1996 amendments to the Safe Drinking Water Act (SDWA) become implemented and enforced, there are a number of proposed rules that will be finalized within the next few years. These rules include the Disinfection/Disinfection By-Products Rule (D/DBPR) and the Enhanced Surface Water Treatment Rule (ESWTR). Future treatment requirements may include enhanced coagulation, modification of pre-chlorination/disinfection systems, and modification of filtration systems.

<u>Enhanced Coagulation</u>

Enhanced coagulation is a treatment technique required by the proposed D/DBPR published in July 1994. It applies when source water contains elevated levels of total organic carbon (TOC). The objective of the treatment is to substantially reduce TOC before disinfectants are added, because TOC may react with disinfectants to form disinfection byproducts. Enhanced coagulation requires lowering the pH of the source water through chemical addition, prior to coagulation. This makes the organic material less soluble and more subject to removal by sedimentation and filtration.

The D/DBPR rule applies to all community water systems and nontransient, noncommunity water systems using a chemical disinfectant for either primary or secondary disinfection. The treatment requirement applies to systems which use surface water or groundwater under the direct influence of surface water with raw water TOC concentrations greater than 4.0 mg/L. Data sheets obtained from the Gulf Coast Water Authority's Dr. Thomas S. Mackay Water Treatment Plant indicate TOC levels of 5.28 mg/l, 4.25 mg/l, and 4.82 mg/l, respectively, for three samples in 1997. Although these samples are not representative of the study area, they provide some insight into the potential application of the D/DBPR rule to water from the Brazos River.

The TOC removal must be accomplished prior to primary disinfection. Since the TOC will be removed in the sedimentation basins, and possibly in the filters, disinfectants cannot be applied in these, or prior units when achieving the disinfection credit required by the Surface Water Treatment Rule (SWTR). This will have the effect of "narrowing" the disinfection zone. As a result, additional attention will be needed in determining terminal storage volumes, as well as considering baffling for prevention of short-circuiting through the reservoirs.

Pre-chlorination/Disinfection

Since there is a "narrowing" of the disinfection zone, a balance must be maintained between the goals of the D/DBPR and the goals of the SWTR. These two rules have the potential to create many changes in the way disinfection will be handled at surface water treatment plants. As previously stated, the D/DBPR requires the TOC removal prior to primary disinfection, which limits the contact time. The SWTR has specific disinfection CT (concentration multiplied by contact time) requirements. Therefore, in order to meet the requirements of both rules, disinfection contact points within the treatment process may need to be modified.

Filtration

Filtration is required at all surface water treatment plants in Texas. The ESWTR, proposed by EPA, is expected to be promulgated in interim and long-term stages. This rule includes treatment requirements aimed at the control of Cryptosporidium, Giardia, and other viruses.

Filtration and sedimentation are the primary processes used for turbidity removal. More efficient removal of turbidity is believed to result in more efficient removal of bacteria, viruses, and other potentially harmful constituents. In addition, there appears to be a correlation between turbidity removal and Cryptosporidium removal. Cryptosporidium oocysts are very small (2-6 micrometer [μm]), and have been shown to be somewhat resistant to chlorine disinfection. Field tests have shown that, if the turbidity in filtered water consistently reaches the optimum level of 0.1 nephelometric turbidity units (NTU), the risk of Cryptosporidium contamination can be minimized.

Based upon the current SWTR rule, the turbidity of the finished water produced by the plant must be 0.5 NTU, or less, in at least 95 percent of the samples taken each month, and less than 5.0 NTU in all samples. The ESWTR would require treatment plants to consistently produce settled water turbidities of 2.0 NTU and filtered water turbidities of 0.1 NTU. If these treatment objectives are maintained, the plant could achieve not only Cryptosporidium removal, but also at least a 2.5 log removal of Giardia. Disinfection would provide the last 0.5 log removal of Giardia required by the rule.

Arsenic

The arsenic maximum contaminant level (MCL) may be lowered in the near future. Arsenic became a designated drinking water priority contaminant for regulation by the Environmental Protection Agency (EPA) under the 1986 Safe Drinking Water Act amendments. Because of recent findings of associated health risks, the arsenic interim standard of 50 micrograms per liter (ug/L) is expected to be lowered (Frey and Edwards, 1997). EPA estimates the revised MCL for arsenic will be between 2 and 20 ug/L, a 25 to 2.5 fold reduction of the current standard (Shank, 1994). The limited data available at this time does not indicate a concern for arsenic levels in the surface water proposed for treatment. This proposed standard is reported for information only.

Impacts of Treatment Changes

The primary impact of the potential changes discussed above for new facilities not yet build is one of economics. The enhanced treatment methods proposed do not present problems of retooling or abandonment of existing facilities when we are dealing with an entirely new design that will be completed after the new rules are finalized. In addition, these methods do not represent radically new concepts that are unknown in Texas. As a result, there is sufficient experience Statewide to allow reasonably accurate predictions of cost for the treatment enhancements. These increased costs are reflected in the cost analyses presented.

Surface and Groundwater Blending Issues

One additional factor that was considered concerns the potential problems that can be encountered in blending surface water and groundwater, because of their potentially dissimilar natures. It is difficult to quantify all of the issues that could occur, since we do not have specific quality analyses from the proposed diversion point over a period of time. However, the majority of problems that are experienced with blending dissimilar waters occur as tastes and odors, and calcium carbonate instability.

The proposed new treatments for surface water, which are aimed at reducing TOC, should also reduce the potential for taste and odor problems, as well. The elements represented in the TOC include the various naturally occurring lignins and tannins from decomposition of leaves and wood that are precursors to trihalomethane formation. Reduction in the levels of these compounds should reduce the formation potential for tastes and odors, also.

The analyses of GCWA's raw water samples indicate that water from the Brazos during the summer is reasonably hard and contains significant alkalinity. Blending with the existing Simsboro water should produce a water that is less aggressive than the existing water, with potential reductions in the dissolution of exposed metal parts in the systems.

Prevention of problems with either tastes and odors or calcium carbonate from blending surface water and groundwater is commonly accomplished through blending the waters in the controlled environment of a storage tank, instead of in the distribution system. For the purposes of this study, all water is assumed to be delivered into the same ground storage tanks that are used to receive the groundwater prior to distribution. This requirement will allow any calcium carbonate which forms to settle to the bottom of the storage tanks prior to delivery to the distribution system. At the same time, chemical feed equipment can be installed to feed sequestering agents to maintain stability, or additional disinfectant to oxidize tastes and odors, as needed. The cost of feeding sequestering agents at these locations is included in the operation and maintenance portion of the treatment costs.

Groundwater Supply Alternatives

Groundwater can potentially be developed on a regional or individual basis. The only groundwater source sufficient to provide water for the entire region, through 2050, is the Simsboro formation, but the Sparta, Catahoula, and Yegua formations should be able to provide future groundwater supply, through the planning horizon, for one or more of the smaller water utilities in the region. The following sections describe typical wells that could be used to develop each aquifer.

Simsboro Wells

The Simsboro formation currently supplies water to the area's largest water users. Typical Simsboro wells in the College Station, Bryan, and Texas A&M University systems range in capacity from about 1,800 gpm to 2,800 gpm. *Table VI-1* summarizes the capital and operation and maintenance costs associated with a 2,100-gpm Simsboro well. Operation and maintenance costs for *Table VI-1* through *Table VI-3* assume current pumping levels.

Table VI-1. Cost for 2,100-gpm Simsboro Wells

O&M Costs	
Pumping Cost (300 ft)	\$0.190 /1,000 gallons[1]
Cooling Cost (118°F to 85°F)	\$0.050 /1,000 gallons[1]
Chlorination	\$0.004 /1,000 gallons[1]
Electric Service (\$300/month)	\$0.005 /1,000 gallons[1]
Gas Service (\$127/month)	\$0.002 /1,000 gallons[1]
Rehab Cost	\$95,000 every 10 years \$16,219 annually[2] \$0.022 /1,000 gallons[1]
New/Replacement Well Cost	\$2,022,000 every 35 years \$164,758 annually[2] \$0.224 /1,000 gallons[1]

Table VI-1. Cost for 2,100 gpm Simsboro Wells

Total O&M COST/1,000 gallons	**$0.25 /1,000 gallons**
Total Rehab Cost/1,000 gallons	**$0.02 /1,000 gallons**
Total Capital Cost/1,000 gallons	**$0.22 /1,000 gallons**
TOTAL COST/1,000 gallons	**$0.50 /1,000 gallons**

[1]Cost per 1,000 gallons based on pump capacity and a 16-hour cycle time
[2]Annual cost based on 7.5% interest rate and well lifespan or rehab frequency

Sparta Wells

Wickson Creek SUD and some of Texas A&M University's older wells currently pump from the Sparta formation. The typical Sparta well for these systems has a capacity of approximately 500 gpm. Costs for new 500 gpm wells in the Sparta formation are summarized in *Table VI-2*. The City of Navasota pumps much of its supply from the Catahoula formation. Costs for future Catahoula wells are similar to that of Sparta wells outlined in *Table VI-2*.

Table VI-2. Cost for 500-gpm Sparta Wells

O&M Costs	
Pumping Cost (300 ft)	$0.190 /1,000 gallons[1]
Chlorination	$0.020 /1,000 gallons[1]
Electric Service ($300/month)	$0.021 /1,000 gallons[1]
Gas Service ($127/month)	$0.005 /1,000 gallons[1]
Rehab Cost	$32,000 every 10 years $4,662 annually[2] $0.027 /1,000 gallons[1]
New/Replacement Well Cost	$967,200 every 35 years $78,810 annually[2] $0.450 /1,000 gallons[1]
Total O&M COST/1,000 gallons	**$0.24 /1,000 gallons**
Total Rehab Cost/1,000 gallons	**$0.03 /1,000 gallons**
Total Capital Cost/1,000 gallons	**$0.45 /1,000 gallons**
TOTAL COST/1,000 gallons	**$0.71 /1,000 gallons**

[1]Cost per 1,000 gallons based on pump capacity and a 16-hour cycle time
[2]Annual cost based on 7.5% interest rate and well lifespan or rehab frequency

Yegua Wells

The Yegua formation is relatively small, compared to the other groundwater supplies in the region, and typical water supply wells currently used by Carlos WSC to provide water from the Yegua have the capacity to provide approximately 80 gpm each. The capital and operation and maintenance costs associated with wells in the Yegua are summarized in *Table VI-3.*

Table VI-3. Cost for 80 gpm Yegua Wells

O&M Costs	
Pumping Cost (300 ft)	\$0.150 /1,000 gallons[1]
Chlorination	\$0.100 /1,000 gallons[1]
Electric Service (\$200/month)	\$0.086 /1,000 gallons[1]
Gas Service (\$125/month)	\$0.005 /1,000 gallons[1]
Rehab Cost	\$12,500 every 10 years \$1,821 annually[2] \$0.065 /1,000 gallons[1]
New/Replacement Well Cost	\$223,200 every 35 years \$18,187 annually[2] \$0.649 /1,000 gallons[1]
Total O&M COST/1,000 gallons	**\$0.34 /1,000 gallons**
Total Rehab Cost/1,000 gallons	**\$0.06 /1,000 gallons**
Total Capital Cost/1,000 gallons	**\$0.65 /1,000 gallons**
TOTAL COST/1,000 gallons	**\$1.05 /1,000 gallons**

[1]Cost per 1,000 gallons based on pump capacity and a 16-hour cycle time
[2]Annual cost based on 7.5% interest rate and well lifespan or rehab frequency

Surface Water Supply Alternatives

Two potential methods exist for incorporating the area's surface water resources into a regional water supply system. The region could develop surface water as a sole supply source, or it could create a combined surface/groundwater system.

The major differences between these methods is the mechanism for meeting water demands during periods of high water usage. A surface water-only system would require construction of large off-channel storage reservoirs to meet water demands during periods of high water demand, whereas a combined surface/groundwater system would utilize the abundant groundwater resources of the area to meet peak demands periods.

Although both of these methods require diversion of sufficient surface water to meet average daily demands, the combined surface/groundwater system has several advantages over a surface water-only system. One of the primary advantages of a combined surface-groundwater system is the costs associated with the surface water treatment plant. A surface water-only system would require a plant sized for peak day capacity (approximately 2.4 times the average daily capacity). This larger treatment plant has a higher capital cost, and operation and maintenance costs would also be higher, as a larger volume of water must be treated for a surface water-only system. If peak demands can be met by readily available groundwater, these additional treatment costs can be avoided. Another advantage of the combined surface/groundwater system is the duplicity of supply. If anything should happen to one of the sources, the other would still be available and ready for use. Because of these advantages, this report considers surface water as a source of supply to meet average daily demands, and assumes that the abundant groundwater in the region will be used to supplement any proposed surface water systems during periods of high water demand.

The three surface water resources proposed for future development in the study region are Lake Somerville, the Brazos River, and Peach Creek Lake. The development of these surface water resources will require raw water intake facilities, pump stations, raw water transmission lines, and a surface water treatment plant (SWTP). The locations of raw water intake facilities and pump stations were selected based on their proximity to proposed transmission line alignments and the SWTP. The transmission line alignments themselves follow existing road right-of-ways, and are sized to convey the maximum amount of water currently available from each source. In addition, the lines were sized with the following constraints: velocity equal to or less than five feet per second, and a maximum head loss of five feet per 1,000 linear feet of transmission line. The proposed SWTP site, diversion, and conveyance facilities for the Brazos River and Lake Somerville are based on alternatives presented in the *Brazos Valley Long-Range Regional Water Supply Planning Study* conducted by Espey, Huston & Associates,

1990. The development of Peach Creek Lake is based on the *Peach Creek Lake Project Development Report*, prepared by Global Natural Resources Corporation and Alan V. Thompson Engineering Consultants, Inc., 1992.

Surface Water Treatment Plant

A single SWTP site has been selected for this cost analysis. The location, near the intersection of FM 60 and FM 2818, provides a central hub for delivering water to the high-demand distribution systems of College Station, Texas A&M University, and Bryan. The location on the west side of the cities provides the easiest access to the larger transmission line from the proposed Brazos River and Lake Somerville diversions. This central location could also serve as headquarters for a regional water supply entity.

The facilities at the SWTP should be sized so the plant could be expanded in three phases corresponding to the quantities of water available from the three surface water sources. In the case of a combined regional surface/groundwater system, the plant should also include connections to the major well field transmission lines and appropriate operations to stabilize and improve the quality of mixed water.

Brazos River

Raw water intake for the Brazos River is proposed at the FM 60 crossing. The intake structure consists of a 200-linear-foot channel. The proposed pump station, which would also be located near the FM 60 crossing, will pump against approximately 150 feet of elevation. A 48-inch transmission line, approximately 4.5 miles in length, along FM 60 would deliver the combined flow from Lake Somerville and the Brazos River to SWTP. Because the Brazos River is known to have periods of low flow, in which chloride concentrations rise to an unacceptable level, a low-flow storage reservoir is required. The storage capacity of this facility has been estimated at 550 million gallons, which is the required storage to meet six month storage at 30 percent of maximum demand, as recommended by Espey, Huston & Associates in the 1990 *Brazos Valley*

Long-Range Regional Water Supply Planning Study. Total and annual capital cost, operation and maintenance cost, and unit cost for the proposed development of the Brazos River as a source of surface water for the region are presented in *Table VI-4.*

Table VI-4. Surface Water Costs for the Brazos River (6,850 gpm)

Raw Water Costs: 13,000 acre-ft/year	$262,730	annual cost
($20.21 per acre-ft from BRA)	$0.07	/1,000 gallons[2]
Diversion Channel and Pumping Facilities	$3,574,000	total cost
	$283,777	annual cost[1]
	$0.08	/1,000 gallons[2]
Tretment Plant Construction	$22,687,200	total cost
($2.30/gallon treated)	$1,801,371	annual cost[1]
	$0.50	/1,000 gallons[2]
Low Flow Storage Reservoir	$1,600,000	total cost
	$127,041	annual cost[1]
	$0.04	/1,000 gallons[2]
Transmission from Brazos River to WTP	$3,015,000.00	total cost
48-inch diameter; 24,120 linear feet	$239,392	annual cost[1]
	$0.07	/1,000 gallons[2]
O&M Costs	$0.66	/1,000 gallons[2]
	$2,376,238	annual cost
Total Annual Cost	**$5,090,548**	
Total Cost per 1000 gallons	**$1.41**	

[1] Annual cost based on 7.5% interest rate and 40-year term.
[2] Cost per 1,000 gallons based on available supply less 15% loss during transfer from upstream reservoirs.

<u>Lake Somerville</u>

The proposed raw water intake facilities and pump station for Lake Somerville are located on the northeast end of the lake near the dam. The intake channel will be approximately 1,000 feet long, and the pump station will be located at the end of the channel. The proposed transmission line is approximately 22 miles in length along FM 60, and the difference in elevation between the pump station and the SWTP is approximately 120 feet. The transmission line must have a 42-inch diameter, in order to convey the maximum available flow rate of 10.75 MGD while still operating within the maximum five feet per second velocity, and maximum head loss of five feet per 1,000 linear feet or transmission line constraints. Total and annual capital cost, operation and maintenance cost, and unit cost for the proposed development of Lake Somerville as a source of surface water for the region are presented in *Table VI-5*.

Table VI-5. Surface Water Costs for Lake Somerville (20,460 gpm)

Raw Water Costs 33,000 acre-ft/year	$666,930	annual cost
($20.21per acre-ft from BRA)	$0.06	/1,000 gallons
Diversion Channel and Pumping Facilities	$4,774,000	total cost
	$379,057	annual cost*
	$0.04	/1,000 gallons
Tretment Plant Construction	$67,813,200	total cost
($2.30/gallon treated)	$5,384,389	annual cost*
	$0.50	/1,000 gallons
Transmission from Lake Somerville to	$3,579,600	total cost
the Brazos Diversion Site	$284,221	annual cost*
42-inch diameter; 92,780 linear feet	$0.03	/1,000 gallons
O&M Costs	$0.66	/1,000 gallons
	$7,097,492	annual cost
Total Annual Cost	**$13,812,090**	
Total Cost per 1,000 gallons	**$1.28**	

* Annual cost based on 7.5% interest rate and 40-year term.

