# TRANS-TEXAS WATER PROGRAM

West Central
Study Area
Phase I
Interim Report

Volume 1


San Antonio River Authority

San Antonio Water System

Edwards Underground Water District

Guadalupe-Blanco River Authority

Lower Colorado River Authority

Bexar Metropolitan Water District

Nueces River Authority

Texas Water Development Board

**May, 1994**

HDR

HDR Engineering, Inc.
in association with
Paul Price Associates, Inc.
LBG-Guyton Associates
H. B. Zachry Company

# TRANS-TEXAS WATER PROGRAM
# WEST CENTRAL STUDY AREA

## PHASE I
## INTERIM REPORT

## VOLUME 1

**Prepared for**

**San Antonio River Authority**
**San Antonio Water System**
**Edwards Underground Water District**
**Guadalupe-Blanco River Authority**
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**by**

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**Espey-Huston & Associates, Inc.**

**May, 1994**

TRANS-TEXAS WATER PROGRAM
WEST CENTRAL STUDY AREA

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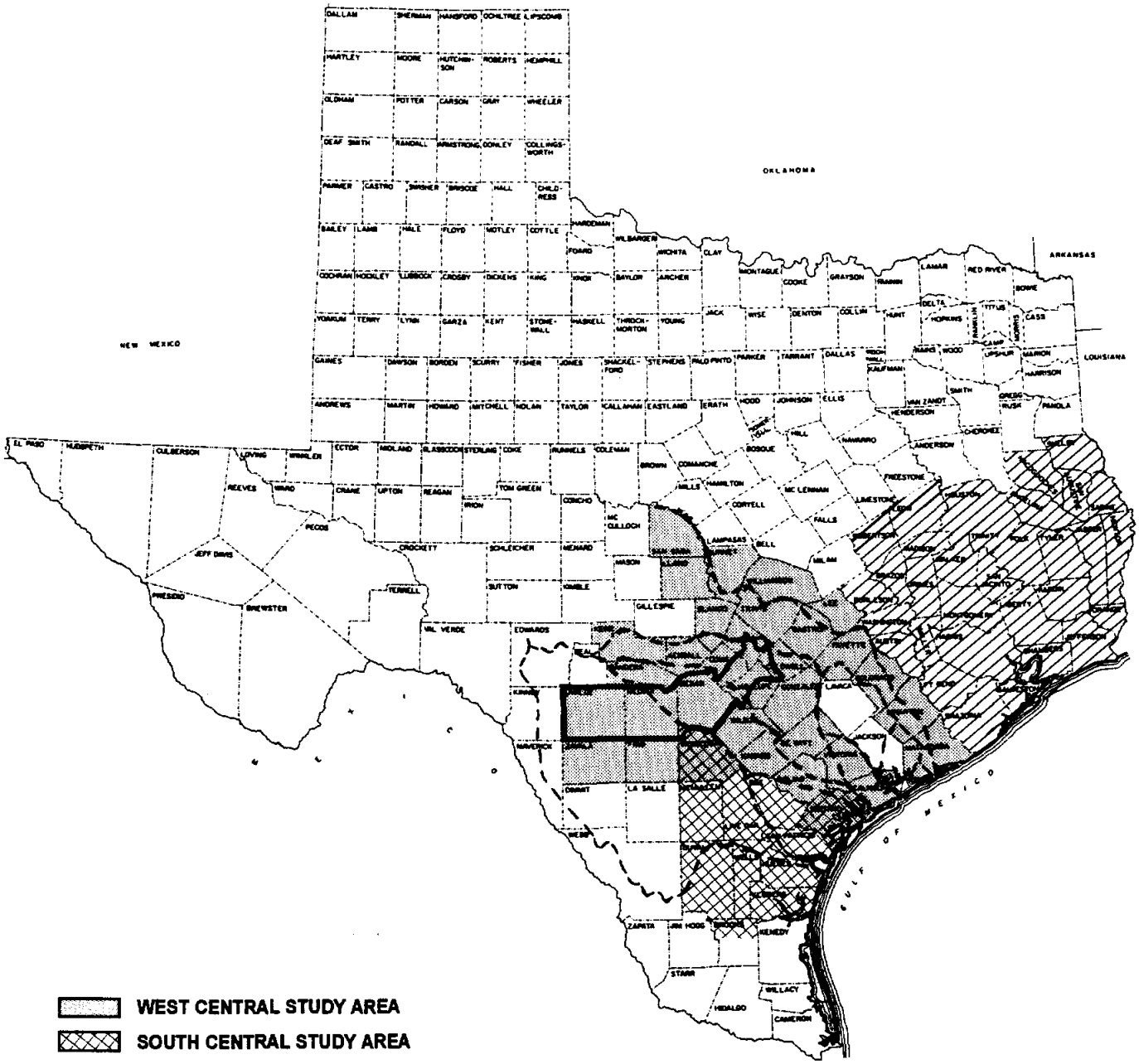
# TRANS-TEXAS WATER PROGRAM
# WEST CENTRAL STUDY AREA
# EXECUTIVE SUMMARY

## ES-1 INTRODUCTION

In the 1990 Texas Water Plan, the projections of population and water demand growth identified immediate water supply needs in the metropolitan areas of Southeast and South Central Texas (San Antonio, Corpus Christi, and Houston). The 1990 Water Plan also identified significant quantities of surplus supply in some river basins. The Trans-Texas Water Program (TWDB) has been created under the leadership of the Texas Water Development Board and with the sponsorship of many of the State's river authorities to address the water supply needs of these areas in an environmentally responsible, coordinated, and economical manner. The Trans-Texas Water Program is a multiple-phase program beginning with Phase I planning studies to determine projected water demands and supplies through the year 2050 and to identify possible water supply alternatives to meet future needs. This Phase I report provides: (1) projections of water demands of the study area for the period 1990 to 2050; (2) comparisons of projected demands to existing supplies; (3) potential water supply alternatives to meet the needs of the area; and, (4) a reconnaissance level assessment of the water supply potentials, costs, and environmental effects of each option. From this, decisions can be made regarding viable water supply alternatives to be studied in more detail in Phase II. Alternatives chosen to be considered further will require significant environmental, hydrologic, and economic study prior to a project or management plan being implemented.

The West Central Study Area of the Trans-Texas Water Program includes all of the San Antonio and Guadalupe River Basins, parts of the Nueces, Colorado and Brazos River Basins, and parts of the San Antonio-Nueces, Lavaca-Navidad, and Brazos-Colorado Coastal Basins. The study area is shown in Figure ES-1 and includes 33 counties. Major population centers of the region are the cities of San Antonio, Austin, San Marcos, New Braunfels, Round Rock, Victoria, and Seguin.

A significant portion of the West-Central Study area is highly dependent on groundwater supply from the Edwards Aquifer, which is used extensively for municipal,




TRANS TEXAS WATER PROGRAM /
WEST CENTRAL STUDY AREA

**STUDY AREA**

HDR

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FIGURE ES - 1

manufacturing, irrigation, and livestock watering. Within the study area, 1.36 million people benefit directly or indirectly from the water supply provided by the Edwards Aquifer to wells or springflows, and by year 2050, the population potentially affected by the aquifer is projected to be 3.7 million. The current dependence on this single water source, coupled with the projected growth of the area and the resulting need for additional water, makes water supply planning essential. Development of alternative water supplies not only is needed to meet growth demands, but to maintain significant ecosystems at Comal and San Marcos Springs.

The TWDB, through the Trans-Texas Water Program, has brought together eight sponsors that collectively commissioned this Phase I study. Alternatives studied include existing surface and groundwater supplies, conservation, reuse, changes in use of existing supplies, potential development of new surface and groundwater sources, and inter-basin transfers. For each water supply option, this screening study provides preliminary estimates of yields, costs, and environmental impacts, for use in making policy decisions for the long term water supply of the area.

## ES-2 POPULATION PROJECTIONS

Population projections have been made by the TWDB for the period 1990 through 2050. The TWDB high case population projections were specified by the TWDB for use in all Trans-Texas studies, and are tabulated for each of the following areas: (a) 33-county West Central Study Area; (b) Edwards Aquifer area[1]; and (c) river basins and adjacent areas.

The 1990 population of the 33-county study area was 2.7 million and the projection to year 2020 is 4.8 million and to 2050 is 7.2 million, a projected total increase of almost 170 percent.

---

[1]The Edwards Aquifer Area is the area specified in Senate Bill 1477, 1993 Texas Legislature, creating the Edwards Aquifer Authority, and includes all of Uvalde, Medina, and Bexar counties, and parts of Atascosa, Comal, Guadalupe, Comal, Hays, and Caldwell counties. (See Figure 2-3 for Edwards Aquifer Authority Area.) At the time of this report the creation of the Edwards Aquifer Authority is still in question as various legal issues regarding its creation, are unresolved.

The 1990 population of the Edwards Aquifer area was 1.4 million (about 50 percent of the 33-county area population), with year 2020 projections of 2.4 million and 2050 projections of 3.7 million (again, about 50 percent of the study area total), a projected total increase of 164 percent.

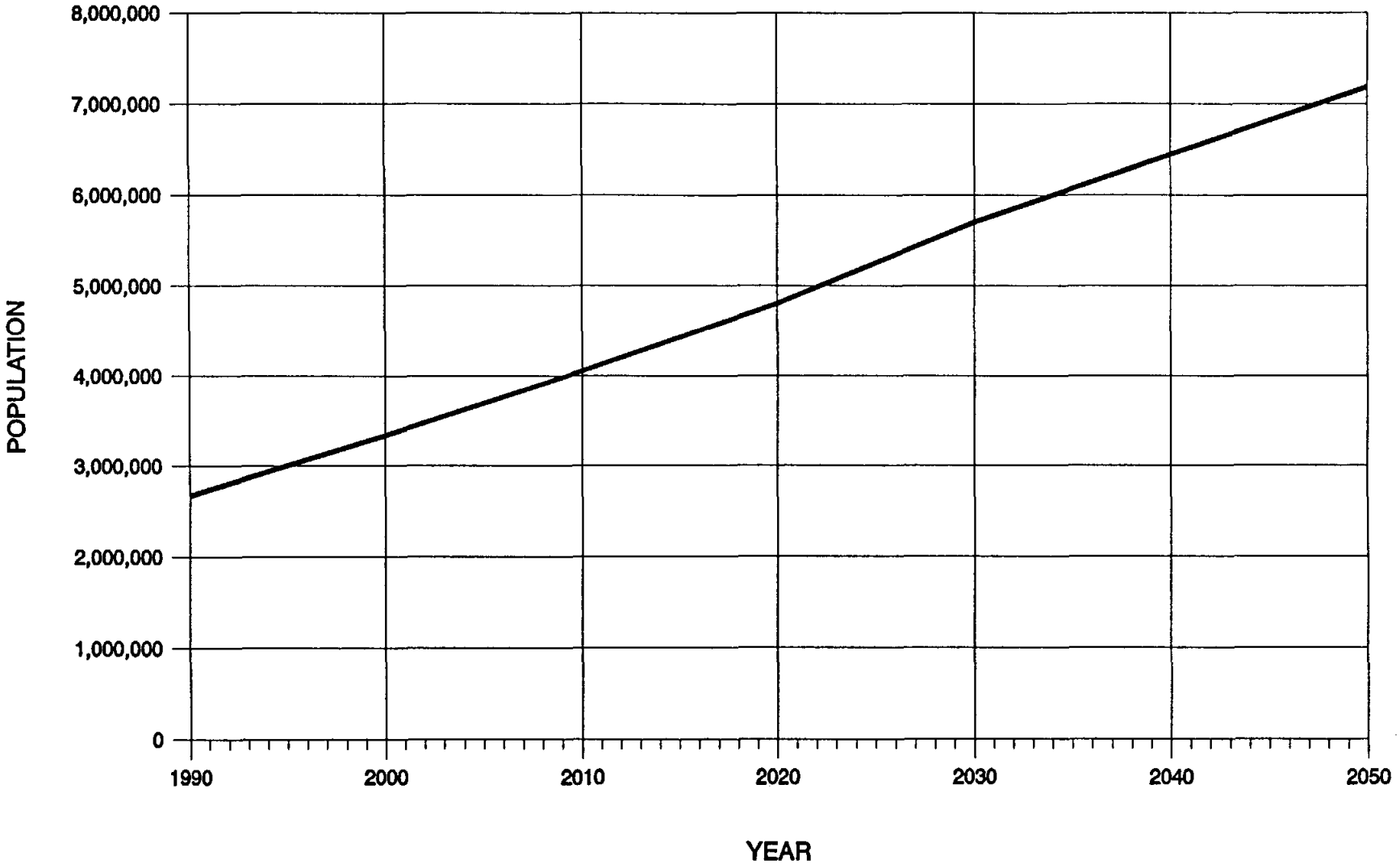
In 1990, Bexar County had 87 percent of the Edwards Aquifer area population, and by 2050 is projected to have about 89 percent of the Edwards Aquifer area projected population.

Table ES-1 contains a summary of population projections through year 2050 for the study area, Edwards Aquifer area, river basins, and selected cities. Figure ES-2 presents a graph of the total projected population growth in the study area during the planning period and Figure ES-3 contains the projected growth in the study river basins.

**Table ES-1**
**Population Projections[1]**

| Area | 1990 | 2020 | 2050 | Annual Growth Rate % |
|---|---|---|---|---|
| 33 Counties | 2,669,016 | 4,805,280 | 7,185,211 | 1.66 |
| Edwards Aquifer Area | 1,363,688 | 2,359,661 | 3,696,204 | 1.67 |
| River Basin Study Areas | | | | |
| Nueces | 110,733 | 169,160 | 220,678 | 1.15 |
| San Antonio | 1,271,334 | 2,184,550 | 3,459,299 | 1.68 |
| Guadalupe | 350,659 | 602,606 | 772,441 | 1.32 |
| Colorado | 936,290 | 1,848,964 | 2,732,793 | 1.80 |
| Selected Counties | | | | |
| Bexar | 1,185,394 | 2,034,080 | 3,271,762 | 1.70 |
| Travis | 576,407 | 1,083,814 | 1,520,837 | 1.63 |
| Victoria | 74,361 | 110,685 | 135,596 | 1.01 |
| State of Texas | 16,986,510 | 27,053,959 | 36,308,602 | 1.27 |

[1]Source: Texas Water Development Board, High Case Population Projections.

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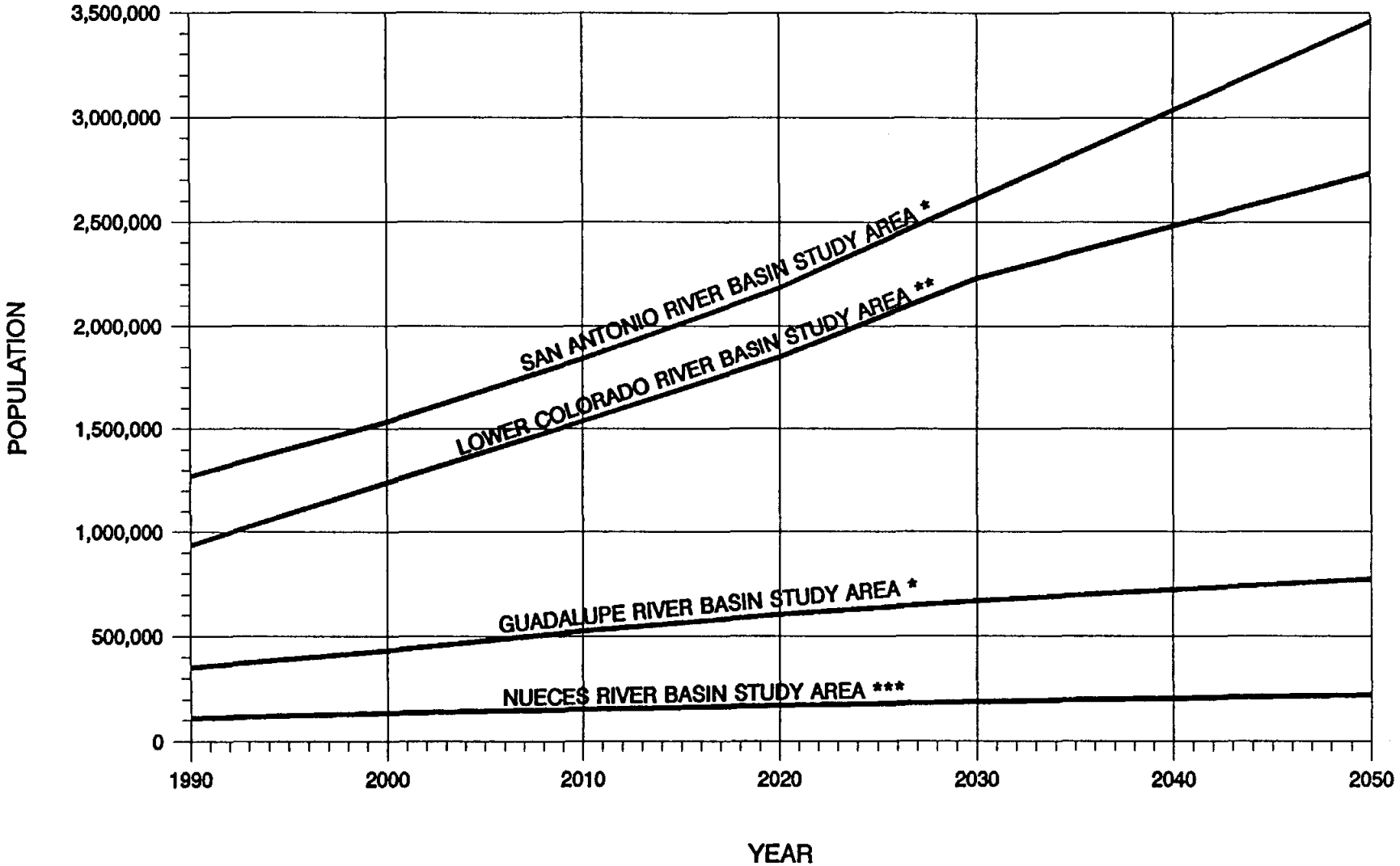
TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

POPULATION PROJECTIONS

33 COUNTY WEST CENTRAL STUDY AREA

FIGURE ES - 2




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## POPULATION PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE ES - 3

## ES-3 WATER DEMAND AND CURRENT SUPPLIES

Water Demand Projections

The Texas Water Development Board has made water demand projections for the period 1990 through 2050. High case water demand projections, with conservation, were specified by the TWDB for use in all Trans-Texas studies, and are tabulated and shown in various figures for each of the following areas: (a) 33-county West Central Study Area; (b) Edwards Aquifer area[2]; and (c) river basins and adjacent areas.

In 1990, total water use[3] in the 33-county study area was 2.2 million acft (see footnote[4]), of which 646,000 acft (30 percent) was in the Edwards Aquifer area. Projected year 2050, total water demand for the 33-county study area is 3.1 million acft (a 41 percent increase), of which 1.1 million acft is in the Edwards Aquifer area (a 70 percent increase). In the Edwards Aquifer area, the two major water use categories are municipal and irrigation. Municipal use is projected to increase from 260,000 acft in 1990 to 765,000 acft in 2050, a 195 percent increase. Conversely, irrigation use is projected to decline from 335,000 acft in 1990 to 240,000 acft in 2050, a 28 percent decrease.

Table ES-2 contains a summary of total water demand projections through year 2050 for the study area, Edwards Aquifer area, river basins, and selected cities. Table ES-3 contains a summary of current and projected water demand by type of use. Figure ES-4 presents a graph of the total projected water demand in the study area during the planning period and Figure ES-5 contains the projected demand in the study river basins.

Section 2 of this report contains individual projections of water demand for municipal, industrial, steam-electric, irrigation, mining, and livestock, for the 33 county area, the Edwards Aquifer area, and the individual river basins.

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[2]The Edwards Aquifer Area is the area specified in Senate Bill 1477, 1993 Texas Legislature, creating the Edwards Aquifer Authority, and includes all of Uvalde, Medina, and Bexar counties, and parts of Atascosa, Comal, Guadalupe, Comal, Hays, and Caldwell counties. (See Figure 2-3 for Edwards Aquifer Authority Area.)

[3]Total water use is the sum of the water demands for municipal, industrial, steam-electric power, irrigation, mining, and livestock purposes.

[4]An acre-foot of water (abbreviated "acft") is the volume contained by covering one acre with water one foot deep; in other terms, this volume is 325,851 gallons.

**Table ES-2**
**Total Water Demand Projections[1]**
**(in Acre-Feet[2])**

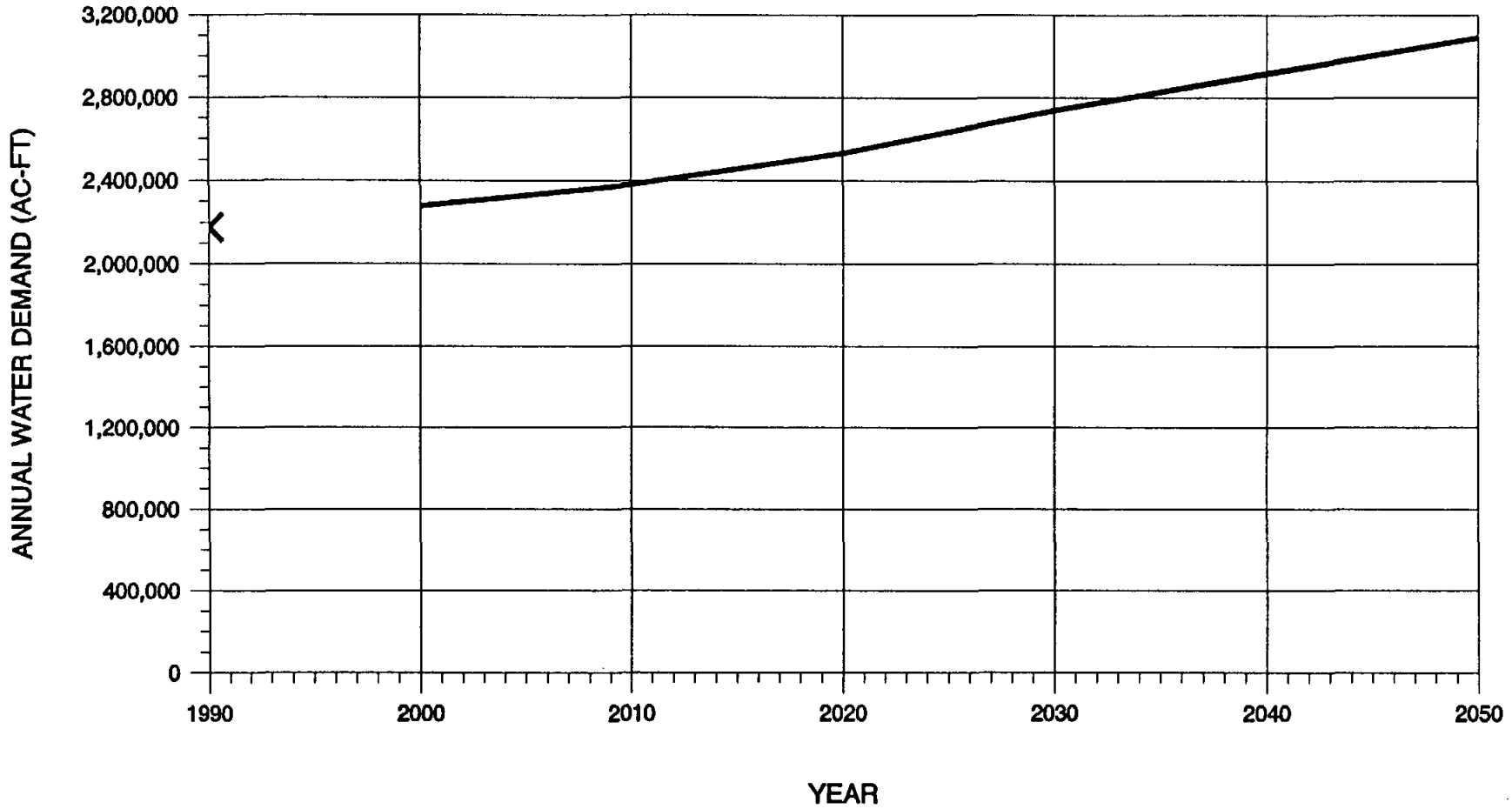
| Area | 1990 | 2020 | 2050 |
|---|---|---|---|
| 33 Counties | 2,177,005 | 2,532,828 | 3,089,709 |
| Edwards Aquifer Area[3] | 646,076 | 853,245 | 1,144,481 |
| River Basin Study Areas | | | |
| Nueces | 555,503 | 457,295 | 470,173 |
| San Antonio | 358,304 | 592,888 | 868,928 |
| Guadalupe | 197,959 | 392,782 | 484,366 |
| Colorado | 1,065,239 | 1,089,836 | 1,266,242 |

[1]Source: Texas Water Development Board; High Case Projection with Conservation.
[2]One acre-foot equals 325,851 gallons.
[3]As defined by SB 1477.

**Table ES-3**
**Water Demand Projection by Type of Use[1]**

| Type of Water Use | 1990 Use | | | | 2050 Projections | | | |
|---|---|---|---|---|---|---|---|---|
| | 33-County Study Area | | Edwards Aquifer Area | | 33-County Study Area | | Edwards Aquifer Area | |
| | Acft | % | Acft | % | Acft | % | Acft | % |
| Municipal | 498,128 | 22.9 | 259,330 | 40.1 | 1,420,211 | 45.9 | 765,017 | 66.8 |
| Industrial | 83,307 | 3.8 | 19,263 | 3.0 | 415,953 | 13.5 | 66,519 | 5.8 |
| Steam-Elec. | 98,755 | 4.5 | 24,263 | 3.8 | 236,200 | 7.6 | 56,000 | 4.9 |
| Irrigation | 1,411,579 | 64.8 | 335,061 | 51.9 | 918,400 | 29.7 | 239,880 | 21.0 |
| Mining | 47,360 | 2.2 | 2,979 | 0.4 | 48,663 | 1.6 | 10,089 | 0.9 |
| Livestock | 37,876 | 1.7 | 5,180 | 0.8 | 50,282 | 1.7 | 6,976 | 0.6 |
| TOTAL | 2,177,005 | 100.0 | 646,076 | 100.0 | 3,089,709 | 100.0 | 1,144,481 | 100.0 |

[1]Source: Texas Water Development Board; High Case Projection with Conservation.

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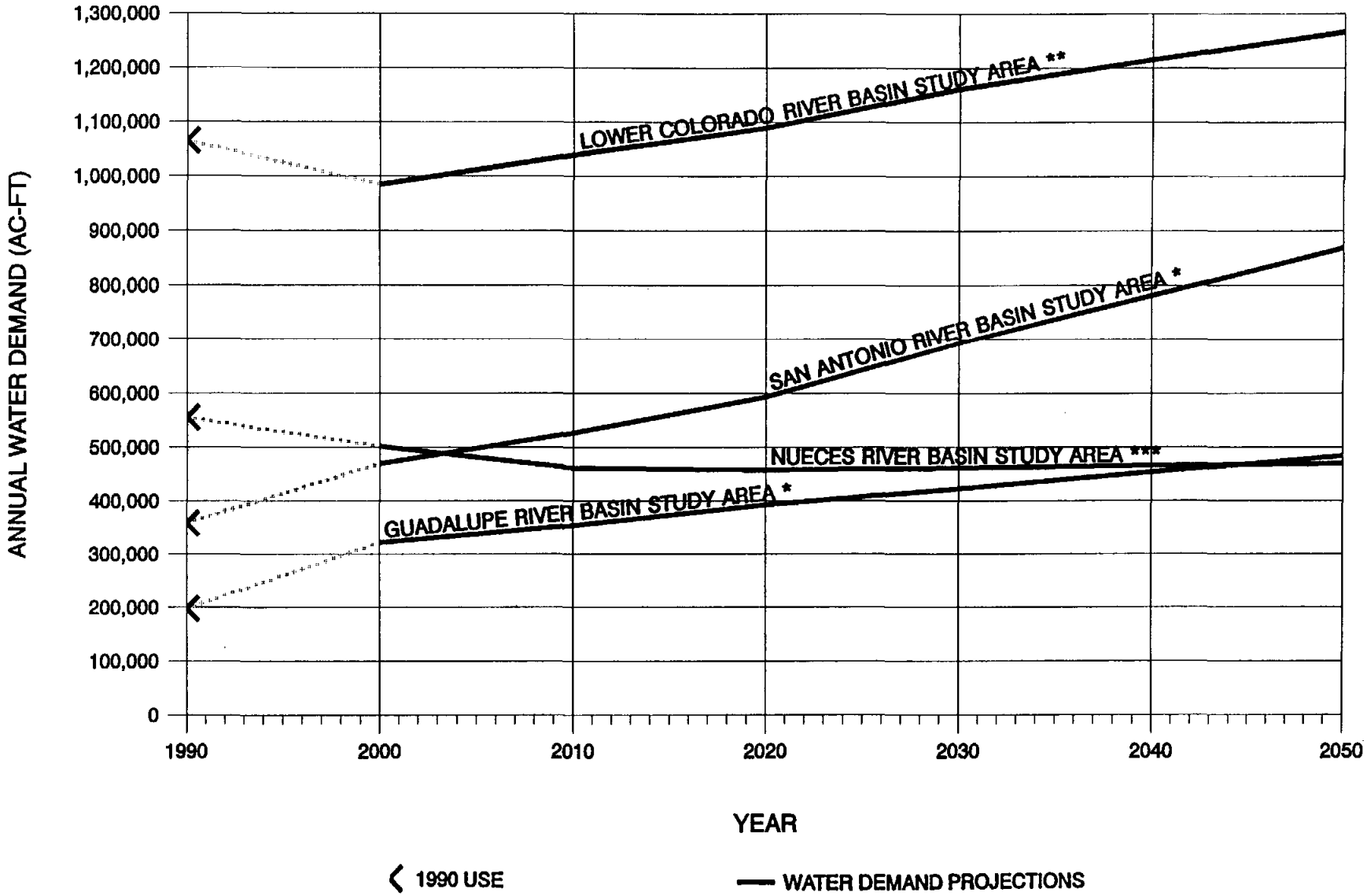
TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# TOTAL WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE ES - 4




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# TOTAL WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE ES - 5

Water Supply Information

Water supply information is listed below and on the following pages for the Edwards Aquifer Area and each major river basin (see Tables ES-4 through ES-8 and Figures ES-6 through ES-10). Water supplies from the Edwards aquifer are based on SB 1477 (450,000 acft thorough 2007 and 400,000 acft thereafter).