Peach Creek Lake

Development of Peach Creek Lake would require construction of the Peach Creek Dam and pumping facilities, as well as diversion facilities on the Navasota River, to pump water purchased from Lake Limestone to the reservoir. The proposed Navasota River diversion facilities and pump station are situated on the Navasota River, approximately three miles upstream of the confluence of Peach Creek and the Navasota River. This diversion site would require a low dam to create a pumping pool in the Navasota river, a pumping plant adjacent to the river, and a transmission line to convey water to the Reservoir. The pump station would work against about 175 feet of elevation difference between the proposed diversion pool and Peach Creek Lake. An estimated 20,800 linear feet of 24-inch-diameter transmission line would convey approximately 4,426 gpm of available water from the Navasota River to the proposed reservoir. A pump station near the proposed embankment on Peach Creek would pump water along about 51,000 linear feet of 24-inch-diameter transmission line from the lake to the SWTP. Total and annual capital cost, O&M cost, and unit cost for the proposed development of Peach Creek Lake as a source of surface water for the region are presented in *Table VI-6.*

Table VI-6. Surface Water Costs for Peach Creek Lake (5,400 gpm)

Raw Water Costs: 8,400 acre-ft/year ($20.21per acre-ft from BRA)	$169,764 $0.04	annual cost /1,000 gallons[2]
Navasota River Diversion and Pumping Facilities	$14,500,000 $1,151,305 $0.41	total cost annual cost[1] /1,000 gallons[2]
Peach Creek Lake (embankment and associated facilities)	$6,700,000 $531,982 $0.19	total cost annual cost[1] /1,000 gallons[2]
Transmission from Peach Creek Lake to WTP 24-inch diameter; 59,660 linear feet	$10,205,800 $810,344 $0.34	total cost annual cost[1] /1,000 gallons[2]
Tretment Plant Construction ($2.30/gallon treated)	$17,884,800 $1,420,059 $0.50	total cost annual cost[1]* /1,000 gallons[2]
WTP O&M Costs	$0.66 $1,873,238	/1,000 gallons[2] annual cost
Total Annual Cost	**$5,956,692**	
Total Cost per 1000 gallons	**$2.13**	

[1] Annual cost based on 7.5% interest rate and 40-year term.
[2] Cost per 1,000 gallons based on available supply less 15% loss during transfer from upstream reservoirs.

Controlling Structure and Organizational Alternatives

The type of controlling structures available for systems depends on the sources expected to be developed in the future. If groundwater is to be used exclusively, two options exist. The region's water entities can continue providing their own independent supply, or a regional groundwater system can be set up. Development of surface water sources, on the other hand, would require a large amount of capital and would probably require the development of a regional supply entity of some sort.

Although remaining independent would maintain each system's total autonomy from a supply and operations perspective, regionalization has several advantages. The main advantage is that a regional system would allow sharing of supply surpluses. Shared surpluses would lower the overall supply required for the region and optimize timing for development of new water supply. Another advantage of a regionalized system is that transmission and storage facilities associated with the supply system can be shared. This introduces cost savings due to the economics of scale: the larger, shared facilities would have a lower per-unit cost than smaller, individual facilities. Other advantages of regionalization are the ability to control larger amounts of capital for future supply projects, and an infrastructure for providing repairs and routine maintenance to the area's water supply facilities. Depending on the type of regional system set up, it could also provide additional services, such as utilities billing.

Several mechanisms exist for developing a regionalized water system. The following organizational structures are potential methods for creating a regional water supply entity.

Municipal Water Authority

A municipal water authority can be set up by act of legislature. Municipal water authorities gain their power through legislative action. All responsibilities must be specifically identified and approved by the State Legislature, and a controlling board appointed. The controlling board would most likely be composed of personnel from existing water entities that are served by the water authority, much like the RWC-50. An example of a currently operating municipal water authority that provides surface and groundwater supplies to customers is the Canadian River Municipal Water Authority.

River Authority

Control of a regional system can also fall under the jurisdiction of an existing river authority. This would require that the river authority either currently have the power to control a regional water supply infrastructure in its existing charter, or that it be granted this power through legislative action. The Brazos River Authority currently owns and operates regional water and wastewater treatment facilities.

Special Utilities District

A regional water supply system can also be operated by a special utilities district. This would require legislative concurrence, and would create a corporate entity with rights and responsibilities similar to that of a municipality and also to a municipal water authority.

Water Supply Corporation

A water supply corporation could also be set up to operate a regional water supply system. However, the powers of such corporations are limited, to the extent that one of the water supply corporations in the area has already converted to a special utilities district, and a second one is considering such a conversion. As a result, no further investigations of water supply corporations was pursued.

Timing and Procedure for Creating a Water District

Water districts can be created by general law or special law. General law districts may be created by the TNRCC, by a County Commissioner's Court, or, to a lesser extent,by the governing board of a City, and Special Law districts are created by act of Texas Legislature (TNRCC, 1995.)

The creation of a water district through general law requires application to the TNRCC. The content of applications vary, based on the type of district proposed. However, some items are common to all applications for creation of water districts. These include the following.

1. A non-refundable application fee of $700.
2. Consent of the governing bodies of any municipalities that intersect with the proposed district
3. A statement, from city officials of municipalities in which part of a district is located, affirming receipt of the petition for creation of the district
4. Evidence of submitting creation petitions to appropriate agency regional offices
5. Information regarding the developer if substantial new development is expected in the proposed district
6. A vicinity map showing the proposed district
7. Other information relating to the petitioners and the affected municipalities

After the application is submitted, the TNRCC will perform an initial review for administrative completeness, which is to be completed within 10 business days after the application is received. A 75-day technical review period begins upon notification of administrative completeness. If additional technical material is required, and is provided within the technical review period, additional days will be added to the technical review period to accommodate the time required to provide the additional technical material. A contested case hearing can be filed by the TNRCC, the applicant for creation of the water district, or any affected persons(s) when authorized by law. If a review hearing is requested, it is usually scheduled approximately 40 days after publication that the technical review has been completed. Public notice for hearings must be issued at least 30 days prior to the scheduled hearing date. Information concerning the application requirements can be found in TAC Title 30, Chapter 293, Section 11.

Creation of a water district by general law would require approximately eighteen to twenty-four months. Twelve to eighteen months would be required to determine what type of district would be required and to prepare the application, and six months would be required to complete the review process and address public concerns.

Only the Texas legislature can create a water district by special law. This requires that a bill specifically creating the district be passed. Approximately six months to one year would be required to plan the proposed district, write the bill, coordinate with municipal and county agencies for support of the bill, and to build the public support required to get the bill sponsored. After the bill is proposed, approximately 12 to 18 months are required to get a vote on the bill. Once the bill authorizing the district is passed into law, approximately three to six months would be required to begin its implementation. The entire process of setting up a water district by special law would require approximately two to three years.

Supply Alternatives to Meet Regional Requirements Through 2050

Four potential scenarios have been developed to illustrate the advantages and disadvantages of the various supply options. This section includes descriptions of the four alternatives, a discussion highlighting the differences between maintaining independent supply and regionalizing supply, and the cost differences between developing surface water and groundwater sources. The following assumptions were used for developing the four alternatives:

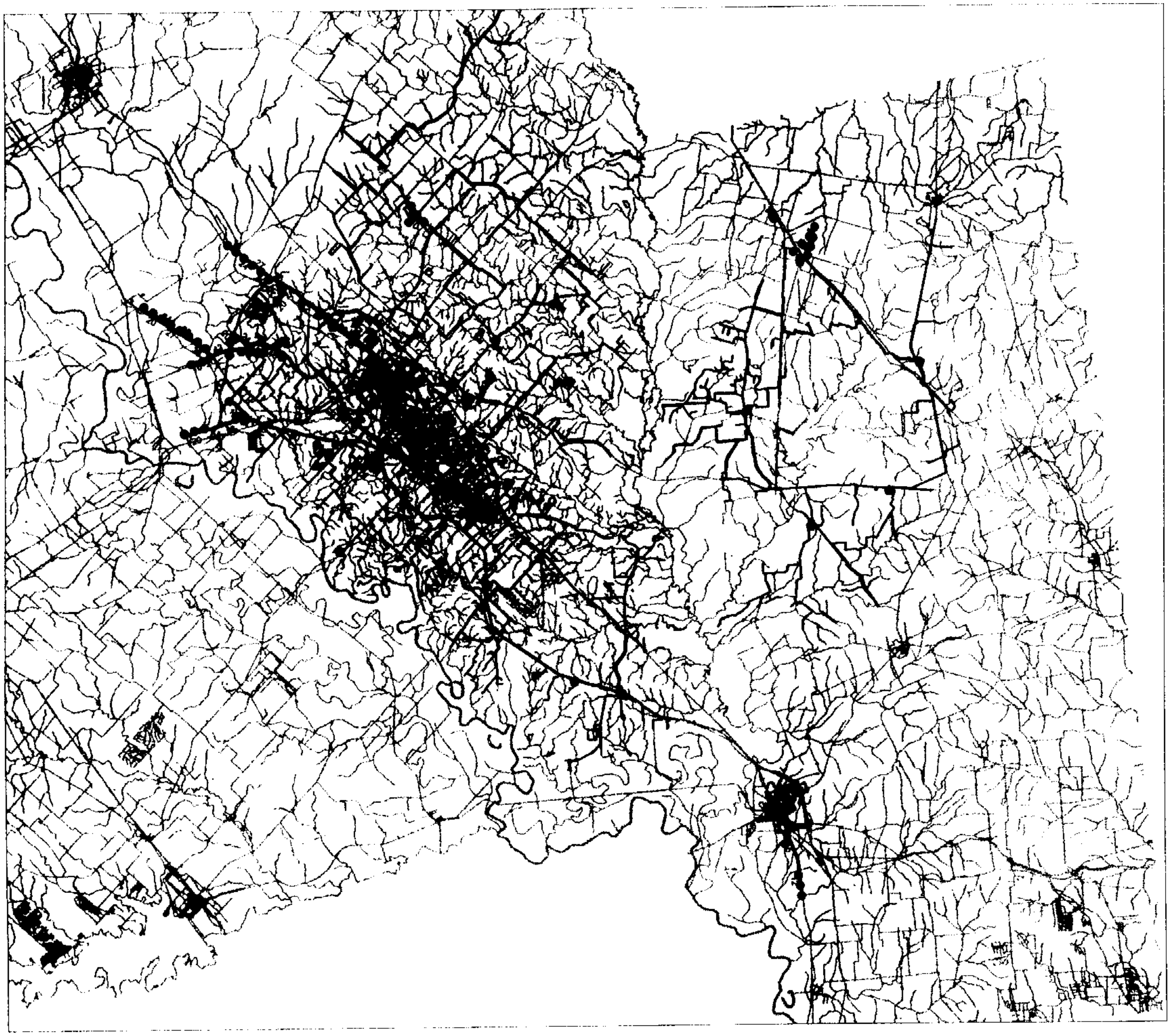
- Wells have an expected life span of 35 years, and will be replaced at the projected end of their life span by new wells in the same location, with no additional land acquisition costs.
- Transmission lines are assumed to have a 50-year life span, after which they require replacement.
- New lines have been sized with five-feet-per-second maximum velocity and a maximum five feet head loss per 1,000 linear feet of water line.
- All proposed lines are sized to convey 2050 requirements.

- Parallel lines are used to convey additional capacity beyond that of the existing line, rather than removing and replacing existing line.

Alternative 1: Existing Systems Remain Independent

Alternative 1 proposes a scenario where existing water supply entities could maintain their autonomy and continue providing their own groundwater supply. To do so would require operating and maintaining existing wells, replacing existing wells and transmission lines as their useful life span ends, and providing new wells to meet increasing supply requirements. In this alternative, new wells would be of similar capacity and would utilized the same sources as recently constructed wells in the area. New wells and required transmission facilities can be seen in *Exhibit VI-1*.

Table VI-7 at the end of this section provides a cost estimate for the entire region when each entity continues providing its own supply. All cost estimates in this section include added cost, due to interference drawdown expected to occur as additional Simsboro wells are developed.



Alternative 1

Independent
Groundwater
Supply

Legend

- Existing Pump Stations
- Existing Wells
- Proposed Well
- Proposed Water Lines
- Existing Water Lines
- 42 Proposed Line Size

N W E S

20000 0 20000 Feet

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Alternative 2: Regional Groundwater Supply

Alternative 2 provides a scenario where a regional groundwater supply system is created to provide water supply for all of the area's water supply utilities through 2050.

The regional system would be initiated by interconnecting existing supply and distribution systems wherever reasonably available surplus water supply exists. The best potential for taking advantage of system interconnections is between College Station, Texas A&M University, and the City of Bryan. Bryan is projected to have a supply surplus through 2020, and, if interconnections are made between these three entities, City of Bryan surpluses could delay the need for new well construction through 2006.

The proposed regional supply system would begin providing water from a regional well field as required supply begins to exceed the capacity of existing and planned resources. The primary regional well field would be located north and west of the existing College Station well field, and would consist of 2,100-gpm Simsboro wells, spaced approximately 2,500 feet apart to minimize interference draw down. The well field configuration has been selected to coincide with the areas of the aquifer that have the best quality water, and to minimize the interference of the new well field on the area's existing wells. The primary regional well field would also have its own pump station and transmission lines, and these would include interconnections with existing transmission facilities.

The configuration of the proposed wellfield, shown in *Exhibit VI-2,* reveals proposed wells in a relatively straight line, advancing toward the area of gradually improving water quality. In addition to the primary regional wellfield configuration, two other configurations were examined. The use of two wellfields, one extending northwest of the existing College Station wellfield and one extending north of the existing Bryan wellfield, has some minor cost savings in the development of the well collection line network. The total dissolved solids, however, could be about 500 to 550 mg/l. from wells drilled in the east line of wells, compared to an estimated 420 to 480 mg/l for wells drilled in the west line of wells. In addition, there would be a greater interference drawdown effect in the existing City of Bryan wells that would offset any potential collection line savings. For these reasons, the split wellfield was not analyzed further as a potential alternative. For these same reasons, changing the orientation of the wellfield to one which runs across from the southwest to the northeast would concentrate the wells in areas with higher dissolved solids and sodium levels. The Simsboro is capable of providing water to a large wellfield or wellfields, in either a northwest to southeast, or a northeast to southwest orientation.

Regional well fields would also be established in the location of existing City of Bryan, City of College Station, and Texas A&M University well fields. This could be accomplished through two methods. The first method for regionalization of existing Simsboro well fields is to gradually acquire the existing systems. As existing wells come to the end of their useful life span, new regional wells could be constructed near the same location to replace supply lost from the wells that go out of service. As the regional system replaces wells in the existing well fields, it would obtain ownership of the existing transmission facilities, as well. Eventually, as the regional system replaces the existing well field, it would come entirely under regional control. The second method is that the proposed regional supply entity could purchase the existing wells and transmission facilities from the current owners.

Having a large regional well field interconnected with three large-diameter transmission lines, combined with the use of interconnections between the distribution systems, provides a considerable level of redundancy in transmission and supply facilities. This increases the reliability of supply for each of the entities involved.

The proposed improvements required for the regional water supply entity are shown in *Exhibit VI-2*. Costs for the regional groundwater system are summarized in *Table VI-8* at the end of this section.

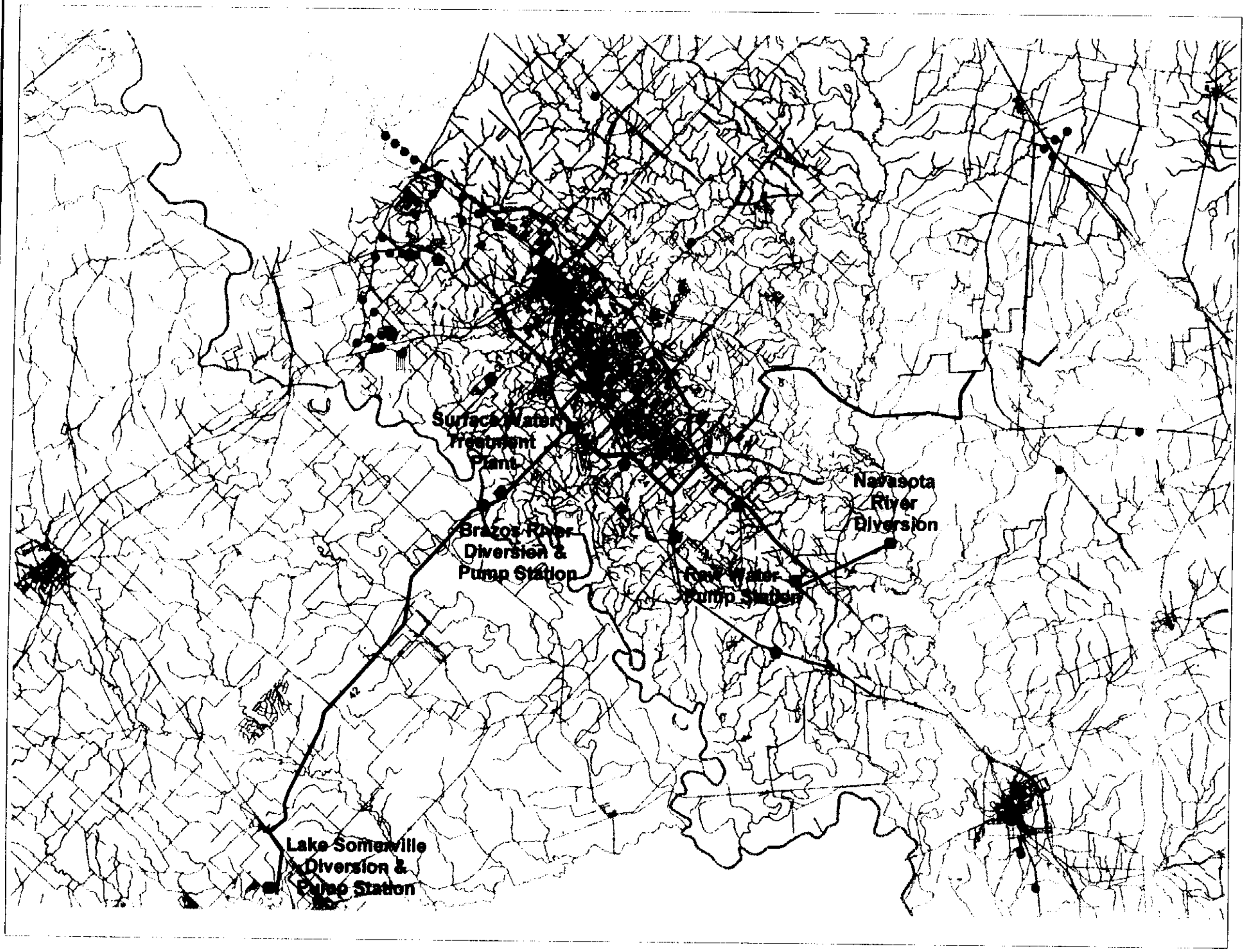
Alternative 3: Regional Surface Water System to Meet Average Daily Demand

Alternative 3 proposes the development of a regional surface water supply system to provide each entity in the study area with average daily demand. The surface water supply would be incorporated into each entity's existing distribution system, and supplemented through the use of existing groundwater supplies to meet peak period demands. This scenario assumes current groundwater supply would be maintained and replaced by each water utility on an individual basis.

For the purposes of this discussion, it is assumed that the regional surface water supply would begin in 2010 with the introduction of treated surface water from the Brazos River and Lake Somerville. Surface water from Peach Creek Lake would be phased in when additional supply is required. All raw surface water from the three available sources would be conveyed to the proposed regional SWTP discussed earlier in this section, and all appropriate transmission lines would be constructed as each distribution system's demand requires. *Exhibit VI-3* shows the regional surface water supply system, and *Table VI-9* at the end of this section summarizes the costs for developing the system.

Alternative 4: Regional Combined Surface/Groundwater System

Alternative 4 provides a scenario similar to Alternative 3, but includes regionalization of the groundwater supply, as well as of the surface water. This alternative assumes that regional surface water supplies would be phased in every 10 years, beginning with the Brazos River diversion in 2010. The Somerville diversion would follow in 2020, and then Water from Peach Creek Lake would be incorporated in 2030. This arrangement was selected based on cost and proximity to the project area. The Brazos River diversion is incorporated first because it is the closest, and includes a portion of the transmission line required to incorporate the Lake Somerville diversion. Lake Somerville was chosen for development prior to Peach Creek Lake because it is an existing source, and of the surface water options, has the least expensive per-unit cost for treated water.



Alternative 3

Regional Surface Water System

Legend
- Existing Pump Stations
- Existing Wells
- Surface Water Sources

Proposed Water Lines
- Raw Water
- Transmission
- Peach Creek Dam
- Existing Water Lines

42 Proposed Line Size

N W E S

10000 0 10000 Feet

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Regional groundwater supply would be integrated into the system to meet the water supply capacity required by the TNRCC, and to replace existing wells as they come to the end of their useful life span. The regional groundwater would be primarily supplied through new wells north and west of the existing College Station well field, and through incorporation of the Bryan and Texas A&M University well fields as existing wells go out of service. The mechanism of expansion would be similar to the two methods described in Alternative 2.

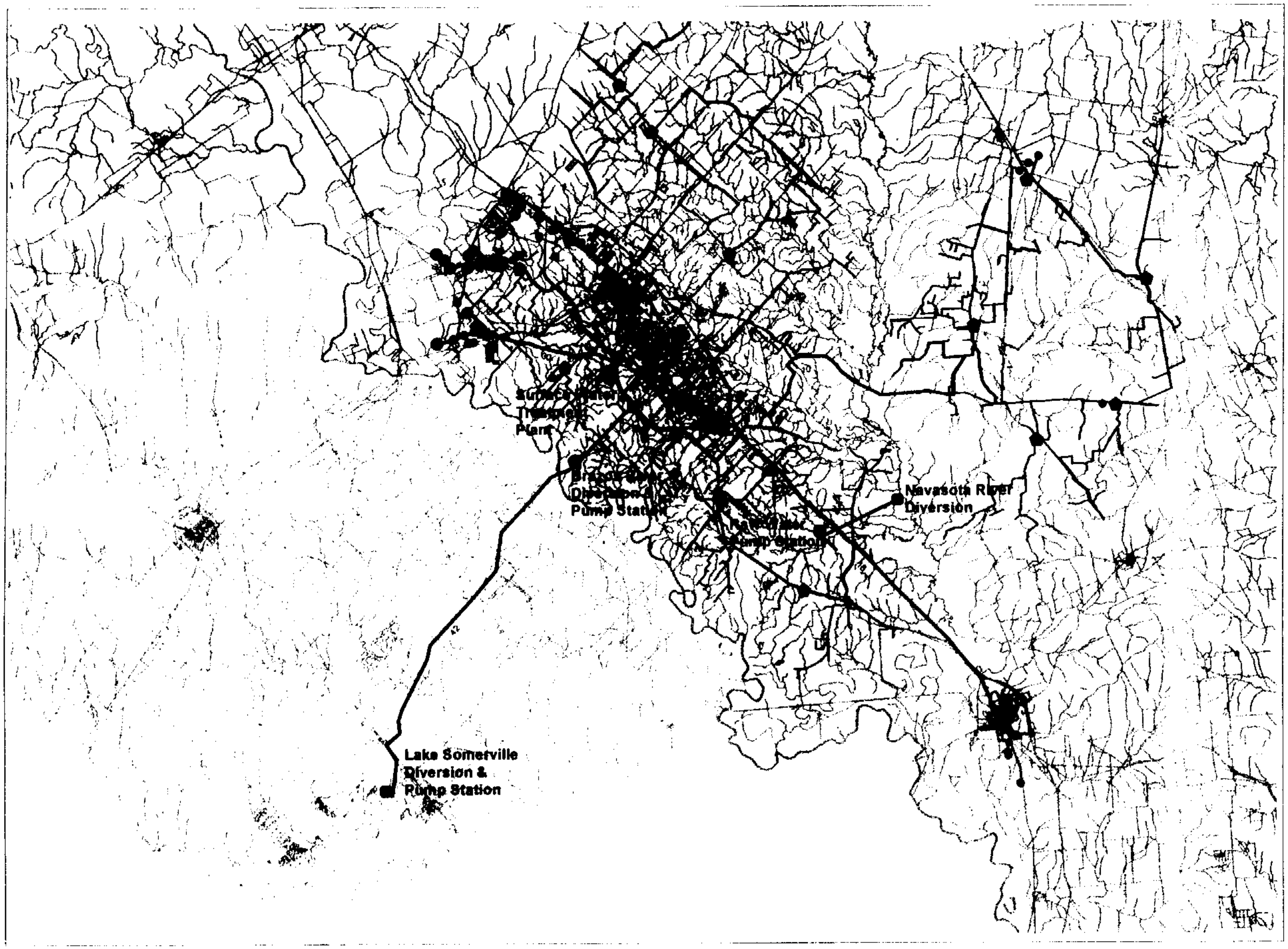
The facilities required to create a combined regional surface/groundwater system and, how they relate to the existing water utilities, are shown in *Exhibit VI-4. Tables VI-10* at the end of this section provides a summary of costs associated with the combined regional system.

Discussion of Alternatives

The information presented for each of the alternatives as noted above is to provide a basis to compare the various costs of each system configuration. *Table VI-11* at the end of this section summarizes the total cumulative present worth cost of each alternative for each 10-year period through 2050. Each of the systems described is feasible from a technical standpoint, and the necessary precedent exists for management and operation of each of the systems described within current structure or structures permitted by state law.

It should be noted that the above costs analyses did not include the costs of managing the system or systems developed, since there is no means of determining at this point what the preferred managing entity is. However, the costs of managing the facilities are built into the operations and maintenance costs of the treatment plant, pumps, pipelines, and related equipment to a certain degree, since these costs include the costs for personnel.

The other factor that is not included in the cost summary tables is the increase in reliability in having two sources of water on which to rely. The population growth projected in *Section III* will face increasing competition for water into and beyond the study period. Having sufficient water to allow that growth to continue will be a key factor in the economic well-being of the study area



Alternative 4

Combined Regional Surface Water and Groundwater System

Legend

- Existing Pump Stations
- Existing Wells
- Proposed Wells
- Surface Water Sources

Proposed Water Lines

- Raw Water
- Transmission
- Peach Creek Dam
- Existing Water Lines
- 24 Proposed Line Size

N
W E
S

20000 0 20000 Feet

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Exhibit VI - 4 Date NOVEMBER 1997

in the long term. The most salient fact developed in this analysis is that there is not an economic or demand based "trigger" that indicates that a certain amount of the demand must be met by surface water by a given year. The alternatives presented allow the determination of the relative costs of each individual alternative. Present worth costs (in 1997 dollars) are included in Tables VI-7 through VI-10 for ease of comparison of the relative contribution of each component.

It should also be noted that, while each of the alternatives using surface water assumed the use of water from all three sources, the costs for each increment were broken down individually to allow comparisons of the individual components. As a result, water from any one of the three surface water sources can be dropped and replaced by wells of the same total capacity.

The following summary timetable provides an estimate of timing issues involved with integrating surface water into the Brazos County Area.

Administrative: (1.5 - 3 years)	Setting up a regional water district to operate and control the surface water system.
Regulatory: (1-2 years)	Gaining approval from regulatory agencies discussed in chapters IV and V.
Funding: (1.5-2 years)	Proposing and approving bond issues, applying for grants or loans, and/or applying for matching funds.
Design/Construction: (2-3 years)	Designing and building diversion, pumping, transmission, and treatment facilities to deliver water to existing distribution systems.

Table VI-7. Alternative 1: Existing Groundwater Systems Remain Independent

			Existing Supply		New/Replacement Supply					Regional Totals					
Year	Required Supply1 (gpm)	Average Daily Demand (gpm)	Existing Capacity (gpm)	O&M Cost	Added Capacity (gpm)	New/Replace-ment Well Cost	Transmission Lines Cost	Conveyance Cost	Drawdown Cost	Total Capacity (gpm)	TOTAL COST	Unit Cost ($/1000 gal)	Pres. Worth ($/1000 gal)	Total PW Cost	Cumulative PW Cost
2000	45,271	21,594	50,405	$4,091,367	4,200	$653,471	$1,246,168	$218,647	$0	54,605	$6,209,653	$0.55	$0.44	4,998,526	4,998,526
2001	46,102	21,935	50,405	$4,214,108	6,300	$985,667	$1,291,863	$222,334	$15,014	56,705	$6,728,987	$0.56	$0.44	5,038,669	10,037,195
2002	46,932	22,275	50,405	$4,340,531	8,400	$1,325,158	$1,291,863	$226,022	$31,443	58,805	$7,215,017	$0.62	$0.43	5,025,683	15,062,877
2003	47,762	22,616	49,770	$4,415,433	8,400	$1,360,230	$1,302,503	$229,710	$49,371	58,170	$7,357,247	$0.62	$0.40	4,767,213	19,830,090
2004	48,593	22,956	49,770	$4,547,896	8,480	$1,422,015	$1,436,793	$233,397	$68,892	58,250	$7,708,993	$0.64	$0.39	4,646,633	24,476,723
2005	49,423	23,297	49,770	$4,684,332	8,480	$1,451,989	$1,446,440	$237,085	$90,100	58,250	$7,909,946	$0.65	$0.36	4,435,124	28,911,848
2006	50,253	23,638	49,770	$4,824,862	10,580	$1,834,187	$1,446,440	$240,772	$113,095	60,350	$8,459,357	$0.68	$0.36	4,412,261	33,324,108
2007	51,084	23,978	49,770	$4,969,608	10,580	$1,874,016	$1,446,440	$244,460	$137,984	60,350	$8,672,508	$0.69	$0.33	4,207,848	37,531,957
2008	51,914	24,319	49,770	$5,118,696	10,580	$1,915,447	$1,446,440	$248,147	$164,877	60,350	$8,893,608	$0.70	$0.31	4,014,069	41,546,026
2009	52,744	24,659	49,770	$5,272,257	12,680	$2,330,083	$1,468,990	$251,835	$193,890	62,450	$9,517,055	$0.73	$0.31	3,995,775	45,541,801
2010	53,575	25,000	49,770	$5,430,425	12,680	$2,381,998	$1,468,990	$255,522	$225,146	62,450	$9,762,082	$0.74	$0.29	3,812,698	49,354,499
2011	54,129	25,189	49,770	$5,593,338	12,680	$2,425,132	$1,468,990	$257,531	$257,096	62,450	$10,002,086	$0.76	$0.27	3,633,893	52,988,391
2012	54,682	25,378	49,770	$5,761,138	12,680	$2,469,797	$1,488,562	$259,540	$291,135	62,450	$10,270,172	$0.77	$0.26	3,470,969	56,459,361
2013	55,236	25,567	49,770	$5,933,972	12,680	$2,516,047	$1,488,562	$261,549	$327,373	62,450	$10,527,503	$0.78	$0.25	3,309,710	59,769,071
2014	55,790	25,756	47,370	$5,828,185	14,780	$3,067,525	$1,488,562	$263,557	$365,921	62,150	$11,013,751	$0.81	$0.24	3,221,005	62,990,076
2015	56,344	25,945	47,170	$5,978,191	14,780	$3,129,699	$1,488,562	$265,566	$406,898	61,950	$11,268,916	$0.83	$0.22	3,065,701	66,055,777
2016	56,898	26,135	47,170	$6,157,537	14,780	$3,190,242	$1,488,562	$267,575	$450,427	61,950	$11,554,343	$0.84	$0.21	2,924,048	68,979,824
2017	57,451	26,324	47,170	$6,342,263	16,880	$3,696,110	$1,489,277	$269,584	$496,636	64,050	$12,293,871	$0.89	$0.21	2,894,139	71,873,963
2018	58,005	26,513	47,170	$6,532,531	16,880	$3,766,370	$1,489,277	$271,593	$545,661	64,050	$12,605,432	$0.90	$0.20	2,760,451	74,634,413
2019	58,559	26,702	47,170	$6,728,507	16,880	$3,839,119	$1,489,277	$273,601	$597,643	64,050	$12,928,147	$0.92	$0.19	2,633,602	77,268,015
2020	59,113	26,891	47,170	$6,930,362	16,880	$3,914,444	$1,508,849	$275,610	$652,728	64,050	$13,281,994	$0.94	$0.18	2,516,915	79,784,930
2021	59,616	27,075	44,870	$6,784,898	18,980	$4,619,178	$1,509,484	$277,477	$710,709	63,850	$13,901,747	$0.98	$0.17	2,450,565	82,235,495
2022	60,118	27,258	42,580	$6,644,197	21,080	$5,357,687	$1,510,119	$279,345	$772,050	63,660	$14,563,398	$1.02	$0.17	2,388,092	84,623,588
2023	60,621	27,441	41,540	$6,679,899	22,160	$5,959,796	$1,525,999	$281,212	$836,915	63,700	$15,283,822	$1.06	$0.16	2,331,374	86,954,961
2024	61,124	27,625	40,590	$6,726,349	26,360	$7,298,298	$1,552,638	$283,080	$905,474	66,950	$16,765,839	$1.15	$0.16	2,379,013	89,333,974
2025	61,626	27,808	37,740	$6,438,010	28,460	$8,126,833	$1,553,273	$284,947	$977,907	66,200	$17,382,971	$1.19	$0.16	2,294,494	91,628,469
2026	62,129	27,992	35,560	$6,262,275	35,260	$9,781,436	$1,569,392	$286,814	$1,054,399	70,820	$18,934,317	$1.29	$0.16	2,324,899	93,953,368
2027	62,632	28,175	35,560	$6,450,143	33,660	$10,291,055	$1,569,392	$288,682	$1,135,145	69,220	$19,734,416	$1.33	$0.15	2,254,085	96,207,453
2028	63,135	28,358	27,445	$5,117,022	40,620	$13,179,275	$1,592,973	$290,549	$1,220,346	68,065	$21,400,166	$1.44	$0.15	2,273,813	98,481,266
2029	63,637	28,542	22,645	$4,336,318	47,420	$15,975,768	$1,642,479	$292,417	$1,310,215	70,065	$23,557,197	$1.57	$0.16	2,328,374	100,809,640
2030	64,140	28,725	14,690	$2,896,080	55,900	$19,809,030	$1,661,932	$294,284	$1,404,972	70,590	$26,066,299	$1.73	$0.16	2,396,625	103,206,265
2031	64,695	28,932	9,380	$1,899,073	60,180	$21,982,884	$1,666,617	$296,388	$1,506,049	69,560	$27,351,011	$1.80	$0.15	2,339,298	105,545,564
2032	65,249	29,139	5,880	$1,245,491	63,860	$24,181,918	$1,671,698	$298,492	$1,612,637	69,740	$29,010,236	$1.89	$0.15	2,308,102	107,853,666
2033	65,804	29,345	5,380	$1,132,715	66,460	$25,453,818	$1,806,369	$300,596	$1,724,997	71,840	$30,418,495	$1.97	$0.15	2,251,298	110,104,964
2034	66,359	29,552	5,380	$1,166,697	66,460	$25,882,029	$1,712,796	$302,700	$1,843,400	71,840	$30,907,622	$1.99	$0.14	2,127,906	112,232,870
2035	66,913	29,758	-	$0	73,340	$29,772,023	$1,774,570	$304,804	$1,968,131	73,340	$33,819,527	$2.16	$0.14	2,165,937	114,398,807
2036	67,468	29,965	-	$0	73,420	$30,155,093	$1,791,165	$306,908	$2,099,487	73,420	$34,352,852	$2.18	$0.13	2,046,587	116,445,394
2037	68,023	30,172	-	$0	73,420	$30,474,100	$1,615,420	$309,012	$2,237,776	73,420	$34,636,307	$2.18	$0.12	1,919,522	118,364,915
2038	68,577	30,378	-	$0	73,420	$32,109,037	$1,624,075	$311,115	$2,383,321	73,420	$36,427,549	$2.28	$0.12	1,877,945	120,242,861
2039	69,132	30,585	-	$0	73,420	$32,632,859	$1,624,075	$313,219	$2,536,459	73,420	$37,106,613	$2.31	$0.11	1,779,491	122,022,352
2040	69,687	30,792	-	$0	75,520	$33,860,110	$557,622	$315,323	$2,697,540	75,520	$37,430,595	$2.31	$0.10	1,669,793	123,692,145
2041	70,299	31,046	-	$0	75,520	$34,858,158	$557,622	$317,884	$2,871,058	75,520	$38,604,722	$2.37	$0.10	1,602,020	125,294,165
2042	70,911	31,300	-	$0	75,520	$35,487,940	$511,927	$320,445	$3,053,721	75,520	$39,374,033	$2.39	$0.09	1,519,949	126,814,114
2043	71,523	31,555	-	$0	75,520	$36,781,880	$511,927	$323,008	$3,245,958	75,520	$40,862,771	$2.46	$0.09	1,467,366	128,281,480
2044	72,135	31,809	-	$0	77,620	$38,628,500	$480,500	$325,567	$3,448,213	77,620	$42,882,780	$2.56	$0.09	1,432,469	129,713,949
2045	72,747	32,063	-	$0	77,620	$39,330,419	$470,853	$328,128	$3,660,951	77,620	$43,790,352	$2.60	$0.08	1,360,731	131,074,680
2046	73,359	32,318	-	$0	77,620	$40,057,247	$470,853	$330,689	$3,884,659	77,620	$44,743,448	$2.63	$0.08	1,293,346	132,368,026
2047	73,971	32,572	-	$0	77,700	$40,915,384	$470,853	$333,250	$4,119,842	77,700	$45,839,328	$2.68	$0.07	1,232,580	133,600,605
2048	74,583	32,826	-	$0	79,800	$42,534,071	$470,853	$335,811	$4,367,027	79,800	$47,707,762	$2.77	$0.07	1,193,321	134,793,927
2049	75,195	33,081	-	$0	80,300	$43,485,224	$454,258	$338,372	$4,626,764	80,300	$48,904,618	$2.81	$0.07	1,137,915	135,931,841
2050	75,807	33,335	-	$0	80,300	$44,325,758	$454,258	$340,933	$4,899,628	80,300	$50,020,577	$2.85	$0.06	1,082,680	137,014,521