**Table ES-4**
**Estimated Edwards Aquifer Area Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 450,000 | 400,000 |
| Other Aquifers | 39,750 | 39,750 |
| Canyon Lake (New Braunfels Contract) | 6,720 | 6,720 |
| Canyon Lake (San Marcos Contract) | 5,000 | 5,000 |
| Medina Lake - Average Supply | 57,970 | 57,970 |
| Medina River - Run-of-River Rights | 11,580 | 11,580 |
| Braunig Lake | 12,000 | 12,000 |
| Calaveras | 37,000 | 37,000 |
| Total | 620,020 | 570,020 |

**Table ES-5**
**Estimated Nueces River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 181,300 | 161,200 |
| Other Aquifers | 133,200 | 133,200 |
| Run-of-River Rights | 52,700 | 52,700 |
| Total | 367,200 | 347,100 |

**Table ES-6**
**Estimated San Antonio River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 250,020 | 222,240 |
| Other Aquifers | 109,200 | 109,200 |
| Run-of-River Rights | 46,800 | 46,800 |
| Medina Lake - Average Supply | 57,900 | 57,900 |
| Braunig Lake | 12,000 | 12,000 |
| Calaveras | 37,000 | 37,000 |
| Total | 512,920 | 485,140 |

**Table ES-7**
**Estimated Guadalupe River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 18,630 | 16,560 |
| Other Aquifers | 144,700 | 144,700 |
| Canyon Lake | 50,000 | 50,000 |
| Consumptive Run-of-River Rights | 259,100 | 259,100 |
| Subtotal | 472,430 | 470,360 |
| Pass-Through Industrial and Steam Electric Run-of-River Rights* | 587,500 | 587,500 |
| Total | 1,059,930 | 1,057,860 |

*Does not include hydroelectric right of 600 cfs at Lake Dunlap, which is a nonconsumptive right and, therefore, these flows can be used downstream of the last hydroelectric power plant near Gonzales for other purposes.

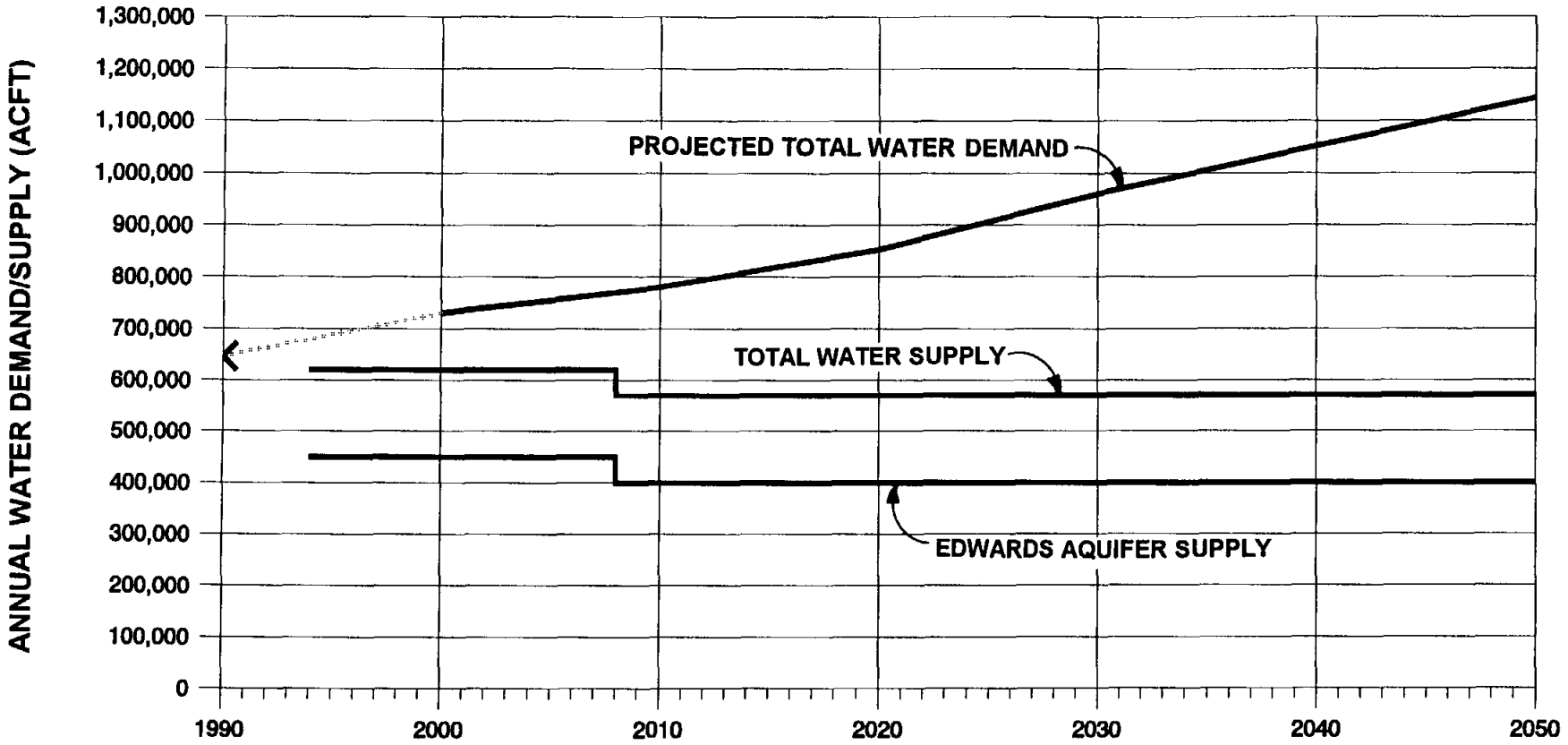
| Table ES-8<br>Estimated Lower Colorado River Basin Water Supply | |
|---|---|
| **Water Source** | **Estimated Supply (acft/yr)** |
| Groundwater | 293,300 |
| Highland Lakes | 445,300 |
| Run-of-River Rights | 1,140,800* |
| Total | 1,879,400 |
| *Estimated supply during critical drought -- 350,921 acft | |

Water supply information for the 33-county study area is summarized below:

- Water supply from the Edwards aquifer, as specified in SB 1477, is as follows:
  - Through 2007, 450,000 acft; and
  - Beginning in 2008, 400,000 acft.

- Groundwater supply information for the Carrizo and other aquifers of the 33-county study area:
  - Recharge (long-term dependable supply), 680,400 acft;
  - Overdrafting is occurring in nine counties;
  - Significant underdevelopment is present in seven counties. (Note: this groundwater is beneath private land and in many cases is more than 50 miles from municipal and industrial users.)

- Annual surface water supply of the 33-county study area are as follows:
  - Nueces Basin Study Area Firm Yield 0 acft
  - San Antonio Basin (Medina Lake) Firm Yield 8,770 acft
  - San Antonio Basin (Medina Lake) Average Yield 57,900 acft
  - Guadalupe Basin (Canyon Lake) Firm Yield 50,000 acft
  - Colorado Basin (Highland Lakes) Firm Yield 445,266 acft
  - Nueces Basin Run-of-River Permits 53,397 acft
  - San Antonio Basin Run-of-River Permits 46,808 acft
  - San Antonio Basin Reuse Permit (Calaveras) 37,000 acft
  - San Antonio Basin Cooling Lake Permit (Braunig) 12,000 acft
  - Guadalupe Basin Run-of-River/Consumptive Permits 272,327 acft
  - Guadalupe Basin Run-of-River Once-Thru Permits 587,500 acft
  - Colorado Basin Run-of-River Permits 1,140,790 acft




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| WATER SOURCE | THRU 2007 | AFTER 2007 |
| EDWARDS AQUIFER | 450,000 | 400,000 |
| OTHER AQUIFERS | 39,750 | 39,750 |
| CANYON LAKE (NEW BRAUNFELS CONTRACT) | 6,720 | 6,720 |
| CANYON LAKE (SAN MARCOS CONTRACT) | 5,000 | 5,000 |
| MEDINA LAKE - AVERAGE SUPPLY | 57,970 | 57,970 |
| MEDINA RIVER - RUN-OF-RIVER RIGHTS | 10,503 | 10,503 |
| BRAUNIG LAKE | 12,000 | 12,000 |
| CALAVERAS LAKE | 37,000 | 37,000 |
| TOTAL | 618,943 | 569,125 |

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TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS EDWARDS AQUIFER AREA**

FIGURE ES - 6

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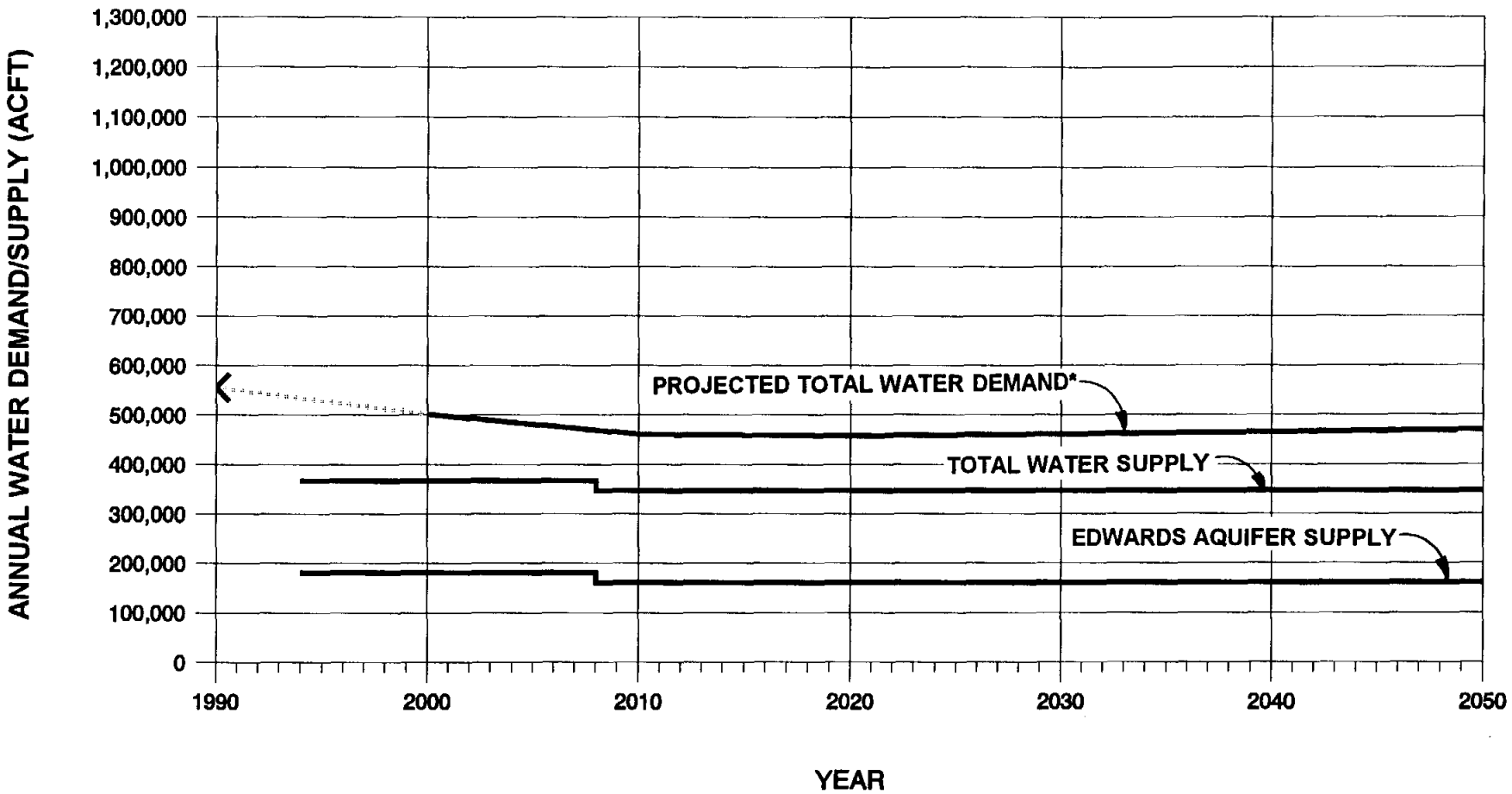


| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| **WATER SOURCE** | **THRU 2007** | **AFTER 2007** |
| EDWARDS AQUIFER | 181,300 | 161,200 |
| OTHER AQUIFERS | 133,200 | 133,200 |
| RUN-OF-RIVER RIGHTS | 52,700 | 52,700 |
| **TOTAL** | 367,200 | 347,100 |

* Includes only study area counties of the Nueces Basin.

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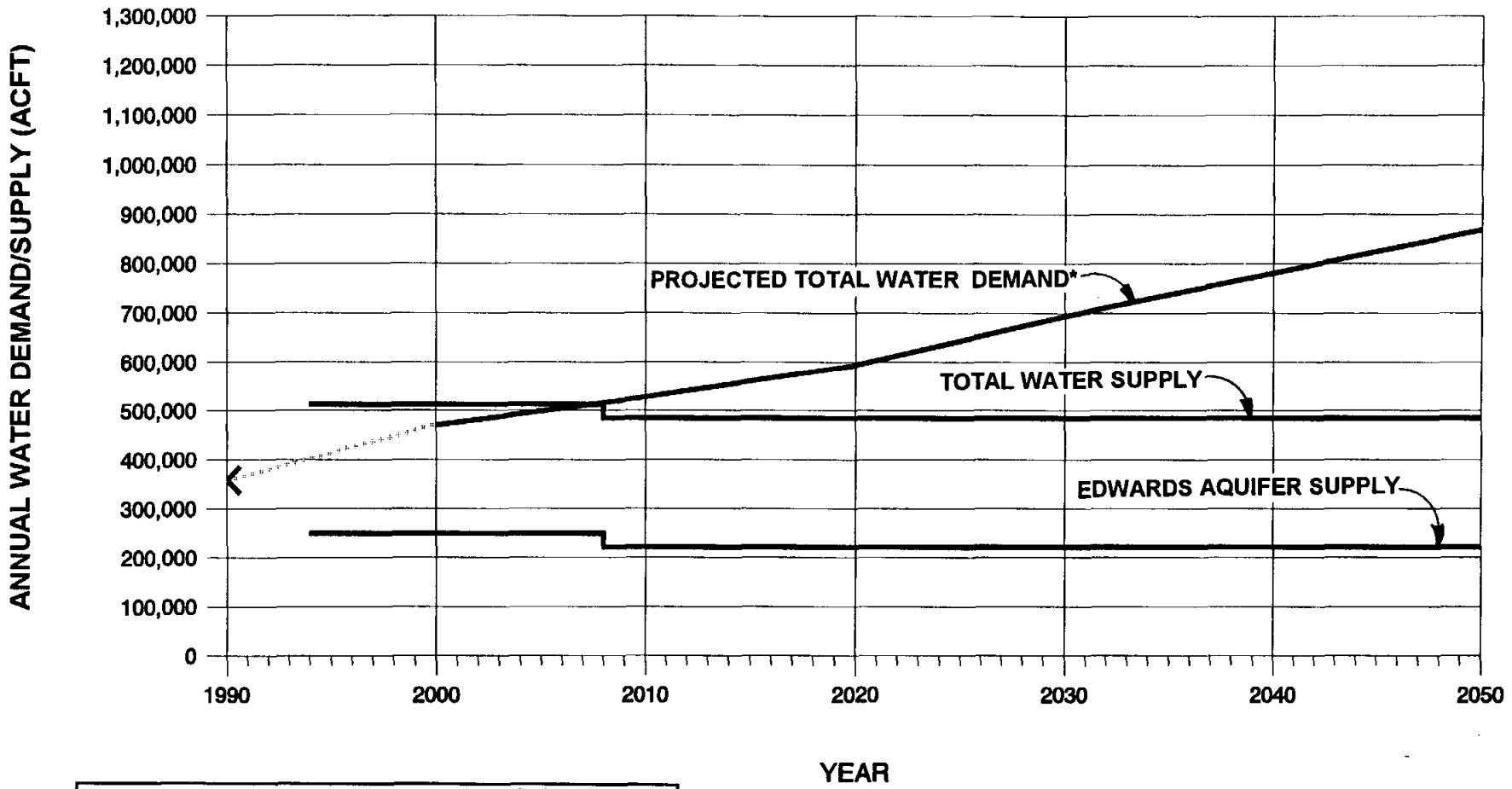
TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS NUECES BASIN STUDY AREA**

FIGURE ES - 7




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| WATER SOURCE | THRU 2007 | AFTER 2007 |
| EDWARDS AQUIFER | 250,020 | 222,240 |
| OTHER AQUIFERS | 109,200 | 109,200 |
| RUN-OF-RIVER RIGHTS | 46,800 | 46,800 |
| MEDINA LAKE - AVERAGE SUPPLY | 57,900 | 57,900 |
| BRAUNIG LAKE | 12,000 | 12,000 |
| CALAVERAS LAKE | 37,000 | 37,000 |
| TOTAL | 512,920 | 485,140 |

* In-basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

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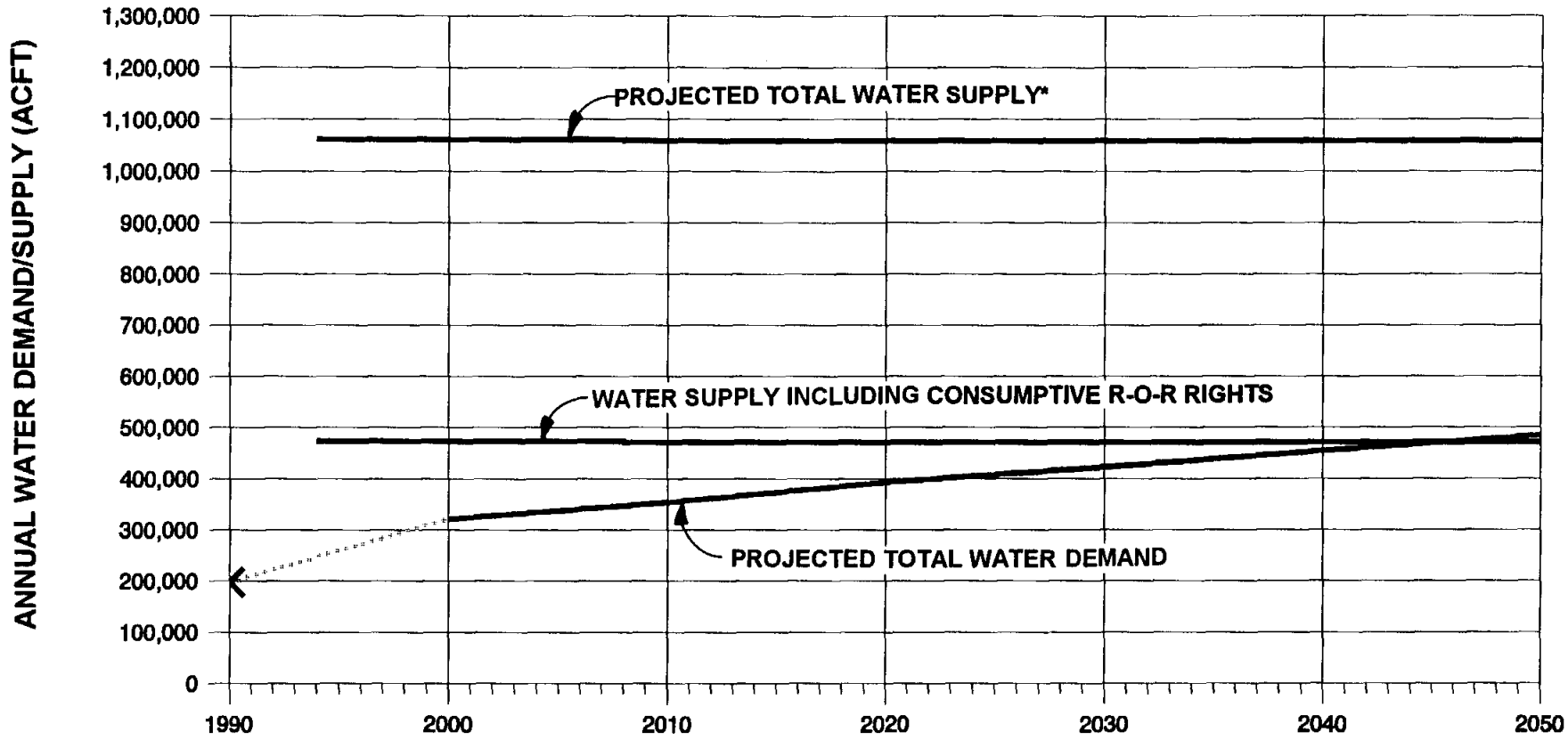
TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS SAN ANTONIO BASIN STUDY AREA**

FIGURE ES - 8




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| **WATER SOURCE** | **THRU 2007** | **AFTER 2007** |
| EDWARDS AQUIFER | 18,630 | 16,560 |
| OTHER AQUIFERS | 144,700 | 144,700 |
| CANYON LAKE | 50,000 | 50,000 |
| CONSUMPTIVE RUN-OF-RIVER RIGHTS | 259,100 | 259,100 |
| **SUBTOTAL** | 472,430 | 470,360 |
| PASS-THROUGH INDUSTRIAL AND STEAM ELECTRIC RUN-OF-RIVER RIGHTS | 587,500 | 587,500 |
| **TOTAL** | 1,059,930 | 1,057,860 |
| NOTE: HYDROELECTRIC RIGHT AT DUNLAP IS 600 CFS. | | |

* In-basin plus adjacent areas that obtain water from the basin.

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TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

# TOTAL WATER DEMAND AND SUPPLY PROJECTIONS GUADALUPE BASIN STUDY AREA

FIGURE ES - 9

Comparison of Supply and Demand

The projected water demands are compared with water supplies from existing sources for the Edwards aquifer area and each of the river basins of the West Central Study area, as follows:

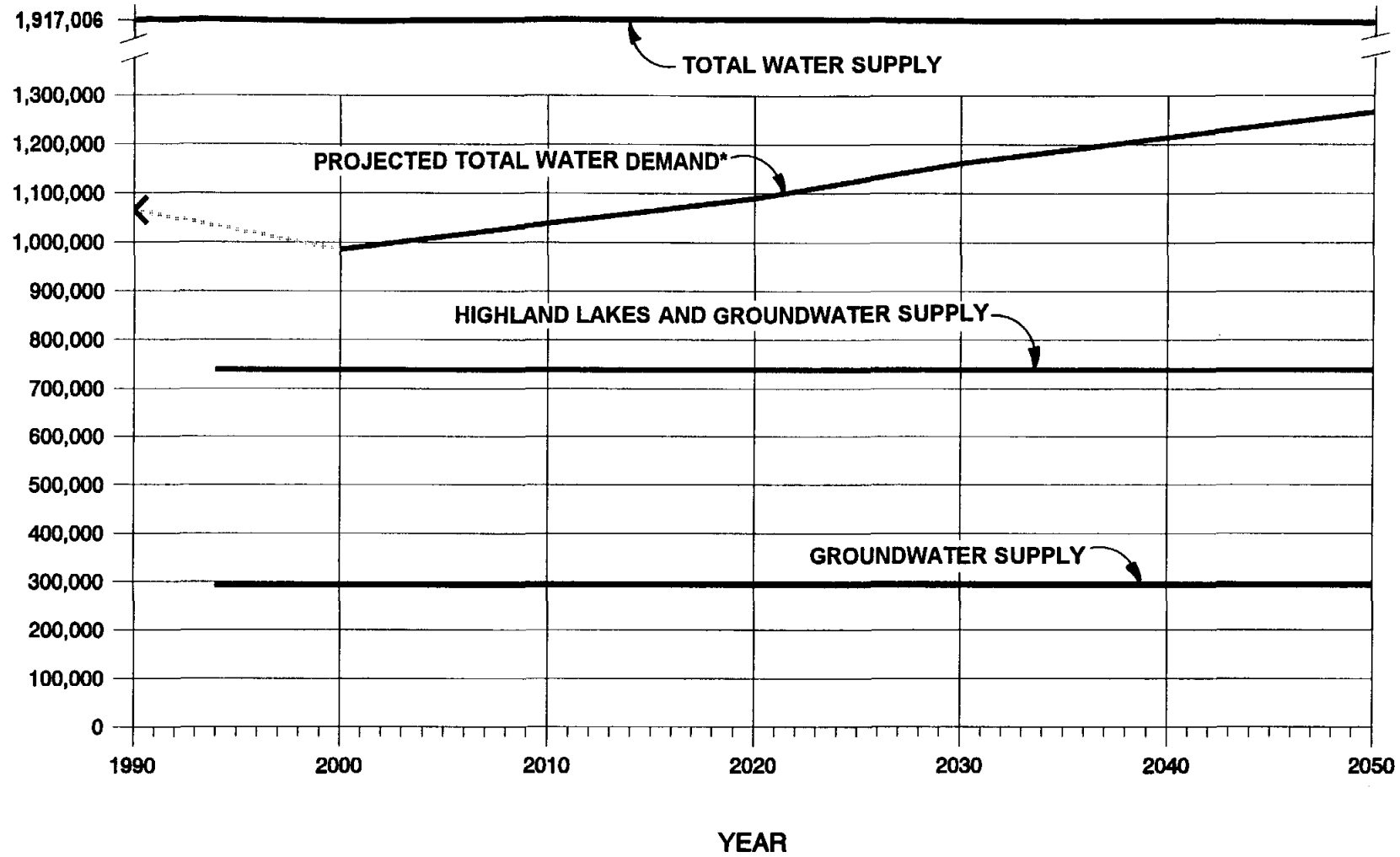
- Shortages are projected for the Edwards aquifer area in the immediate future:
  - Year 2000 shortage of 110,788 acft; and
  - Year 2050 shortage of 574,461 acft.

- Shortages are projected for the Nueces Basin Study area in the immediate future:
  - Year 2000 shortage of 134,626 acft; and
  - Year 2050 shortage of 123,073 acft.

- Shortages are projected for the San Antonio Basin after year 2008:
  - Year 2010 shortage of 41,531 acft; and
  - Year 2050 shortage of 383,788 acft.

- For the Guadalupe Basin and adjacent areas, projected demands are less than projected supplies to year 2046, when run-of-river consumptive permits are considered. When once-through industrial and electric power permits of 587,500 acft are included as available supplies for downstream diversion, then supplies exceed demand through 2050.

- For the Lower Colorado Basin and adjacent areas, projected demands are less than the sum of firm yields from lakes, groundwater, and run-of-river surface water rights throughout the planning period (surplus of 894,780 acft in 2000 and 613,158 acft in 2050). However, for drought-of-record conditions (when 1,140,800 acft of run-of-river rights are estimated to yield 350,921 acft), supply equals projected demands in year 2020 and there would be a shortage of 176,721 acft for projected demands in year 2050.




| ESTIMATED WATER SUPPLY | |
|---|---|
| WATER SOURCE | ESTIMATED SUPPLY (ACFT/YR) |
| GROUNDWATER | 293,300 |
| HIGHLAND LAKES | 445,300 |
| RUN-OF-RIVER RIGHTS | 1,178,406 |
| TOTAL | 1,917,006 |

* In-basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

HDR Engineering, Inc.

TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

# TOTAL WATER DEMAND AND SUPPLY PROJECTIONS COLORADO BASIN STUDY AREA

FIGURE ES - 10

REV 5-31-94

## ES-4 SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES

A total of 37 primary water supply alternatives with over 130 sub-alternative configurations were evaluated in this Phase I planning and screening level study. Each of these alternatives was evaluated for water supply potential, environmental effects, and cost. The names of the alternatives are listed in Table ES-9 and the locations of the water supply sources for each alternatives are shown on Figure ES-6.

Table ES-10 lists the potential available water supply, a summary of environmental issues and special concerns, and the estimated unit cost in 1994-dollars (including capital, operation and maintenance, and water purchase costs) of the water supply alternatives. The Environmental Overview (Section 3.0.1 in the main report) contains a more detailed summary of the environmental assessment and study requirements of each alternative and Section 3.0.2 in the main report contains a summary of cost estimating procedures.

The water supply alternatives have all been studied on a stand-alone basis and many of the alternatives, if implemented, could affect water availability of other alternatives located in the same basin. Because of the inter-relationship between projects, implementation of one project may affect either the firm yield of another project, or the annual distribution of availability. For these reasons, the yields of projects listed in Table ES-10 within the same river basin, cannot be added together. An example of this would be a reuse alternative, such as L-12, Exchange of Reclaimed Water for BMA Medina Lake Water. The implementation of L-12 would significantly reduce the yield of the other reuse alternatives (i.e., L-11, L-13, and L-14). Further, the yield of downstream projects, (i.e., Goliad Reservoir, S-16) could be affected. The yield available from implementation of various groups or scenarios of water supply alternative projects will require more detailed analysis in Phase II of the study in order to accurately determine the interaction between various alternatives.

### Classification of Alternatives

Alternatives have been classified into four basic groups each of which considers alternatives method of supplying water to the study area. This grouping includes:

## Table ES-9
## Water Supply Alternatives[1]

| Alternate No. | Description |
|---|---|
| | **Conservation / Local Alternatives** |
| L-10 | Demand Reduction |
| L-11 | Exchange Reclaimed Water for Edwards Irrigation Water |
| L-12 | Exchange Reclaimed Water for BMA Medina Lake Water |
| L-13A | Recycling/Reuse Plans by SAWS |
| L-13B | Reclaimed Water to Edwards Aquifer |
| L-14 | Transfer of Reclaimed Water to Corpus Christi Through Choke Canyon Reservoir |
| L-15 | Purchase or Lease of Edwards Irrigation Water for Municipal and Industrial Use |
| L-16 | Demineralization of Edwards "Bad Water" |
| L-17 | Natural Recharge - Type 1 Projects |
| L-18 | Natural Recharge - Type 2 Projects |
| L-19 | Springflow Augmentation |
| 3.11 | Nueces River Basin Water Rights |
| L-20 | Mayor's 2050 Committee Regional Plan[2] |
| | **San Antonio River Basin** |
| S-10 | Unappropriated Streamflow near Elmendorf |
| S-11 | Unappropriated Streamflow near Falls City |
| S-12 | Unappropriated Streamflow near Goliad |
| S-13 | Medina Lake |
| S-14 | Applewhite Reservoir |
| S-15 | Cibolo Reservoir |
| S-16 | Goliad Reservoir |
| | **Guadalupe River Basin** |
| G-10 | Unappropriated Streamflow near Gonzales |
| G-11 | Unappropriated Streamflow near Cuero |
| G-12 | Unappropriated Streamflow at Salt Water Barrier |
| G-13 | San Marcos River Diversion |
| G-14 | Guadalupe River at Lake Dunlap Diversion |
| G-15 | Canyon Lake Released to Lake Dunlap |
| G-16 | Cuero Reservoir |
| G-17 | Lindenau Reservoir |
| G-18 | McFaddin Reservoir |
| G-19 | Guadalupe River Dam 7 |
| G-20 | Gonzales Reservoir |
| G-21 | Lockhart Reservoir |
| G-22 | Dilworth Reservoir |
| G-23 | Canyon Lake/Mid-Cities Regional Plan[2] |
| | **Colorado River Basin** |
| C-10 | Colorado River at Lake Austin with Purchase of Irrigation Rights |
| C-13 | Lake Travis with Purchase of Irrigation Rights |
| C-17 | Colorado River at Columbus with Purchase of Irrigation Rights |
| C-18 | Shaws Bend Reservoir |
| C-19 | Lake Mason[2] |
| | **Brazos and Sabine River Basins** |
| B-10 | Allens Creek Reservoir |
| SB-10 | Toledo Bend Reservoir |
| SBB-10 | Allens Creek Reservoir and Toledo Bend Reservoir |
| | **Carrizo Aquifer** |
| CZ-10 | Carrizo Aquifer |

[1]Refer to Figure ES-11 for location of Water Supply Alternatives.
[2]Amended scope items to be published in a supplemental report. West Central PMC Action 5/24/94.

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Natural Recharge: For purpose of this study natural recharge is considered to be recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through either an injection well or through the delivery of water to a stream or reservoir located in the recharge zone.

Imported Recharge: Imported recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer.

Treatment and Distribution: This classification considers alternatives which would include conventional water treatment (or just disinfection in the case of Carrizo water) and delivery to a municipal water distribution system at a point near the water treatment plant. (Note: Distribution costs are based on costs as estimated in previous studies for delivery to the SAWS system. This is a simplifying assumption for the Phase I study and does not preclude other entities receiving treated water from a regional water treatment plant or from an interconnection with the SAWS system.)

Other: This classification includes all other alternatives including: demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**Water Delivery Locations**

The water supply from many of the alternatives could be delivered into the study area in one or more of the following three ways: (1) to the recharge zone by discharge into a stream or a recharge structure; (2) to an injection well placed into the Edwards formation; and, (3) to a water treatment plant.

For delivery to the recharge zone, the Edwards formation outcrop between Leon Creek and Medina Lake was identified as the representative terminal point area with the existing San Geronimo Creek recharge site included as one of the terminal locations. Other potential recharge sites on Culebra, Government, Limekiln, and Deep creeks were selected as potential delivery locations. For recharge into the aquifer through injection wells, a possible recharge area is along the BMA canal in Medina County as identified in previous

studies.[5] For the treatment and distribution alternatives, two delivery points have been identified. For alternative sources located north or northeast of San Antonio, water would be delivered to a treatment facility to be located in the vicinity of FM 1604 and Nacogdoches Road; and, for sources east or southeast, delivery would be to the previously proposed water treatment plant site located in the vicinity of Highway 16 and FM 1604. Generally, each alternative considered in this study is described in a figure which shows potential water sources and the various delivery options considered.

Figure ES-12 is a summary of unit costs and firm water supply for all alternatives with a unit cost of $1,500 per acre foot or less. Alternatives have been grouped into four general categories as follows:

1) Conservation, Reuse, and Lease Alternatives;
2) Natural Recharge Alternatives;
3) Imported Recharge Alternatives; and,
4) Treatment and Distribution Alternatives.

A review of Figure ES-12 shows that generally the more economical alternatives fall into the first two categories listed above (i.e. Conservation, Reuse and Lease Alternatives and Natural Recharge Alternatives). However the unit cost of many of the individual alternatives presented in this Phase I study could either increase or be reduced by combining alternatives. The combination of alternatives is to be considered in the next phase (i.e. Phase II) of the Trans-Texas Water Program.

[5]W. E. Simpson Co. and William F. Guyton Assoc. Inc., "Medina Lake Study, Recharge Evaluation," Edwards Underground Water District, no date.

## ES-5 ENVIRONMENTAL ISSUES

Table ES-10 includes a brief listing of the potentially most important environmental effects expected to result if an individual water supply alternative is implemented. Interactive effects, where two or more alternatives are implemented, have not yet been evaluated. Although an attempt has been made to be as comprehensive as possible, it should be understood that, in some instances, substantial background detail that is important in impact evaluation does not exist. The background material that was available is included in the text, figures and other tables in the Phase I report.

The alternatives involving new reservoir construction involve land disturbance and long-term habitat alteration over much larger areas than do other water supply alternatives. The remaining alternatives tend to have streamflow reduction and pipeline construction activity as the primary sources of potential impact. Most alternatives, regardless of whether new construction is involved or not, involve changes in streamflow and, consequently, inflows to their respective estuaries. The alternatives considered in the Phase I work, (with the exception of possible small impoundments associated with reuse alternatives) meet the instream flow and the bay & estuary inflow requirements established as screening criteria for the Trans Texas Water Program by the Texas Water Development Board. It is anticipated that alternatives selected for further evaluation will require site specific study to determine streamflow needs.

Alternatives involving new construction will require environmental and cultural resources surveys, including endangered species evaluations. The amount of effort that will have to be invested, and the likelihood of encountering significant environmental and cultural resource problems will be roughly proportional to the area to be disturbed, and to the degree of flexibility in specific project locations and operational characteristics. Reservoir alternatives generally require specific locations for efficient impoundment and storage, and are therefore usually less able to mitigate potential impacts by avoidance than are, for example, diversion and pipeline alternatives.

None of the alternatives considered appears to have adverse impacts so pronounced that the alternative can be eliminated at this time. However, alternatives involving recharge of the Edwards Aquifer with treated wastewater, or with water from sources not originating

on the Edwards Plateau, and springflow augmentation will likely require extensive study of their potential effects on the Edwards Aquifer and spring run fauna and flora before implementation. The portion of the Carrizo Aquifer alternative in Bastrop County has the potential to adversely impact Houston Toad breeding habitat. Some of the reservoir alternatives may have potential conflicts with protected species, recreational interests, or existing state parks.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| | Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| G-13 | **SAN MARCOS RIVER** | | | | | | | Reduced streamflows in San Marcos River/ Terrestrial habitat impacts slight/ Interbasin transfer.<br><br>(a) with treatment.<br>(b) without treatment. |
| A | San Marcos River Unappropriated Streamflow Below Blanco River Confluence, Divert and Inject to Aquifer | 6,600 [2] | $3,640(a)<br>$2,796(b) | | | | | |
| B | San Marcos River Unappropriated Streamflow Below Blanco River Confluence, Divert to Recharge Zone | 6,600 [2] | $2,420(b) | | | | | |
| G-14 | **GUADALUPE RIVER AT LAKE DUNLAP** | | | | | | | Reduced streamflow in Guadalupe River/ Terrestrial habitat impacts slight/ Interbasin transfer.<br><br>(a) with treatment.<br>(b) without treatment. |
| A | Guadalupe River Unappropriated Streamflow at Lake Dunlap, Divert and Inject to Aquifer (No Use of Stored Water from Canyon) | 3,500 [2] | $5,793(a)<br>$4,213(b) | | | | | |
| B | Guadalupe River Unappropriated Streamflow at Lake Dunlap, Divert to Recharge Zone (No Use of Stored Water from Canyon) | 3,500 [2] | $3,437(b) | | | | | |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| G-15 | **CANYON LAKE (RELEASED TO LAKE DUNLAP)** | | | | | | | Increased streamflows in Guadalupe between Canyon Dam and Lake Dunlap, slight to no effect below Lake Dunlap/ Interbasin Transfer.<br><br>(a) with treatment.<br>(b) without treatment. |
| A | Canyon Lake, Divert and Inject to Aquifer | 10,000 | $765(a)<br>$629(b) | | | | | |
| B | Canyon Lake, Divert to Recharge Zone | 10,000 | $536(b) | | | | | |
| C | Canyon Lake, Divert to Recharge Zone | 15,000 | $467(b) | | | | | |
| D | Canyon Lake, Divert to WTP | 10,000 | | | | $533 | | |
| E | Canyon Lake, Divert to WTP | 15,000 | | | | $497 | | |
| G-16 | **CUERO RESERVOIR** | | | | | | | Reduced streamflows in Guadalupe River/ Riverine habitats converted to lake habitats, terrestrial habitat impacts/ Potential protected species conflict/ Interbasin transfer. |
| A | Cuero Reservoir, Divert and Inject to Aquifer | 168,000 [3] | | | $688 | | | |
| B | Cuero Reservoir, Divert to Recharge Zone | 168,000 [3] | | $647 | $730 | | | |
| C | Cuero Reservoir, Divert to WTP | 168,000 [3] | | | | $648 | | |
| G-17 | **LINDENAU RESERVOIR (with diversion from Guadalupe)** | | | | | | | Reduced streamflows in Guadalupe River/ Small stream habitats converted to lake habitats/ Terrestrial habitat impacts/ Potential protected species conflicts/ Interbasin transfer. |
| A | Lindenau Reservoir, Divert and Inject to Aquifer | 45,800 [30 | | | $1,211 | | | |
| B | Lindenau Reservoir, Divert to Recharge Zone | 45,800 [3] | | $1,151 | $1,249 | | | |
| C | Lindenau Reservoir, Divert to WTP | 45,800 [3] | | | | $1,132 | | |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| | **LOCAL ALTERNATIVES** | | | | | | | |
| L-10 | Demand Reduction | | | | | | | Conservation alternatives could reduce treated wastewater discharge to the San Antonio River/ Water not extracted from the Edwards Aquifer would contribute to spring discharge.<br><br>(a) Values listed in water supply column are reductions in demand, not water supply. 90,000 includes combined effects of Items A thru F.<br><br>(b) Value listed is reduction in demand. 11,200 includes combined effects of H and I. |
| A | Public Information | | | | | | | |
| B | Incentive Programs | | | | | | | |
| C | Conservation Pricing | 90,000(a) | | | | | $272 | |
| D | Leak Detection and Repair | | | | | | | |
| E | Conservation Landscaping | | | | | | | |
| F | Retrofit Plumbing Fixtures | | | | | | | |
| G | Gray Water Use for Lawns and Landscaping | N/A | | | | | | |
| H | Low Energy Precision Application for Agriculture | 11,200(b) | | | | | $38 | |
| I | Furrow Diking for Agriculture | | | | | | | |
| J | Surge Valves for Agriculture | N/A | | | | | | |
| L-11 | Exchange Reclaimed Water for Edwards Irrigation Water | 38,000(a) | | | | | $469 | Potential increase in soil salinity/ Potential for reduced streamflows/ Requires elimination of certain food crops from irrigation acreage.<br>(a) Annual volume of reclaimed water to irrigators. |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| L-12 | Exchange Reclaimed Water for BMA Medina Lake Water | 31,000(a)<br>66,000(b) | Costs are included in Alternative S-13 (Purchase of BMA Medina Lake Water). | | | | | Potential increase in soil salinity/ Potential for reduced streamflows/ Willingness of owners to sell water/Requires elimination of certain food crops from irrigation acreage/ Willingness of CPS to allow use of cooling reservoirs.<br>(a) Water available using top 3 feet of Braunig & Calaveras<br>(b) Water available with new off-channel reservoir. |
| L-13 | Reclaimed Water Reuse | | | | | | | A. Potential to reduce streamflows.<br>B. Potential impacts to Edwards aquifer fauna. |
| A | Recycling/Reuse Plans by SAWS | 30,000 to 50,000 | | | | | $375 | |
| B | Reclaimed Water to Edwards Aquifer | 92,000 | | | | | $761 | |
| L-14 | Transfer of Reclaimed Water to Corpus Christi - Diversion from San Antonio River to Choke Canyon | 27,850(a) | Possible mitigation project for Alternatives L-17 and L-18, (Natural Recharge Enhancement). | | | | | Reduced San Antonio River flows/ Water quality in Choke Canyon Reservoir.<br>(a) 27,850 acft/yr is drought recharge enhancement available from Type 2 Recharge projects in Nueces River Basin. May require purchase of existing water rights on San Antonio River. |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| L-15 | Purchase (or Lease) of Edwards Irrigation Water for Municipal and Industrial Use | 68,900(a)(d)<br>69,800(b)(d) | | | | | $150(c) | Land use changes may affect wildlife habitats and fertilizer and pesticide runoff to area streams/Willingness of irrigators to lease rights.<br>(a) Water available under full conservation strategy.<br>(b) Water available under full conservation strategy with average weather irrigation, with provisions of SB 1477.<br>(c) Estimated by SAWS.<br>(d) Economic impact to the local economy of converting irrigated acres to dryland production is $498 of gross farm income and an additional $552 of gross business loss to farm supply sectors per acre converted.<br>(e) Need to refine monthly distribution of withdrawals to match seasonal crop needs and TWDB aquifer model parameters. |
| L-16 | Demineralization of Edwards "bad water" | None | | | | | N/A | Withdrawal and treatment of bad water from the Edwards produces no net increase in supply. |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|
| | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | Without Treatment | With Treatment | | | |
| L-17 Natural Recharge - Type 1 Projects | | | | | | | Potential impacts to terrestrial and karst inhabitants and to Edwards aquifer fauna will vary with impoundment location/ Streamflow impacts occur below Type 1 structures. |
| a. Maximum Size | 71,000 [2] | $642 | | | | | |
| b. Optimum Size | 35,600 [2] | $460 | | | | | |
| L-18 Natural Recharge - Type 2 Projects (Optimum Size) | 52,000 [2](a) | $505 | | | | | Potential impacts to terrestrial and karst inhabitants and to Edwards aquifer fauna will vary with impoundment location/Enhanced streamflow across outcrop zone/Reduced flood flows below the outcrop. (a) 27,850 acft/yr occurs in Nueces River Basin and 24,150 acft/yr per year occurs in other basins. |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|
| | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | Without Treatment | With Treatment | | | |
| L-19 Springflow Augmentation | -108,800(a)<br>-32,500(b) | | | | | | Water temperature and quality must be carefully maintained for springflow augmentation to successfully preserve the San Marcos and Comal spring run communities/Other springs or seeps would not necessarily be protected.<br>(a) 108,800 acft/yr represents average annual deficit which would be needed to maintain the flow of Comal Springs at 200 cfs under a repeat of the critical drought based on historical recharge and aquifer pumpage of 400,000 acft/yr.<br>(b) 32,500 acft/yr represents average annual deficit which would be needed to maintain the flow of San Marcos Springs at 100 cfs under a repeat of the critical drought based on historical recharge and aquifer pumpage of 400,000 acft/yr. |
| L-20 **MAYOR'S 2050 COMMITTEE REGIONAL PLAN(a)** | | | | | | | (a) Amended scope item to be published in a supplemental report. West Central Study Area PMC action 5/24/94. |

(1) WATER SUPPLY VALUES FOR EACH ALTERNATIVE ARE ON A STAND-ALONE BASIS AND CANNOT BE ADDED TO OTHER ALTERNATIVES IN THEIR PRESENT FORM.
(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| S-13 | **MEDINA LAKE** | | | | | | | Potential increase in soil salinity with use of wastewater for irrigation/ Potential to reduce streamflows/ Willingness of owners to sell and or exchange water.<br>(a) Includes cost of Alt L-12, Exchange Reclaimed Water with BMA Medina Lake water, 31,000 acft/yr.<br>(b) Firm yield delivered to WTP.<br>(c) Recharge to the Edwards is also increased 20,200 acft/yr during drought conditions under this alternative. |
| A | Purchase Medina Lake Rights and Inject to Aquifer, (Combined with L-12, Reclaimed Water Exchange) | 26,700 [2] | $884(a) | | | | | |
| B | Purchase Medina Lake Rights and Divert to Recharge Zone (Combined with L-12, Reclaimed Water Exchange) | 26,700 [2] | $606(a) | | | | | |
| C | Purchase Medina Lake Rights and Divert to WTP (Combined with L-12, Reclaimed Water Exchange) | 8,800 [3](b)<br>29,000 [3](c) | | | | $1,499(a)(b)<br>$455(a)(c) | | |
| D | Purchase Medina Lake Rights and Release to Applewhite (See Alternative S-14D) | | | | | | | |

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(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| S-14 | **APPLEWHITE RESERVOIR** | | | | | | | Impacts to terrestrial habitat as stated in EIS/Effects on streamflow similar to those stated in EIS.<br><br>(a) Firm yield delivered to WTP.<br>(b) Recharge to the Edwards is also increased 22,600 acft/yr during drought conditions under this alternative. |
| A | Applewhite Reservoir, Divert and Inject to Aquifer | 22,500 [2] | | | $1,168 | | | |
| B | Applewhite Reservoir, Divert to Recharge Zone | 22,500 [2] | | $1,041 | $1,288 | | | |
| C | Applewhite Reservoir, Divert to WTP | 7,700 [3] | | | | $1,498 | | |
| D | Applewhite Reservoir Operated in Conjunction with Medina Lake (Same as Alternative S-13D) | 14,900 [3](a)<br>37,500 [3](b) | | | | $1,537(a)<br>$611(b) | | |
| S-15 | **CIBOLO RESERVOIR** | | | | | | | Reduced streamflows in Cibolo Creek/ Riverine habitats converted to lake habitats/ Terrestrial habitat impacts. |
| A | Cibolo Reservoir, Divert and Inject to Aquifer | 32,300 [3] | | | $1,230 | | | |
| B | Cibolo Reservoir, Divert to Recharge Zone | 32,300 [3] | | $1,161 | $1,264 | | | |
| C | Cibolo Reservoir, Divert to WTP | 32,300 [3] | | | | $1,130 | | |
| S-16 | **GOLIAD RESERVOIR** | | | | | | | Reduced streamflows in San Antonio River/ Riverine habitats converted to lake habitats/ Terrestrial habitat impacts. |
| A | Goliad Reservoir, Divert and Inject to Aquifer | 115,500 [3] | | | $700 | | | |
| B | Goliad Reservoir, Divert to Recharge Zone | 115,500 [3] | | $654 | $738 | | | |
| C | Goliad Reservoir, Divert to WTP | 115,500 [3] | | | | $653 | | |

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(2) WATER SUPPLY VALUE BASED ON 10-YEAR DROUGHT AVERAGE.
(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| G-18 | **MCFADDIN RESERVOIR (Includes Purchase of Irrigation Water Rights in Calhoun County)** | | | | | | | |
| A | McFaddin Reservoir, Divert and Inject to Aquifer | 37,000 [3] | | | $907 | | | Small reduction in inflows to Guadalupe Estuary/Potential interbasin transfer. |
| B | McFaddin Reservoir, Divert to Recharge Zone | 37,000 [3] | | $845 | $945 | | | |
| C | McFaddin Reservoir, Divert to WTP | 37,000 [3] | | | | $826 | | |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|
| | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | Without Treatment | With Treatment | | | |
| **MINOR RESERVOIRS** | | | | | | | Reduced streamflows in Guadalupe River/ Riverine habitats converted to lake habitats/ Terrestrial habitat impacts proportional to reservoir size/ Potential conflict with recreation/ Scenic uses/ Interbasin transfer. (a) Annual cost of raw water at reservoir with no conveyance or treatment is $402/acft. (b) Annual cost of raw water at reservoir with no conveyance or treatment is $256/acft. (c) Annual cost of raw water at reservoir with no conveyance or treatment is $426/acft. (d)Annual cost of raw water at reservoir with no conveyance or treatment is $286/acft. |
| G-19 Guadalupe River Dam 7 | 33,300 [3](a) | | | | | | |
| G-20 Gonzales Reservoir | 52,700 [3](b) | | | | | | |
| G-21 Lockhart Reservoir | 8,000 [3](c) | | | | | | |
| G-22 Dilworth Reservoir | 27,000 [3](d) | | | | | | |
| G-23 **CANYON LAKE/MID-CITIES REGIONAL PLAN(a)** | | | | | | | (a)Amended scope item to be published in a supplemental report. West Central Study Area PMC action 5/24/94. |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| | Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| C-13 | **LAKE TRAVIS (DELIVERED TO LAKE AUSTIN)** | | | | | | | Reduced streamflow in Colorado River/ Interbasin transfer/ Potential organism transfer/ Willingness of owners to sell rights. |
| A | Lake Travis Divert and Inject to Aquifer; Purchase of Stored Water and Irrigation Rights | 68,000 [3] | | | $701 | | | |
| B | Lake Travis Divert to Recharge Zone; Purchase of Stored Water and Irrigation Rights | 68,000 [3] | | $587 | $681 | | | |
| C | Lake Travis Divert to WTP; Purchase of Stored Water and Irrigation Rights | 68,000 [3] | | | | $658 | | |
| D | Lake Travis Divert and Inject to Aquifer; Purchase of Stored Water | 50,000 [3] | | | $775 | | | |
| E | Lake Travis Divert to Recharge Zone; Purchase of Stored Water | 50,000 [3] | | $653 | $749 | | | |
| F | Lake Travis Divert to WTP; Purchase of Stored Water | 50,000 [3] | | | | $715 | | |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

**TABLE ES-10**
**SUMMARY OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR THE TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA**

| Alternative | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|
| | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | Without Treatment | With Treatment | | | |
| C-17 **COLORADO RIVER DELIVERY AT COLUMBUS** | | | | | | | Reduced streamflow in Colorado River/ Interbasin transfer/ Potential organism transfer/ Willingness of owners to sell rights. |
| A Colorado River at Columbus, Divert to WTP; Purchase of Stored Water and Irrigation Rights | 125,000 [3] | | | | $726 | | |
| B Colorado River at Columbus, Divert to WTP; Purchase of Stored Water | 50,000 [3] | | | | $783 | | |
| C-18 **SHAWS BEND RESERVOIR** | | | | | | | Reduced streamflows in Colorado River/ Riverine habitats converted to lake habitats/ Terrestrial habitat impacts as stated in EIS/ Interbasin transfer/ Potential organism transfer. |
| Shaws Bend Reservoir Divert to WTP | 100,000 [3] | | | | $816 | | |
| C-19 **LAKE MASON (a)** | | | | | | | (a)Amended scope item to be published in a supplemental report. West Central Study Area PMC action 5/24/94. |
| B-10 **BRAZOS RIVER - ALLENS CREEK RESERVOIR** | | | | | | | Reduced streamflow in Brazos River/ Smaller stream habitats converted to lake habitats/ Terrestrial habitat impacts proportional to reservoir size/ Interbasin transfer/ Potential organism transfer. |
| A Allens Creek Reservoir Divert and Inject to Aquifer | 57,800 [3] | | | $1,079 | | | |
| B Allens Creek Reservoir Divert to Recharge Zone | 57,800 [3] | | $952 | $1,047 | | | |
| C Allens Creek Reservoir Divert to WTP | 57,800 [3] | | | | $1,015 | | |
| D Allens Creek Reservoir Divert to WTP | 152,800 [3] | | | | $700 | | |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

Note: Alternatives are classified into four categories: Natural Recharge is recharge to the aquifer with water originating from the Edwards Plateau catchment, recharge zone, or from springs originating from the Edwards. Natural recharge to the aquifer can be accomplished through an injection well or recharge zone. Imported Recharge is recharge to the aquifer with all or a portion of the water originating from sources other than those listed under Natural Recharge, regardless of the delivery system into the aquifer. Treatment and Distribution considers alternatives which would include conventional water treatment, or just disinfection in the case of Carrizo water. Distribution costs will be based on costs as estimated in previous studies for delivery to the SAWS system. Other use includes demand reduction by conservation, reclaimed water reuse, transfer of water through purchase or lease, and treatment of brackish water by demineralization.

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| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| SB-10 | **SABINE RIVER - TOLEDO BEND RESERVOIR** | | | | | | | Interbasin transfer/ Potential organism transfer/Potential water availability may be limited by Southeast Study Area needs. |
| A | Toledo Bend Reservoir Divert and Inject to Aquifer | 300,000 [3] | | | $977 | | | |
| B | Toledo Bend Reservoir Divert to Recharge Zone | 300,000 [3] | | $955 | $1,037 | | | |
| C | Toledo Bend Reservoir Divert to WTP | 300,000 [3] | | | | $944 | | |
| D | Toledo Bend Reservoir Divert to WTP | 600,000 [3] | | | | $861 | | |
| SBB-10 | **SABINE AND BRAZOS RIVERS** | | | | | | | Interbasin transfer/ Potential organism transfer/ Reduced streamflow in Brazos River/ Smaller stream habitats converted to lake habitats/ Terrestrial habitat impacts proportional to reservoir size/Potential water availability may be limited by Southeast Study Area needs. |
| A | Allens Creek and Toledo Bend Reservoirs Divert and Inject to Aquifer | 357,800 [3] | | | $952 | | | |
| B | Allens Creek and Toledo Bend Reservoirs Divert to Recharge Zone | 357,800 [3] | | $860 | $929 | | | |
| C | Allens Creek and Toledo Bend Reservoirs Divert to WTP | 357,800 [3] | | | | $923 | | |
| D | Allens Creek and Toledo Bend Reservoirs Divert to WTP | 452,800 [3] | | | | $837 | | |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

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**TABLE ES-10**
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| Alternative | | Firm Water Supply [1] (Acft/Yr) | Unit Cost of Additional Water (1994 Dollars) ($/Acft/Yr) | | | | | Environmental Issues/Special Concerns |
|---|---|---|---|---|---|---|---|---|
| | | | Natural Recharge | Imported Recharge | | Treatment & Municipal Distribution | Other | |
| | | | | Without Treatment | With Treatment | | | |
| CZ-10 | **CARRIZO AQUIFER** | | | | | | | Potential effect on river flows where streams cross outcrop/ Potential dewatering of Houston Toad breeding habitats in Bastrop County/Subject to underground water district regulations where applicable. |
| A | Carrizo Aquifer Supply Injected to Edwards | 90,000 [3] | | | $538 | | | |
| B | Carrizo Aquifer Supply Imported to Edwards Recharge Zone | 90,000 [3] | | $404 | $460 | | | |
| C | Carrizo Aquifer Supply to WTP | 90,000 [3] | | | | $413 | | |
| D | Carrizo Aquifer Supply to WTP | 220,000 [3] | | | | $474 | | |

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(3) WATER SUPPLY VALUE BASED ON FIRM YIELD.

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# TRANS-TEXAS WATER PROGRAM
# WEST CENTRAL STUDY AREA
# PHASE I REPORT

## 1.0 INTRODUCTION

In its 1990 Texas Water Plan, the Texas Water Development Board (TWDB) presented projections of population and water demand for each area of Texas[6]. The projections showed immediate water shortages for the metropolitan areas of South Central and Southeast Texas.

In response to the water supply needs identified in the 1990 Texas Water Plan, the TWDB, city leaders of San Antonio, Corpus Christi, and Houston, water supply organizations, and other state officials met on May 7, 1992 and initiated the Trans-Texas Water Program in an effort to address the water supply needs of these areas in a coordinated, local, efficient, and environmentally responsible manner. The Trans-Texas water program is anticipated to become an integral part of the State Water Plan[7].

The Trans-Texas Water Program planning studies are being conducted in phases through a cooperative state and regional effort in which each study is managed by a Policy Management Committee whose membership includes representatives of the local sponsor and state water and environmental agencies. In Phase I, water demands will be identified for the ensuing 50-year period, and available options to meet projected demands will be identified and assessed in terms of costs, and environmental effects. From the results of the Phase I studies, the Policy Management Committee will select the most attractive options for more detailed evaluations in Phase II. Upon completion of the Phase II studies, a recommended plan of action to meet the demands of each respective area will be developed for implementation. Following Phase II studies, the implementation phases will be conducted, as follows:

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[6]The Texas Water Development Board is the State agency responsible for the preparation and maintenance of a comprehensive Texas Water Plan (Texas Water Code; Sections 16.051 and 16.055).

[7]"Water for Texas--Trans-Texas Water Program; Overall Program Description," Texas Water Development Board, Austin, Texas June, 1992.

Phase III - Preliminary Design/State and Federal Permitting
Phase IV - Property Acquisition/Final Design
Phase V - Project Construction, Start-Up, and Operation

This is the Phase I Study Report for the West Central area of the Trans-Texas Water Program.