Table VI-8. Alternative 2: Regional Groundwater System

			Existing Supply		Regional System Supply					Regional Totals					
Year	Required Supply[1] (gpm)	Average Daily Demand (gpm)	Existing Capacity (gpm)	O&M Cost	Added Capacity (gpm)	New Wells Cost	Transmission Lines Cost	Conveyance Cost	Drawdown Cost	Total Capacity (gpm)	TOTAL COST	Unit Cost ($/1000 gal)	Pres. Worth ($/1000 gal)	Total PW Cost	Cumulative PW Cost
2000	45,271	21,594	50,405	$4,091,367	-	$0	$870,232	$152,479	$0	50,405	$5,114,078	$0.45	$0.36	4,116,631	4,116,631
2001	46,102	21,935	50,405	$4,214,108	-	$0	$870,232	$154,197	$14,413	50,405	$5,252,950	$0.46	$0.34	3,933,411	8,050,043
2002	46,932	22,275	50,405	$4,340,531	-	$0	$870,232	$155,915	$29,147	50,405	$5,395,824	$0.46	$0.32	3,758,508	11,808,551
2003	47,762	22,616	49,770	$4,415,433	-	$0	$1,068,760	$294,755	$44,202	49,770	$5,823,149	$0.49	$0.32	3,773,177	15,581,727
2004	48,593	22,956	49,770	$4,547,896	-	$0	$1,068,760	$297,967	$59,578	49,770	$5,974,200	$0.50	$0.30	3,600,978	19,182,706
2005	49,423	23,297	49,770	$4,684,332	-	$0	$1,068,760	$301,179	$75,275	49,770	$6,129,546	$0.50	$0.28	3,436,850	22,619,556
2006	50,253	23,638	49,770	$4,824,862	2,100	$398,515	$1,346,458	$341,273	$91,293	51,870	$7,002,401	$0.56	$0.29	3,652,337	26,271,893
2007	51,084	23,978	49,770	$4,969,608	2,100	$405,719	$1,346,458	$344,874	$107,632	51,870	$7,174,291	$0.57	$0.28	3,480,923	29,752,815
2008	51,914	24,319	49,770	$5,118,696	4,200	$851,695	$1,391,301	$375,682	$133,997	53,970	$7,871,370	$0.62	$0.28	3,552,689	33,305,505
2009	52,744	24,659	49,770	$5,272,257	4,200	$867,416	$1,391,301	$379,283	$152,191	53,970	$8,062,448	$0.62	$0.26	3,385,052	36,690,557
2010	53,575	25,000	49,770	$5,430,425	4,200	$871,037	$1,391,301	$370,081	$164,999	53,970	$8,227,842	$0.63	$0.24	3,213,482	39,904,039
2011	54,129	25,189	49,770	$5,593,338	6,300	$1,335,252	$1,435,798	$372,081	$182,479	56,070	$8,918,947	$0.67	$0.24	3,240,374	43,144,413
2012	54,682	25,378	49,770	$5,761,138	6,300	$1,357,575	$1,435,798	$374,081	$200,138	56,070	$9,128,729	$0.68	$0.23	3,085,200	46,229,613
2013	55,236	25,567	49,770	$5,933,972	6,300	$1,380,658	$1,435,798	$376,080	$217,975	56,070	$9,344,484	$0.70	$0.22	2,937,784	49,167,397
2014	55,790	25,756	47,370	$5,828,185	10,500	$2,392,489	$1,538,523	$378,080	$235,991	57,870	$10,373,269	$0.77	$0.22	3,033,694	52,201,091
2015	56,344	25,945	47,170	$5,978,191	10,500	$2,436,036	$1,538,523	$380,080	$254,185	57,670	$10,587,015	$0.78	$0.21	2,880,190	55,081,281
2016	56,898	26,135	47,170	$6,157,537	10,500	$2,477,541	$2,120,103	$481,949	$272,557	57,670	$11,509,688	$0.84	$0.21	2,912,747	57,994,028
2017	57,451	26,324	47,170	$6,342,263	10,500	$2,520,458	$2,120,103	$484,472	$291,108	57,670	$11,758,404	$0.85	$0.20	2,768,083	60,762,111
2018	58,005	26,513	47,170	$6,532,531	12,600	$3,089,157	$2,174,829	$486,994	$309,837	59,770	$12,593,349	$0.90	$0.20	2,757,805	63,519,915
2019	58,559	26,702	47,170	$6,728,507	12,600	$3,142,529	$2,174,829	$489,517	$328,744	59,770	$12,864,125	$0.92	$0.19	2,620,560	66,140,475
2020	59,113	26,891	47,170	$6,930,362	12,600	$3,226,543	$2,174,829	$502,130	$354,962	59,770	$13,188,826	$0.93	$0.18	2,499,260	68,639,735
2021	59,616	27,075	44,870	$6,784,898	16,800	$4,473,358	$2,234,630	$504,576	$374,526	61,670	$14,371,988	$1.01	$0.18	2,533,458	71,173,193
2022	60,118	27,258	42,580	$6,644,197	18,900	$5,194,809	$2,432,280	$577,775	$394,263	61,480	$15,243,324	$1.06	$0.17	2,499,586	73,672,779
2023	60,621	27,441	41,540	$6,679,899	21,000	$5,899,660	$2,548,188	$601,956	$414,173	62,540	$16,143,877	$1.12	$0.17	2,462,565	76,135,344
2024	61,124	27,625	40,590	$6,726,349	21,000	$6,042,227	$2,548,188	$604,846	$434,256	61,590	$16,355,866	$1.13	$0.16	2,320,839	78,456,183
2025	61,626	27,808	37,740	$6,438,010	25,200	$7,479,313	$2,606,411	$607,737	$454,512	62,940	$17,585,983	$1.20	$0.16	2,321,291	80,777,475
2026	62,129	27,992	35,560	$6,262,275	27,300	$8,330,914	$2,606,411	$610,627	$474,941	62,860	$18,285,168	$1.24	$0.15	2,245,192	83,022,667
2027	62,632	28,175	35,560	$6,450,143	27,300	$8,476,883	$2,606,411	$613,518	$495,542	62,860	$18,642,498	$1.26	$0.14	2,129,365	85,152,032
2028	63,135	28,358	27,445	$5,117,022	35,700	$11,659,238	$3,414,137	$835,229	$516,317	63,145	$21,541,942	$1.45	$0.15	2,288,877	87,440,909
2029	63,637	28,542	22,645	$4,336,318	42,000	$14,079,005	$3,472,000	$993,532	$537,264	64,645	$23,418,119	$1.56	$0.15	2,314,628	89,755,537
2030	64,140	28,725	14,690	$2,896,080	50,400	$17,624,920	$4,614,695	$1,016,718	$568,762	65,090	$26,721,175	$1.77	$0.16	2,456,836	92,212,373
2031	64,695	28,932	9,380	$1,899,073	56,700	$20,301,270	$4,715,723	$1,021,942	$590,740	66,080	$28,528,747	$1.88	$0.16	2,440,029	94,652,402
2032	65,249	29,139	5,880	$1,245,491	60,900	$22,263,480	$4,770,573	$1,027,166	$612,913	66,780	$29,919,622	$1.95	$0.16	2,380,454	97,032,856
2033	65,804	29,345	5,380	$1,132,715	60,900	$22,725,944	$4,770,573	$1,032,389	$635,281	66,280	$30,296,903	$1.96	$0.15	2,242,299	99,275,155
2034	66,359	29,552	5,380	$1,166,697	63,000	$23,712,017	$4,816,912	$1,037,613	$657,844	68,380	$31,391,083	$2.02	$0.14	2,161,191	101,436,346
2035	66,913	29,758	-	$0	67,200	$25,681,859	$4,855,779	$1,042,837	$680,601	67,200	$32,261,075	$2.06	$0.13	2,066,128	103,502,474
2036	67,468	29,965	-		69,300	$27,262,275	$4,904,940	$1,048,060	$703,554	69,300	$33,918,828	$2.15	$0.13	2,020,741	105,523,215
2037	68,023	30,172	-		69,300	$27,750,571	$4,904,940	$1,053,284	$726,701	69,300	$34,435,495	$2.17	$0.12	1,908,393	107,431,608
2038	68,577	30,378	-		69,300	$28,255,368	$4,904,940	$1,058,508	$750,043	69,300	$34,968,858	$2.19	$0.11	1,802,745	109,234,354
2039	69,132	30,585	-		69,300	$28,777,217	$4,904,940	$1,063,731	$773,580	69,300	$35,519,468	$2.21	$0.11	1,703,378	110,937,731
2040	69,687	30,792	-		71,400	$30,248,599	$4,090,039	$1,089,850	$812,896	71,400	$36,241,385	$2.24	$0.10	1,616,742	112,554,474
2041	70,299	31,046	-		71,400	$31,222,604	$4,090,039	$1,096,281	$838,135	71,400	$37,247,059	$2.28	$0.09	1,545,680	114,100,154
2042	70,911	31,300	-		71,400	$31,826,768	$4,090,039	$1,102,712	$863,614	71,400	$37,883,132	$2.30	$0.09	1,462,396	115,562,550
2043	71,523	31,555	-		73,500	$33,588,814	$3,940,375	$1,109,142	$889,332	73,500	$39,527,664	$2.38	$0.09	1,419,423	116,981,972
2044	72,135	31,809	-		73,500	$34,237,666	$3,940,375	$1,115,573	$915,291	73,500	$40,208,906	$2.41	$0.08	1,343,150	118,325,122
2045	72,747	32,063	-		73,500	$34,908,789	$3,940,375	$1,122,004	$941,489	73,500	$40,912,658	$2.43	$0.08	1,271,310	119,596,432
2046	73,359	32,318	-		73,500	$36,054,971	$3,662,677	$1,128,435	$967,927	73,500	$41,814,010	$2.46	$0.07	1,208,668	120,805,100
2047	73,971	32,572	-		75,600	$37,587,151	$3,708,972	$1,134,866	$994,605	75,600	$43,425,594	$2.54	$0.07	1,167,677	121,972,777
2048	74,583	32,826	-		75,600	$38,332,456	$3,664,129	$1,141,296	$1,021,523	75,600	$44,159,405	$2.56	$0.06	1,104,566	123,077,342
2049	75,195	33,081	-		75,600	$40,091,184	$3,664,129	$1,147,727	$1,048,680	75,600	$45,951,721	$2.64	$0.06	1,069,207	124,146,549
2050	75,807	33,335	-		77,700	$42,224,604	$3,705,208	$1,179,881	$1,100,061	77,700	$48,209,754	$2.75	$0.06	1,043,485	125,190,034

Table VI-9. Alternative 3: Regional Surface Water System for Average Daily Demand

Year	Supply1 (gpm)	Average Daily Demand (gpm)	Existing Supply: Existing Capacity (gpm)	Existing Supply: O&M Cost	Replacement of Existing Supply: Added Capacity (gpm)	Replacement of Existing Supply: New Wells Cost	Replacement of Existing Supply: Conveyance Cost	Surface Water From Brazos River: Added Capacity (gpm)	Surface Water From Brazos River: Surface Water Cost	Diversion/Pumping Facilities Cost	Transmission Line Cost	Conveyance Cost	Low-Flow Storage Cost	Treatment Plant Cost	Treament Plant O&M Cost
2000	45,271	21,594	50,405	$4,091,367	2,100	$320,381	$25,242		$270,691						
2001	46,102	21,935	50,405	$4,214,108	2,100	$328,942	$25,999		$273,398						
2002	46,932	22,275	50,405	$4,340,531	2,100	$337,889	$26,779		$276,132						
2003	47,762	22,616	49,770	$4,415,433	2,735	$347,240	$35,923		$278,893						
2004	48,593	22,956	49,770	$4,547,896	2,735	$357,010	$37,001		$281,682						
2005	49,423	23,297	49,770	$4,684,332	2,735	$367,215	$38,111		$284,499						
2006	50,253	23,638	49,770	$4,824,862	2,735	$377,873	$39,254		$287,344						
2007	51,084	23,978	49,770	$4,969,608	2,735	$389,003	$40,432		$290,217						
2008	51,914	24,319	49,770	$5,118,696	2,735	$400,622	$41,645		$293,120						
2009	52,744	24,659	49,770	$5,272,257	2,735	$412,750	$42,894		$296,051						
2010	53,575	25,000	49,770	$5,430,425	2,735	$425,407	$44,181	6850	$299,011	$419,068	$351,555	$221,308	$186,563	$2,645,374	$3,489,585
2011	54,129	25,189	49,770	$5,593,338	2,735	$434,840	$45,506	6850	$302,001	$419,068	$351,555	$227,947	$186,563	$2,645,374	$3,594,273
2012	54,682	25,378	49,770	$5,761,138	2,735	$444,618	$46,871	6850	$305,021	$419,068	$351,555	$234,786	$186,563	$2,645,374	$3,702,101
2013	55,236	25,567	49,770	$5,933,972	2,735	$454,753	$48,278	6850	$308,072	$419,068	$351,555	$241,829	$186,563	$2,645,374	$3,813,164
2014	55,790	25,756	47,370	$5,828,185	5,135	$1,031,416	$93,361	6850	$311,152	$419,068	$351,555	$249,084	$186,563	$2,645,374	$3,927,559
2015	56,344	25,945	47,170	$5,976,191	5,335	$1,053,532	$99,907	6850	$314,284	$419,068	$351,555	$256,557	$186,563	$2,645,374	$4,045,385
2016	56,898	26,135	47,170	$6,157,537	5,335	$1,076,453	$102,905	6850	$317,406	$419,068	$351,555	$264,253	$186,563	$2,645,374	$4,166,747
2017	57,451	26,324	47,170	$6,342,263	5,335	$1,100,208	$105,992	6850	$320,581	$419,068	$351,555	$272,181	$186,563	$2,645,374	$4,291,749
2018	58,005	26,513	47,170	$6,532,531	5,335	$1,124,827	$109,171	6850	$323,786	$419,068	$351,555	$280,346	$186,563	$2,645,374	$4,420,502
2019	58,559	26,702	47,170	$6,728,507	5,335	$1,150,339	$112,447	6850	$327,024	$419,068	$351,555	$288,757	$186,563	$2,645,374	$4,553,117
2020	59,113	26,891	47,170	$6,930,362	5,335	$1,828,578	$115,820	6850	$330,294	$419,068	$351,555	$297,419	$186,563	$2,645,374	$4,689,710
2021	59,616	27,075	44,870	$6,784,898	7,635	$1,868,177	$170,724	6850	$333,597	$419,068	$351,555	$306,342	$186,563	$2,645,374	$4,830,402
2022	60,118	27,258	42,580	$6,644,197	9,925	$2,620,011	$228,588	6850	$336,933	$419,068	$351,555	$315,532	$186,563	$2,645,374	$4,975,314
2023	60,621	27,441	41,540	$6,679,899	10,965	$2,904,307	$260,117	6850	$340,303	$419,068	$351,555	$324,998	$186,563	$2,645,374	$5,124,573
2024	61,124	27,625	40,590	$6,726,349	11,915	$3,754,179	$291,133	6850	$343,706	$419,068	$351,555	$334,748	$186,563	$2,645,374	$5,278,310
2025	61,626	27,808	37,740	$6,438,010	14,765	$3,828,787	$371,594	6850	$347,143	$419,068	$351,555	$344,791	$186,563	$2,645,374	$5,436,660
2026	62,129	27,992	35,560	$6,262,275	16,945	$4,984,935	$439,252	6850	$350,614	$419,068	$351,555	$355,134	$186,563	$2,645,374	$5,599,760
2027	62,632	28,175	35,560	$6,450,143	18,945	$6,760,193	$452,430	6850	$354,120	$419,068	$351,555	$365,788	$186,563	$2,645,374	$5,767,752
2028	63,135	28,358	27,445	$5,117,022	25,080	$9,795,223	$689,172	6850	$357,662	$419,068	$351,555	$376,762	$186,563	$2,645,374	$5,940,785
2029	63,637	28,542	22,845	$4,336,318	29,660	$10,381,497	$845,812	6850	$361,238	$419,068	$351,555	$388,065	$186,563	$2,645,374	$6,119,008
2030	64,140	28,725	14,690	$2,896,080	37,615	$14,725,001	$1,103,279	6850	$364,851	$419,068	$351,555	$399,707	$186,563	$2,645,374	$6,302,579
2031	64,695	28,932	9,380	$1,899,073	43,125	$17,265,481	$1,295,948	6850	$368,499	$419,068	$351,555	$411,698	$186,563	$2,645,374	$6,491,656
2032	65,249	29,139	5,880	$1,245,491	46,625	$17,622,646	$1,443,160	6850	$372,184	$419,068	$351,555	$424,049	$186,563	$2,645,374	$6,686,406
2033	65,804	29,345	5,380	$1,132,715	47,125	$18,304,112	$1,502,395	6850	$375,906	$419,068	$351,555	$436,771	$186,563	$2,645,374	$6,886,998
2034	66,359	29,552	5,380	$1,166,697	47,125	$18,690,109	$1,547,467	6850	$379,665	$419,068	$351,555	$449,874	$186,563	$2,645,374	$7,093,608
2035	66,913	29,758	-	$0	52,505	$21,988,206	$1,775,857	6850	$383,462	$419,068	$351,555	$463,370	$186,563	$2,645,374	$7,306,416
2036	67,468	29,965	-		52,505	$23,050,184	$1,829,132	6850	$387,296	$419,068	$351,555	$477,271	$186,563	$2,645,374	$7,525,609
2037	68,023	30,172	-		52,505	$23,533,101	$1,884,006	6850	$391,169	$419,068	$351,555	$491,589	$186,563	$2,645,374	$7,751,377
2038	68,577	30,378	-		52,505	$25,140,160	$1,940,526	6850	$395,061	$419,068	$351,555	$506,337	$186,563	$2,645,374	$7,983,918
2039	69,132	30,585	-		52,505	$25,657,660	$1,998,742	6850	$399,032	$419,068	$351,555	$521,527	$186,563	$2,645,374	$8,223,436
2040	69,687	30,792	-		52,505	$26,208,146	$2,058,704	6850	$403,022	$419,068	$351,555	$537,173	$186,563	$2,645,374	$8,470,139
2041	70,299	31,046	-		52,505	$27,389,098	$2,120,466	6850	$407,052	$419,068	$351,555	$553,288	$186,563	$2,645,374	$8,724,243
2042	70,911	31,300	-		52,505	$27,985,888	$2,184,080	6850	$411,123	$419,068	$351,555	$569,886	$186,563	$2,645,374	$8,985,970
2043	71,523	31,555	-		52,505	$29,991,019	$2,249,602	6850	$415,234	$419,068	$351,555	$586,983	$186,563	$2,645,374	$9,255,549
2044	72,135	31,809	-		52,505	$30,634,017	$2,317,090	6850	$419,386	$419,068	$351,555	$604,593	$186,563	$2,645,374	$9,533,216
2045	72,747	32,063	-		52,505	$31,300,085	$2,386,603	6850	$423,580	$419,068	$351,555	$622,730	$186,563	$2,645,374	$9,819,212
2046	73,359	32,318	-		52,505	$31,990,028	$2,458,201	6850	$427,816	$419,068	$351,555	$641,412	$186,563	$2,645,374	$10,113,789
2047	73,971	32,572	-		52,505	$32,704,680	$2,531,947	6850	$432,094	$419,068	$351,555	$660,655	$186,563	$2,645,374	$10,417,202
2048	74,583	32,826	-		52,505	$33,444,902	$2,607,905	6850	$436,415	$419,068	$351,555	$680,474	$186,563	$2,645,374	$10,729,718
2049	75,195	33,081	-		52,505	$33,939,264	$2,686,142	6850	$440,779	$419,068	$351,555	$700,889	$186,563	$2,645,374	$11,051,610
2050	75,807	33,335	-		52,505	$33,939,264	$2,766,727	6850	$445,187	$419,068	$351,555	$721,915	$186,563	$2,645,374	$11,383,158