## 1.1 The Study Area

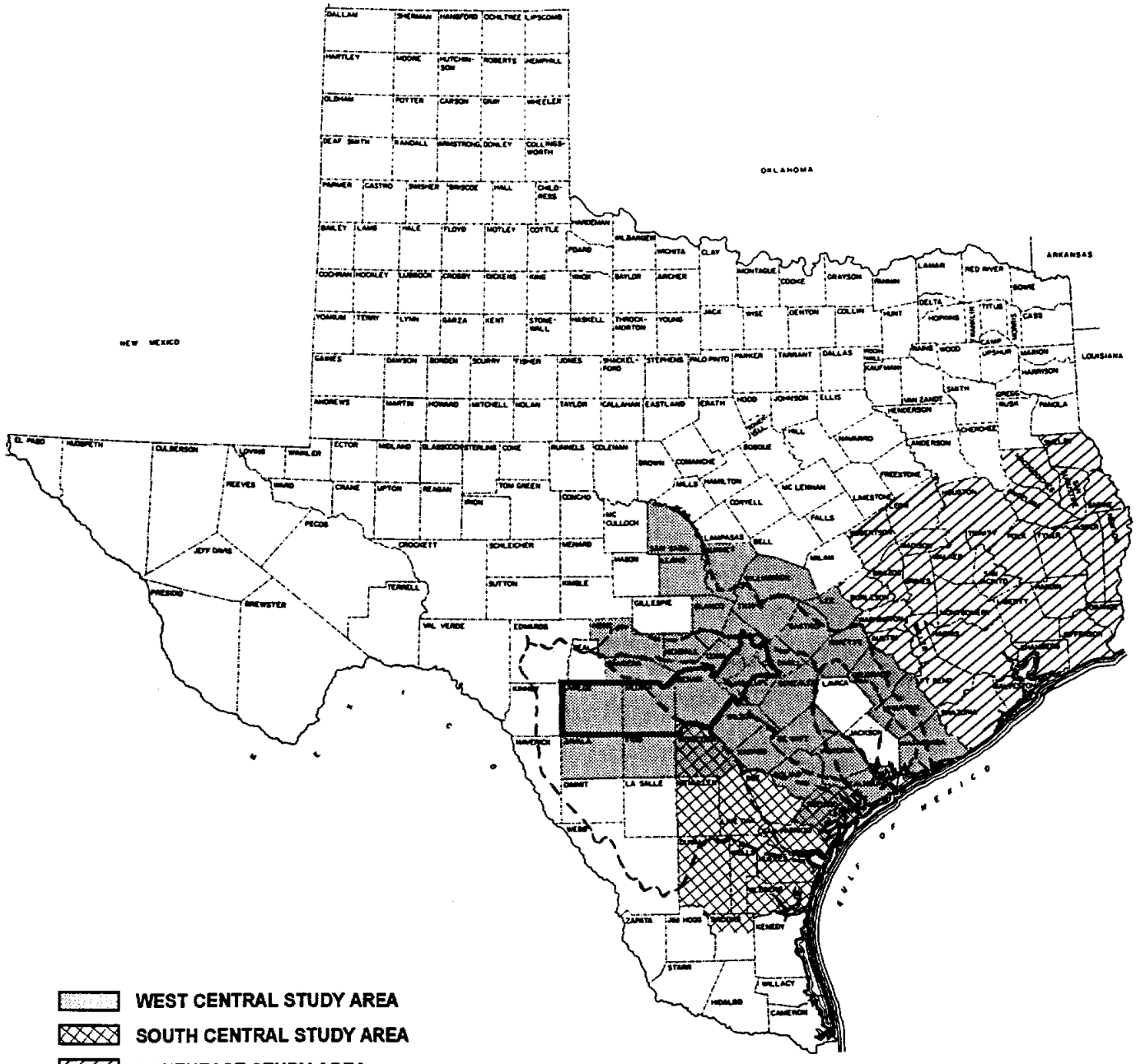
The West Central Trans-Texas study area includes the following 33 counties:

| | | | | | |
|---|---|---|---|---|---|
| 1 | Atascosa | 12 | Fayette | 23 | Matagorda |
| 2 | Bandera | 13 | Frio | 24 | Medina |
| 3 | Bastrop | 14 | Goliad | 25 | Refugio |
| 4 | Bexar | 15 | Gonzales | 26 | San Saba |
| 5 | Blanco | 16 | Guadalupe | 27 | Travis |
| 6 | Burnet | 17 | Hays | 28 | Uvalde |
| 7 | Caldwell | 18 | Karnes | 29 | Victoria |
| 8 | Calhoun | 19 | Kendall | 30 | Wharton |
| 9 | Colorado | 20 | Kerr | 31 | Williamson |
| 10 | Comal | 21 | Lee | 32 | Wilson |
| 11 | Dewitt | 22 | Llano | 33 | Zavala |

The 33-county study area, along with the South Central and Southeast study areas is shown in Figure 1-1. Population of the area was 2.7 millon in 1990 and is projected to be 7.2 million in 2050.

The Edwards Aquifer area is the area specified in Senate Bill (SB) 1477 and includes all of Bexar, Medina, and Uvalde counties, and parts of Atascosa, Comal, Caldwell, Hays, and Guadalupe counties (Figure 1-2). This area depends upon the Edwards Aquifer for municipal, industrial, and irrigation water. The population of the Edwards Aquifer area (Figure 1-2) was 1.36 million in 1990 and is projected to be 3.7 million in 2050.

In addition to supplying the people and economy of San Antonio and neighboring areas, the Edwards Aquifer is home to several endangered or threatened species and is the source of water for several important springs, including Comal and San Marcos Springs. The aquifer cannot meet the growing needs for water and, at the same time, supply adequate spring flows for endangered species as well as downstream needs of the environment and water rights holders.




TRANS TEXAS WATER PROGRAM /
WEST CENTRAL STUDY AREA

**STUDY AREA**

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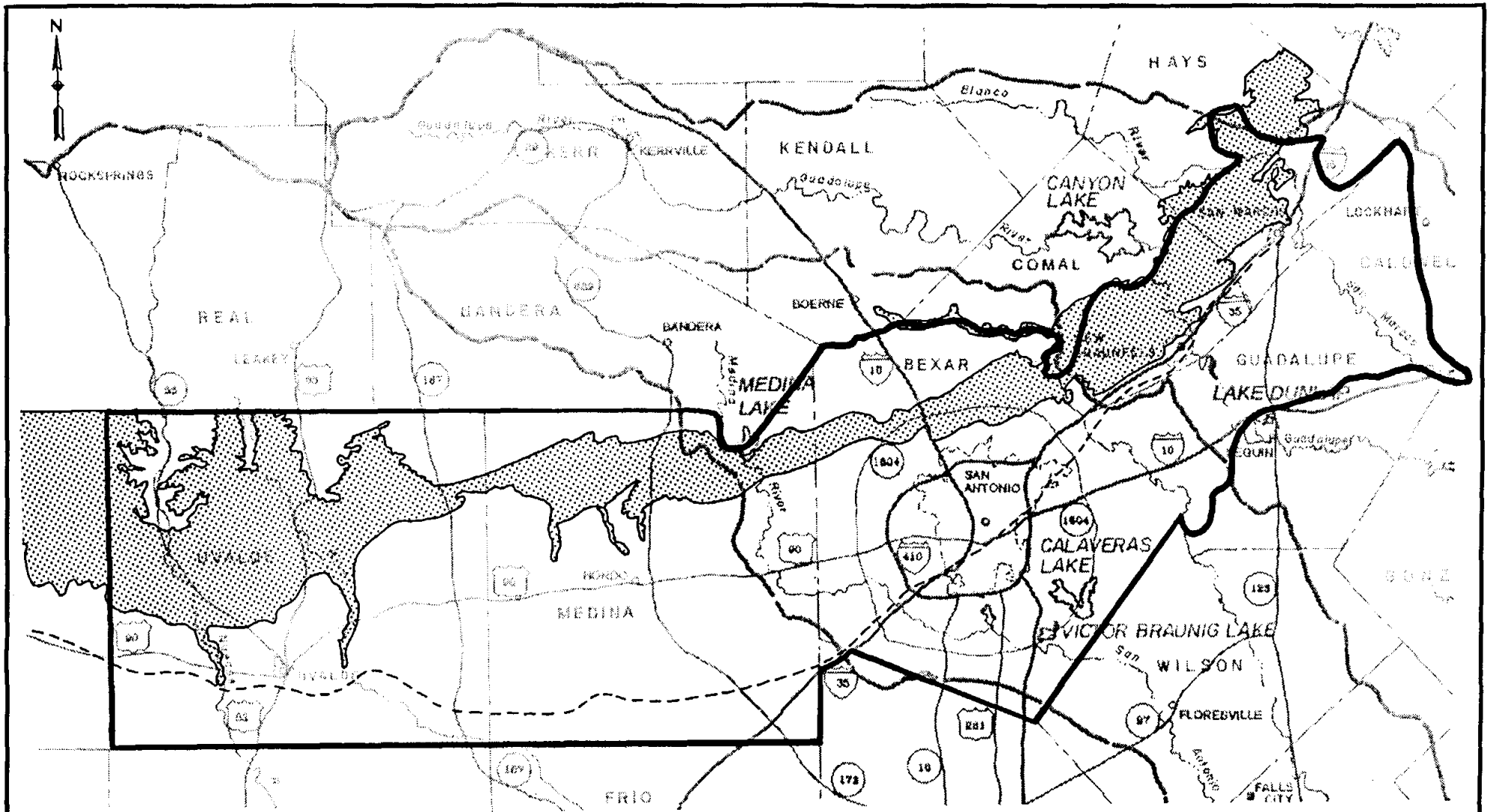
FIGURE 1 - 1




Source: The Texas Water Development Board

**Legend**

- Edwards Aquifer Authority Boundary
- Basin Divide
- Edwards Aquifer Recharge Zone
- "Bad Water" Line

0 10 20 Miles

Scale

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TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

# EDWARDS AQUIFER AUTHORITY AREA

FIGURE 1 - 2

Areas outside of the Edwards Aquifer area within the Nueces, San Antonio, and Guadalupe Basins and in the Colorado Basin to the east are also growing and in need of water planning. These areas depend upon the Carrizo and other aquifers and upon surface water for their supplies and include some downstream areas which depend upon spring flows from the Edwards Aquifer. In the Phase I Study, the needs and supplies of all parts of the West Central Study Area will be considered.

## 1.2 Objectives

The objectives of this Phase I West Central Trans-Texas study are to:

1) Present projections of water demands of the 33-county study area for the period 1990 through 2050; (see Section 2.0)

2) Identify potential water supply alternatives to meet the needs of the study area; (see Section 3.0) and

3) Provide a general assessment of the water supply potentials, costs, and environmental advantages and disadvantages of each alternative, so that decisions can be made as to which alternatives should be pursued in more detail in Phase II (see Section 3.0).

Water supply alternatives are identified within the 33-county study area, and in neighboring basins to the east, including the Colorado and Brazos River Basins, as well as the Sabine River Basin within the Southeast Trans-Texas study area.

## 1.3 Review of Previous Studies

This study of water supply alternatives for the West Central area of the Trans-Texas Water Program has extensively used existing information from agency files and particularly the results of previous studies of potential water supply projects within the Nueces, San Antonio, Guadalupe, Colorado, and Brazos River Basins. Reviews were made of more than 45 reports that have been prepared since 1965 that pertain to various water supply topics relevant to the study.

## 2.0 POPULATION, WATER DEMAND AND WATER SUPPLY PROJECTIONS

The purposes of this section are to present the Texas Water Development Board's (TWDB): (1) High case population projections, (2) High case, with conservation, water demand projections, and (3) Water supply projections for use in the study[8]. Projections are shown for the following three areas:

1) The 33 counties in the West-Central study area (Figure 2-1);
2) The Edwards Aquifer Area[9] (with projections shown for each of the cities within this area including cities in Bexar, Medina, Uvalde, and parts of Comal, Hays, Guadalupe and Caldwell Counties); and
3) The Nueces, San Antonio, Guadalupe, and Lower Colorado River Basin subareas of the 33 county study area.

Projections are shown in 10-year intervals beginning with 1990 and ending in 2050. Population is shown in numbers of people; water demand is shown in acft per year (one acre-foot is 325,851 gallons) for each of the following list of water use categories: (1) Municipal, (2) Industrial, (3) Steam-Electric Power Generation, (4) Irrigation, (5) Mining, (6) Livestock, and (7) Total Water Demand. Descriptions of each water use category are given with the respective projections.

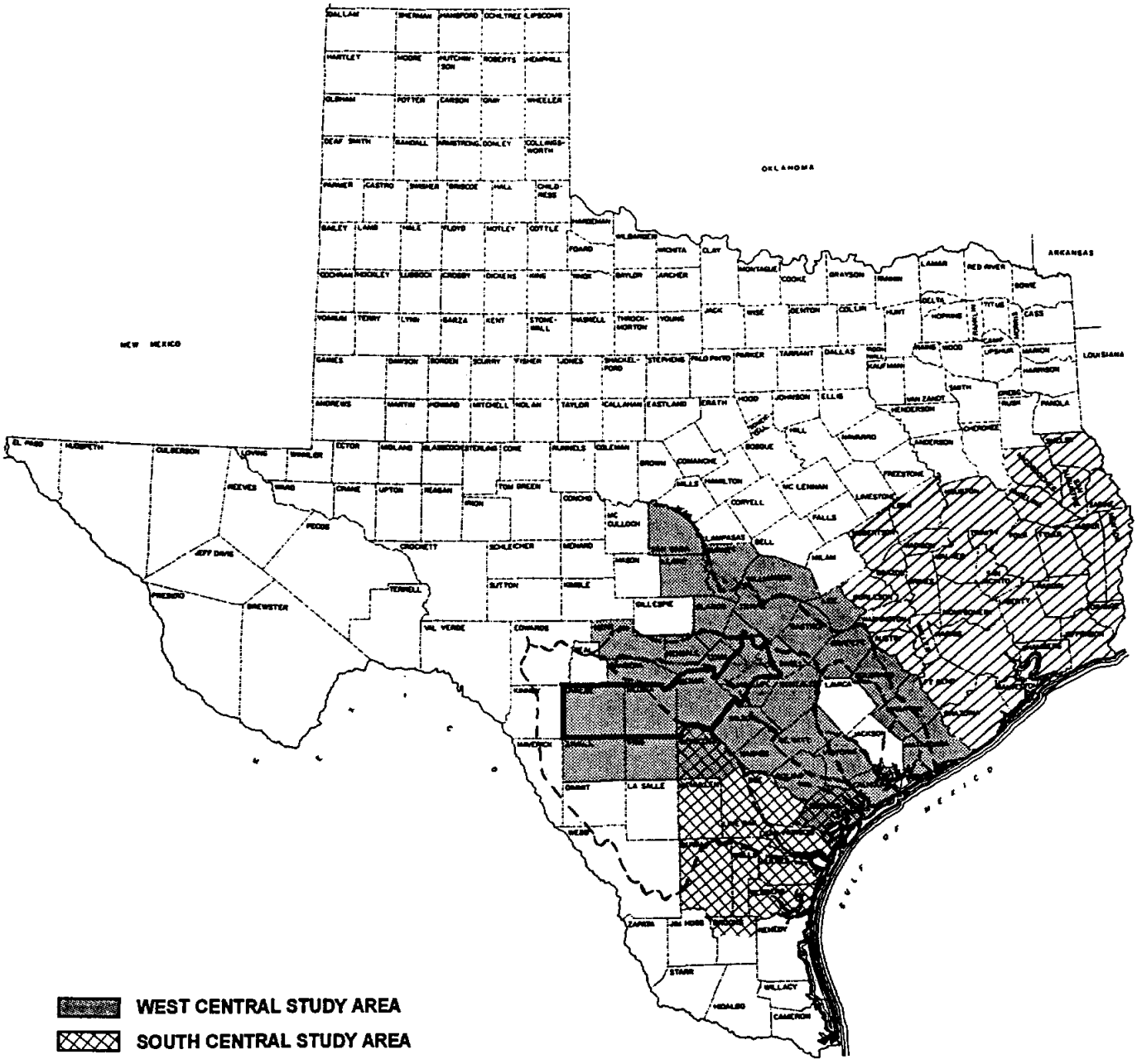
### 2.1 Population Projections

TWDB high case population projections are shown in tabular and graphic form for: (1) the 33 county study area, (2) the Edwards Aquifer Area (including cities of Bexar, Medina, Uvalde, and parts of Comal, Hays, Guadalupe and Caldwell counties) and (3) the Nueces, San Antonio, Guadalupe, and Lower Colorado River Cohort Basin areas. The TWDB uses a cohort component population projection method in which the existing (1990) population of each city and county is divided into five year age groups for males and females. Life expectancy rates of each age group, migration statistics for counties, and the respective vital statistics (births and deaths) of each county are used to compute projections.

---

[8]The Texas Water Development Board (TWDB) specified that TWDB's high case, with conservation, projections were to be used for each of the Trans Texas, Phase I projects.

[9]The Edwards Aquifer area, as defined in this study, includes the boundaries as defined in Senate Bill 1477 as enacted by the Texas Legislature, 1993 Regular Session.




TRANS TEXAS WATER PROGRAM /
WEST CENTRAL STUDY AREA

## STUDY AREA

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FIGURE 2-1

The high case population projections were based upon migration rates of the 1980's[10]. Using these projection methods, future populations of each city and each county of Texas are developed for each of the decadal points in time from 1990 to 2050. The projections are presented below.

### 2.1.1 Population Projections for the 33-County Study Area

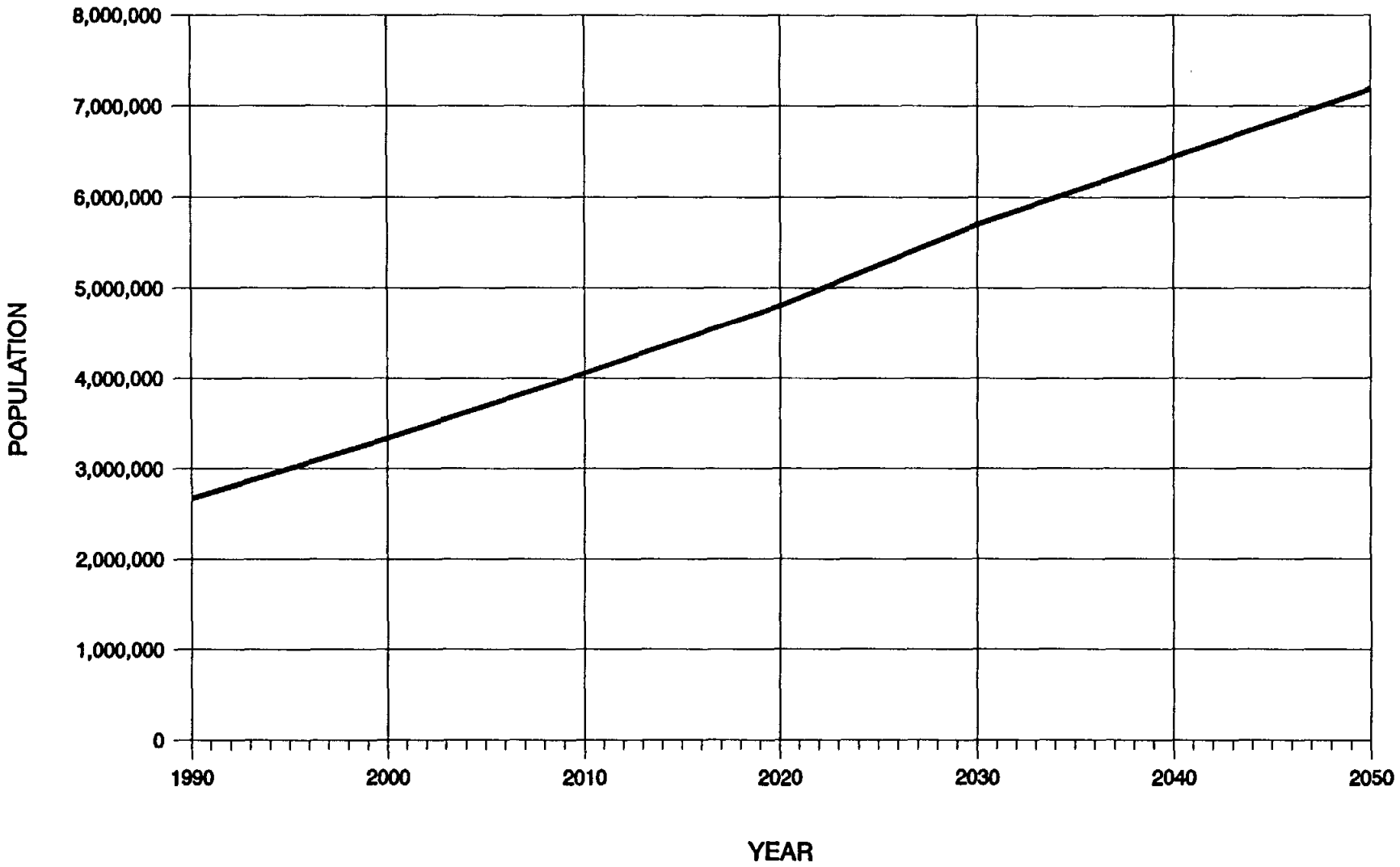
The population of the 33-county study area was reported at 2,669,016 in 1990 (Table 2-1) and is projected to be 3.34 million in 2000, 4.81 million in 2020, and 7.18 million in 2050 (Table 2-1 and Figure 2-2). The compound annual growth rate of this projection is 1.66 percent. The TWDB projections of the State of Texas population is from 16,986,510 in 1990 to 36,308,602 in 2050, having a compound annual growth rate of 1.27 percent. At 1.66 percent, the 33-county study area growth rate is about 30 percent higher than that projected for the State. For the 1990-2050 projection period, the 33 county study area population increases from 15.71 percent of the State total in 1990 to 19.78 percent of the State total in 2050.

[10]Unpublished planning information, Texas Water Development Board, Austin, Texas, 1992.

## Table 2-1
## Population Projections -- 33-County West Central Study Area
## Trans-Texas Water Program

| County[1] | 1990[2] | Projections[3] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 30,533 | 37,785 | 44,108 | 49,394 | 54,480 | 59,580 | 64,680 |
| Bandera | 10,562 | 13,820 | 18,638 | 20,563 | 21,848 | 22,507 | 23,166 |
| Bastrop | 38,263 | 54,400 | 73,263 | 87,910 | 98,623 | 107,437 | 116,251 |
| Bexar | 1,185,394 | 1,422,629 | 1,705,074 | 2,034,080 | 2,449,468 | 2,860,615 | 3,271,762 |
| Blanco | 5,972 | 7,356 | 9,319 | 11,539 | 13,523 | 15,162 | 16,801 |
| Burnet | 22,677 | 27,551 | 32,544 | 36,373 | 38,620 | 40,131 | 41,642 |
| Caldwell | 26,392 | 30,112 | 35,216 | 40,662 | 44,838 | 48,183 | 51,528 |
| Calhoun | 19,053 | 22,548 | 26,493 | 29,832 | 32,633 | 34,827 | 37,021 |
| Colorado | 18,383 | 20,417 | 21,463 | 22,653 | 23,656 | 24,482 | 25,308 |
| Comal | 51,832 | 68,754 | 86,446 | 103,929 | 121,548 | 136,106 | 150,664 |
| Dewitt | 18,840 | 19,485 | 20,040 | 20,553 | 21,276 | 21,942 | 22,608 |
| Fayette | 20,095 | 21,521 | 22,828 | 24,162 | 24,736 | 25,041 | 25,346 |
| Frio | 13,472 | 16,331 | 18,307 | 19,958 | 21,712 | 23,628 | 25,544 |
| Goliad | 5,980 | 6,618 | 7,182 | 7,627 | 8,246 | 8,805 | 9,364 |
| Gonzales | 17,205 | 18,023 | 18,603 | 18,883 | 19,179 | 19,538 | 19,897 |
| Guadalupe | 64,873 | 86,388 | 110,879 | 128,148 | 141,019 | 153,368 | 165,717 |
| Hays | 65,614 | 95,359 | 135,230 | 170,486 | 200,895 | 216,766 | 232,637 |
| Karnes | 12,455 | 13,116 | 13,564 | 13,797 | 14,085 | 14,207 | 14,329 |
| Kendall | 14,589 | 18,499 | 21,630 | 24,161 | 26,987 | 28,491 | 29,995 |
| Kerr | 36,304 | 43,849 | 50,060 | 54,978 | 58,955 | 62,690 | 66,425 |
| Lee | 12,854 | 14,880 | 17,173 | 19,037 | 20,741 | 22,435 | 24,129 |
| Llano | 11,631 | 13,001 | 14,155 | 15,734 | 17,889 | 18,120 | 18,351 |
| Matagorda | 36,928 | 43,241 | 46,987 | 49,992 | 52,496 | 55,098 | 57,700 |
| Medina | 27,312 | 31,774 | 36,421 | 39,815 | 42,855 | 44,859 | 46,863 |
| Refugio | 7,976 | 7,939 | 8,415 | 8,780 | 9,096 | 9,278 | 9,460 |
| San Saba | 5,401 | 5,466 | 5,665 | 5,821 | 5,944 | 6,008 | 6,072 |
| Travis | 576,407 | 747,012 | 906,601 | 1,083,814 | 1,273,733 | 1,397,285 | 1,520,837 |
| Uvalde | 23,340 | 27,518 | 31,662 | 35,462 | 39,637 | 44,132 | 48,627 |
| Victoria | 74,361 | 87,180 | 100,334 | 110,685 | 118,748 | 127,172 | 135,596 |
| Wharton | 39,955 | 44,926 | 50,503 | 55,061 | 61,940 | 68,036 | 74,132 |
| Williamson | 139,551 | 225,008 | 311,795 | 403,388 | 558,821 | 658,572 | 758,323 |
| Wilson | 22,650 | 30,064 | 37,221 | 41,839 | 45,890 | 49,583 | 53,276 |
| Zavala | 12,162 | 13,607 | 14,939 | 16,164 | 17,672 | 19,416 | 21,160 |
| Total | 2,669,016 | 3,336,177 | 4,052,758 | 4,805,280 | 5,701,789 | 6,443,500 | 7,185,211 |

[1]Study Area
[2]1990 Census, U.S. Bureau of the Census, U.S. Department of Commerce
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
Note: Texas population in 1990 was 16,986,510. TWDB projections of Texas population for 2000 is 20,257,960 and for 2050 is 36,308,602 (1.27% growth rate).

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

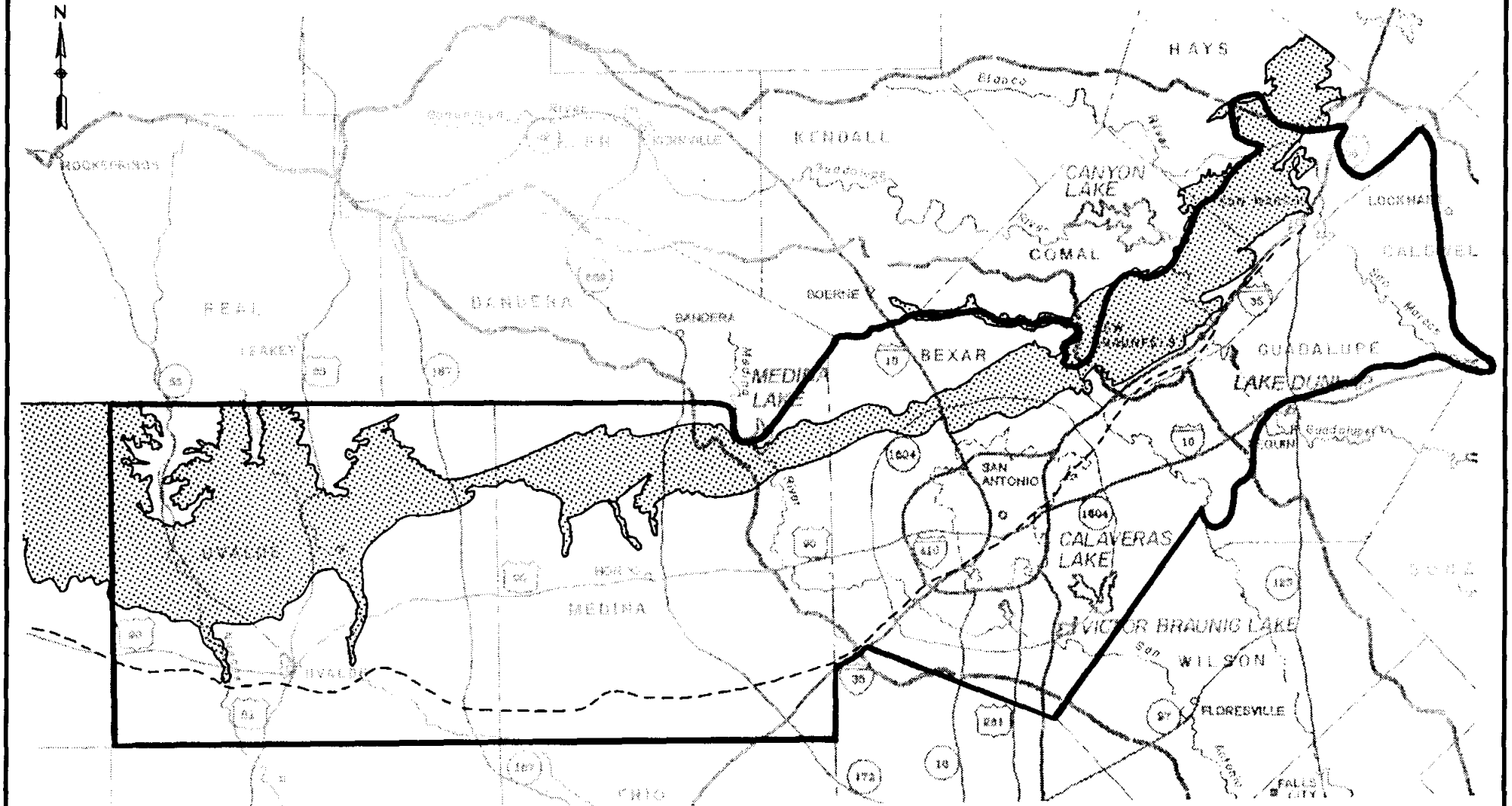
POPULATION PROJECTIONS

33 COUNTY WEST CENTRAL STUDY AREA

FIGURE 2 - 2

### 2.1.2 Population Projections for the Edwards Aquifer Area Counties and Cities

The Edwards Aquifer area referenced here is the area specified in Senate Bill 1477, Texas Legislature, 73rd Session (1993), and includes all of the areas of Bexar, Medina, and Uvalde Counties, and parts of Atascosa, Comal, Caldwell, Hays, and Guadalupe Counties (Figure 2-3). Population projections for the portions of the counties and cities located within the Edwards Aquifer area are shown in Table 2-2 and Figure 2-4. The population of the Edwards Aquifer area was 1,363,688 in 1990 and is projected to be 3,696,204 in 2050. The compound annual growth rate of this area for the 1990-2050 projection period is 1.67 percent, which is nearly equal to the 1.66 percent rate for the 33-county study area (Table 2-2).