Table VI-9. Alternative 3: Regional Surface Water System for Average Daily Demand (continued)

Year	Surface Water From Lake Somerville							Surface Water From Peach Creek Lake							
	Added Capacity (gpm)	Surface Water Cost	Diversion/Pumping Facilities Cost	Transmission Line Cost	Conveyance Cost	Treatment Plant Cost	Treament Plant O&M Cost	Added Capacity (gpm)	Surface Water Cost	Navasota River Diversion Cost	Peach Creek Reservoir Cost	Transmission Line Cost	Conveyance Cost	Treatment Plant Cost	Treament Plant O&M Cost
2000		$687,139							$174,908						
2001		$694,010							$176,657						
2002		$700,950							$178,424						
2003		$707,960							$180,208						
2004		$715,039							$182,010						
2005		$722,190							$183,830						
2006		$729,412							$185,668						
2007		$736,706							$187,525						
2008		$744,073							$189,400						
2009		$751,513							$191,294						
2010	20457	$759,029	$556,658	$1,190,017	$660,919	$7,907,157	$10,421,378		$193,207						
2011	20457	$766,619	$556,658	$1,190,017	$680,747	$7,907,157	$10,734,020		$195,139						
2012	20457	$774,285	$556,658	$1,190,017	$701,169	$7,907,157	$11,056,040		$197,091						
2013	20457	$782,028	$556,658	$1,190,017	$722,205	$7,907,157	$11,387,721		$199,062						
2014	20457	$789,848	$556,658	$1,190,017	$743,871	$7,907,157	$11,729,353		$201,052						
2015	20457	$797,747	$556,658	$1,190,017	$766,187	$7,907,157	$12,081,234		$203,063						
2016	20457	$805,724	$556,658	$1,190,017	$789,172	$7,907,157	$12,443,671		$205,093						
2017	20457	$813,781	$556,658	$1,190,017	$812,848	$7,907,157	$12,816,981		$207,144						
2018	20457	$821,919	$556,658	$1,190,017	$837,233	$7,907,157	$13,201,490		$209,216						
2019	20457	$830,138	$556,658	$1,190,017	$862,350	$7,907,157	$13,597,535		$211,308						
2020	20457	$838,440	$556,658	$1,190,017	$888,221	$7,907,157	$14,005,461		$213,421						
2021	20457	$846,824	$556,658	$1,190,017	$914,867	$7,907,157	$14,425,625		$215,555						
2022	20457	$855,292	$556,658	$1,190,017	$942,313	$7,907,157	$14,858,393		$217,711						
2023	20457	$863,845	$556,658	$1,190,017	$970,583	$7,907,157	$15,304,145		$219,888						
2024	20457	$872,484	$556,658	$1,190,017	$999,700	$7,907,157	$15,763,270	5400	$222,087	$2,557,380	$1,181,686	$1,800,008	$448,812	$3,154,361	$4,161,004
2025	20457	$881,209	$556,658	$1,190,017	$1,029,691	$7,907,157	$16,236,168	5400	$224,308	$2,567,380	$1,181,686	$1,800,008	$462,070	$3,154,361	$4,286,834
2026	20457	$890,021	$556,658	$1,190,017	$1,060,582	$7,907,157	$16,723,253	5400	$226,551	$2,557,380	$1,181,686	$1,800,008	$475,932	$3,154,361	$4,414,409
2027	20457	$898,921	$556,658	$1,190,017	$1,092,399	$7,907,157	$17,224,950	5400	$228,816	$2,557,380	$1,181,686	$1,800,008	$490,210	$3,154,361	$4,546,841
2028	20457	$907,910	$556,658	$1,190,017	$1,125,171	$7,907,157	$17,741,699	5400	$231,104	$2,557,380	$1,181,686	$1,800,008	$504,916	$3,154,361	$4,683,247
2029	20457	$916,989	$556,658	$1,190,017	$1,158,926	$7,907,157	$18,273,950	5400	$233,415	$2,557,380	$1,181,686	$1,800,008	$520,064	$3,154,361	$4,823,744
2030	20457	$926,159	$556,658	$1,190,017	$1,193,694	$7,907,157	$18,822,168	5400	$235,750	$2,557,380	$1,181,686	$1,800,008	$535,666	$3,154,361	$4,968,456
2031	20457	$935,421	$556,658	$1,190,017	$1,229,505	$7,907,157	$19,386,833	5400	$238,107	$2,557,380	$1,181,686	$1,800,008	$551,736	$3,154,361	$5,117,510
2032	20457	$944,775	$556,658	$1,190,017	$1,266,390	$7,907,157	$19,968,438	5400	$240,488	$2,557,380	$1,181,686	$1,800,008	$568,288	$3,154,361	$5,271,035
2033	20457	$954,223	$556,658	$1,190,017	$1,304,382	$7,907,157	$20,567,492	5400	$242,893	$2,557,380	$1,181,686	$1,800,008	$585,336	$3,154,361	$5,429,166
2034	20457	$963,765	$556,658	$1,190,017	$1,343,513	$7,907,157	$21,184,516	5400	$245,322	$2,557,380	$1,181,686	$1,800,008	$602,896	$3,154,361	$5,592,041
2035	20457	$973,402	$556,658	$1,190,017	$1,383,819	$7,907,157	$21,820,052	5400	$247,775	$2,557,380	$1,181,686	$1,800,008	$620,983	$3,154,361	$5,759,802
2036	20457	$983,137	$556,658	$1,190,017	$1,425,333	$7,907,157	$22,474,653	5400	$250,253	$2,557,380	$1,181,686	$1,800,008	$639,613	$3,154,361	$5,932,597
2037	20457	$992,968	$556,658	$1,190,017	$1,468,093	$7,907,157	$23,148,893	5400	$252,755	$2,557,380	$1,181,686	$1,800,008	$658,601	$3,154,361	$6,110,574
2038	20457	$1,002,898	$556,658	$1,190,017	$1,512,136	$7,907,157	$23,843,360	5400	$255,283	$2,557,380	$1,181,686	$1,800,008	$678,565	$3,154,361	$6,293,892
2039	20457	$1,012,927	$556,658	$1,190,017	$1,557,500	$7,907,157	$24,558,660	5400	$257,836	$2,557,380	$1,181,686	$1,800,008	$698,922	$3,154,361	$6,482,708
2040	20457	$1,023,056	$556,658	$1,190,017	$1,604,225	$7,907,157	$25,295,420	5400	$260,414	$2,557,380	$1,181,686	$1,800,008	$719,890	$3,154,361	$6,677,190
2041	20457	$1,033,286	$556,658	$1,190,017	$1,652,352	$7,907,157	$26,054,283	5400	$263,018	$2,557,380	$1,181,686	$1,800,008	$741,487	$3,154,361	$6,877,506
2042	20457	$1,043,619	$556,658	$1,190,017	$1,701,922	$7,907,157	$26,835,911	5400	$265,649	$2,557,380	$1,181,686	$1,800,008	$763,731	$3,154,361	$7,083,831
2043	20457	$1,054,055	$556,658	$1,190,017	$1,752,980	$7,907,157	$27,640,989	5400	$268,305	$2,557,380	$1,181,686	$1,800,008	$786,643	$3,154,361	$7,296,345
2044	20457	$1,064,596	$556,658	$1,190,017	$1,805,569	$7,907,157	$28,470,218	5400	$270,966	$2,557,380	$1,181,686	$1,800,008	$810,242	$3,154,361	$7,515,236
2045	20457	$1,075,242	$556,658	$1,190,017	$1,859,736	$7,907,157	$29,324,325	5400	$273,698	$2,557,380	$1,181,686	$1,800,008	$834,550	$3,154,361	$7,740,693
2046	20457	$1,085,994	$556,658	$1,190,017	$1,915,529	$7,907,157	$30,204,055	5400	$276,435	$2,557,380	$1,181,686	$1,800,008	$859,586	$3,154,361	$7,972,914
2047	20457	$1,096,854	$556,658	$1,190,017	$1,972,994	$7,907,157	$31,110,176	5400	$279,199	$2,557,380	$1,181,686	$1,800,008	$885,374	$3,154,361	$8,212,101
2048	20457	$1,107,823	$556,658	$1,190,017	$2,032,184	$7,907,157	$32,043,482	5400	$281,991	$2,557,380	$1,181,686	$1,800,008	$911,935	$3,154,361	$8,458,464
2049	20457	$1,118,901	$556,658	$1,190,017	$2,093,150	$7,907,157	$33,004,786	5400	$284,811	$2,557,380	$1,181,686	$1,800,008	$939,293	$3,154,361	$8,712,218
2050	20457	$1,130,090	$556,658	$1,190,017	$2,155,944	$7,907,157	$33,994,930	5400	$287,659	$2,557,380	$1,181,686	$1,800,008	$967,472	$3,154,361	$8,973,585

Table VI-9. Alternative 3: Regional Surface Water System for Average Daily Demand (continued)

Year	Surface Water System Totals Total Capacity (gpm)	Average Daily Demand (gpm)	TOTAL COST	Unit Cost ($/1000 gal)	Pres. Worth ($/1000 gal)	Total PW Cost	Cumulative PW Cost
2000	52,505	21,594	$5,569,728	$0.49	$0.40	$4,483,411	$4,483,411
2001	52,505	21,935	$5,713,114	$0.50	$0.37	$4,277,983	$8,761,394
2002	52,505	22,275	$5,860,706	$0.50	$0.35	$4,082,325	$12,843,719
2003	52,505	22,616	$5,965,656	$0.50	$0.33	$3,865,516	$16,709,235
2004	52,505	22,956	$6,120,637	$0.51	$0.31	$3,689,244	$20,398,479
2005	52,505	23,297	$6,280,177	$0.51	$0.29	$3,521,309	$23,919,788
2006	52,505	23,638	$6,444,413	$0.52	$0.27	$3,361,300	$27,281,088
2007	52,505	23,978	$6,613,491	$0.52	$0.25	$3,208,825	$30,489,913
2008	52,505	24,319	$6,787,555	$0.53	$0.24	$3,063,517	$33,553,430
2009	52,505	24,659	$6,966,760	$0.54	$0.23	$2,925,023	$36,478,453
2010	79,812	25,000	$35,200,843	$2.68	$1.05	$13,748,111	$50,226,564
2011	79,812	25,189	$35,830,822	$2.71	$0.98	$13,017,820	$63,244,385
2012	79,812	25,378	$36,479,513	$2.73	$0.92	$12,328,836	$75,573,220
2013	79,812	25,567	$37,147,475	$2.76	$0.87	$11,678,683	$87,251,903
2014	79,812	25,756	$38,161,274	$2.82	$0.82	$11,160,380	$98,412,283
2015	79,812	25,945	$38,852,458	$2.85	$0.78	$10,569,785	$108,982,068
2016	79,812	26,135	$39,585,354	$2.88	$0.73	$10,017,831	$118,999,899
2017	79,812	26,324	$40,340,120	$2.92	$0.69	$9,496,595	$128,496,494
2018	79,812	26,513	$41,117,414	$2.95	$0.65	$9,004,260	$137,500,754
2019	79,812	26,702	$41,917,914	$2.99	$0.61	$8,539,127	$146,039,881
2020	79,812	26,891	$43,394,119	$3.07	$0.58	$8,223,112	$154,262,993
2021	79,812	27,075	$43,953,405	$3.09	$0.54	$7,747,996	$162,010,989
2022	79,812	27,258	$45,250,678	$3.16	$0.52	$7,420,164	$169,431,152
2023	79,812	27,441	$46,249,051	$3.21	$0.49	$7,054,768	$176,485,921
2024	85,212	27,625	$61,145,408	$4.21	$0.60	$8,676,315	$185,162,236
2025	85,212	27,808	$61,836,069	$4.23	$0.56	$8,162,156	$193,324,391
2026	85,212	27,992	$63,712,544	$4.33	$0.53	$7,823,111	$201,147,502
2027	85,212	28,175	$66,582,392	$4.50	$0.51	$7,605,109	$208,752,612
2028	85,212	28,358	$69,420,500	$4.66	$0.49	$7,376,075	$216,128,687
2029	85,212	28,542	$70,308,854	$4.69	$0.46	$6,949,270	$223,077,957
2030	85,212	28,725	$74,423,216	$4.93	$0.45	$6,842,725	$229,920,682
2031	85,212	28,932	$77,141,293	$5.07	$0.43	$6,597,800	$236,518,482
2032	85,212	29,139	$78,003,177	$5.09	$0.41	$6,206,061	$242,724,543
2033	85,212	29,345	$79,672,215	$5.17	$0.38	$5,896,607	$248,621,150
2034	85,212	29,552	$81,209,300	$5.23	$0.36	$5,591,040	$254,212,190
2035	85,212	29,758	$84,670,971	$5.41	$0.35	$5,422,667	$259,634,856
2036	85,212	29,965	$86,924,905	$5.52	$0.33	$5,178,621	$264,813,477
2037	85,212	30,172	$88,633,155	$5.59	$0.31	$4,911,992	$269,725,469
2038	85,212	30,378	$91,501,983	$5.73	$0.30	$4,717,191	$274,442,660
2039	85,212	30,585	$93,318,777	$5.81	$0.28	$4,475,211	$278,917,871
2040	85,212	30,792	$95,207,206	$5.88	$0.26	$4,247,231	$283,165,102
2041	85,212	31,046	$97,765,905	$5.99	$0.25	$4,057,093	$287,222,195
2042	85,212	31,300	$99,781,437	$6.07	$0.23	$3,851,846	$291,074,041
2043	85,212	31,555	$103,247,532	$6.23	$0.22	$3,707,578	$294,781,619
2044	85,212	31,809	$105,394,978	$6.30	$0.21	$3,520,644	$298,302,263
2045	85,212	32,063	$107,610,281	$6.39	$0.20	$3,343,855	$301,646,118
2046	85,212	32,318	$109,895,585	$6.47	$0.19	$3,176,622	$304,822,740
2047	85,212	32,572	$112,253,104	$6.56	$0.18	$3,018,389	$307,841,129
2048	85,212	32,826	$114,685,121	$6.65	$0.17	$2,868,636	$310,709,764
2049	85,212	33,081	$116,921,670	$6.72	$0.16	$2,720,538	$313,430,303
2050	85,212	33,335	$118,715,758	$6.78	$0.15	$2,569,566	$315,999,869

Table VI-10. Alternative 4: Regional Combined Surface/Groundwater System

			Existing Supply		Regional Groundwater Supply				Surface Water From Brazos River							
Year	Required Supply1 (gpm)	Average Daily Demand (gpm)	Existing Capacity (gpm)	O&M Cost	Added Capacity (gpm)	New Wells Cost	Transmission Lines Cost	Conveyance Cost	Added Capacity (gpm)	Surface Water Cost	Diversion/Pumping Facilities Cost	Transmission Line Cost	Conveyance Cost	Low-Flow Storage Cost	Treatment Plant Cost	Treament Plant O&M Cost
2000	45,271	21,594	50,405	$4,091,367		-	$890,708	$0		$270,691						
2001	46,102	21,935	50,405	$4,214,108		-	$917,429	$0		$273,398						
2002	46,932	22,275	50,405	$4,340,531		-	$944,952	$0		$276,132						
2003	47,762	22,616	49,770	$4,415,433		-	$973,300	$0		$278,893						
2004	48,593	22,956	49,770	$4,547,896		-	$1,002,499	$0		$281,682						
2005	49,423	23,297	49,770	$4,684,332		-	$1,032,574	$0		$284,499						
2006	50,253	23,638	49,770	$4,824,862	2100	398,515	$1,063,551	$23,100		$287,344						
2007	51,084	23,978	49,770	$4,969,608	2100	405,719	$1,095,458	$23,100		$290,217						
2008	51,914	24,319	49,770	$5,118,696	4200	851,695	$1,128,322	$46,200		$293,120						
2009	52,744	24,659	49,770	$5,272,257	4200	867,416	$1,162,171	$46,200		$296,051						
2010	53,575	25,000	49,770	$5,430,425	4200	871,037	$1,197,037	$46,200	6850	$299,011	$419,068	$351,555	$221,308	$186,563	$2,645,374	$3,469,585
2011	54,129	25,189	49,770	$5,593,338	4200	885,916	$1,232,948	$46,200	6850	$302,001	$419,068	$351,555	$227,947	$186,563	$2,645,374	$3,594,273
2012	54,682	25,378	49,770	$5,761,138	4200	901,303	$1,269,936	$46,200	6850	$305,021	$419,068	$351,555	$234,786	$186,563	$2,645,374	$3,702,101
2013	55,236	25,567	49,770	$5,933,972	4200	917,215	$1,308,034	$46,200	6850	$308,072	$419,068	$351,555	$241,829	$186,563	$2,645,374	$3,813,164
2014	55,790	25,756	47,370	$5,828,185	4200	953,276	$1,347,275	$46,200	6850	$311,152	$419,068	$351,555	$249,084	$186,563	$2,645,374	$3,927,559
2015	56,344	25,945	47,170	$5,978,191	4200	972,763	$1,387,693	$46,200	6850	$314,264	$419,068	$351,555	$256,557	$186,563	$2,645,374	$4,045,385
2016	56,898	26,135	47,170	$6,157,537	4200	991,138	$1,429,324	$46,200	6850	$317,406	$419,068	$351,555	$264,253	$186,563	$2,645,374	$4,166,747
2017	57,451	26,324	47,170	$6,342,263	4200	1,010,140	$1,472,204	$46,200	6850	$320,581	$419,068	$351,555	$272,181	$186,563	$2,645,374	$4,291,749
2018	58,005	26,513	47,170	$6,532,531	4200	1,029,788	$1,516,370	$46,200	6850	$323,786	$419,068	$351,555	$280,346	$186,563	$2,645,374	$4,420,502
2019	58,559	26,702	47,170	$6,728,507	4200	1,050,104	$1,561,861	$46,200	6850	$327,024	$419,068	$351,555	$288,757	$186,563	$2,645,374	$4,553,117
2020	59,113	26,891	47,170	$6,930,362	4200	1,082,294	$1,608,717	$46,200	6850	$330,294	$419,068	$351,555	$297,419	$186,563	$2,645,374	$4,689,710
2021	59,616	27,075	44,870	$6,784,898	4200	1,131,261	$1,656,978	$46,200	6850	$333,597	$419,068	$351,555	$306,342	$186,563	$2,645,374	$4,830,402
2022	60,118	27,258	42,580	$6,644,197	4200	1,185,469	$1,706,688	$46,200	6850	$336,933	$419,068	$351,555	$315,532	$186,563	$2,645,374	$4,975,314
2023	60,621	27,441	41,540	$6,679,899	4200	1,226,400	$1,757,888	$46,200	6850	$340,303	$419,068	$351,555	$324,998	$186,563	$2,645,374	$5,124,573
2024	61,124	27,625	40,590	$6,726,349	4200	1,268,538	$1,810,625	$46,200	6850	$343,706	$419,068	$351,555	$334,748	$186,563	$2,645,374	$5,278,310
2025	61,626	27,808	37,740	$6,438,010	4200	1,346,411	$1,864,944	$46,200	6850	$347,143	$419,068	$351,555	$344,791	$186,563	$2,645,374	$5,436,660
2026	62,129	27,992	35,560	$6,262,275	4200	1,425,465	$1,920,892	$46,200	6850	$350,614	$419,068	$351,555	$355,134	$186,563	$2,645,374	$5,599,760
2027	62,632	28,175	35,560	$6,450,143	4200	1,459,246	$1,978,519	$46,200	6850	$354,120	$419,068	$351,555	$365,788	$186,563	$2,645,374	$5,767,762
2028	63,135	28,358	27,445	$5,117,022	4200	1,738,831	$2,037,875	$46,200	6850	$357,662	$419,068	$351,555	$376,762	$186,563	$2,645,374	$5,940,785
2029	63,637	28,542	22,645	$4,338,318	8400	3,812,213	$2,099,011	$92,400	6850	$361,238	$419,068	$351,555	$388,065	$186,563	$2,645,374	$6,119,008
2030	64,140	28,725	14,690	$2,896,080	16800	7,390,709	$2,161,981	$184,800	6850	$364,851	$419,068	$351,555	$399,707	$186,563	$2,645,374	$6,302,579
2031	64,695	28,932	9,380	$1,899,073	23100	10,202,448	$2,226,841	$254,100	6850	$368,499	$419,068	$351,555	$411,698	$186,563	$2,645,374	$6,491,656
2032	65,249	29,139	5,880	$1,245,491	27300	12,191,539	$2,293,646	$300,300	6850	$372,184	$419,068	$351,555	$424,049	$186,563	$2,645,374	$6,686,406
2033	65,804	29,345	5,380	$1,132,715	29400	13,038,188	$2,362,455	$323,400	6850	$375,906	$419,068	$351,555	$436,771	$186,563	$2,645,374	$6,886,998
2034	66,359	29,552	5,380	$1,166,697	29400	13,386,414	$2,433,329	$323,400	6850	$379,665	$419,068	$351,555	$449,874	$186,563	$2,645,374	$7,093,608
2035	66,913	29,758	-	$0	35700	16,382,072	$2,506,329	$392,700	6850	$383,462	$419,068	$351,555	$463,370	$186,563	$2,645,374	$7,306,416
2036	67,468	29,965	-		35700	16,823,448	$2,581,519	$392,700	6850	$387,296	$419,068	$351,555	$477,271	$186,563	$2,645,374	$7,525,609
2037	68,023	30,172	-		35700	17,279,865	$2,658,964	$392,700	6850	$391,169	$419,068	$351,555	$491,589	$186,563	$2,645,374	$7,751,377
2038	68,577	30,378	-		37800	18,037,260	$2,738,733	$415,800	6850	$395,081	$419,068	$351,555	$506,337	$186,563	$2,645,374	$7,983,918
2039	69,132	30,585	-		37800	18,527,401	$2,820,895	$415,800	6850	$399,032	$419,068	$351,555	$521,527	$186,563	$2,645,374	$8,223,436
2040	69,687	30,792	-		37800	19,304,077	$2,905,522	$415,800	6850	$403,022	$419,068	$351,555	$537,173	$186,563	$2,645,374	$8,470,139
2041	70,299	31,046	-		37800	20,242,200	$2,992,687	$415,800	6850	$407,052	$419,068	$351,555	$553,288	$186,563	$2,645,374	$8,724,243
2042	70,911	31,300	-		39900	21,103,684	$3,082,468	$438,900	6850	$411,123	$419,068	$351,555	$569,886	$186,563	$2,645,374	$8,985,970
2043	71,523	31,555	-		39900	22,106,605	$3,174,942	$438,900	6850	$415,234	$419,068	$351,555	$586,983	$186,563	$2,645,374	$9,255,549
2044	72,135	31,809	-		39900	22,716,250	$3,270,190	$438,900	6850	$419,386	$419,068	$351,555	$604,593	$186,563	$2,645,374	$9,533,216
2045	72,747	32,063	-		42000	23,646,619	$3,368,296	$462,000	6850	$423,580	$419,068	$351,555	$622,730	$186,563	$2,645,374	$9,819,212
2046	73,359	32,318	-		42000	24,303,768	$3,469,345	$462,000	6850	$427,816	$419,068	$351,555	$641,412	$186,563	$2,645,374	$10,113,789
2047	73,971	32,572	-		42000	24,981,546	$3,573,425	$462,000	6850	$432,094	$419,068	$351,555	$660,656	$186,563	$2,645,374	$10,417,202
2048	74,583	32,826	-		42000	25,682,722	$3,680,628	$462,000	6850	$436,415	$419,068	$351,555	$680,474	$186,563	$2,645,374	$10,729,718
2049	75,195	33,081	-		44100	26,720,598	$3,791,047	$485,100	6850	$440,779	$419,068	$351,555	$700,889	$186,563	$2,645,374	$11,051,610
2050	75,807	33,335	-		44100	27,920,390	$3,904,778	$485,100	6850	$445,187	$419,068	$351,555	$721,915	$186,563	$2,645,374	$11,383,158

Table VI-10. Alternative 4: Regional Combined Surface/Groundwater System (continued)

Year	Surface Water From Lake Somerville							Surface Water From Peach Creek Lake								
	Added Capacity (gpm)	Surface Water Cost	Diversion/Pumping Facilities Cost	Transmission Line Cost	Conveyance Cost	Treatment Plant Cost	Treament Plant O&M Cost	Added Capacity (gpm)	Surface Water Cost	Navasota River Diversion Cost	Peach Creek Reservoir Cost	Transmission Line Cost	Conveyance Cost	Treatment Plant Cost	Treament Plant O&M Cost
2000		$687,139							$174,908						
2001		$694,010							$176,657						
2002		$700,950							$178,424						
2003		$707,960							$180,208						
2004		$715,039							$182,010						
2005		$722,190							$183,830						
2006		$729,412							$185,668						
2007		$736,706							$187,525						
2008		$744,073							$189,400						
2009		$751,513							$191,294						
2010		$759,029							$193,207						
2011		$766,619							$195,139						
2012		$774,285							$197,091						
2013		$782,028							$199,062						
2014		$789,848							$201,052						
2015		$797,747							$203,063						
2016		$805,724							$205,093						
2017		$813,781							$207,144						
2018		$821,919							$209,216						
2019	20457	$830,138	$726,313	$1,552,702	$862,350	$10,317,047	$13,597,535		$211,308						
2020	20457	$838,440	$726,313	$1,552,702	$888,221	$10,317,047	$14,005,461		$213,421						
2021	20457	$846,824	$726,313	$1,552,702	$914,867	$10,317,047	$14,425,625		$215,555						
2022	20457	$855,292	$726,313	$1,552,702	$942,313	$10,317,047	$14,858,393		$217,711						
2023	20457	$863,845	$726,313	$1,552,702	$970,583	$10,317,047	$15,304,145		$219,888						
2024	20457	$872,484	$726,313	$1,552,702	$999,700	$10,317,047	$15,763,270		$222,087						
2025	20457	$881,209	$726,313	$1,552,702	$1,029,691	$10,317,047	$16,236,168		$224,308						
2026	20457	$890,021	$726,313	$1,552,702	$1,060,582	$10,317,047	$16,723,253		$226,551						
2027	20457	$898,921	$726,313	$1,552,702	$1,092,399	$10,317,047	$17,224,950		$228,816						
2028	20457	$907,910	$726,313	$1,552,702	$1,125,171	$10,317,047	$17,741,699	5400	$231,104	$2,557,380	$1,181,686	$631,338	$297,010	$3,154,361	$4,683,247
2029	20457	$916,989	$726,313	$1,552,702	$1,158,926	$10,317,047	$18,273,950	5400	$233,415	$2,557,380	$1,181,686	$631,338	$305,920	$3,154,361	$4,823,744
2030	20457	$926,159	$726,313	$1,552,702	$1,193,694	$10,317,047	$18,822,168	5400	$235,750	$2,557,380	$1,181,686	$631,338	$315,097	$3,154,361	$4,968,456
2031	20457	$935,421	$726,313	$1,552,702	$1,229,505	$10,317,047	$19,386,833	5400	$238,107	$2,557,380	$1,181,686	$631,338	$324,550	$3,154,361	$5,117,510
2032	20457	$944,775	$726,313	$1,552,702	$1,266,390	$10,317,047	$19,968,438	5400	$240,488	$2,557,380	$1,181,686	$631,338	$334,287	$3,154,361	$5,271,036
2033	20457	$954,223	$726,313	$1,552,702	$1,304,382	$10,317,047	$20,567,492	5400	$242,893	$2,557,380	$1,181,686	$631,338	$344,315	$3,154,361	$5,429,166
2034	20457	$963,765	$726,313	$1,552,702	$1,343,513	$10,317,047	$21,184,516	5400	$245,322	$2,557,380	$1,181,686	$631,338	$354,645	$3,154,361	$5,592,041
2035	20457	$973,402	$726,313	$1,552,702	$1,383,819	$10,317,047	$21,820,052	5400	$247,775	$2,557,380	$1,181,686	$631,338	$365,284	$3,154,361	$5,759,802
2036	20457	$983,137	$726,313	$1,552,702	$1,425,333	$10,317,047	$22,474,653	5400	$250,253	$2,557,380	$1,181,686	$631,338	$376,243	$3,154,361	$5,932,597
2037	20457	$992,968	$726,313	$1,552,702	$1,468,093	$10,317,047	$23,148,893	5400	$252,755	$2,557,380	$1,181,686	$631,338	$387,530	$3,154,361	$6,110,574
2038	20457	$1,002,898	$726,313	$1,552,702	$1,512,136	$10,317,047	$23,843,360	5400	$255,283	$2,557,380	$1,181,686	$631,338	$399,156	$3,154,361	$6,293,892
2039	20457	$1,012,927	$726,313	$1,552,702	$1,557,500	$10,317,047	$24,558,660	5400	$257,836	$2,557,380	$1,181,686	$631,338	$411,131	$3,154,361	$6,482,708
2040	20457	$1,023,056	$726,313	$1,552,702	$1,604,225	$10,317,047	$25,295,420	5400	$260,414	$2,557,380	$1,181,686	$631,338	$423,465	$3,154,361	$6,677,190
2041	20457	$1,033,286	$726,313	$1,552,702	$1,652,352	$10,317,047	$26,054,283	5400	$263,018	$2,557,380	$1,181,686	$631,338	$436,169	$3,154,361	$6,877,505
2042	20457	$1,043,619	$726,313	$1,552,702	$1,701,922	$10,317,047	$26,835,911	5400	$265,649	$2,557,380	$1,181,686	$631,338	$449,254	$3,154,361	$7,083,831
2043	20457	$1,054,055	$726,313	$1,552,702	$1,752,980	$10,317,047	$27,640,989	5400	$268,305	$2,557,380	$1,181,686	$631,338	$462,731	$3,154,361	$7,296,345
2044	20457	$1,064,596	$726,313	$1,552,702	$1,805,569	$10,317,047	$28,470,218	5400	$270,988	$2,557,380	$1,181,686	$631,338	$476,613	$3,154,361	$7,515,236
2045	20457	$1,075,242	$726,313	$1,552,702	$1,859,736	$10,317,047	$29,324,325	5400	$273,698	$2,557,380	$1,181,686	$631,338	$490,912	$3,154,361	$7,740,693
2046	20457	$1,085,994	$726,313	$1,552,702	$1,915,529	$10,317,047	$30,204,055	5400	$276,435	$2,557,380	$1,181,686	$631,338	$505,639	$3,154,361	$7,972,914
2047	20457	$1,096,854	$726,313	$1,552,702	$1,972,994	$10,317,047	$31,110,176	5400	$279,199	$2,557,380	$1,181,686	$631,338	$520,808	$3,154,361	$8,212,101
2048	20457	$1,107,823	$726,313	$1,552,702	$2,032,184	$10,317,047	$32,043,482	5400	$281,991	$2,557,380	$1,181,686	$631,338	$536,432	$3,154,361	$8,458,464
2049	20457	$1,118,901	$726,313	$1,552,702	$2,093,150	$10,317,047	$33,004,786	5400	$284,811	$2,557,380	$1,181,686	$631,338	$552,525	$3,154,361	$8,712,218
2050	20457	$1,130,090	$726,313	$1,552,702	$2,155,944	$10,317,047	$33,994,930	5400	$287,659	$2,557,380	$1,181,686	$631,338	$569,101	$3,154,361	$8,973,585

Table VI-10. Alternative 4: Regional Combined Surface/Groundwater System (continued)

Year	Regioinal Totals Total Capacity (gpm)	TOTAL COST	Unit Cost ($/1000 gal)	Pres. Worth ($/1000 gal)	Total P W Cost	Cumulative P W Cost
2000	-	6,114,812	$0.54	$0.43	$4,922,183	$4,922,183
2001	-	6,275,602	$0.54	$0.41	$4,699,174	$9,621,357
2002	-	6,440,989	$0.55	$0.38	$4,486,526	$14,107,883
2003	-	6,555,793	$0.55	$0.36	$4,247,902	$18,355,785
2004	-	6,729,126	$0.56	$0.34	$4,056,014	$22,411,799
2005	-	6,907,425	$0.56	$0.32	$3,873,009	$26,284,808
2006	2,100	7,512,453	$0.60	$0.32	$3,918,371	$30,203,179
2007	2,100	7,708,333	$0.61	$0.30	$3,740,036	$33,943,215
2008	4,200	8,371,506	$0.65	$0.30	$3,778,422	$37,721,638
2009	4,200	8,586,903	$0.66	$0.28	$3,605,247	$41,326,884
2010	11,050	16,109,399	$1.23	$0.48	$6,291,719	$47,618,603
2011	11,050	16,446,941	$1.24	$0.45	$5,975,395	$53,593,998
2012	11,050	16,794,421	$1.26	$0.43	$5,675,944	$59,269,942
2013	11,050	17,152,135	$1.28	$0.40	$5,392,408	$64,662,350
2014	11,050	17,256,192	$1.27	$0.37	$5,046,625	$69,708,975
2015	11,050	17,604,423	$1.29	$0.35	$4,789,271	$74,498,247
2016	11,050	17,985,984	$1.31	$0.33	$4,551,697	$79,049,944
2017	11,050	18,378,803	$1.33	$0.31	$4,326,612	$83,376,556
2018	11,050	18,783,218	$1.35	$0.30	$4,113,318	$87,489,874
2019	31,507	46,255,523	$3.30	$0.67	$9,422,744	$96,912,617
2020	31,507	47,129,162	$3.33	$0.63	$8,930,896	$105,843,514
2021	31,507	47,691,172	$3.35	$0.59	$8,406,880	$114,250,394
2022	31,507	48,282,665	$3.37	$0.55	$7,917,346	$122,167,740
2023	31,507	49,057,344	$3.40	$0.52	$7,483,142	$129,650,881
2024	31,507	49,864,638	$3.43	$0.49	$7,075,614	$136,726,495
2025	31,507	50,396,155	$3.45	$0.46	$6,652,125	$143,378,620
2026	31,507	51,059,368	$3.47	$0.43	$6,269,458	$149,648,078
2027	31,507	52,065,478	$3.52	$0.40	$5,946,973	$155,595,051
2028	36,907	64,322,664	$4.32	$0.46	$6,834,419	$162,429,470
2029	41,107	66,644,585	$4.44	$0.44	$6,587,096	$169,016,566
2030	49,507	69,885,417	$4.63	$0.43	$6,425,505	$175,442,071
2031	55,807	72,809,628	$4.79	$0.41	$6,227,318	$181,669,389
2032	60,007	75,262,414	$4.91	$0.39	$5,988,001	$187,657,390
2033	62,107	77,122,290	$5.00	$0.37	$5,707,885	$193,365,275
2034	62,107	78,640,175	$5.06	$0.35	$5,414,163	$198,779,438
2035	68,407	81,707,869	$5.22	$0.33	$5,232,898	$204,012,335
2036	68,407	83,353,444	$5.29	$0.32	$4,965,848	$208,978,183
2037	68,407	85,049,864	$5.36	$0.30	$4,713,408	$213,691,592
2038	70,507	87,107,239	$5.46	$0.28	$4,490,629	$218,182,221
2039	70,507	88,912,239	$5.53	$0.27	$4,263,891	$222,446,112
2040	70,507	91,042,888	$5.63	$0.25	$4,061,459	$226,507,571
2041	70,507	93,375,271	$5.72	$0.24	$3,874,891	$230,382,461
2042	72,607	95,695,603	$5.82	$0.22	$3,694,121	$234,076,582
2043	72,607	98,177,006	$5.92	$0.21	$3,525,498	$237,602,080
2044	72,607	100,309,142	$6.00	$0.20	$3,350,755	$240,952,835
2045	74,707	102,832,430	$6.10	$0.19	$3,195,390	$244,148,224
2046	74,707	105,102,081	$6.19	$0.18	$3,038,062	$247,186,286
2047	74,707	107,442,442	$6.28	$0.17	$2,889,034	$250,075,320
2048	74,707	109,855,721	$6.37	$0.16	$2,747,837	$252,823,157
2049	76,807	112,679,800	$6.48	$0.15	$2,621,838	$255,444,996
2050	76,807	115,695,224	$6.60	$0.14	$2,504,187	$257,949,183

Table VI-11. Summary of Costs by Decade through 2050

Period	Alternative 1	Alternative 2	Alternative 3	Alternative 4
2000-2010	$49,354,499	$39,904,039	$50,226,564	$47,618,603
2011-2020	$30,430,432	$28,735,696	$104,036,429	$58,224,911
2021-2030	$23,421,335	$23,572,638	$75,657,689	$69,598,557
2031-2040	$20,485,880	$20,342,100	$53,244,420	$51,065,500
2041-2050	$13,322,376	$12,635,561	$32,834,767	$31,441,612
TOTAL	$137,014,521	$125,190,034	$315,999,869	$257,949,183

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Appendix A
Correspondence with TWDB

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TEXAS WATER DEVELOPMENT BOARD

May 29, 1997

RECEIVED JUN 3 1997

Alan Potok, P.E.
Turner Collie & Braden Inc.
P.O. Box 130089
Houston, Texas 77219-0089

Dear Mr. Potok:

The purpose of this letter is to restate the Texas Water Development Board's (TWDB) position regarding population projections for the Brazos County Regional Surface Water System Feasibility Study. The terms of the contract state that if differences between population projections in the master plan and the TWDB exceed 15 percent in any one category, then a thorough analysis must be made of the discrepancies. If the master plan numbers are used in lieu of the TWDB projections, the contractor must prepare a letter to the TWDB justifying the use of alternative numbers and ask for concurrence.