**Legend**

- Edwards Aquifer Authority Boundary
- Basin Divide
- Edwards Aquifer Recharge Zone
- "Bad Water" Line

0 10 20 Miles

Scale

HDR

**HDR Engineering, Inc.**

TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

**EDWARDS AQUIFER AUTHORITY AREA**

FIGURE 2 - 3

## Table 2-2
## Population Projections for Counties and Cities
## Edwards Aquifer Area -- West Central Area
## Trans-Texas Water Program

| County and City[1] | Projections[3] | | | | | | | Compound Annual Growth Rate |
|---|---|---|---|---|---|---|---|---|
| | 1990[2] | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | |
| **ATASCOSA COUNTY** | | | | | | | | |
| Lytle | 1,567 | 2,066 | 2,479 | 2,827 | 3,161 | 3,498 | 3,835 | 1.50 |
| **BEXAR COUNTY** | | | | | | | | |
| Alamo Heights | 6,502 | 6,791 | 7,092 | 7,407 | 7,736 | 8,080 | 8,424 | 0.43 |
| Balcones Heights | 3,022 | 3,316 | 3,638 | 3,992 | 4,380 | 4,806 | 5,232 | 0.92 |
| Castle Hills | 4,198 | 4,792 | 5,112 | 5,410 | 5,681 | 5,830 | 5,979 | 0.59 |
| Converse | 8,887 | 13,177 | 19,598 | 26,379 | 34,940 | 43,415 | 51,890 | 2.98 |
| Fairoaks Ranch | 1,640 | 2,236 | 2,946 | 3,773 | 4,817 | 5,850 | 6,883 | 2.42 |
| Fort Sam Houston | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 0.00 |
| Helotes | 1,535 | 1,973 | 2,495 | 3,103 | 3,871 | 4,360 | 4,849 | 1.94 |
| Hill Country Village | 1,038 | 1,244 | 1,493 | 1,789 | 2,134 | 2,570 | 3,006 | 1.79 |
| Hollywood Park | 2,841 | 3,538 | 4,156 | 4,882 | 5,735 | 6,514 | 7,293 | 1.58 |
| Kirby | 8,326 | 9,686 | 11,507 | 13,628 | 16,306 | 18,957 | 21,608 | 1.60 |
| Lackland AFB | 9,352 | 9,352 | 9,352 | 9,352 | 9,352 | 9,352 | 9,352 | 0.00 |
| Leon Valley | 9,581 | 10,317 | 11,050 | 11,722 | 12,503 | 13,525 | 14,547 | 0.70 |
| Live Oak | 10,023 | 12,001 | 14,584 | 17,593 | 21,391 | 25,152 | 28,913 | 1.78 |
| Olmos Park | 2,161 | 2,352 | 2,561 | 2,787 | 3,034 | 3,303 | 3,572 | 0.84 |
| Randolph AFB | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 0.00 |
| San Antonio | 935,933 | 1,097,349 | 1,305,620 | 1,548,224 | 1,854,525 | 2,157,699 | 2,460,873 | 1.62 |
| Schertz (Part) | 414 | 596 | 700 | 822 | 966 | 1,100 | 1,234 | 1.84 |

## Table 2-2
## Population Projections for Counties and Cities
## Edwards Aquifer Area -- West Central Area
## Trans-Texas Water Program

| County and City[1] | Projections[3] | | | | | | | Compound Annual Growth Rate |
|---|---|---|---|---|---|---|---|---|
| | 1990[2] | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | |
| Shavano Park | 1,708 | 2,023 | 2,327 | 2,565 | 2,737 | 2,961 | 3,185 | 1.04 |
| Somerset | 1,144 | 1,207 | 1,261 | 1,299 | 1,299 | 1,299 | 1,299 | 0.21 |
| St. Hedwig | 1,443 | 1,778 | 2,327 | 2,966 | 3,773 | 4,572 | 5,371 | 2.21 |
| Terrell Hills | 4,592 | 4,940 | 5,198 | 5,546 | 5,870 | 6,060 | 6,250 | 0.52 |
| Universal City | 13,057 | 15,429 | 18,665 | 22,435 | 27,194 | 31,905 | 36,616 | 1.73 |
| Windcrest | 5,331 | 5,613 | 5,911 | 6,224 | 6,553 | 6,900 | 7,247 | 0.51 |
| Rural San Antonio[4] | 133,915 | 192,957 | 246,422 | 309,823 | 390,654 | 470,745 | 550,836 | 2.39 |
| Lytle (Part) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 0.00 |
| Rural Nueces[4] | 2,747 | 3,958 | 5,055 | 6,355 | 8,013 | 9,656 | 11,299 | 2.39 |
| **Total - Bexar Co.** | **1,185,394** | **1,422,629** | **1,705,074** | **2,034,080** | **2,449,468** | **2,860,615** | **3,271,762** | **1.71** |
| | | | | | | | | |
| MEDINA COUNTY | | | | | | | | |
| Castroville | 2,159 | 2,508 | 2,822 | 3,096 | 3,308 | 3,422 | 3,536 | 0.83 |
| Lacoste | 1,021 | 1,359 | 1,712 | 1,969 | 2,200 | 2,352 | 2,504 | 1.51 |
| Other | 2,251 | 2,657 | 3,106 | 3,401 | 3,688 | 3,897 | 4,106 | 1.01 |
| Devine | 3,928 | 4,310 | 4,708 | 4,998 | 5,259 | 5,431 | 5,603 | 0.59 |
| Hondo | 6,018 | 6,700 | 7,539 | 8,266 | 8,837 | 9,144 | 9,451 | 0.76 |
| Lytle (Part) | 340 | 364 | 385 | 400 | 415 | 428 | 441 | 0.43 |
| Natalia | 1,216 | 1,623 | 1,826 | 2,001 | 2,140 | 2,214 | 2,288 | 1.06 |
| Rural Nueces[4] | 10,379 | 12,253 | 14,323 | 15,684 | 17,008 | 17,971 | 18,934 | 1.01 |
| **Total - Medina Co.** | **27,312** | **31,774** | **36,421** | **39,815** | **42,855** | **44,859** | **46,863** | **0.90** |

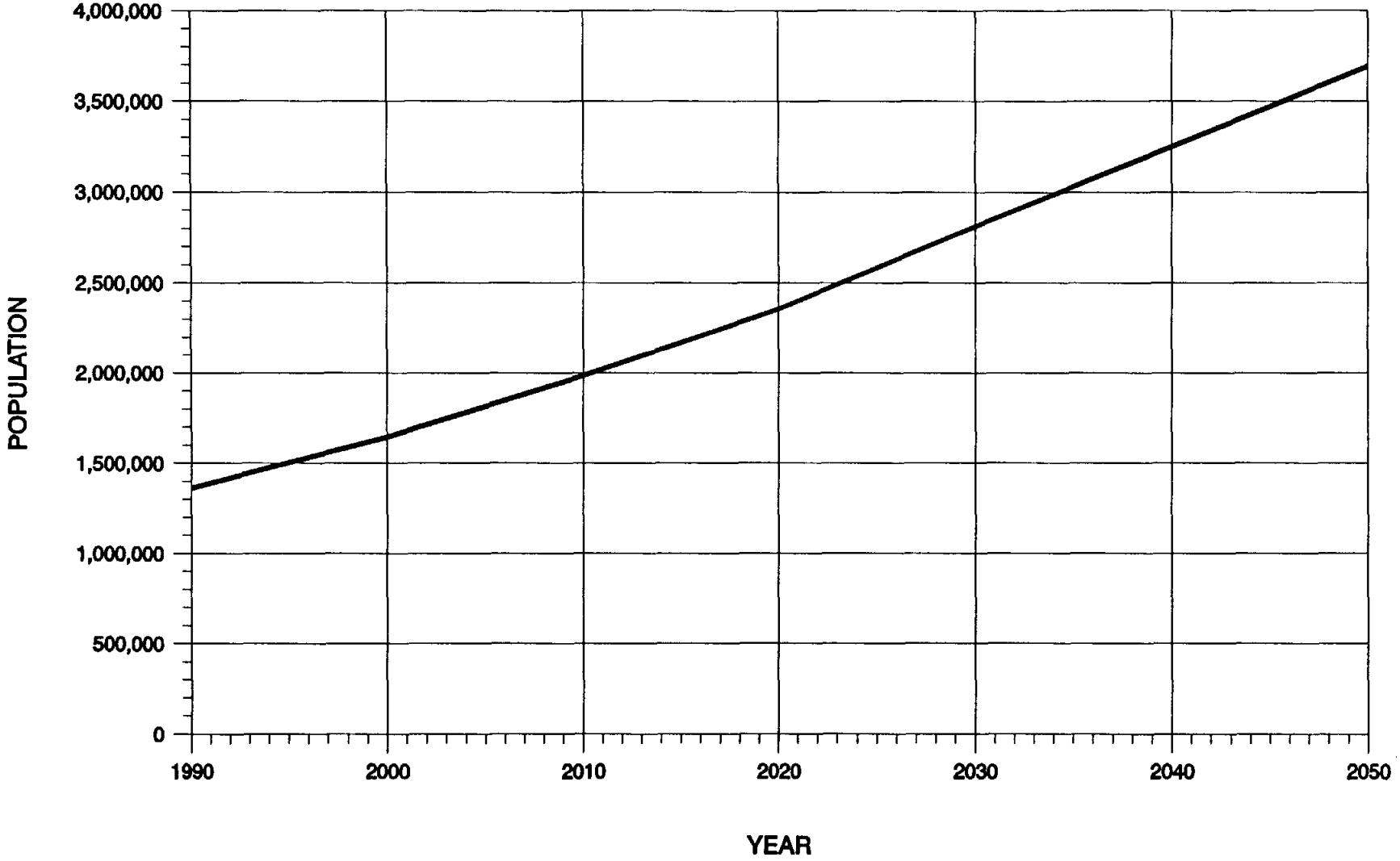
## Table 2-2
## Population Projections for Counties and Cities
## Edwards Aquifer Area -- West Central Area
## Trans-Texas Water Program

| County and City[1] | Projections[3] | | | | | | | Compound Annual Growth Rate |
|---|---|---|---|---|---|---|---|---|
| | 1990[2] | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | |
| **UVALDE COUNTY** | | | | | | | | |
| Sabinal | 1,584 | 1,955 | 2,324 | 2,661 | 3,048 | 3,448 | 3,848 | 1.49 |
| Uvalde | 14,729 | 17,984 | 21,705 | 25,076 | 28,949 | 33,091 | 37,233 | 1.56 |
| Rural Nueces[4] | 7,027 | 7,579 | 7,633 | 7,725 | 7,640 | 7,593 | 7,546 | 0.12 |
| **Total - Uvalde Co.** | **23,340** | **27,518** | **31,662** | **35,462** | **39,637** | **44,132** | **48,627** | **1.23** |
| **COMAL COUNTY** | | | | | | | | |
| Garden Ridge | 1,450 | 1,993 | 2,561 | 3,122 | 3,687 | 4,155 | 4,623 | 1.95 |
| New Braunfels | 27,091 | 33,023 | 40,460 | 46,633 | 53,747 | 57,434 | 61,121 | 1.37 |
| Rural Guadalupe | 1,698 | 2,460 | 3,167 | 3,951 | 4,676 | 5,435 | 6,195 | 2.18 |
| Schertz (Part) | 129 | 173 | 211 | 258 | 299 | 347 | 395 | 1.88 |
| Rural San Antonio[4] | 613 | 889 | 1,144 | 1,427 | 1,689 | 1,964 | 2,238 | 2.18 |
| **Total - Comal Co. (Part)** | **30,981** | **38,538** | **47,543** | **55,391** | **64,098** | **69,335** | **74,572** | **1.47** |
| **HAYS COUNTY** | | | | | | | | |
| Kyle | 2,225 | 2,612 | 2,970 | 3,282 | 3,528 | 3,654 | 3,780 | 0.89 |
| San Marcos | 28,743 | 36,320 | 46,477 | 55,459 | 63,205 | 67,250 | 71,295 | 1.53 |
| Rural Guadalupe[4] | 5,127 | 8,463 | 12,944 | 16,900 | 20,328 | 22,122 | 23,916 | 2.60 |
| **Total - Hays Co. (Part)** | **36,095** | **47,395** | **62,391** | **75,641** | **87,061** | **93,026** | **98,991** | **1.69** |

## Table 2-2
## Population Projections for Counties and Cities
## Edwards Aquifer Area -- West Central Area
## Trans-Texas Water Program

| County and City[1] | Projections[3] | | | | | | | Compound Annual Growth Rate |
|---|---|---|---|---|---|---|---|---|
| | 1990[2] | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | |
| **GUADALUPE COUNTY** | | | | | | | | |
| New Braunfels (Part) | 243 | 277 | 332 | 378 | 472 | 496 | 520 | 1.28 |
| Rural Guadalupe[4] | 21,373 | 31,198 | 43,780 | 51,294 | 56,496 | 61,955 | 67,414 | 1.93 |
| Cibolo | 1,757 | 2,715 | 3,802 | 4,569 | 5,141 | 5,690 | 6,239 | 2.13 |
| Schertz (Part) | 10,012 | 13,457 | 15,212 | 16,898 | 19,102 | 20,727 | 22,352 | 1.35 |
| Rural San Antonio[4] | 5,832 | 8,514 | 11,948 | 13,999 | 15,418 | 16,908 | 18,397 | 1.93 |
| **Total - Guadalupe Co. (Part)** | **39,217** | **56,161** | **75,074** | **87,138** | **96,629** | **105,776** | **114,922** | **1.80** |
| **CALDWELL COUNTY** | | | | | | | | |
| Lockhart | 9,205 | 10,401 | 12,291 | 14,308 | 15,854 | 17,093 | 18,332 | 1.15 |
| Luling | 4,661 | 4,706 | 4,770 | 4,835 | 4,886 | 4,927 | 4,968 | 0.11 |
| Rural Guadalupe[4] | 5,916 | 7,087 | 8,574 | 10,164 | 11,381 | 12,357 | 13,332 | 1.36 |
| **Total - Caldwell Co. (Part)** | **19,782** | **22,194** | **25,635** | **29,307** | **32,121** | **34,377** | **36,632** | **1.03** |
| **TOTAL** | **1,363,688** | **1,648,275** | **1,986,279** | **2,356,661** | **2,815,030** | **3,255,168** | **3,696,204** | **1.67** |

[1]Study Area
[2]1990 Census, U.S. Bureau of the Census, U.S. Department of Commerce
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[4]Estimates of residents living in rural areas of the county that are located in each respective river basin area that is also located within that part of the county that is included within the Edwards Aquifer Area, as specified in S.B. 1477.
Note: Texas population in 1990 was 16,986,510. TWDB projections of Texas population for 2000 is 20,257,960 and for 2050 is 36,308,602 (1.27% compound annual growth rate).




HDR Engineering, Inc.

TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

POPULATION PROJECTIONS

EDWARDS AQUIFER AREA

FIGURE 2 - 4

### 2.1.3 Population Projections for River Basins and Adjacent Areas.

The 33-county West Central Study Area contains all or parts of the Nueces, San Antonio, Guadalupe, and Lower Colorado River Basins, however, parts of some study area counties are located in areas adjacent to one or more of these river basins. In addition, some study area counties are located in two or more study area river basins. For purposes of making projections of water demands for each individual river basin, it is necessary to sum the population and water demand projections of the counties and parts of counties located within each river basin as well as adjacent areas that depend upon each basin, respectively. In this section, the river basin and adjacent area population projections are presented. Water demand projections for these areas are presented in Section 2.2.3.

The population projections for the counties of the West Central Study Area that are located within the Nueces, San Antonio, Guadalupe, and Lower Colorado Basins, respectively, were summed and are shown in Table 2-3 and Figure 2-5. For the Nueces River Basin, it was necessary to adjust the total basin population for that portion located outside the study area. The resulting population projections of the counties of the Nueces Basin that are included in the 33-county study area (Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes counties) are shown on row 2 of Table 2-3; i.e., 110,733 in 1990, and 220,678 projected in 2050.

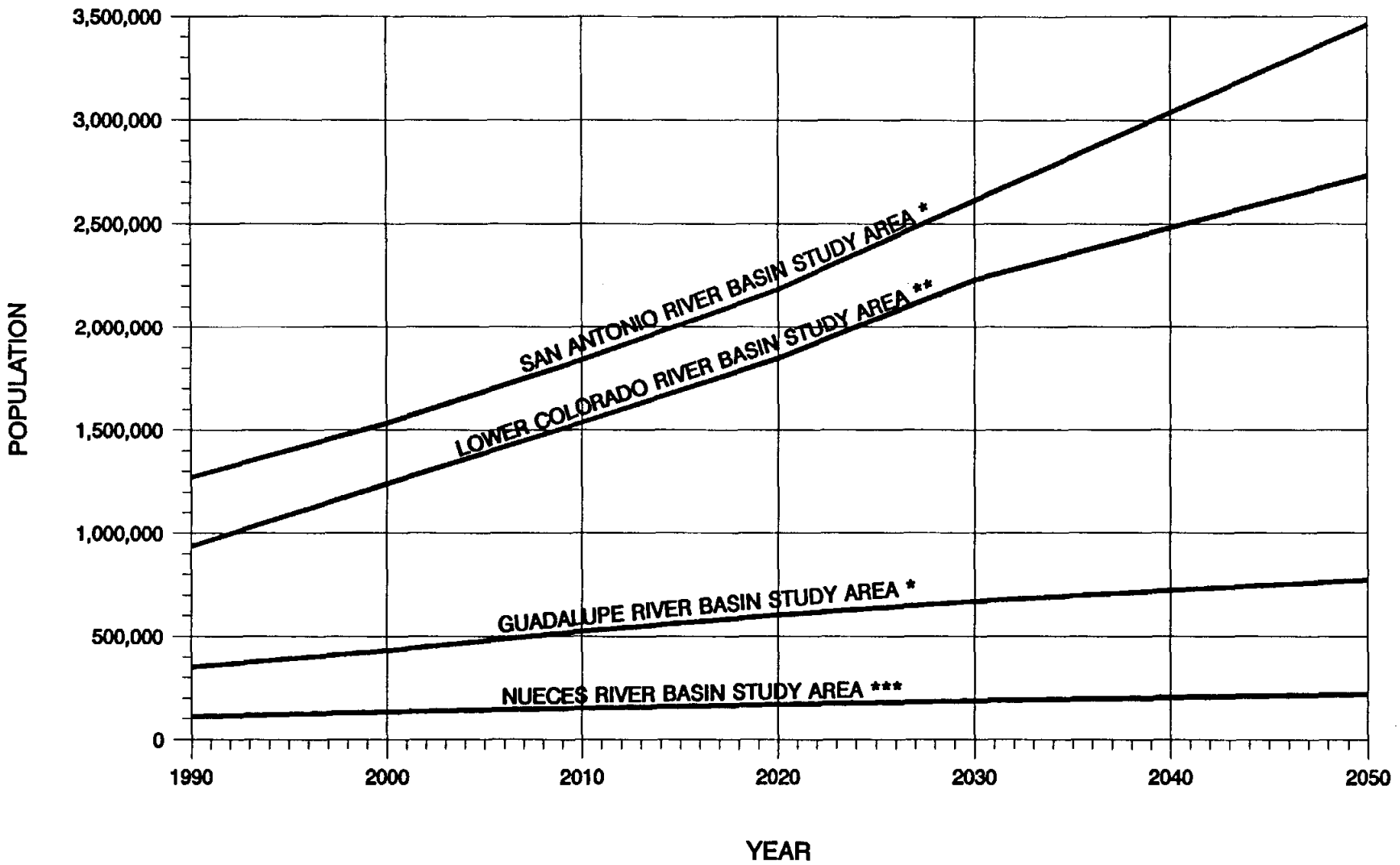
In the case of the San Antonio Basin, the basin totals are shown as follows: 1,270,884 in 1990 and 3,458,520 projected for 2050. The population of areas adjacent to the San Antonio Basin (the part of Goliad County that is located in the adjacent San Antonio-Nueces Coastal Basin) that is included in the 33-county study is shown to total 450 in 1990 and 779 in 2050.

The total for the Guadalupe Basin was also tabulated and listed on Table 2-3. For the Guadalupe Basin, the part of Victoria County located in the adjacent Lavaca-Guadalupe Coastal Basin plus Refugio and Calhoun counties were tabulated and included as a separate element, since Calhoun County obtains water from the Guadalupe Basin, and Victoria and Refugio counties may need water from the Guadalupe Basin in the future. The population for the areas adjacent to the Guadalupe were 48,250 in 1990 and are projected to be 85,210 in 2050 (Table 2-3).

**Table 2-3**
**Population Projections for River Basins and Adjacent Areas--West Central Study Area**
**Trans-Texas Water Program**

| RIVER BASIN[1] | 1990[2] | Projected[3] 2000 | 2010 | 2020 | 2030 | 2040 | 20 |
|---|---|---|---|---|---|---|---|
| NUECES | | | | | | | |
| Total In-Basin | 165,139 | 194,657 | 220,567 | 241,683 | 262,746 | 283,247 | 303, |
| Study Area Subtotal[4] | 110,733 | 132,470 | 152,305 | 169,160 | 186,554 | 203,616 | 220, |
| Remainder of Basin | 54,406 | 62,187 | 68,262 | 72,523 | 76,192 | 79,631 | 83, |
| SAN ANTONIO | | | | | | | |
| Total In-Basin | 1,270,884 | 1,532,451 | 1,838,947 | 2,183,948 | 2,613,416 | 3,035,968 | 3,458, |
| Adjacent Area[5] | 450 | 511 | 562 | 722 | 665 | 722 | 779 |
| Study Area Subtotal | 1,271,334 | 1,532,962 | 1,839,509 | 2,184,550 | 2,614,081 | 3,036,690 | 3,459, |
| GUADALUPE | | | | | | | |
| Total In-Basin | 302,409 | 375,420 | 460,254 | 532,452 | 593,985 | 640,608 | 687, |
| Adjacent Area[6] | 48,250 | 55,424 | 63,504 | 70,154 | 75,650 | 80,430 | 85, |
| Study Area Subtotal | 350,659 | 430,844 | 523,754 | 602,606 | 669,635 | 721,038 | 772, |
| LOWER COLORADO | | | | | | | |
| Total In-Basin | 709,456 | 920,081 | 1,124,397 | 1,340,653 | 1,566,477 | 1,712,900 | 1,859 |
| Adjacent Area[7] | 73,250 | 83,700 | 91,968 | 98,758 | 106,886 | 114,435 | 121 |
| Subtotal | 782,706 | 1,003,781 | 1,216,365 | 1,439,411 | 1,673,363 | 1,827,335 | 1,981 |
| Adjacent Inland Area[8] | 153,584 | 236,120 | 320,385 | 409,553 | 558,156 | 654,821 | 751 |
| Study Area Subtotal | 936,290 | 1,239,901 | 1,537,190 | 1,848,964 | 2,231,519 | 2,482,156 | 2,732 |
| RIVER BASIN TOTALS | 2,447,888 | 3,022,609 | 3,644,165 | 4,298,736 | 5,036,624 | 5,672,723 | 6,308 |
| STUDY AREA | 2,669,016 | 3,336,177 | 4,052,758 | 4,805,280 | 5,701,789 | 6,443,500 | 7,185 |

[1]Study Area
[2]1990 Census, U.S. Bureau of the Census, U.S. Department of Commerce
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 19 Austin, Texas.
[4]Only counties of Nueces Basin included in study area (Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes).
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
Note: Texas population in 1990 was 16,986,510. TWDB projections of Texas population for 2000 is 20,257,960 and for 2050 is 36,308,602 (1.27% compound annual growth rate).




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# POPULATION PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 5

Areas adjacent to the Lower Colorado Basin are also shown in Table 2-3. Those parts of counties located in coastal basins adjacent to the Lower Colorado Basin (i.e., Colorado, Wharton, and Matagorda) had a 1990 population of 73,250. Projected 2050 population of these counties is 121,984 (Table 2-3). Additionally, the population of inland study area counties adjacent to the Lower Colorado Basin, including parts of Fayette, Lee, Williamson, and Burnet counties, are shown separately. The population of this area was 153,584 in 1990 and is projected to increase to 751,476 by 2050 (Table 2-3). It should be noted, however, that even though these inland counties adjacent to the Colorado Basin are included in the 33-county study area, it is expected that only a part of their future water needs might be obtained from the Colorado Basin (e.g. southern Williamson County and southern Fayette County).

## 2.2 Water Demand Projections

Texas Water Development Board high case water demand projections, with conservation, are tabulated for the counties and are shown in tabular and graphic form for: (1) the 33-county study area, (2) the Edwards Aquifer area, including counties of Bexar, Medina, Uvalde, Comal, Hays, and parts of Guadalupe, and Caldwell counties, and (3) the Nueces, San Antonio, Guadalupe, and Lower Colorado River Basin areas included within the study area. Projections are shown for each of the major water-using categories, as follows: (1) Municipal, (2) Manufacturing, (3) Steam-Electric Power Generation, (4) Irrigation, (5) Mining, (6) Livestock, and (7) Total of (1) through(6). Each type of water use is explained below, together with a brief description of projection methods, procedures, and data.

Municipal Water Use

Municipal water use includes freshwater for drinking, food preparation, dishwashing, bathing, toilet flushing, laundry, lawn watering, private and public swimming pools, hot tubs, restaurants, car washes, commercial laundries, office, service, hotel, motel, and retail building bathrooms and air conditioning, fire protection, fountains, public parks, sports centers, aquariums, zoos, and street washing. Municipal water must meet safe drinking standards as specified by Federal and State laws and regulations.

The municipal water demand projection for a city for any future date is computed by the following formula:

$$MW = \frac{gpcd(P)(365)}{325,851}$$

| | | |
|---|---|---|
| Where | MW = | Number of acft of municipal water needed for one year; |
| | gpcd = | Number of gallons of water used per person per day during the year; |
| | P = | Projected population of the city in the projection year; |
| | 365 = | Number of days in one year; and |
| | 325,851 = | Number of gallons of water in one acre-foot. |

For purposes of making projections of future municipal water demands, TWDB has conducted an annual survey of cities, and public and private water districts and authorities since the mid-1960's. In the annual survey, each respondent reports the quantities of water that have been obtained from each respective water source and supplied to municipal-type customers. From the water use reports of the cities, TWDB has computed an annual per capita water use, in gallons per person per day, for each city. For the high case projection, the per capita use for the year with the highest computed value of the 1977-1986 period was chosen as the projection starting point (1990) per capita municipal water use rate for the city.

The effects of water conservation were used to adjust the per capita water use rates of each city as follows. In 1991, the Texas Legislature enacted legislation which allows only the sale of low-flow rate plumbing fixtures in Texas after January 1, 1993. TWDB estimated that by 2020, the effects of this legislation will have reduced per capita water use by 18 gallons per person per day. This 18 gallons per person per day was phased into the projection methodology by reducing the computed per capita water use rate of each city by six gallons per decade between 1990 and 2020; i.e., if per capita water use for City A, in 1990, as explained above, was computed at 190 gallons per day, then the rate used for the year 2000 would be 184 gallons per day, the rate used for 2010 would be 178 gallons per day, and the rate used for 2020 and the following decades would be 172 gallons per day. Projections of annual municipal water demand for each city for the 1990-2050 planning period were made by multiplying the projected per capita water use of the city at each decadal point in time, times 365 days, times the number of people projected for that city (Section 2.1) at the corresponding decadal point in time. Similar computations are made

for rural areas using data from water use reports of water supply corporations. County and area projections are obtained by summing the projections for cities and rural areas of the counties, respectively.

Industrial Water Use

Industrial water use includes freshwater used by industries for processing raw materials, including cooling of manufacturing processes, on-site power generation for use in the manufacturing plants, cleaning and waste removal, grounds maintenance, sanitation, pollution control, internal transportation, and in some cases, such as food and beverage manufacture, is included as part of the finished product.

As is done for cities, TWDB conducts an annual water use survey of business establishments of the major water using industries of Texas (petroleum refining, petrochemicals, inorganic chemicals, cement and concrete, steel, nonferrous smelters, construction machinery, pulp, paper and paperboard, food and beverages, and electronics). From the survey data, the quantity of freshwater used by each industry sector of a county is computed for the projections starting point (1990). Projections are made of quantities of water needed at future decadal points by applying estimated growth rates of each respective industry. Industrial water conservation effects are included by using projected recirculation and technology improvements coefficients for the projection period, which reduces the projected quantities obtained when growth rates are applied to the starting point water use data mentioned above.