Given the population projections presented at the May 19th College Station meeting, it is our current position that we would not concur with the proposed population projections for College Station or the City of Bryan. The projections for the City of Navasota appear reasonable.

The population projections used in the feasibility plan use a constant growth rate of 2.26 and 1.68 percent for College Station and the City of Bryan, respectively. In our opinion, the use of constant growth rates over 50 years over-estimates the population, particularly for the later decades. We do recognize that the area has experienced significant growth in the early part of the 1990's, resulting in overly conservative TWDB projections through 2010. However, we do not believe that the area will be able to sustain the economic growth and positive net migration necessary to attain the proposed 2050 population projections.

Population estimates from the State Data Center (SDC) at Texas A&M University estimate that the 1996 population for College Station and Bryan is 63,091 and 60,451, respectively. If the SDC estimates prove correct, both cities have already surpassed the TWDB's 2000 population projection. Given the recent information from the State Data Center, it is possible that College Station could reach a 2000 population of approximately 68,000, and the City of Bryan could reach 63,000.

While the TWDB Projections Unit believes it is essential to recognize current growth, we also believe it is important not to abandon the underlying demographic components that influence future growth. Even with the recent growth in the area, the TWDB believes a 2050 population projection of 149,455 for Bryan and 178,263 for College Station is too optimistic. We would be more comfortable with alternative population scenarios in the range of 118,000 for the City of Bryan, and 130,000 for College Station by 2050.

Again, it is our intention here to provide you with our interpretation of the population projections presented at the May 19th meeting. We recognize that recent growth may enhance the population projections in the early decades, but we are troubled by the projections in the later decades. We would appreciate your consideration of the population ranges suggested above, and ask that you advise us of any revisions to the population projections prior to proceeding with the water planning process.

Should you have any questions, please feel free to call me. We look forward to seeing you again at the June public meeting.

Sincerely,

Caty Hanson

Caty Hanson
Chief, Projections Unit
(512) 936-0883

CC: Gilbert Ward
F.G. Bloodworth

CMH/cmh
COLLEGEB.LET

Turner Collie & Braden Inc.
Engineers • Planners • Project Managers

P.O. Box 130089
Houston, Texas 77219-0089
5757 Woodway 77057-1599
713 780-4100
Fax 713 780-0838

July 7, 1997

Ms. Caty Hanson
Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231

Re: Population Projects for College Station and Bryan
Brazos County Area Regional Water Supply System
Turner Collie & Braden Inc. Job No. 37-00500-001

Dear Ms. Hanson:

We have updated our population projections for College Station and Bryan to concur with Texas Water Development Board's (TWDB) position as stated in your May 29, 1997 letter to Alan Potok. The following table shows the updated population projections for 2050 and how they relate to the revised TWDB projections included in your letter.

	TC&B	TWDB (revised)	% Difference
College Station	138,771	130,000	6.75%
Bryan	119,709	118,000	1.45%

These changes were made to better reflect the TWDB's opinion that the area's current period of rapid growth is not sustainable through the study's entire 50-year planning horizon. Calculation of these new figures account for both the rapid growth rate the area is currently experiencing and the more sustainable growth rate reflected by the TWDB "most-likely" series population projections.

We have assumed the rapid growth experienced by College Station between 1990 and 1996 (3.12% annually) will last through 2010 at which time growth will slow to the 0.90% per year rate predicted between 2010 and 2050 by the original TWDB "most-likely" series projections. The 1990 to 1996 annual growth of Bryan was smaller than that of College Station, and assumed to be more sustainable. The historical growth rate of 1.59% for Bryan was projected through 2020 and the TWDB "most-likely" series growth rate of 1.02% from 2020 to 2050 was used for the remainder of the planning horizon.

We utilized the higher interim growth rates based on a number of factors. Medium size cities like College Station and Bryan are receiving increasing favorable reviews on quality of life issues due largely to the desirability of living in smaller cities as opposed to larger cities. A second factor is the lack of any natural geographic borders to expansion. A third factor is the current emphasis on diversification to add additional sources of jobs in the area economy.

Turner Collie & Braden Inc.

The attached tables and graphs are provided to show how the revised projections compare to Turner Collie & Braden's (TC&B)original estimates, TWDB "most-likely" series projections and TWDB's revised estimates.

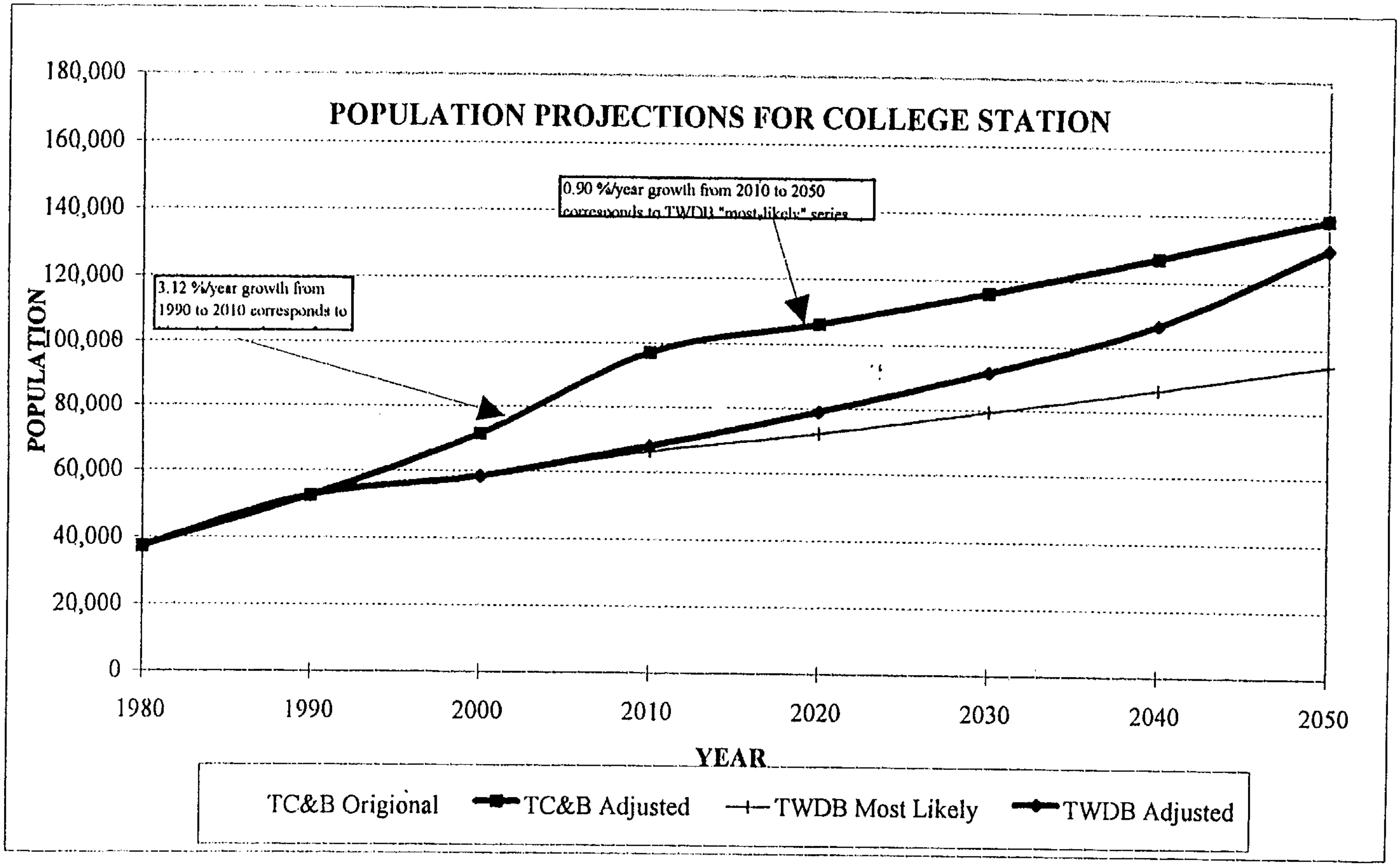
We believe these revised figures will meet the concerns brought forward in your May 29th letter, and are using them to proceed with the study. If you have any further questions or concern regarding the revised population estimates or any other aspect of the study, please contact me at (713)267-3293 or Doug Goss at (713)267-2958.

Very truly yours,

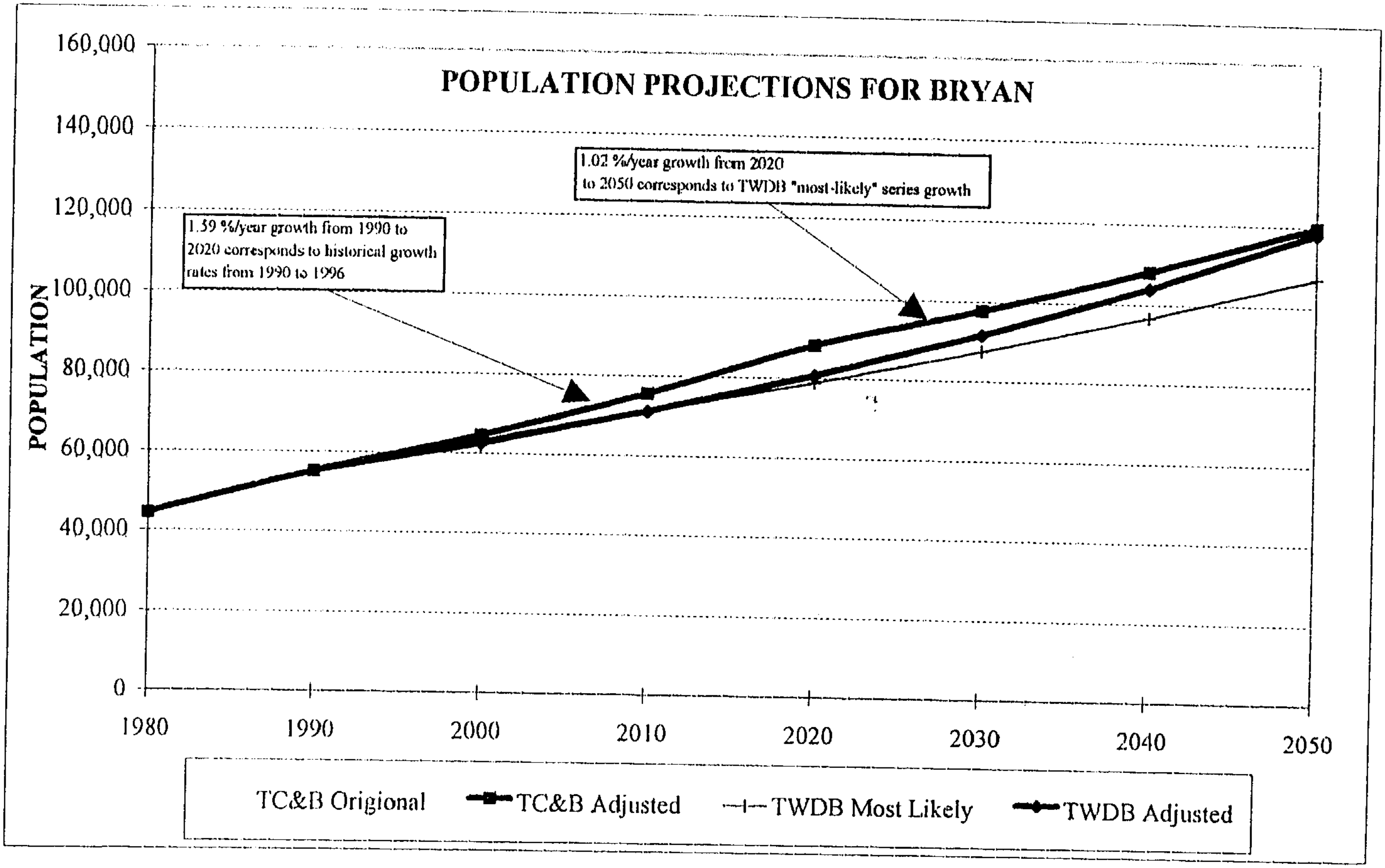
Mark Lowry, PE
Senior Project Manager

/srb

cc: Stephen Cast, Wellborn Water Supply Corporation
Michael A. Collins, City of Bryan
Rick Conner, City of Bryan
Thomas M. Hagge, P.E., Texas A&M University
Tony Jones, Brazos County Commissioners
Bill Riley, City of College Station
John Seifert, P.E., LBG-Guyton Associates
Charles A. Sippial, Sr., Texas A&M University
Kent Watson, Wickson Creek Special Utility District
John Woody, City of College Station



College Station	1980	1990	2000	2010	2020	2030	2040	2050
TC&B Origional	37,272	52,456	58,314	72,917	91,178	114,011	142,562	178,263
TC&B Adjusted	37,272	52,456	71,322	96,974	106,063	116,005	126,879	138,771
TWDB Most Likely	37,272	52,456	58,314	66,259	72,224	79,413	86,737	94,736
TWDB Adjusted	37,272	52,456	58,314	67,809	78,851	91,690	106,620	130,000



Bryan	1980	1990	2000	2010	2020	2030	2040	2050
TC&B Origional	44,337	55,002	64,973	76,752	90,666	107,103	126,519	149,455
TC&B Revised	44,337	55,002	64,400	75,405	88,289	97,719	108,157	119,709
TWDB Most Likely	44,337	55,002	61,863	70,872	78,839	87,454	96,743	107,019
TWDB Adjusted	44,337	55,002	62,462	70,934	80,554	91,480	103,887	118,000

September 26, 1997

Mr. Mark Lowry, PE
Senior Project Manager
Turner Collie & Braden Inc.
P.O. Box 130089
Houston, Texas 77219-0089

RE: Population projections for the cities of College Station and Bryan for the Brazos County Regional Surface Water System Feasiblity Study.

Dear Mr. Lowry:

We very much appreciate your efforts in revising the population projections for the College Station and the City of Bryan in the Brazos County Regional Regional Surface Water System Feasiblity Study. The revised population projections presented in your letter, dated July 7, 1997, and shown below are within an reasonable range of the Texas Water Development Board's projections and are acceptable for facility planning.

	TC&B	TWDB
College Station	138,771	130,000
Bryan	119,709	118,000

Should you have any questions, please contact Butch Bloodworth at (512) 936-0880.

Sincerely,

Caty Hanson

Caty Hanson
Chief, Projections Unit

cc: Gilbert Ward

Appendix B
Well Data

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
Texas A&M University	1950	Layne Texas Co.	263	515	400-503	18, 10	Aurora Pump/	1996	6	340	60	10.7	503	143	96	5/08/50
Well 1				Sparta	[83]	[10]	Layne & Bowler		1-1/2		1800	9.1	517	196.8	140	5/12/92
BJ-59-21-706							9 BEH-7		2-1/2				412			5/31/95
												9.0	513	272	215	8/23/96
													543			6/18/97
Texas A&M University	1950	Layne Texas Co.	254	486	373-473	18, 10	Layne & Bowler	1997	7	300	75	13.1	650	145.6	96	4/17/50
Well 2				Sparta	[100]	[10]	10 RKEH-7?		1-1/2		1780		630			5/31/95
BJ-59-21-705							Smith Pump Co.		---			16.1	659	229	188	7/19/95
													635			8/23/95
															145.18	6/18/97
Texas A&M University	1950	Layne Texas Co.	254	484	366-473	18, 10	Layne & Bowler	1953?	6	300	50	8.6	465	166.1	112	1/24/50
Well 3				Sparta	[107]	[10]	10 RKLC-10		1-1/2		1800	7.9	470	201.2	142	5/13/92
BJ-59-21-704									---				452			5/31/95
Texas A&M University	1950	Layne Texas Co.	246	424	292-412	18, 10	Layne & Bowler	1996?	5	300	25	2.8	355	248	123	3/25/50
Well 4				Sparta	[105]	[10]	8 PRHC-9		1		1800	4.0	443	218.8	108	8/04/50
BJ-59-20-920									---						140	12/23/80
												2.4	185	231	154	7/19/95
Texas A&M University	1953	Layne Texas Co.	262	1345	1120-1330	16, 8	Byron Jackson	1997?	8	350	100	3.5	654	211.9	25	5/07/53
Well 5				Carrizo/	[200]	[8]	11 MQL-5		1-11/16		1800		600-650			10/27/89
BJ-59-21-402				Wilcox			Smith Pump Co.		---			3.6	716	228	31.3	5/13/92
							Rehab?						520			5/31/95
													500			8/23/95

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
Texas A&M University	1960	Katy Drilling Co.	263	2984	2600-2974	20, 13, 9	Byron Jackson	1991	10	180	200	16.1	2,513	87.1	+69	10/11/60
Well 6				Simsboro	[329]	[9]	12 HQRH-3		1-15/16		1770				+80	10/14/60
BJ-59-21-723									---						+28	1/25/77
													2,600			5/10/91
												30.7	2,200	116.6	45	3/06/92
													1,899			5/31/95
													1,783			8/23/95
													1,604			6/18/97
	1979	Layne-Texas	265	3018	2490-3010	20, 13, 9	Floway	1995	10	260	150	40.1	2,539	52.3	+11.0	4/09/79
Well 7				Simsboro	[436]	[9]	14FKII-2		1-15/16		1770	43.7	2,740	112.8	50.1	2/28/92
BJ-59-21-732									---			40.1	2,600	117.9	53	4/22/94
															54.9	5/31/95
													2,138			8/23/95
Texas A&M University	1954	Layne Texas Co.	263	3010	2741-2990	20, 13, 8	Byron Jackson	1987	8	180	150	19.4	2,500	77.9	+51	11/30/70
Well A-7				Simsboro	[203]	[8]	12 HQH-3		1-11/16		1770	23.2	1,860	58.8	+21.4	12/01/76
BJ-59-21-714									---				1,800			5/12/87
												36.1	2,208	75.5	14.3	2/28/92
													1,881			5/31/95
													1,880			8/23/95
Sanderson Farms	1996	Layne Texas Co.	---	3334	2972-3280	18, 14, 10	Aurora Pump/	1996	12	310	300	38.8	2,514	189.0	124.17	10/07/96
Well 1				Simsboro	[288]	[10]	Layne & Bowler		1-15/16		1770				116.6	1/10/97
BJ-59-21-9xx							14 TLC-5		3							