Steam-Electric Power Water Use

Steam-electric power generation plants use freshwater for condenser cooling, boiler feed make-up, sanitation, grounds maintenance, and pollution control. Consumptive use typically ranges from one-third to one-half gallon of water for each kilowatt-hour of electricity produced, however, from 20 to 60 gallons of water must be circulated through the power plant condensers for each kilowatt-hour of electricity produced. The electric power industry uses both once-through and recirculation methods of operation. In the TWDB projections, each power plant is treated separately, and the projections are in terms of consumptive water use as opposed to total flows.

Annual water use surveys of electric power utilities provide TWDB with quantities of water used annually at each steam electric power plant. These data, together with

projections of additional generating units, and additional electric power plants form the basis for computing projections of quantities of water needed for electric power generation. It is important to note that TWDB projections of steam electric power generation water needs are tied to projections of population growth; i.e., it is assumed that electric power generation capacity will be added as needed in order to meet the needs of the population projected for each area of the state. (Note: In some cases, electric power may be obtained from neighboring areas, with the required water supplies being provided at the power generation site).

Irrigation Water Use

The application of freshwater to land to grow crops is irrigation water use. The TWDB high case, with conservation, irrigation projections are based upon annual estimates of acreages of each irrigated crop and estimates of the quantities of water required per acre irrigated.

For water planning purposes TWDB, in cooperation with the Texas State Soil and Water Conservation Board and the U.S. Soil Conservation Service's County Work Units, conducts a field survey of irrigation water use every five years. The latest such survey was done in 1989 and is the basis for making estimates of the quantities of irrigation water used in each county in which irrigation was done in 1990. The irrigation survey involves locating irrigation acreages on individual county maps, site visits to representative irrigation tracts, and checking soil conservation farm management plans and irrigation research results in order to determine the quantities of irrigation water used to produce each crop. Through this process, the number of irrigated acreages of each crop within each county is estimated. The acreages, together with estimated quantities of irrigation water used per acre allows the computation of quantities of irrigation water used in the projections starting point year (1990). For the projection period 1990-2050, irrigation water demands are projected by making projections of irrigated acreages at each decadal point in time and the quantity of water needed for each acre, assuming that efficient irrigation technology and methods appropriate at each decade point will be used by irrigation farmers.

## Mining Water Use

Freshwater used in the recovery of petroleum, sand, gravel, clay and stone is mining water use. In the case of petroleum production, water is injected into petroleum bearing formations to drive crude oil and natural gas to the wells for pumping to the surface. In the case of sand, gravel, clay, and stone production, water is used to wash and separate materials into usable sizes and simply to remove soil and unusable materials.

TWDB's annual water use surveys includes mining establishments. In addition, records of the Texas Railroad Commission are used to determine the quantities of freshwater used in "water flooding operations" for petroleum production. From these survey data and reports, computations are made of the quantities of freshwater used for mining purposes for the projections starting point year (1990). The growth rate (in the case of petroleum production, the direction is downward over the long run in most cases) of each mining activity of each county is projected and applied to the 1990 computed water use in order to obtain projections of quantities of water that will be needed at each decade point of the projection period (2000 - 2050).

## Livestock Water Use

Drinking water and water for washing and sanitation of livestock housing and production facilities are needed for farm and ranch animals and poultry.

Livestock and poultry water requirements are estimated from nutritional needs, in gallons per day, for each type of livestock, times the number of each type. Projections are made of the numbers at each decadal point of the projection period for each county. Carrying capacity and the acreages of rangeland are used in making projections for beef cattle, sheep, and goats. Growth rates of dairy and poultry numbers are developed for making projections for these groups. Projections are made for each county by summing the projections for each livestock type.

## Total Water Demand

Total water use projected for each subarea (city, county, Edwards Aquifer area, and river basin area) of the study area is the sum of the projected water demands for municipal, industrial, steam-electric power, irrigation, mining, and livestock purposes.

### 2.2.1 Water Demand Projections for the 33-County Study Area

The TWDB high case, with conservation water demand projections, are shown in tabular and graphic form for the 33-county study area for: (1) Municipal, (2) Industrial, (3) Steam-Electric Power Generation, (4) Irrigation, (5) Mining, (6) Livestock, and (7) Total water use.

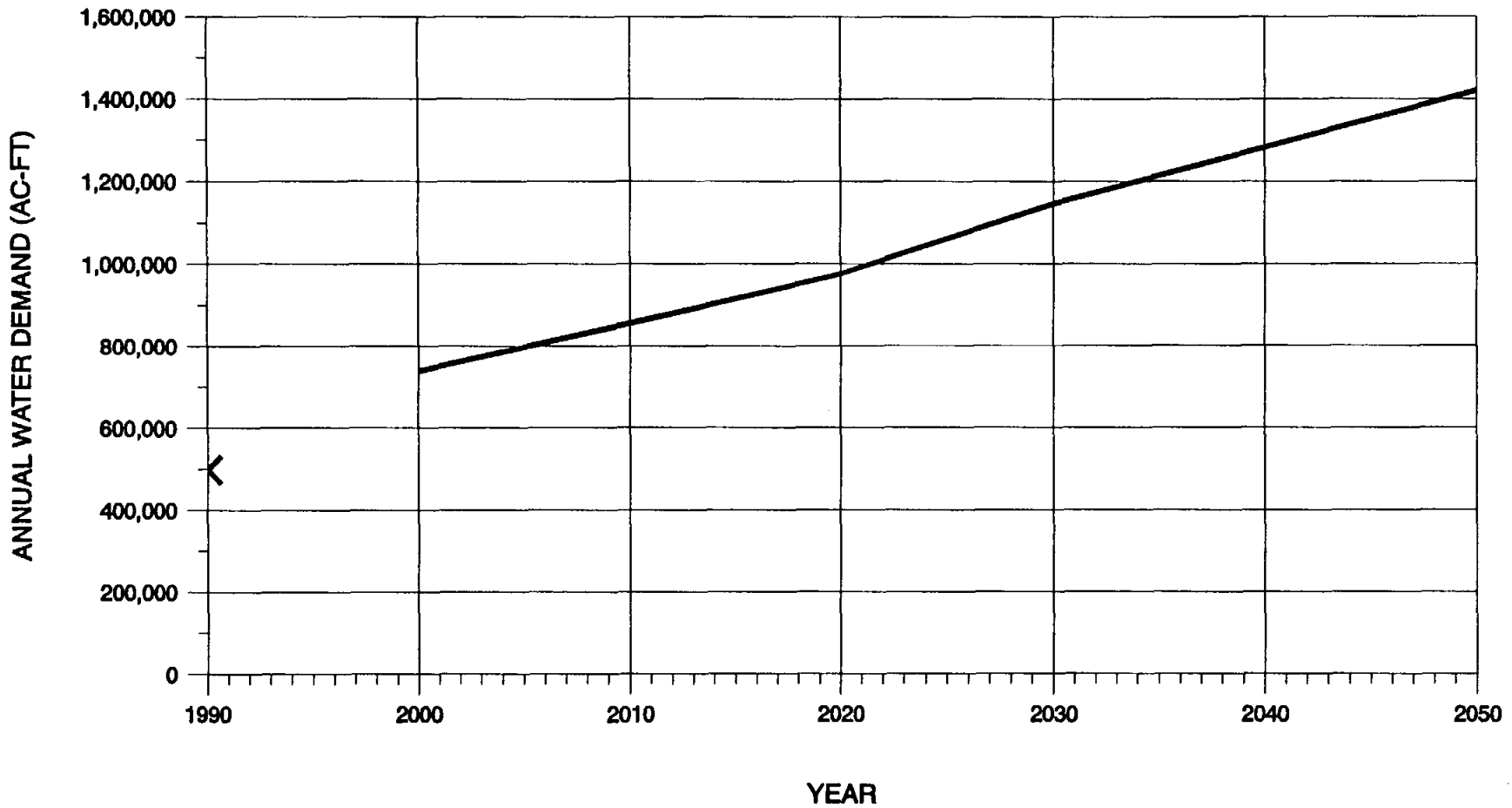
#### 2.2.1.1 Municipal Water Demand Projections for the 33-County Study Area

For the 33-County study area, municipal water use in 1990 was 498,128 acft and ranged from 916 acft in Goliad County to 225,057 acft in Bexar County (Table 2-4 and Figure 2-6). The high case projection, with conservation is 737,908 acft in 2000, 975,998 acft in 2020 and 1,420,211 acre feet in 2050 (Table 2-4). Projections for the individual counties are a function of the number of people projected for the counties and the per capita water use rates of the respective counties. The individual county projections are displayed in Table 2-4 and for year 2050 range from a low of 1,359 acft for Goliad County to a high of 678,925 acft for Bexar County. It should be noted that for 1990 the quantities are of actual use, while the projections for 2000 and beyond are for dry year conditions. Since 1990 was not a dry year, the per capita use is lower than that which was used in the projections, thus the point for 1990 is not located on the projections curve of Figure 2-6.

## Table 2-4
## Municipal Water Demand Projections -- 33-County West Central Study Area
## Trans-Texas Water Program

| County | 1990[1] Actual Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 5,670 | 6,979 | 7,657 | 8,157 | 8,808 | 9,465 | 10,122 |
| Bandera | 1,445 | 2,122 | 2,647 | 2,774 | 2,894 | 2,954 | 3,014 |
| Bastrop | 6,234 | 10,481 | 13,316 | 15,291 | 17,018 | 18,313 | 19,608 |
| Bexar | 225,057 | 332,801 | 381,895 | 436,129 | 518,799 | 598,862 | 678,925 |
| Blanco | 904 | 1,273 | 1,498 | 1,743 | 1,995 | 2,203 | 2,411 |
| Burnet | 3,526 | 4,767 | 5,380 | 5,720 | 5,987 | 6,135 | 6,283 |
| Caldwell | 4,931 | 5,481 | 5,951 | 6,439 | 6,889 | 7,230 | 7,571 |
| Calhoun | 3,916 | 4,022 | 4,497 | 4,849 | 5,221 | 5,500 | 5,779 |
| Colorado | 2,927 | 3,709 | 3,734 | 3,783 | 3,898 | 3,965 | 4,032 |
| Comal | 10,415 | 17,271 | 20,617 | 23,643 | 27,288 | 30,074 | 32,860 |
| Dewitt | 3,556 | 3,699 | 3,646 | 3,562 | 3,614 | 3,654 | 3,694 |
| Fayette | 3,397 | 3,596 | 3,624 | 3,638 | 3,634 | 3,621 | 3,608 |
| Frio | 3,045 | 3,469 | 3,753 | 3,922 | 4,226 | 4,463 | 4,700 |
| Goliad | 916 | 1,146 | 1,177 | 1,186 | 1,243 | 1,301 | 1,359 |
| Gonzales | 3,832 | 4,075 | 4,033 | 3,918 | 3,916 | 3,924 | 3,932 |
| Guadalupe | 9,627 | 16,728 | 20,095 | 22,196 | 24,073 | 25,813 | 27,553 |
| Hays | 11,709 | 18,789 | 24,247 | 28,863 | 33,147 | 35,330 | 37,513 |
| Karnes | 2,187 | 2,446 | 2,408 | 2,334 | 2,334 | 2,310 | 2,286 |
| Kendall | 2,130 | 3,085 | 3,412 | 3,649 | 4,001 | 4,163 | 4,325 |
| Kerr | 5,821 | 8,084 | 8,780 | 9,096 | 9,546 | 9,926 | 10,306 |
| Llano | 2,488 | 2,951 | 3,042 | 3,190 | 3,551 | 3,537 | 3,523 |
| Lee | 2,991 | 2,981 | 3,250 | 3,438 | 3,680 | 3,911 | 4,142 |
| Matagorda | 5,225 | 7,632 | 7,909 | 8,032 | 8,284 | 8,532 | 8,780 |
| Medina | 5,254 | 6,988 | 7,560 | 7,882 | 8,348 | 8,591 | 8,834 |
| Refugio | 1,227 | 1,359 | 1,372 | 1,363 | 1,382 | 1,380 | 1,378 |
| San Saba | 1,272 | 1,499 | 1,482 | 1,451 | 1,459 | 1,453 | 1,447 |
| Travis | 114,809 | 174,069 | 203,075 | 235,214 | 273,721 | 297,268 | 320,815 |
| Uvalde | 5,278 | 7,456 | 8,389 | 9,138 | 10,238 | 11,461 | 12,684 |
| Victoria | 11,545 | 14,851 | 16,400 | 17,327 | 18,326 | 19,316 | 20,306 |
| Wharton | 6,218 | 7,145 | 7,589 | 7,876 | 8,670 | 9,320 | 9,970 |
| Williamson | 24,482 | 48,643 | 64,486 | 80,348 | 109,137 | 127,781 | 146,425 |
| Wilson | 3,745 | 5,423 | 6,328 | 6,762 | 7,303 | 7,769 | 8,235 |
| Zavala | 2,349 | 2,888 | 2,997 | 3,085 | 3,313 | 3,552 | 3,791 |
| Total | 498,128 | 737,908 | 856,246 | 975,998 | 1,145,943 | 1,283,077 | 1,420,211 |

[1]As reported to the Texas Water Development Board, dry-year demands would be significantly higher.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

MUNICIPAL WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE 2 - 6

2.2.1.2 Industrial Water Demand Projections for the 33-County Study Area

Industrial water use in the study area in 1990 was reported at 83,307 acft and is projected to increase to 415,953 acft in 2050 (Table 2-5 and Figure 2-7). Industrial water use is concentrated in the coastal counties of Calhoun, Victoria, and Matagorda, and along the I-35 corridor (Bexar, Comal, Guadalupe, and Travis Counties). Seven of the study area counties do not have any projected industrial water use (Table 2-5). In 1990, the heavy water using industries of Calhoun, Victoria, and Matagorda counties were operating at much less than full capacity due to sluggish economic conditions. Thus, reported water use was below normal. As economic conditions improve, water use is projected to increase to that needed to return idle capacity to production. This is reflected in the projections and explains a part of the large increase in the industrial water demand projections between 1990 and 2000.

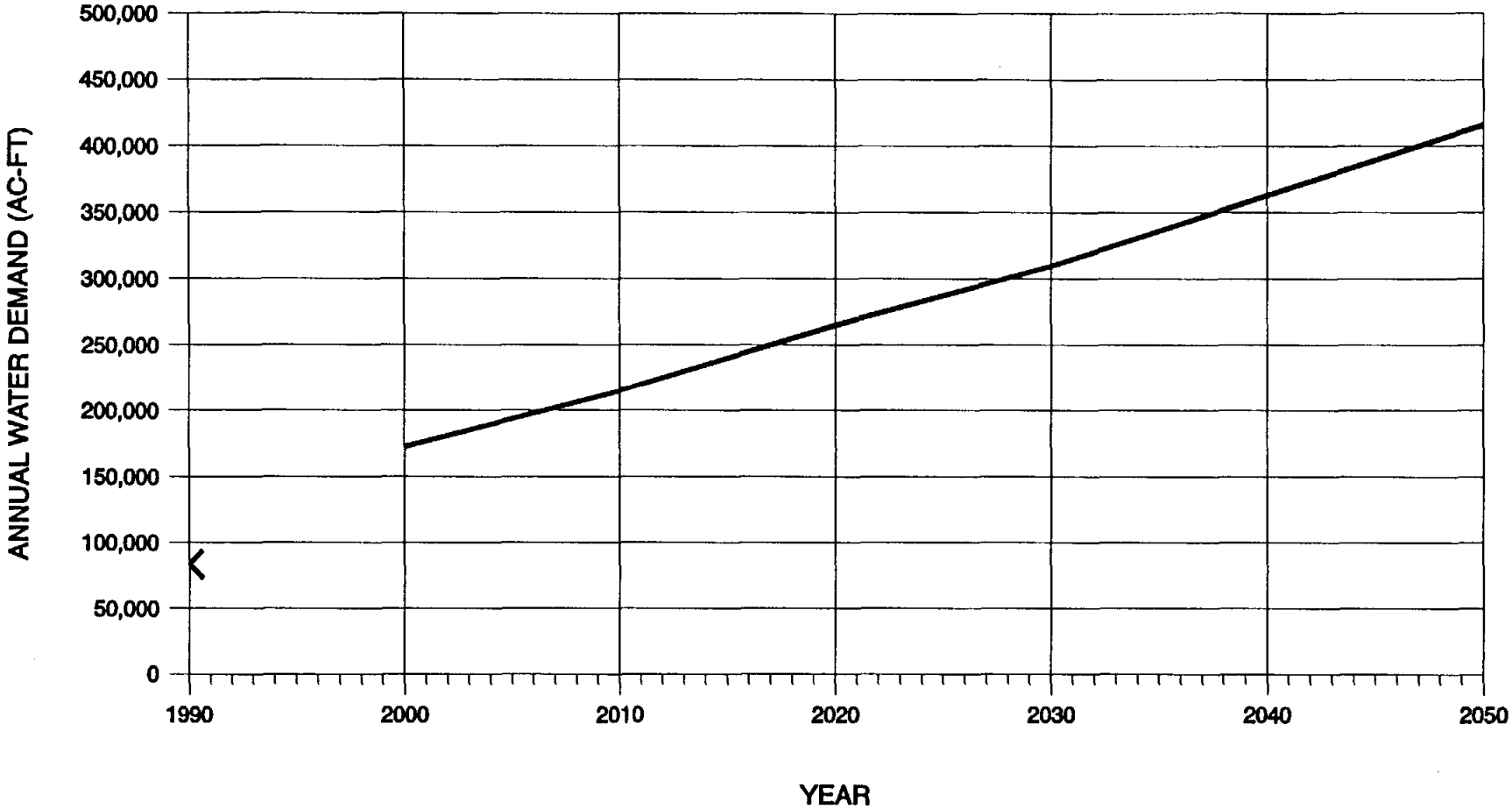
2.2.1.3 Steam-Electric Power Water Demand Projections for the 33-County Study Area

Steam-electric power generation is located in 10 of the 33-study area counties, with the larger plants located in Bexar, Matagorda, Goliad, and Fayette Counties. Consumptive use by power plants in 1990 was 98,755 acft (Table 2-6 and Figure 2-8). Projected consumptive use of water for steam-electric power generation in 2050 is 236,200 acft (Table 2-6). It is important to note that total volume of water required for circulation in steam-electric power plants is perhaps 50 times that which is consumed by evaporation. It is further useful to note that treated municipal wastewater can and is being used for make-up water for electric power generation.

## Table 2-5
## Industrial Water Demand Projections -- 33-County West Central Study Area
## Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bandera | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bastrop | 27 | 51 | 68 | 87 | 111 | 127 | 143 |
| Bexar | 14,049 | 19,567 | 24,399 | 30,031 | 36,441 | 42,617 | 48,793 |
| Blanco | 0 | 2 | 3 | 4 | 4 | 5 | 6 |
| Burnet | 1,116 | 108 | 137 | 169 | 206 | 246 | 286 |
| Caldwell | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calhoun | 24,539 | 73,297 | 83,156 | 94,154 | 103,934 | 114,509 | 125,084 |
| Colorado | 1,078 | 2,047 | 2,530 | 3,110 | 3,738 | 4,211 | 4,684 |
| Comal | 3,248 | 4,745 | 5,647 | 6,674 | 7,562 | 8,181 | 8,800 |
| Dewitt | 91 | 139 | 181 | 228 | 282 | 326 | 370 |
| Fayette | 32 | 54 | 65 | 76 | 90 | 107 | 124 |
| Frio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Goliad | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gonzales | 865 | 1,303 | 1,584 | 1,921 | 2,309 | 2,717 | 3,125 |
| Guadalupe | 1,661 | 1,807 | 2,049 | 2,314 | 2,679 | 3,073 | 3,467 |
| Hays | 293 | 2,492 | 3,093 | 3,815 | 4,611 | 5,209 | 5,807 |
| Karnes | 270 | 214 | 278 | 351 | 434 | 498 | 562 |
| Kendall | 2 | 5 | 6 | 8 | 10 | 12 | 14 |
| Kerr | 28 | 11 | 14 | 17 | 20 | 24 | 28 |
| Lee | 5 | 8 | 9 | 10 | 12 | 13 | 14 |
| Llano | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Matagorda | 6,807 | 11,946 | 21,072 | 34,524 | 44,019 | 60,404 | 76,789 |
| Medina | 286 | 120 | 150 | 182 | 221 | 266 | 311 |
| Refugio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| San Saba | 0 | 27 | 34 | 42 | 50 | 56 | 62 |
| Travis | 6,243 | 13,803 | 18,139 | 22,227 | 26,379 | 30,569 | 34,759 |
| Uvalde | 557 | 435 | 526 | 635 | 765 | 920 | 1,075 |
| Victoria | 20,032 | 37,974 | 49,097 | 61,388 | 71,794 | 83,891 | 95,988 |
| Wharton | 396 | 473 | 570 | 674 | 788 | 918 | 1,048 |
| Williamson | 326 | 457 | 596 | 731 | 876 | 1,029 | 1,182 |
| Wilson | 50 | 99 | 118 | 139 | 163 | 179 | 195 |
| Zavala | 1,306 | 1,213 | 1,494 | 1,835 | 2,243 | 2,740 | 3,237 |
| Total | 83,307 | 172,397 | 215,015 | 265,346 | 309,741 | 362,847 | 415,953 |

[1]As reported to the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

INDUSTRIAL WATER DEMAND PROJECTIONS

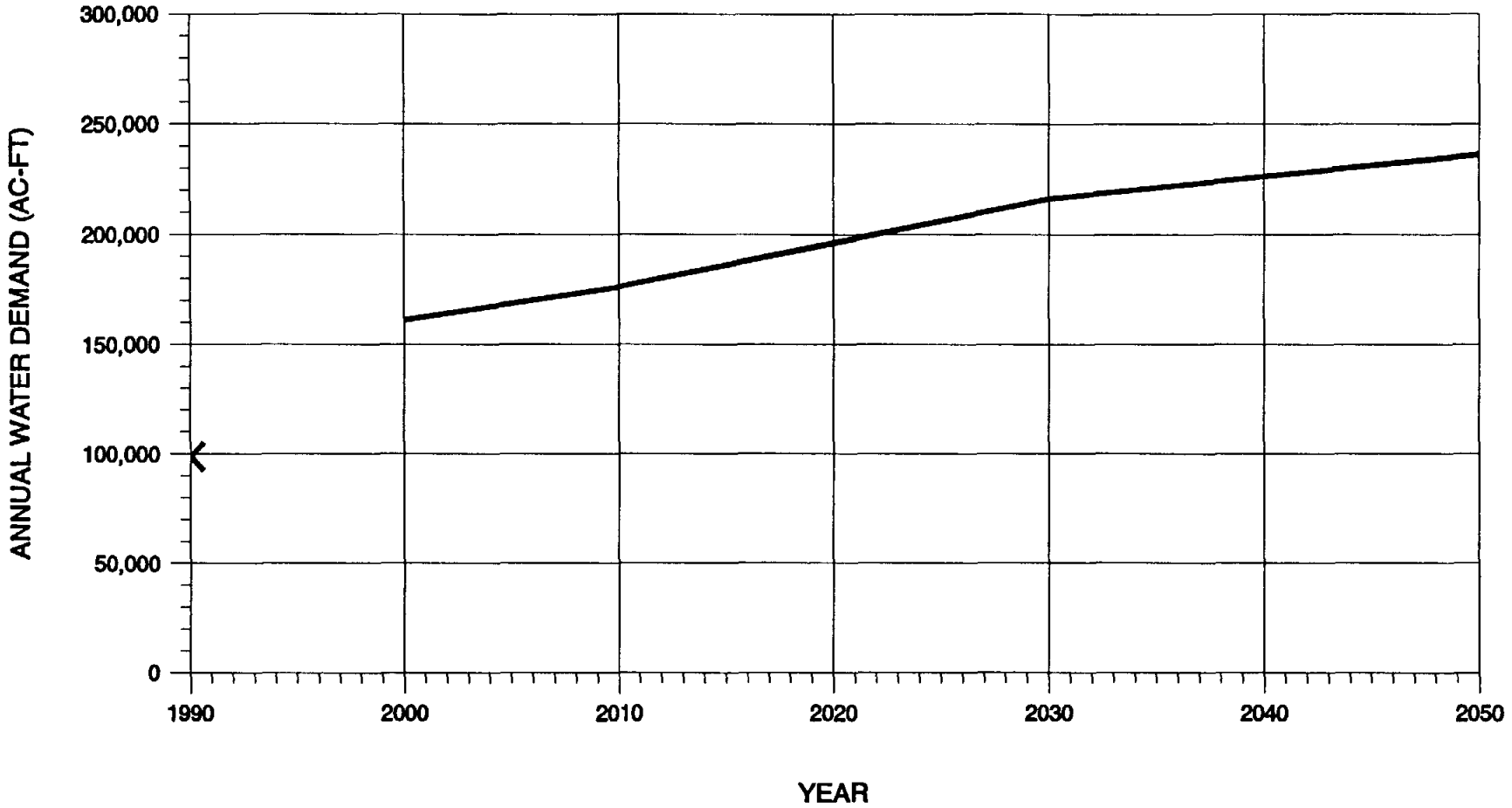
33 COUNTY AREA

FIGURE 2 - 7

**Table 2-6**
**Steam-Electric Power Water Demand Projections -- 33-County West Central Area**
**Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 3,622 | 12,000 | 12,000 | 17,000 | 22,000 | 27,000 | 32,000 |
| Bandera | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bastrop | 2,967 | 8,000 | 8,000 | 8,000 | 8,000 | 8,000 | 8,000 |
| Bexar | 24,263 | 36,000 | 41,000 | 46,000 | 56,000 | 56,000 | 56,000 |
| Blanco | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Burnet | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Caldwell | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calhoun | 62 | 200 | 200 | 200 | 200 | 200 | 200 |
| Colorado | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Comal | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dewitt | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fayette | 11,701 | 25,500 | 35,500 | 40,500 | 45,500 | 50,500 | 55,500 |
| Frio | 38 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Goliad | 12,165 | 16,000 | 16,000 | 16,000 | 16,000 | 16,000 | 16,000 |
| Gonzales | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Guadalupe | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hays | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Karnes | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kendall | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kerr | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lee | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Llano | 937 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Matagorda | 35,915 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 |
| Medina | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Refugio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| San Saba | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Travis | 6,198 | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 |
| Uvalde | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Victoria | 887 | 26,000 | 26,000 | 31,000 | 31,000 | 31,000 | 31,000 |
| Wharton | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Williamson | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wilson | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zavala | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 98,755 | 161,200 | 176,200 | 196,200 | 216,200 | 226,200 | 236,200 |

[1]As reported to the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.




HDR Engineering, Inc.

TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## STEAM-ELECTRIC POWER WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE 2 - 8

2.2.1.4 Irrigation Water Demand Projections for the 33-County Study Area

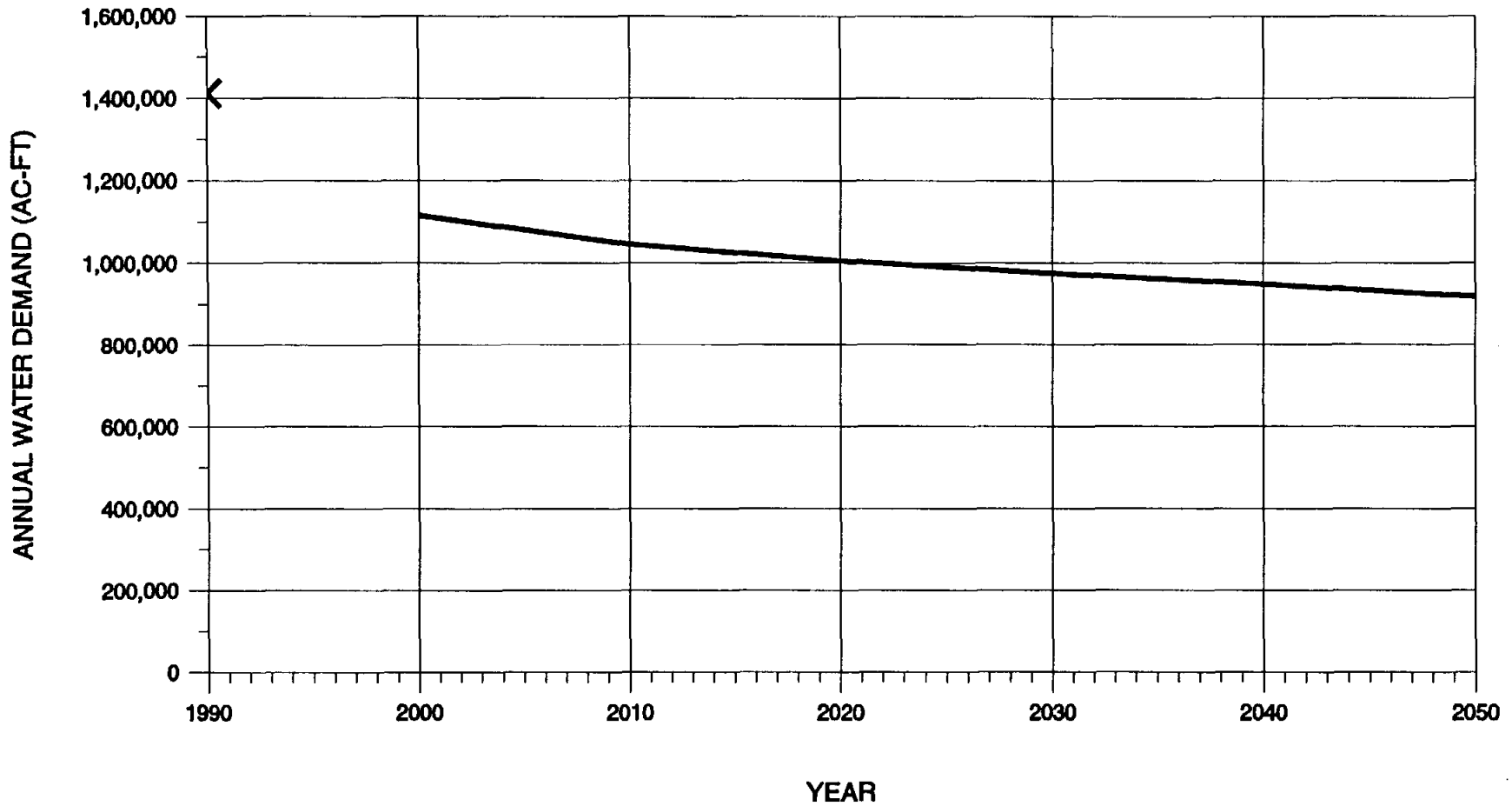
Irrigation is done in practically all of the counties of the study area, with large acreages, and consequently large quantities of water used in the coastal counties (Wharton, Matagorda, Colorado, and Calhoun), the Winter Garden area (Zavala, Frio, and Uvalde Counties), the western Edwards Aquifer area (Bexar, Medina, and Uvalde Counties), and in Atascosa and Wilson Counties (Table 2-7). The sources of irrigation water for the coastal counties are diversions from the Colorado and Guadalupe/San Antonio rivers and groundwater from the Gulf Coast Aquifer. The sources for the Winter Garden area are the Edwards and Carrizo Aquifers, with small quantities from the Nueces River. The sources for Bexar and Medina counties are the Edwards Aquifer and Medina and Diversion Lakes (the Medina River). Uvalde County irrigation is supplied from the Edwards Aquifer. Atascosa and Wilson County irrigation is supplied largely from the Carrizo Aquifer, with some water obtained from streams which flow through the counties. Irrigation water for other counties of the study area is obtained from both ground and surface water sources.

In 1990, irrigation water use in the study area from all sources was estimated at 1,411,579 acft (Table 2-7 and Figure 2-9). Irrigation water demand is projected to decline to 1.1 million acft in 2000, 1.0 million acft in 2020, and 918,400 acft in 2050. The projected decline is anticipated to occur due to improved application efficiency, canal lining and pipeline installation to reduce losses between the river bank diversion points and the fields, and reduced acreages of some irrigated crops.

**Table 2-7**
**Irrigation Water Demand Projections -- 33-County West Central Study Area**
**Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 47,208 | 50,000 | 42,500 | 40,000 | 40,000 | 40,000 | 40,000 |
| Bandera | 290 | 330 | 330 | 330 | 330 | 330 | 330 |
| Bastrop | 645 | 866 | 866 | 866 | 866 | 866 | 866 |
| Bexar | 37,012 | 25,000 | 20,240 | 18,880 | 17,520 | 16,200 | 14,880 |
| Blanco | 483 | 495 | 495 | 495 | 495 | 495 | 495 |
| Burnet | 300 | 250 | 250 | 250 | 250 | 250 | 250 |
| Caldwell | 1,375 | 125 | 125 | 125 | 125 | 125 | 125 |
| Calhoun | 35,421 | 27,959 | 27,899 | 27,099 | 25,169 | 25,169 | 25,169 |
| Colorado | 216,480 | 129,675 | 122,543 | 117,438 | 112,332 | 107,263 | 102,118 |
| Comal | 479 | 500 | 500 | 500 | 500 | 500 | 500 |
| Dewitt | 285 | 3,250 | 3,250 | 3,250 | 3,250 | 3,250 | 3,250 |
| Fayette | 400 | 1,314 | 1,314 | 1,314 | 1,314 | 1,314 | 1,314 |
| Frio | 83,233 | 90,000 | 83,373 | 79,146 | 74,767 | 70,400 | 66,033 |
| Goliad | 685 | 495 | 495 | 495 | 495 | 495 | 495 |
| Gonzales | 3,540 | 2,310 | 2,310 | 2,310 | 2,310 | 2,310 | 2,310 |
| Guadalupe | 2,646 | 4,455 | 4,455 | 4,455 | 4,455 | 4,455 | 4,455 |
| Hays | 320 | 660 | 660 | 660 | 660 | 660 | 660 |
| Karnes | 2,034 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Kendall | 380 | 248 | 248 | 248 | 248 | 248 | 248 |
| Kerr | 850 | 1,125 | 1,125 | 1,125 | 1,125 | 1,125 | 1,125 |
| Lee | 283 | 220 | 220 | 220 | 220 | 220 | 220 |
| Llano | 1,122 | 1,250 | 1,250 | 1,250 | 1,250 | 1,250 | 1,250 |
| Matagorda | 204,827 | 138,257 | 138,253 | 128,478 | 122,893 | 117,406 | 111,718 |
| Medina | 157,380 | 110,000 | 105,000 | 105,000 | 105,000 | 105,000 | 105,000 |
| Refugio | 0 | 83 | 83 | 83 | 83 | 83 | 83 |
| San Saba | 5,734 | 9,599 | 9,500 | 9,403 | 9,305 | 9,199 | 9,093 |
| Travis | 800 | 990 | 990 | 990 | 990 | 990 | 990 |
| Uvalde | 140,669 | 130,000 | 120,000 | 120,000 | 120,000 | 120,000 | 120,000 |
| Victoria | 13,699 | 12,172 | 10,800 | 10,350 | 9,900 | 9,450 | 9,000 |
| Wharton | 328,220 | 283,920 | 272,562 | 261,206 | 249,849 | 240,145 | 227,136 |
| Williamson | 160 | 165 | 165 | 165 | 165 | 165 | 165 |
| Wilson | 13,697 | 8,660 | 8,512 | 8,364 | 8,216 | 8,069 | 7,922 |
| Zavala | 110,922 | 80,000 | 65,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Total | 1,411,579 | 1,115,573 | 1,045,713 | 1,005,695 | 975,282 | 948,632 | 918,400 |

[1]As estimated by the Texas Water Development Board from irrigation surveys.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas. The projections have been adjusted to include canal seepage losses for irrigation using surface water diversions from the rivers.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## IRRIGATION WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE 2 - 9

2.2.1.5 Mining Water Demand Projections for the 33-County Study Area

Mining is done in all of the counties, with the largest quantities of water use in Colorado, Wharton, Victoria, Travis, Bexar and Williamson Counties (Table 2-8). Estimated mining water use in 1990 was 47,360 acft, with projected use for the period 2010 to 2030 dropping to a range of 37,721 to 41,814 acft per year (Table 2-8 and Figure 2-10). The decline is due to a projected decline in water flooding for petroleum recovery. The high case, with conservation, projection at 2050 is 48,663 acft. The growth in mining after 2030 is due to growth in sand, gravel, and limestone quarrying in the San Antonio and Austin areas.

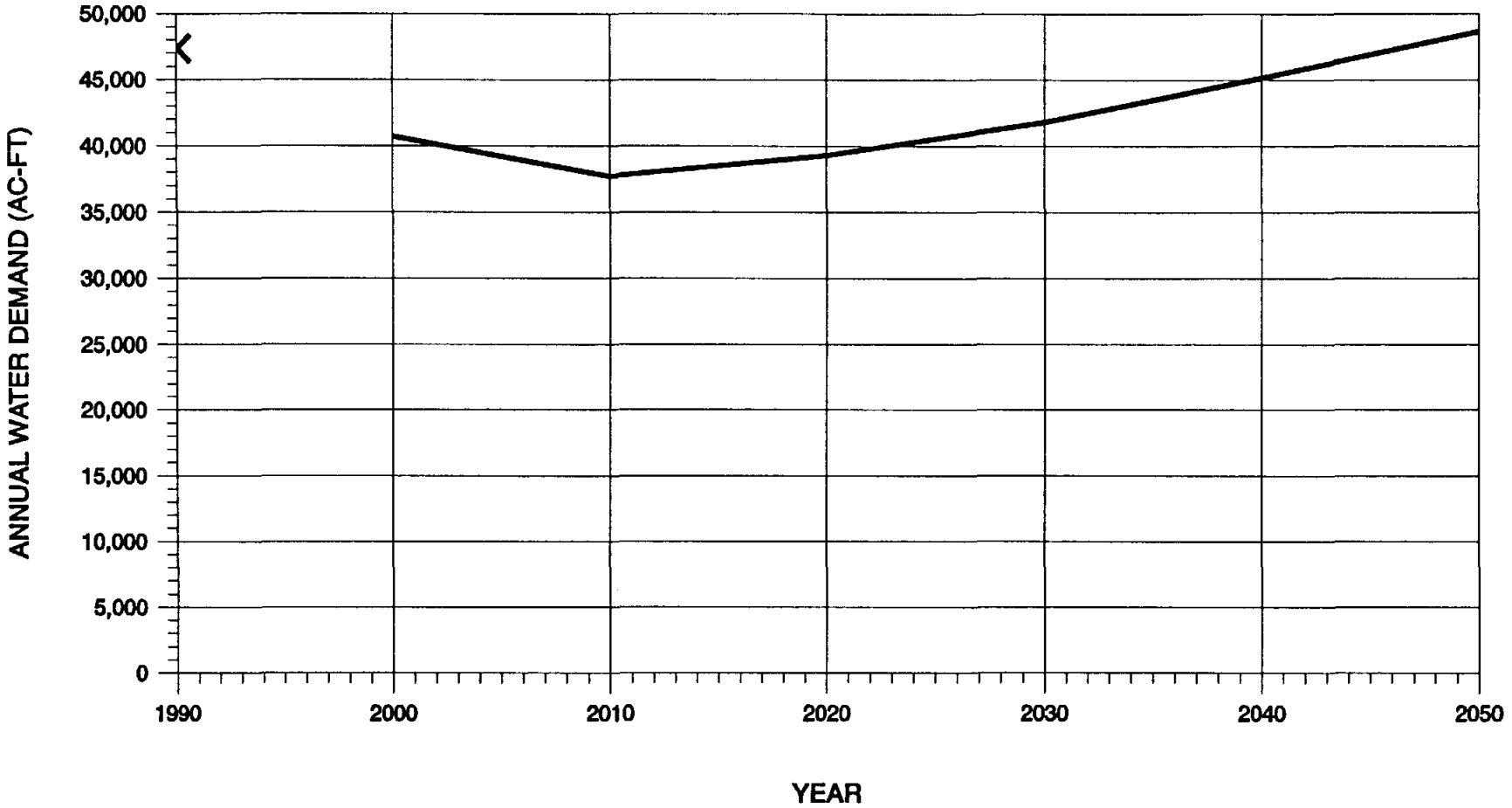
2.2.1.6 Livestock Water Demand Projections for the 33-County Study Area

Livestock production is done throughout the study area, with the predominant activity being grazing of beef and goats. Poultry production is concentrated in Gonzales County. Estimated livestock water use in 1990 was 38,876 acft with projections of 50,282 for 2000 through 2050 (Table 2-9 and Figure 2-11). The TWDB projection method for livestock water requirements estimates the maximum grazing capacity for rangeland in each county and computes the quantity of water needed by livestock for this grazing capacity. Thus, in areas where range livestock production predominates the projection reaches its upper limit and is held constant thereafter.

## Table 2-8
## Mining Water Demand Projections -- 33-County West Central Study Area
## Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 664 | 1,444 | 1,554 | 2,680 | 3,806 | 4,931 | 6,056 |
| Bandera | 20 | 24 | 24 | 25 | 26 | 26 | 26 |
| Bastrop | 16 | 52 | 46 | 38 | 33 | 34 | 39 |
| Bexar | 1,591 | 4,691 | 4,936 | 5,201 | 5,406 | 5,645 | 5,884 |
| Blanco | 0 | 12 | 9 | 5 | 1 | 0 | 0 |
| Burnet | 936 | 949 | 971 | 990 | 1,011 | 1,040 | 1,069 |
| Caldwell | 27 | 23 | 17 | 10 | 4 | 0 | 0 |
| Calhoun | 1 | 35 | 34 | 20 | 9 | 4 | 2 |
| Colorado | 31,967 | 14,742 | 12,825 | 13,305 | 14,147 | 15,393 | 16,639 |
| Comal | 946 | 4,799 | 4,464 | 4,151 | 3,861 | 3,590 | 3,319 |
| Dewitt | 129 | 148 | 120 | 95 | 67 | 53 | 45 |
| Fayette | 7 | 80 | 58 | 34 | 13 | 4 | 1 |
| Frio | 313 | 276 | 280 | 287 | 296 | 305 | 314 |
| Goliad | 0 | 17 | 12 | 6 | 3 | 0 | 0 |
| Gonzales | 21 | 41 | 37 | 33 | 29 | 29 | 29 |
| Guadalupe | 8 | 195 | 198 | 200 | 202 | 207 | 212 |
| Hays | 0 | 11 | 8 | 4 | 1 | 0 | 0 |
| Karnes | 187 | 356 | 183 | 93 | 47 | 17 | 1 |
| Kendall | 0 | 12 | 9 | 5 | 1 | 0 | 0 |
| Kerr | 73 | 143 | 122 | 110 | 103 | 102 | 102 |
| Lee | 0 | 28 | 21 | 13 | 5 | 1 | 0 |
| Llano | 65 | 140 | 112 | 99 | 95 | 92 | 89 |
| Matagorda | 250 | 294 | 265 | 250 | 244 | 242 | 243 |
| Medina | 120 | 131 | 128 | 128 | 129 | 132 | 135 |
| Refugio | 77 | 28 | 14 | 7 | 4 | 1 | 0 |
| San Saba | 86 | 154 | 133 | 124 | 123 | 122 | 121 |
| Travis | 2,288 | 4,934 | 5,021 | 5,384 | 5,884 | 6,429 | 6,974 |
| Uvalde | 399 | 574 | 628 | 699 | 776 | 866 | 956 |
| Victoria | 2,409 | 2,314 | 2,088 | 2,090 | 2,207 | 2,424 | 2,641 |
| Wharton | 2,650 | 1,890 | 953 | 481 | 241 | 83 | 0 |
| Williamson | 1,713 | 2,014 | 2,344 | 2,673 | 3,002 | 3,375 | 3,749 |
| Wilson | 281 | 107 | 65 | 42 | 30 | 23 | 17 |
| Zavala | 116 | 59 | 42 | 25 | 8 | 2 | 0 |
| Total | 47,360 | 40,717 | 37,721 | 39,307 | 41,814 | 45,172 | 48,663 |

[1]As estimated by the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## MINING WATER DEMAND PROJECTIONS

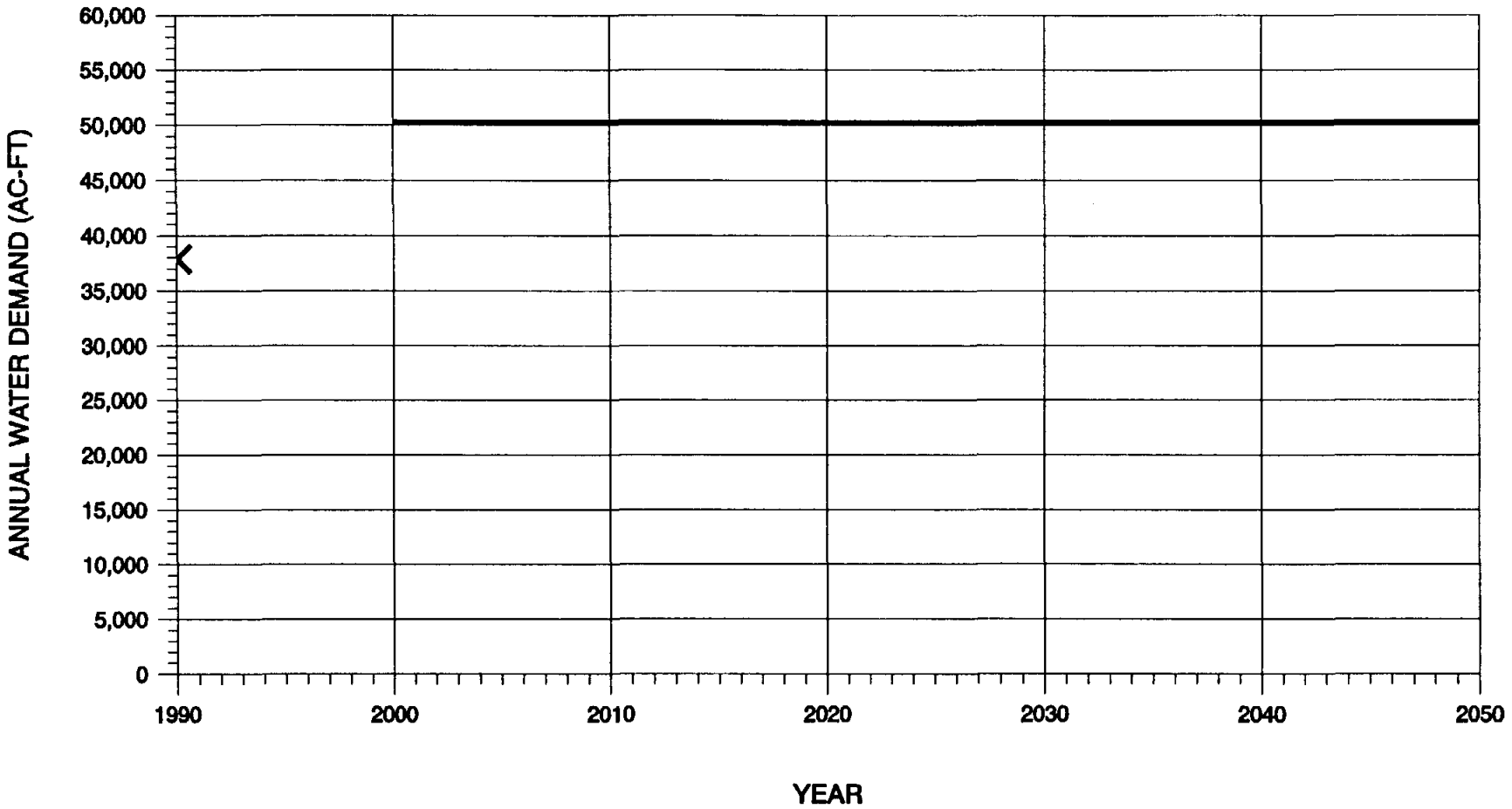
33 COUNTY AREA

FIGURE 2 - 10

## Table 2-9
## Livestock Water Demand Projections -- 33-County West Central Study Area
## Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 1,613 | 1,945 | 1,945 | 1,945 | 1,945 | 1,945 | 1,945 |
| Bandera | 325 | 506 | 506 | 506 | 506 | 506 | 506 |
| Bastrop | 1,431 | 2,033 | 2,033 | 2,033 | 2,033 | 2,033 | 2,033 |
| Bexar | 1,376 | 1,245 | 1,245 | 1,245 | 1,245 | 1,245 | 1,245 |
| Blanco | 553 | 639 | 639 | 639 | 639 | 639 | 639 |
| Burnet | 820 | 846 | 846 | 846 | 846 | 846 | 846 |
| Caldwell | 816 | 1,416 | 1,416 | 1,416 | 1,416 | 1,416 | 1,416 |
| Calhoun | 291 | 649 | 649 | 649 | 649 | 649 | 649 |
| Colorado | 1,395 | 2,191 | 2,191 | 2,191 | 2,191 | 2,191 | 2,191 |
| Comal | 316 | 468 | 468 | 468 | 468 | 468 | 468 |
| Dewitt | 1,840 | 2,432 | 2,432 | 2,432 | 2,432 | 2,432 | 2,432 |
| Fayette | 2,037 | 2,647 | 2,647 | 2,647 | 2,647 | 2,647 | 2,647 |
| Frio | 1,097 | 1,532 | 1,532 | 1,532 | 1,532 | 1,532 | 1,532 |
| Goliad | 884 | 1,271 | 1,271 | 1,271 | 1,271 | 1,271 | 1,271 |
| Gonzales | 4,108 | 4,443 | 4,443 | 4,443 | 4,443 | 4,443 | 4,443 |
| Guadalupe | 1,031 | 1,450 | 1,450 | 1,450 | 1,450 | 1,450 | 1,450 |
| Hays | 676 | 777 | 777 | 777 | 777 | 777 | 777 |
| Karnes | 1,371 | 1,644 | 1,644 | 1,644 | 1,644 | 1,644 | 1,644 |
| Kendall | 389 | 722 | 722 | 722 | 722 | 722 | 722 |
| Kerr | 382 | 709 | 709 | 709 | 709 | 709 | 709 |
| Lee | 1,398 | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 |
| Llano | 908 | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 | 1,057 |
| Matagorda | 1,120 | 1,380 | 1,380 | 1,380 | 1,380 | 1,380 | 1,380 |
| Medina | 1,560 | 2,001 | 2,001 | 2,001 | 2,001 | 2,001 | 2,001 |
| Refugio | 563 | 673 | 673 | 673 | 673 | 673 | 673 |
| San Saba | 1,121 | 1,850 | 1,850 | 1,850 | 1,850 | 1,850 | 1,850 |
| Travis | 942 | 1,099 | 1,099 | 1,099 | 1,099 | 1,099 | 1,099 |
| Uvalde | 994 | 1,869 | 1,869 | 1,869 | 1,869 | 1,869 | 1,869 |
| Victoria | 1,271 | 1,623 | 1,623 | 1,623 | 1,623 | 1,623 | 1,623 |
| Wharton | 1,213 | 1,684 | 1,684 | 1,684 | 1,684 | 1,684 | 1,684 |
| Williamson | 1,508 | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 |
| Wilson | 1,813 | 2,149 | 2,149 | 2,149 | 2,149 | 2,149 | 2,149 |
| Zavala | 714 | 1,639 | 1,639 | 1,639 | 1,639 | 1,639 | 1,639 |
| Total | 37,876 | 50,282 | 50,282 | 50,282 | 50,282 | 50,282 | 50,282 |

[1]As estimated by the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

LIVESTOCK WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE 2 - 11

2.2.1.7 Total Water Demand Projections for the 33-County Study Area

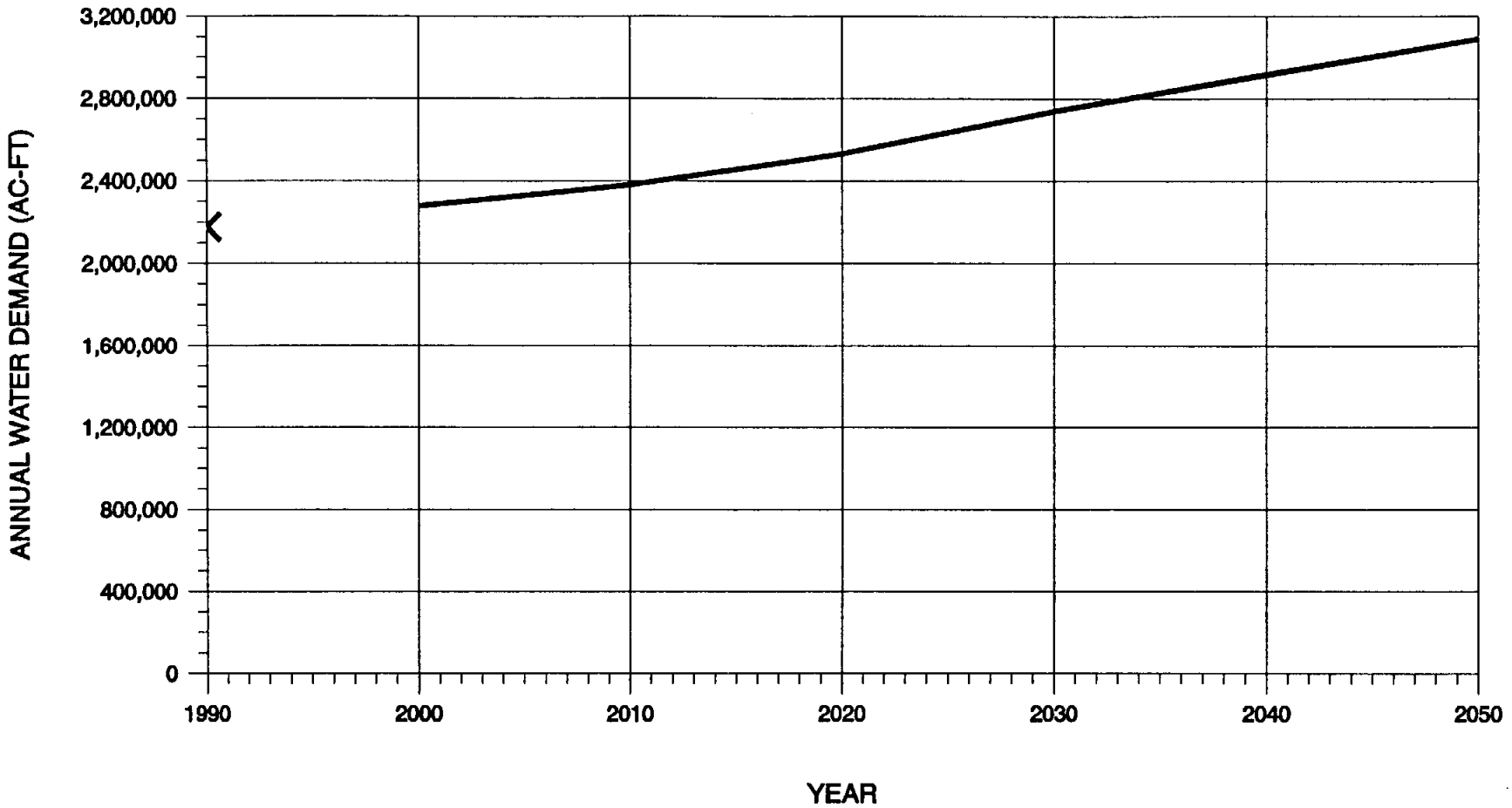
In previous sections, projections of future water demands have been tabulated for each of the major water using functions of the 33-county area; i.e., municipal, industrial, steam-electric power generation, irrigation, mining, and livestock water. In this section, the totals of all uses projected for each county are shown along with the sum for the 33-counties (Table 2-10).

Water use in 1990 was 2,177,005 for the 33-county area, with 15.5 percent in Wharton County, 14 percent in Bexar County, 12 percent in each of Matagorda and Colorado counties, 7.5 percent in Medina County, 6.7 percent in Uvalde County, 6.0 percent in Travis County, and 5.2 percent in Zavala County (Table 2-10). The TWDB high case, with conservation, projected total water demand for the 33-county area is approximately 2.28 million acft in 2000, 2.53 million acft in 2020, and 3.09 million acft in 2050 (Table 2-10 and Figure 2-12).

**Table 2-10**
**Total Water Demand Projections -- 33-County West Central Study Area**
**Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa | 58,777 | 72,368 | 65,656 | 69,782 | 76,559 | 83,341 | 90,123 |
| Bandera | 2,080 | 2,982 | 3,507 | 3,635 | 3,756 | 3,816 | 3,876 |
| Bastrop | 11,320 | 21,483 | 24,329 | 26,315 | 28,061 | 29,373 | 30,685 |
| Bexar | 303,348 | 419,304 | 473,715 | 537,486 | 635,411 | 720,569 | 805,727 |
| Blanco | 1,940 | 2,421 | 2,644 | 2,886 | 3,134 | 3,342 | 3,550 |
| Burnet | 6,698 | 6,920 | 7,584 | 7,975 | 8,300 | 8,517 | 8,734 |
| Caldwell | 7,149 | 7,045 | 7,509 | 7,990 | 8,434 | 8,771 | 9,108 |
| Calhoun | 64,230 | 106,162 | 115,635 | 126,971 | 135,182 | 146,031 | 156,883 |
| Colorado | 253,847 | 152,367 | 143,823 | 139,827 | 136,306 | 133,023 | 129,664 |
| Comal | 15,404 | 27,783 | 31,696 | 35,436 | 39,679 | 42,813 | 45,947 |
| Dewitt | 5,901 | 9,668 | 9,629 | 9,567 | 9,645 | 9,715 | 9,785 |
| Fayette | 17,574 | 33,191 | 43,208 | 48,209 | 53,198 | 58,193 | 63,188 |
| Frio | 87,726 | 97,277 | 90,938 | 86,887 | 82,821 | 78,700 | 74,579 |
| Goliad | 14,650 | 18,929 | 18,955 | 18,958 | 19,012 | 19,067 | 19,122 |
| Gonzales | 12,366 | 12,172 | 12,407 | 12,625 | 13,007 | 13,423 | 13,839 |
| Guadalupe | 14,973 | 24,635 | 28,247 | 30,615 | 32,859 | 34,998 | 37,137 |
| Hays | 12,998 | 22,729 | 28,785 | 34,119 | 39,196 | 41,976 | 44,756 |
| Karnes | 6,049 | 5,860 | 5,713 | 5,622 | 5,659 | 5,669 | 5,679 |
| Kendall | 2,901 | 4,072 | 4,397 | 4,632 | 4,982 | 5,145 | 5,308 |
| Kerr | 7,154 | 10,072 | 10,750 | 11,057 | 11,503 | 11,886 | 12,269 |
| Lee | 4,677 | 5,287 | 5,550 | 5,731 | 5,967 | 6,195 | 6,423 |
| Llano | 5,520 | 7,398 | 7,461 | 7,596 | 7,953 | 7,936 | 7,919 |
| Matagorda | 254,144 | 185,509 | 194,879 | 198,664 | 202,820 | 213,964 | 224,910 |
| Medina | 164,600 | 119,240 | 114,839 | 115,193 | 115,699 | 115,990 | 116,281 |
| Refugio | 1,867 | 2,143 | 2,142 | 2,126 | 2,142 | 2,137 | 2,132 |
| San Saba | 8,213 | 13,129 | 12,999 | 12,870 | 12,787 | 12,680 | 12,573 |
| Travis | 131,280 | 202,395 | 235,824 | 272,414 | 315,573 | 343,855 | 372,137 |
| Uvalde | 147,897 | 140,334 | 131,412 | 132,341 | 133,648 | 135,116 | 136,584 |
| Victoria | 49,843 | 94,934 | 106,008 | 123,778 | 134,850 | 147,704 | 160,558 |
| Wharton | 338,697 | 295,112 | 283,358 | 271,921 | 261,232 | 252,150 | 239,891 |
| Williamson | 28,189 | 52,922 | 69,234 | 85,560 | 114,823 | 133,993 | 153,163 |
| Wilson | 19,586 | 16,438 | 17,172 | 17,456 | 17,861 | 18,189 | 18,517 |
| Zavala | 115,407 | 85,799 | 71,172 | 66,584 | 67,203 | 67,933 | 68,663 |
| Total | 2,177,005 | 2,278,077 | 2,381,177 | 2,532,828 | 2,739,262 | 2,916,210 | 3,089,709 |

[1]As reported to and estimated by Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## TOTAL WATER DEMAND PROJECTIONS

33 COUNTY AREA

FIGURE 2 - 12

### 2.2.2 Water Demand Projections for the Edwards Aquifer Area

The TWDB high case, with conservation, water demand projections are shown in tabular form for municipal water demand for cities and counties of the Edwards Aquifer area, as defined in Senate Bill 1477, 1993 Texas Legislature (Figure 2-1). The projections are also shown in tabular and graphic form for counties of the Edwards Aquifer area for: (1) Municipal, (2) Industrial, (3) Steam-Electric Power, (4) Irrigation, (5) Mining, (6) Livestock, and (7) Total Water Demand. Only the municipal water demand projections are available at the city level.