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of College Station	1975	Layne Texas Co.		1700	1450-1685	12, 6						1.7	495	307	75.8	10/22/75
Old Well 1				Queen	[160]	[6]										
BJ-				City?												
Plugged & Abandoned																
City of College Station	1979	Layne-Western Co.	352	2973	2530-2960	16, 13, 9	Johnston Pump Co.	1995	12	400	400	40.9	2,600	141.54	78	9/04/79
Well 1				Simsboro	[384]	[9]	14DC-5		2-3/16		1770	40.0	2,322	230	172	7/23/91
BJ-59-21-410									3-1/2				2,293		184	10/20/92
												34.9	2,161	246	184	9/20/94
												34.6	2,875	246	163	5/23/95
															163.5	1/96
												35.5	2,700	255	179	1/97
City of College Station	1979	Layne-Western Co.	345	2975	2520-2960	16, 13, 9	Johnston Pump Co.	1997?	12	420	400	50.1	2,590	120.59	68.9	11/12/79
Well 2				Simsboro	[390]	[9]	14DC-5		2-3/16		1770				67.7	4/29/81
									3-1/2			42.6	2,384	221	165	7/23/91
															173	10/20/92
												40.8	2,649	246	181	9/20/94
															163	1/96
												44.4	2,750	235	173	1/97
City of College Station	1982	Layne-Western Co.	330	2940	2430-2920	16, 13, 9	Floway	1995	10	400	400	32.6	3,368	189.0	85.79	4/07/82
Well 3				Simsboro	[462]	[9]	14 FKH-5		1-15/16		1770	41.6	3,035	225	152	7/23/91
BJ-59-21-411									3				2,967		177	10/20/92
													2,936	238	169	9/20/94
															155	2/96
												42.4	2,800	234	168	1/97

Table 1. Well, Pump and Motor Data

Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of College Station	1987	Alsay-Texas	350	2838	2416-2918	16, 13, 9	Peerless Pump	1993?	12	400	400	32.6	2,805	246.46	160.34	9/17/87
Well 4				Simsboro	[392]	[9]	14 HXB-6		2-3/16		1770	29.8	3,134	271	166	7/23/91
BJ-59-21-412									3-1/2						177	10/20/92
															161	6/06/93
												32.9	2,863	268	181	9/20/94
															170	2/96
												34.5	2,900	265	181	1/97
City of College Station	1996	Alsay Inc.		2884	2364-2862	18, 13, 9	Byron Jackson	1996	12	400	400	40.8	2,805	225.80	157.0	5/30/96
Well 5				Simsboro	[456]	[9]	15 MQ-H		2-3/16		1800				153	10/96
BJ-59-									3-1/2						139	1/97

Table 1. Well, Pump and Motor Data

Well Owner & State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of Bryan	1943	Layne Texas Co.	301	584	430-573	16, 8	Layne & Bowler	---	8	330	75	8.3	640	---	125	8/21/44
Well 5				Sparta		[8]	12 RKLC-13		1-1/2		1200				121.2	4/09/47
BJ-59-21-501									2-1/2			9.9	700	220	149	4/52
Currently Unused																
City of Bryan	1947	Layne Texas Co.	307	499	389-479	16, 8	Layne & Bowler	---	8	500	60	4.2	503	---	---	7/08/47
Well 6				Sparta		[8]	12 RKLC-17		1-1/2		1175				149.4	9/11/47
BJ-59-21-201									---							
Currently Unused																
City of Bryan	1948	Layne Texas Co.	298	539	423-533	10, 8	Layne & Bowler	---	8	350	60	---	---	---	---	---
Well 7				Sparta		[8]	10 RKLC-11		---		1800					
BJ-59-21-204									---							
Currently Unused																
City of Bryan	1948	Layne Texas Co.	334	554	401-542	10?	Layne & Bowler	---	8	350	60	---	---	---	---	---
Well 8				Sparta		[10]	10 RKLC-11		---		1800					
BJ-59-21-203									---							
Currently Unused																
City of Bryan	1952	Layne Texas Co.	372	710	---	8	Layne & Bowler	---	7	400	100	---	---	---	266.6	2/19/60
Well 9				Sparta		[ ]?	10 RKHC-11		---		1800					

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of Bryan	1954	Layne Texas Co.	350	2950	2670-2940	20, 13, 9	Goulds Pumps	1997	12	400	400	---	2,200	---	---	1955
Well 10				Simsboro	[270]	[9]	18 BHC-5		2-3/16		1185		1,520	210	---	6/90
BJ-59-21-303									3-1/2				1,300	---	162	8/93
												45.0	1,800	215	175	8/96
															170	12/05/96
															147.68	6/18/97
City of Bryan	1957	Texas Water Wells?	315	2950	2514-2904	20, 13, 9	Byron Jackson	1994	---	400	400	---	2,500	---	---	4/17/57
Well 11				Simsboro	[390]	[9]	17 MQH-5				1182				+45	2/19/60
															55.16	4/29/81
													1,200	170	---	6/90
													1,139	---	145	8/93
													2,400	227	---	8/96
City of Bryan	1964	Texas Water Wells	330	2880	2480-2860	20, 13, 9	Goulds Pumps	1996	---	400	400	29.4	2,500	---	---	1964
Well 12				Simsboro	[368]	[9]	18 BHC-7				1185				+15	6/11/64
BJ-59-21-205													2,050	190	---	6/90
													1,841	---	160	8/93
													2,400	---	165	8/96
															140	1/15/96
City of Bryan	1964	Texas Water Wells	360	2834	2320-2814	20, 13, 9	Layne & Bowler	1993	12	400	400	---	---	---	176	8/18/92
Well 13				Simsboro	[470]	[9]	17 DROHC-7		2-3/16		1182		1,900	210	---	6/90
BJ-59-21-208									3-1/2			49.8	2,042	234	193	8/17/93
													2,400	---	190	8/96

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of Bryan	1968	Layne Texas Co.?	300	2730	2225-2709	20, 13, 9	Crane-Deming	1990	10	300	400	41.2	2,511	180	119	3/27/90
Well 14				Simsboro	[484]	[9]	16 H-16E-8		2-3/16		1185		2,500	---	160	6/90
BJ-59-21-207									3-1/2				2,378	188	---	8/93
													2,400	218	---	8/96
City of Bryan	1972	Layne Texas Co.	356	2880	2400-2830?	20, 13, 9	Floway	1994	12	400	400	---	2,146	---	63	5/25/72
				Simsboro		[9]	16 MKM-10		2-3/16		1182		2,100	---	---	6/90
BJ-59-21-107									3-1/2				1,714	---	---	8/17/93
															186	10/05/93
												42.1	2,612	237	175	6/94?
													2,400	---	---	8/96
City of Bryan	1976	Layne Texas Co.	370	2867	2402-2852	20, 13, 9	Byron Jackson	1993	12	400	400	---	2,136	---	126	4/76
Well 16				Simsboro	[375]	[9]	17 MQH-5		2-3/16		1182				110	7/76
BJ-59-21-209									3-1/2				1,800	212	---	6/90
												55.7?	2,004	214	178	4/21/92
													2,125	---	---	8/17/93
													2,400	---	210	8/96
															207.95	11/13/96
City of Bryan	1986	Layne Texas Co.?	---	2865	2359-2844	20, 13, 9	Peerless Pump	1986	12	360	350	38.8	2,209	171	114	1/07/86
Well 17				Simsboro	[420]	[9]	16 MC-8		2-3/16		1180		2,000	---	---	6/90
									3-1/2				1,958	246	---	8/93
													2,300	263	---	8/96

Table 1. Well, Pump and Motor Data

Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
Brushy Water Supply	1966	Key Water Well	292	1110	1022-1100	14, 8, 4						1.2	60	129	80	8/31/66
Corporation		Drilling		Sparta	[40]	[4]										
Well 1																
BJ-59-29-603																
Brushy Water Supply	1981	Layne Texas Co.	291	3380	3120-3360	10, 6		1995		200	20	22.5?	465	24.8	4.1	6/14/81
Corporation				Simsboro	[200]	[6]					1760				103	6/18/97
Well 2							Smith Pump Co.									
BJ-59-21-909							Rehab									
Wickson Creek	1972	Lanford Drilling	338	3061	2756-3056	12, 6	Byron Jackson	1988			75	33.3	300	30	21	12/09/72
Special Utility District		Company		Simsboro	[203]	[6]					1770				49	11/30/78
Well 1							Smith Pump Co.								53	5/21/81
BJ-59-14-706							Rehab								100	1988
															105.2	7/18/95
															114.49	11/13/96
Wickson Creek	1982	Lanford Drilling		1008	805-1003	10, 6	Layne & Bowler?	1982?	4?	250?	20?	2.2	201	208.1	115	4/05/82
Special Utility District		Company		Sparta	[168]	[6]	8 EDH-11?		1?		1770?		200		115	1987
Well 2									---							
BJ-59-22-6?																
Wickson Creek	1991	J. L. Meyers		760	510-750	20, 14, 8	Byron Jackson	1991		280?	75	3.8	449	217	100	8/15/91
Special Utility District		Company		Sparta	[130]	[8]				300?	1770				134.5?	6/18/97
Well 3							Smith Pump Co.								154.5?	6/18/97
BJ-59-14-7							Rehab									

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of Navasota	1925	Pomeroy &	212	304	188-283	14, 10	---	---	---	---	---	---	---	---	45	1/27/27
Unused observation well		McMasters		Catahoula	[50]	[10]									82.96	9/29/70
(Old Well 8)															95.03	2/19/88
KW-59-40-701															73.50	2/19/93
City of Navasota	1938	Layne Texas Co.	212	282	178-270	20, 10, 8	---	---	---	---	---	---	---	---	67	7/28/38
Well 1 (Old Well 10)				Catahoula	[89]	[10, 8]							275	---	---	4/55
KW-59-40-702															93	7/17/86
Plugged & Abandoned																
City of Navasota	1955	Layne Texas Co.	213	765	660-755	12, 6	Crown	1997	4	400	75	---	---	---	21	1/28/55
Well 2				Jackson	[60]	[6]	7H400-7				3450				66.8	9/29/70
KW-59-40-708				Group			Submersible					4.4	463	---	---	5/18/76
(Old Well 12)															76.4	1/31/85
												4.1	450	---	---	9/19/85
												4.2	485	194	79	3/02/90
															72	7/12/90
													482	---	92	3/10/96
													525	---	---	5/28/97
															103.5?	6/18/97
City of Navasota	1948	Layne Texas Co.	210	272	210-260	18, 8	Floway	1988	5	200	30	---	---	---	65	8/19/48
Well 3				Catahoula	[50]	[8]	8 JKL-9		1-1/4		1770	2.3	408	---	---	5/14/68
									2						68.1	9/29/70
(Old Well 11)															73.3	5/13/86
													278	---	70	5/07/87
												3.9	329	---	86	5/05/88
													240	158?	---	8/30/96
													265	161?	---	5/28/97

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com- pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur- bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
City of Navasota	1968	Layne Texas Co.	208	358	276-303	16, 10	Floway	1993	6	260	50	2.5	413	---	---	5/15/68
Well 4				Catahoula	[54]	[10]	8 JKH-15		1-3/16		1770				47.1	9/29/70
KW-59-48-106					316-343				2			3.2	478	---	---	5/19/76
(Old Well 15)					Open Hole							4.5	450	---	116.4	9/19/85
															70.6	5/20/86
													442	---	85	5/07/87
												3.8	461	210	89	9/07/93
												3.9	410	235?	131?	8/30/96
															112?	5/28/97
City of Navasota	1981	Layne Western	205	365	295-355	16, 10	Floway	1987	6	280	50	2.5	413	---	129.7	11/12/81
Well 5				Catahoula	[60]	[10]	8 JKH-14		1-1/4		1750	3.4	406	---	---	11/13/81
KW-59-48-1xx									2			4.4	200	---	72.3	5/20/86
(Old Well 16)													481	---	100	6/03/87
													427	---	110	4/05/88
													410	243?	---	8/30/96
															106	9/25/96
															111?	5/28/97
	1988	Layne Texas Co.		430	356-420	16, 10	Floway	1997	6	320	75	3.9	506	193.50	64.55	3/24/88
Well 6				Catahoula	[48]	[10]	8 FKH-12		1-1/4		1760		295	213?	---	8/30/96
KW-59-48-2xx									2				290	---	75	9/25/96
												4.6	557	198	76	3/19/97
													430	---	---	5/28/97
City of Navasota	1997	Friedel Drilling Co.		519	403-509	16, 10	Goulds Pumps	1997	8	360	100	7.7	500	165	100	6/23/97
Well 7				Catahoula	[78]	[10]	9 THC-11		1-1/2		1800					
KW-59-48-2xx?									2-1/2					---		

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date
Carlos Water Supply Well 1A (Carlos) KW-59-32-503?	1972	Lanford Drilling Company		336 Jackson Group?	296-336 [40]	8, 4 [4]	Crown S6-100-4 Submersible	1996	3	231?	7.5 3500	14.2	100	147	140	2/02/72
Carlos Water Supply Corporation Well 3C (Local)	1982	Snook Drilling Company		410 Yegua?	279-410? [60]	8, 4 [4]	Russell Drilling Rehab					0.4	56	249	110	1982
Carlos Water Supply Corporation Well 4D (Rock Road) KW-59-16-8xx	1982	Snook Drilling Company		386 Yegua?	286-386 [100]	8, 4 [4]	Russell Drilling Rehab					0.9	92	214	117	1982
Carlos Water Supply Corporation Well 6F (Isabel)	1982	Snook Drilling Company		508? Yegua?	408-508? [70]	8, 4 [4]	Grunfos 135-S-150 Submersible	1994	3	350	15 3500					
Plugged & Abandoned? Carlos Water Supply Corporation Well 7G (Iola) KW-59-16-8xx	1995	Russell Drilling Company		984 Yegua?	880-976 [62]	8, 4 [4]	Grunfos 80S150-12 Submersible	1995	3	320	15	1.3	100		80	7/95

Table 1. Well, Pump and Motor Data

Well Owner & Well No./Name State Well No.	Year Com-pleted	Drilling Firm	Well Elevation (feet)	Total Depth of Well (feet) & Aquifer 1/	Screened Interval & [Total Screen] (feet)	Casing & [Screen] Diameter/s (inches) 2/	Pump Manufacturer, Pump Model - No. of Stages	Year Pump Installed or Refur-bished	Pump Column, Shaft & Tubing Sizes (inches)	Pump Bowl Setting (feet)	Motor Hp & Speed (rpm)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Pumping Water Level (feet)	Static Water Level (feet)	Date

EXPLANATION:

1/ Aquifer:
Catahoula Sandstone (Tcs)
Jackson Group (Tj)

Sparta Sand (Ts)
Queen City (Tqc)

Simsboro Sand (Twis)

Estimated aquifer designation based on available information from U. S. Geological Survey, Texas Water Development Board and our files.

2/ Ten-inch diameter liners in Texas A&M University Wells 1, 2, 3 and 4 extend from top of screened interval back up to ground level.

NOTE:

Well, material settings, pump, motor and testing data, etc. are based on available information provided by well owners, well and pump contractors, U. S. Geological Survey, Texas Water Development Board, LBG-Guyton Associates files and field checks.

Appendix C

Surface Water Availability from BRA

37-00500-001 2.

Brazos River Authority

QUALITY • CONSERVATION • SERVICE

May 12, 1997

HAND DELIVERED

Mr. Mark Lowry, P.E.
Turner Collie & Braden, Inc.
P.O. Box 130089
Houston, Texas 77219-0089

Re: Brazos County Area Regional Water Supply System

Dear Mark:

This letter is in response to your request for information concerning the location and amounts of available water from the Authority's water supply system that could be delivered to the Brazos County study area. There are three possible sources of surface water to consider, Lake Limestone, Lake Somerville, and the Brazos River. Each of these sources are expanded upon below.

Lake Limestone

Lake Limestone located on the upper Navasota River in Limestone and Robertson counties currently has the following amounts of water available at the following price:

Quantity acre-feet per year[1]	Price per Acre Foot	Status
8,400	$20.21[2]	Currently available, contract(s) could be signed today.
3,248	Undetermined[3]	Currently available for local municipal use, local municipal use is defined in HL&P and TU Electric contracts. Authority's Board could authorize its use.
2,240	Undetermined[3]	Not currently available, would require negotiation with Industrial Customers.

Notes: [1]To convert acre-feet per year to million gallons per day multiply acre-feet per year by 0.000893
[2]System Water Price, this is set annually by the Authority's Board of Directors.
[3]This water may not be available at the system price.

Houston Lighting and Power Company has a contract with the Authority for an annual withdrawal average of 18,000 acre-feet and Texas Utilities Electric Company has a contract with the Authority for an annual average of 25,000 acre-feet. In a recent telephone conversation between representatives of Turner Collie & Braden and HL&P, HL&P stated they did not have any water for sale. On Friday, April 18, 1997, Mr. Roberts, the Authority's General Manager, received a telephone call from Mr. Dick White with TU Electric. Mr. White stated that should any of their water become available in the future and

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the time came for negotiating an actual sale of their water, TU Electric would negotiate through the Authority.

Please keep in mind that the issue of contacting TU Electric and HL&P is secondary to establishing whether or not surface water is needed and, if so, how much is needed. Any water negotiated from existing Lake Limestone contracts would most likely exceed the current system price of $20.21 per acre-foot.

Lake Somerville

Lake Somerville is located on Yegua Creek in Burleson, Lee and Washington counties. There is approximately 33,000 acre-feet available in Lake Somerville at the system price of $20.21 per acre-foot.

Brazos River

There is approximately 46,000 acre-feet of system water available in the Brazos River system below the confluence of Yegua Creek at the system price of $20.21 per acre-foot, however this 46,000 acre-feet of water does not take into account any stream loses which may occur upstream of the point of delivery. This water is from Lakes Granbury, Granger, Possum Kingdom, Somerville, and Whitney. Note that the 8,400 acre-feet currently available in Lake Limestone is not considered in the 46,000 acre-feet available in the Brazos River system because of natural delivery problems in the Navasota River. If a delivery location is selected in the Brazos River above the confluence of Yegua Creek there would be approximately 13,000 acre-feet available at the system price of $20.21 per acre-foot, again this does not factor in any stream loses.

The quantities of water listed above as "available" are generally uncommitted at this time. Please recognize in the study that the Authority responds to requests for new system water contracts as they are received. Therefore, water that is uncommitted today may be contractually committed tomorrow.

If you have any questions, comments or need additional information, please call me at (817) 772-6010.

Sincerely,

DENIS QUALLS, EIT
Water Resources Planner

DQ:rp
Enclosure
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