#### 2.2.2.1 Municipal Water Demand Projections for Cities and Counties of the Edwards Aquifer Area

In 1990, reported municipal water use in cities and rural areas of the Edwards Aquifer area was 259,330 acft (Table 2-11 and Figure 2-13). Projected high case municipal water demand for the area, with conservation, is 384,727 acft in 2000, 504,003 acft in 2020, and 765,017 acft in 2050 (Table 2-11 and Figure 2-13). The projections for individual cities can be seen in Table 2-11.

**Table 2-11**
**Municipal Water Demand Projections for Cities and Counties**
**Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

| County/City | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| **ATASCOSA COUNTY** | | | | | | | |
| Lytle | 336 | 446 | 508 | 554 | 613 | 670 | 727 |
| **BEXAR COUNTY** | | | | | | | |
| Alamo Heights | 2,210 | 2,883 | 2,900 | 2,921 | 3,024 | 3,141 | 3,258 |
| Balcones Heights | 538 | 787 | 827 | 872 | 942 | 1,017 | 1,092 |
| Castle Hills | 1,311 | 1,653 | 1,712 | 1,763 | 1,833 | 1,868 | 1,903 |
| Converse | 1,213 | 2,258 | 3,139 | 4,019 | 5,244 | 6,468 | 7,692 |
| Fairoaks Ranch | 617 | 1,087 | 1,383 | 1,712 | 2,174 | 2,634 | 3,094 |
| Fort Sam Houston | 4,340 | 3,508 | 3,374 | 3,253 | 3,199 | 3,159 | 3,119 |
| Helotes | 310 | 440 | 528 | 629 | 776 | 864 | 952 |
| Hill Country Village | 460 | 474 | 549 | 637 | 755 | 904 | 1,053 |
| Hollywood Park | 1,714 | 1,823 | 2,067 | 2,351 | 2,743 | 3,101 | 3,459 |
| Kirby | 1,080 | 1,920 | 2,153 | 2,427 | 2,868 | 3,291 | 3,714 |
| Lackland AFB | 3,300 | 3,677 | 3,551 | 3,426 | 3,394 | 3,363 | 3,332 |
| Leon Valley | 1,146 | 1,525 | 1,535 | 1,549 | 1,611 | 1,697 | 1,783 |
| Live Oak | 1,221 | 2,473 | 2,842 | 3,252 | 3,882 | 4,536 | 5,190 |
| Olmos Park | 385 | 577 | 602 | 627 | 673 | 725 | 777 |
| Randolph AFB | 1,494 | 1,635 | 1,582 | 1,528 | 1,514 | 1,501 | 1,488 |
| San Antonio | 166,616 | 247,067 | 282,259 | 320,833 | 380,152 | 437,465 | 494,778 |
| Schertz (Part) | 60 | 124 | 140 | 157 | 182 | 205 | 228 |
| Shavano Park | 840 | 879 | 970 | 1,029 | 1,088 | 1,171 | 1,254 |
| Somerset | 215 | 178 | 177 | 172 | 167 | 163 | 159 |
| St. Hedwig | 187 | 273 | 336 | 405 | 507 | 609 | 711 |
| Terrell Hills | 817 | 1,101 | 1,106 | 1,131 | 1,177 | 1,201 | 1,225 |
| Universal City | 2,323 | 3,405 | 3,910 | 4,473 | 5,361 | 6,218 | 7,075 |
| Windcrest | 1,329 | 1,503 | 1,523 | 1,548 | 1,608 | 1,669 | 1,730 |
| Rural San Antonio | 31,000 | 50,535 | 61,489 | 73,919 | 92,057 | 109,663 | 127,269 |
| Lytle (Part) | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rural Nueces | 330 | 1,015 | 1,240 | 1,495 | 1,867 | 2,228 | 2,589 |
| **Total - Bexar Co.** | **225,057** | **332,801** | **381,895** | **436,129** | **518,799** | **598,862** | **678,925** |

(continued)

**Table 2-11**
**Municipal Water Demand Projections for Cities and Counties**
**Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

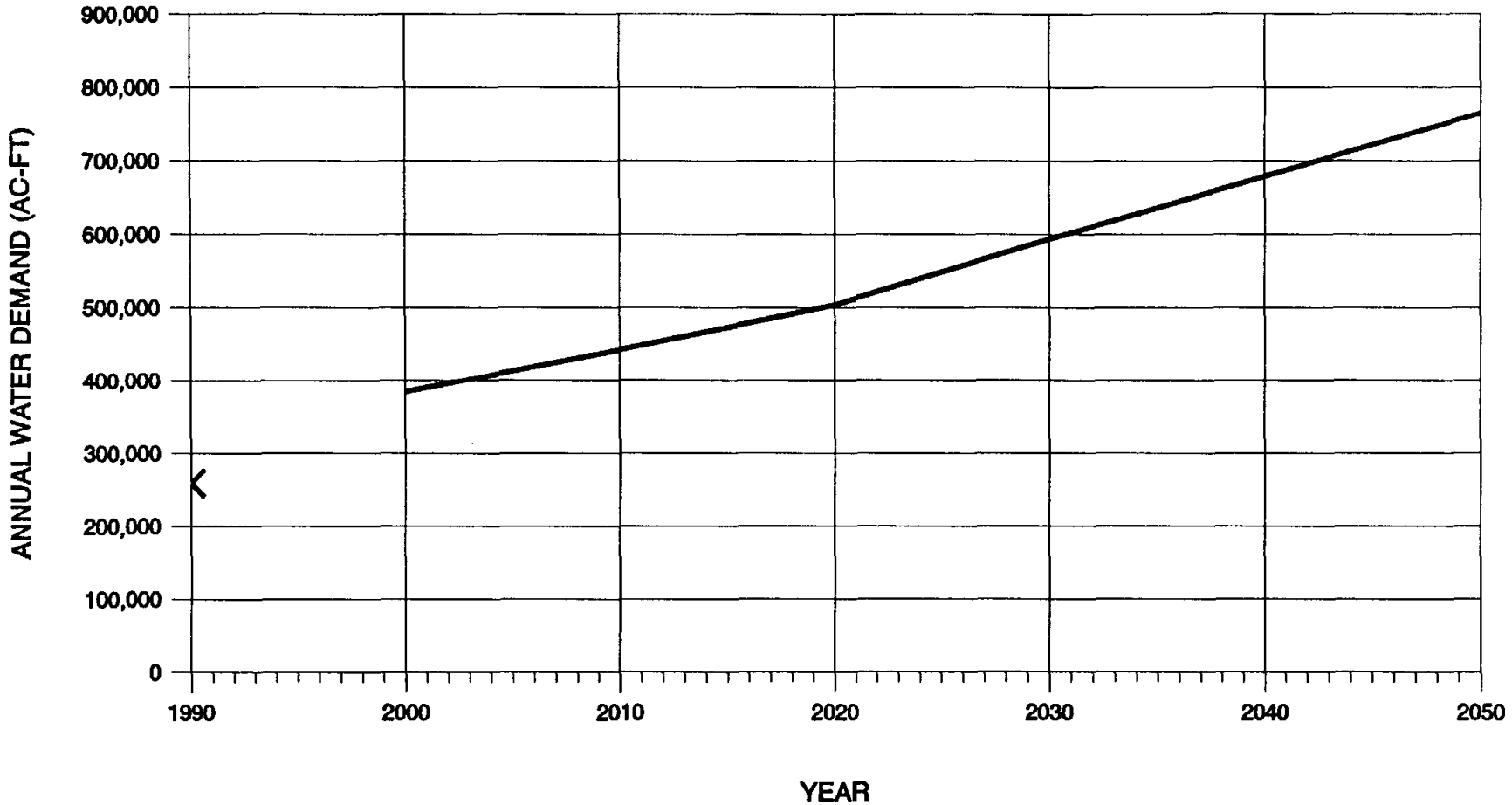
| County/City | 1990[1] Use | Projections in Acre-Feet[2] 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| **MEDINA COUNTY** | | | | | | | |
| Castroville | 779 | 840 | 904 | 950 | 1,004 | 1,031 | 1,058 |
| Lacoste | 229 | 330 | 395 | 437 | 483 | 511 | 539 |
| Other | 258 | 425 | 467 | 483 | 515 | 535 | 555 |
| Devine | 630 | 826 | 854 | 868 | 895 | 906 | 917 |
| Hondo | 1,456 | 2,101 | 2,263 | 2,380 | 2,524 | 2,581 | 2,638 |
| Lytle (Part) | 73 | 79 | 79 | 78 | 80 | 82 | 84 |
| Natalia | 294 | 265 | 282 | 294 | 309 | 315 | 321 |
| Rural Nueces | 1,535 | 2,122 | 2,316 | 2,392 | 2,538 | 2,630 | 2,722 |
| **Total - Medina Co.** | **5,254** | **6,988** | **7,560** | **7,882** | **8,348** | **8,591** | **8,834** |
| **UVALDE COUNTY** | | | | | | | |
| Sabinal | 381 | 499 | 568 | 623 | 707 | 792 | 877 |
| Uvalde | 3,915 | 5,802 | 6,710 | 7,444 | 8,496 | 9,674 | 10,852 |
| Rural Nueces | 982 | 1,155 | 1,111 | 1,071 | 1,035 | 995 | 955 |
| **Total - Uvalde Co.** | **5,278** | **7,456** | **8,389** | **9,138** | **10,238** | **11,461** | **12,684** |
| **COMAL COUNTY** | | | | | | | |
| Garden Ridge | 361 | 650 | 800 | 941 | 1,103 | 1,233 | 1,363 |
| New Braunfels | 6,199 | 9,692 | 11,376 | 12,693 | 14,509 | 15,376 | 16,243 |
| Rural Guadalupe | 210 | 502 | 612 | 725 | 845 | 977 | 1,107 |
| Schertz (Part) | 19 | 36 | 42 | 49 | 56 | 65 | 74 |
| Rural San Antonio | 172 | 184 | 223 | 265 | 308 | 355 | 402 |
| **Total - Comal Co. (Part)** | **6,961** | **11,064** | **13,053** | **14,673** | **16,821** | **18,006** | **19,189** |
| **HAYS COUNTY** | | | | | | | |
| Kyle | 326 | 474 | 509 | 537 | 569 | 577 | 585 |
| San Marcos | 6,321 | 9,357 | 11,453 | 13,232 | 14,939 | 15,819 | 16,699 |
| Rural Guadalupe | 773 | 1,406 | 1,988 | 2,332 | 2,716 | 2,913 | 3,109 |
| **Total - Hays Co. (Part)** | **7,420** | **11,237** | **13,870** | **16,101** | **18,224** | **19,309** | **20,393** |

(continued)

**Table 2-11**
**Municipal Water Demand Projections for Cities and Counties**
**Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

| County/City | 1990[1] Use | Projections in Acre-Feet[2] 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| **GUADALUPE COUNTY** | | | | | | | |
| New Braunfels (Part) | 55 | 81 | 93 | 103 | 127 | 133 | 139 |
| Rural Guadalupe | 2,649 | 5,696 | 7,504 | 8,447 | 9,176 | 9,925 | 10,673 |
| Cibolo | 178 | 414 | 545 | 624 | 691 | 758 | 825 |
| Schertz (Part) | 1,454 | 2,804 | 3,033 | 3,218 | 3,595 | 3,854 | 4,113 |
| Rural San Antonio | 819 | 1,554 | 2,048 | 2,305 | 2,504 | 2,708 | 2,912 |
| **Total-Guadalupe Co. (Part)** | **5,155** | **10,549** | **13,223** | **14,697** | **16,093** | **17,378** | **18,662** |
| **CALDWELL COUNTY** | | | | | | | |
| Lockhart | 1,816 | 1,771 | 1,983 | 2,196 | 2,380 | 2,527 | 2,674 |
| Luling | 1,207 | 1,239 | 1,208 | 1,175 | 1,166 | 1,159 | 1,152 |
| Rural Guadalupe | 846 | 1,176 | 1,312 | 1,458 | 1,588 | 1,682 | 1,777 |
| **Total-Caldwell Co. (Part)** | **3,869** | **4,186** | **4,503** | **4,829** | **5,134** | **5,368** | **5,603** |
| **TOTAL** | **259,330** | **384,727** | **443,001** | **504,033** | **594,270** | **679,645** | **765,017** |

[1]As reported to and estimated by the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

MUNICIPAL WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 13

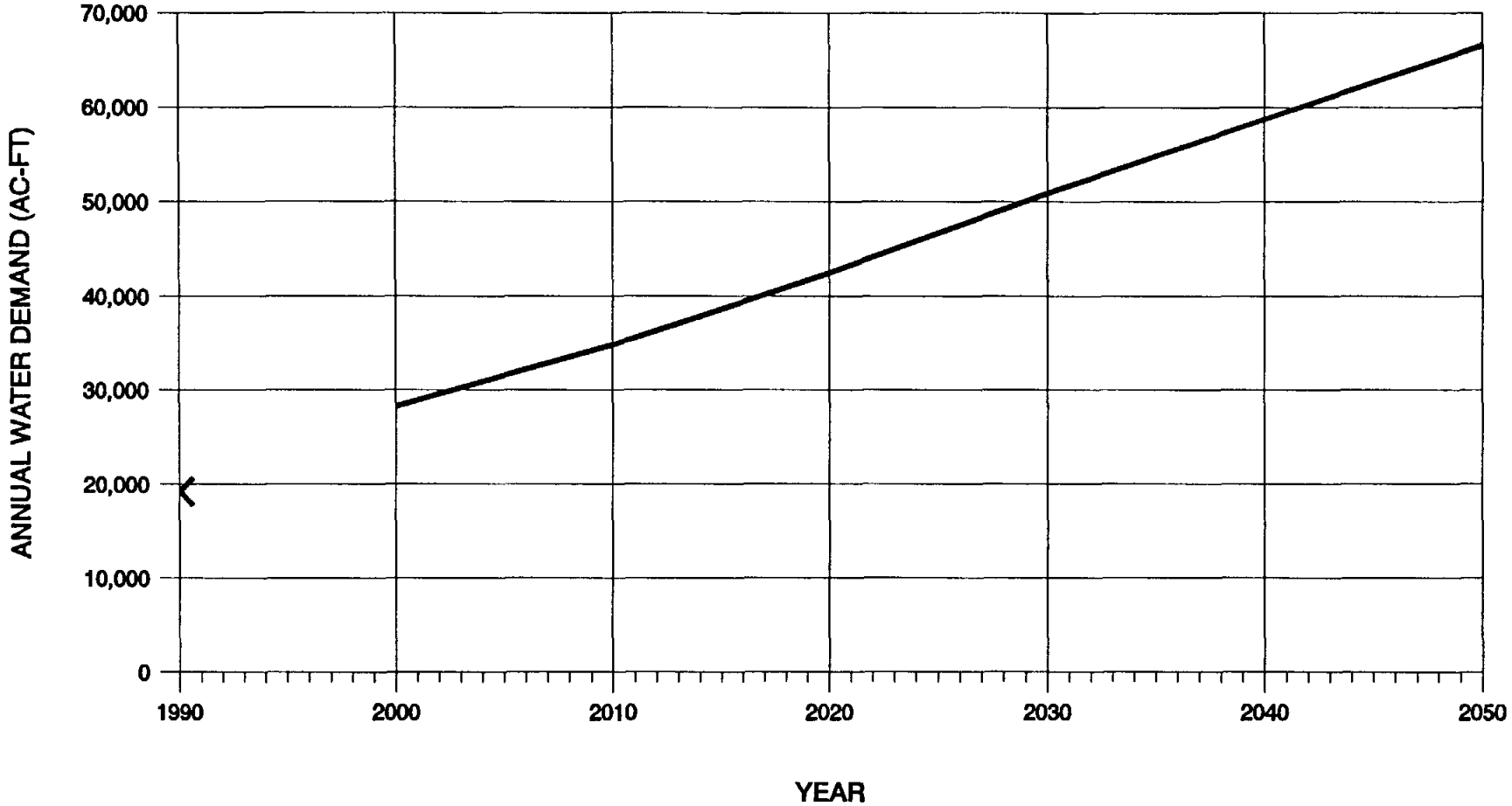
#### 2.2.2.2 Industrial Water Demand Projections for Counties of the Edwards Aquifer Area

Industrial water use in the Edwards Aquifer area in 1990 was reported at 19,264 acft and is projected to increase to 28,263 acft in 2000, 42,494 acft in 2020, and 66,520 acft in 2050 (Table 2-12 and Figure 2-14). Industrial water use is located primarily in Bexar, Comal, Hays, and Guadalupe counties. However, there is some industrial water use in all the other Edwards Aquifer area counties, except Caldwell. It should be noted that a part of the industrial water use is for electric power generation for use within manufacturing plants (primarily cement plants) located within the area.

**Table 2-12**
**Industrial Water Demand Projections for the Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| BEXAR | 14,049 | 19,567 | 24,399 | 30,031 | 36,441 | 42,617 | 48,793 |
| MEDINA | 286 | 120 | 150 | 182 | 221 | 266 | 311 |
| UVALDE | 557 | 435 | 526 | 635 | 765 | 920 | 1,075 |
| COMAL[3] | 3,248 | 4,745 | 5,647 | 6,674 | 7,562 | 8,181 | 8,800 |
| HAYS[3] | 293 | 2,492 | 3,093 | 3,815 | 4,611 | 5,209 | 5,807 |
| GUADALUPE[3] | 830 | 903 | 1,025 | 1,157 | 1,339 | 1,538 | 1,733 |
| CALDWELL[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **19,263** | **28,262** | **34,840** | **42,494** | **50,939** | **58,731** | **66,519** |

[1]As reported to the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Only a portion of these counties are located within the Edwards Aquifer area.

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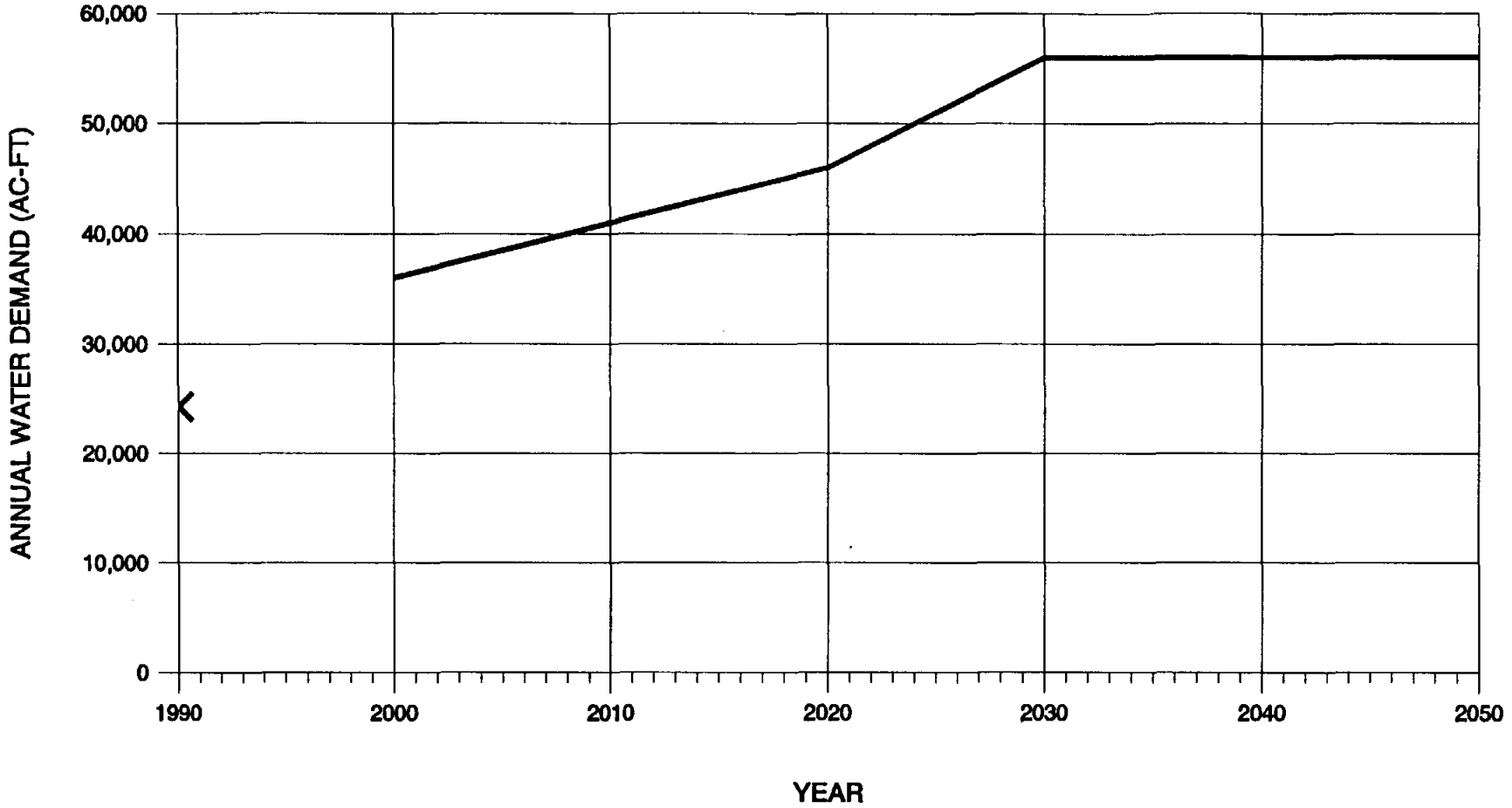
TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# INDUSTRIAL WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 14

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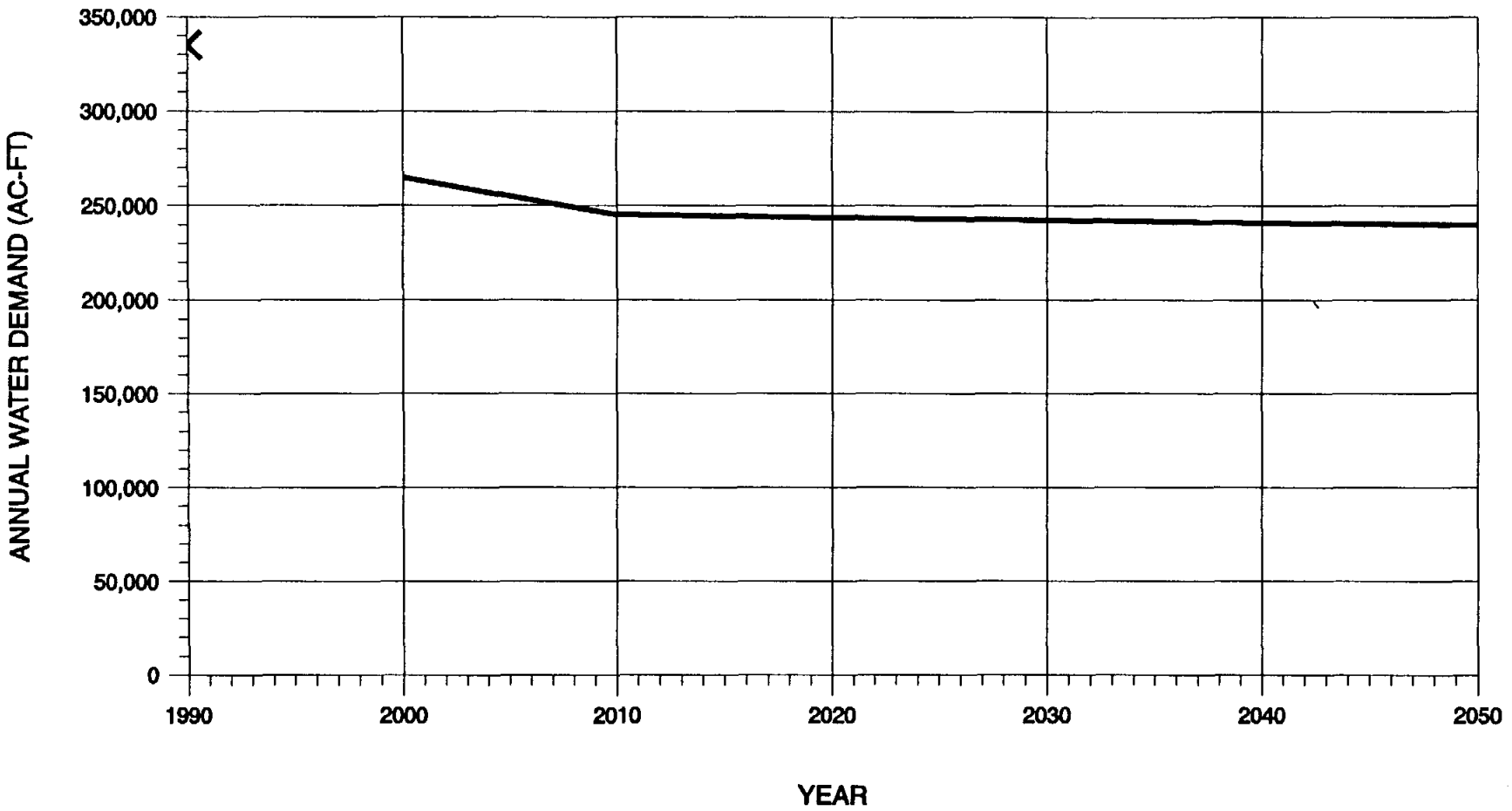
TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# STEAM-ELECTRIC POWER WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 15

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

IRRIGATION WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 16

### 2.2.2.3 Steam-Electric Power Water Demand Projections for Counties of the Edwards Aquifer Area

The only steam-electric power generation within the Edwards Aquifer area for production of electricity for distribution through electric utilities to private and public customers is located in Bexar County. In 1990, reported water use for steam-electric power generation was 24,263 acft. The high case projected demands, with conservation, are 36,000 acft in 2000, 46,000 acft in 2020, and 56,000 acft in 2050 (Table 2-13 and Figure 2-15). The projected demands level off after 2030 since at this time there are no plans for the addition of electric power generating capacity within the area. This could change however, as growth in population occurs. It should be noted, however, that the Edwards Aquifer area is also served electricity from hydroelectric plants located on the Guadalupe River and from power plants that are located outside the area. Water demands for plants located outside the area are included in neighboring area water demand projections.

## Table 2-13
## Steam-electric Power Water Demand Projections for the Edwards Aquifer Area
## West Central Area -- Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| BEXAR | 24,263 | 36,000 | 41,000 | 46,000 | 56,000 | 56,000 | 56,000 |
| MEDINA | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| UVALDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| COMAL[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HAYS[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GUADALUPE[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CALDWELL[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Region | 24,263 | 36,000 | 41,000 | 46,000 | 56,000 | 56,000 | 56,000 |

[1]As reported to and estimated by the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Only a portion of these counties are located in the Edwards Aquifer area.

2.2.2.4 Irrigation Water Demand Projections for Counties of the Edwards Aquifer Area

Irrigation within the Edwards Aquifer area is located in Bexar, Medina, and Uvalde counties. The sources of irrigation water are the Edwards Aquifer and the Medina and Nueces Rivers.

Estimated irrigation water use in the area in 1990 was 336,061 acft, with high case projections showing a reduction to 265,000 acft in 2000, 243,800 acft in 2020, and 239,880 acft in 2050 (Table 2-14 and Figure 2-16). The projections are declining due to improved irrigation efficiency and reduced acreages due to poor economic conditions expected for agricultural irrigation over the long run.

## Table 2-14
## Irrigation Water Demand Projections for the Edwards Aquifer Area
## West Central Area -- Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| BEXAR | 37,012 | 25,000 | 20,240 | 18,880 | 17,520 | 16,200 | 14,880 |
| MEDINA | 157,380 | 110,000 | 105,000 | 105,000 | 105,000 | 105,000 | 105,000 |
| UVALDE | 140,669 | 130,000 | 120,000 | 120,000 | 120,000 | 120,000 | 120,000 |
| COMAL[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| HAYS[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GUADALUPE[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CALDWELL[3] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 335,061 | 265,000 | 245,240 | 243,880 | 242,520 | 241,200 | 239,880 |

[1]As estimated by the Texas Water Development Board from irrigation surveys.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas. Note: Projections are for on-farm demand and are low to the extent that canal losses for surface water sources are not included. In the case of Medina County, canal losses could be as much as 8,000 acft/yr.
[3]Only the portion of these counties that are located within the Edwards Aquifer area.

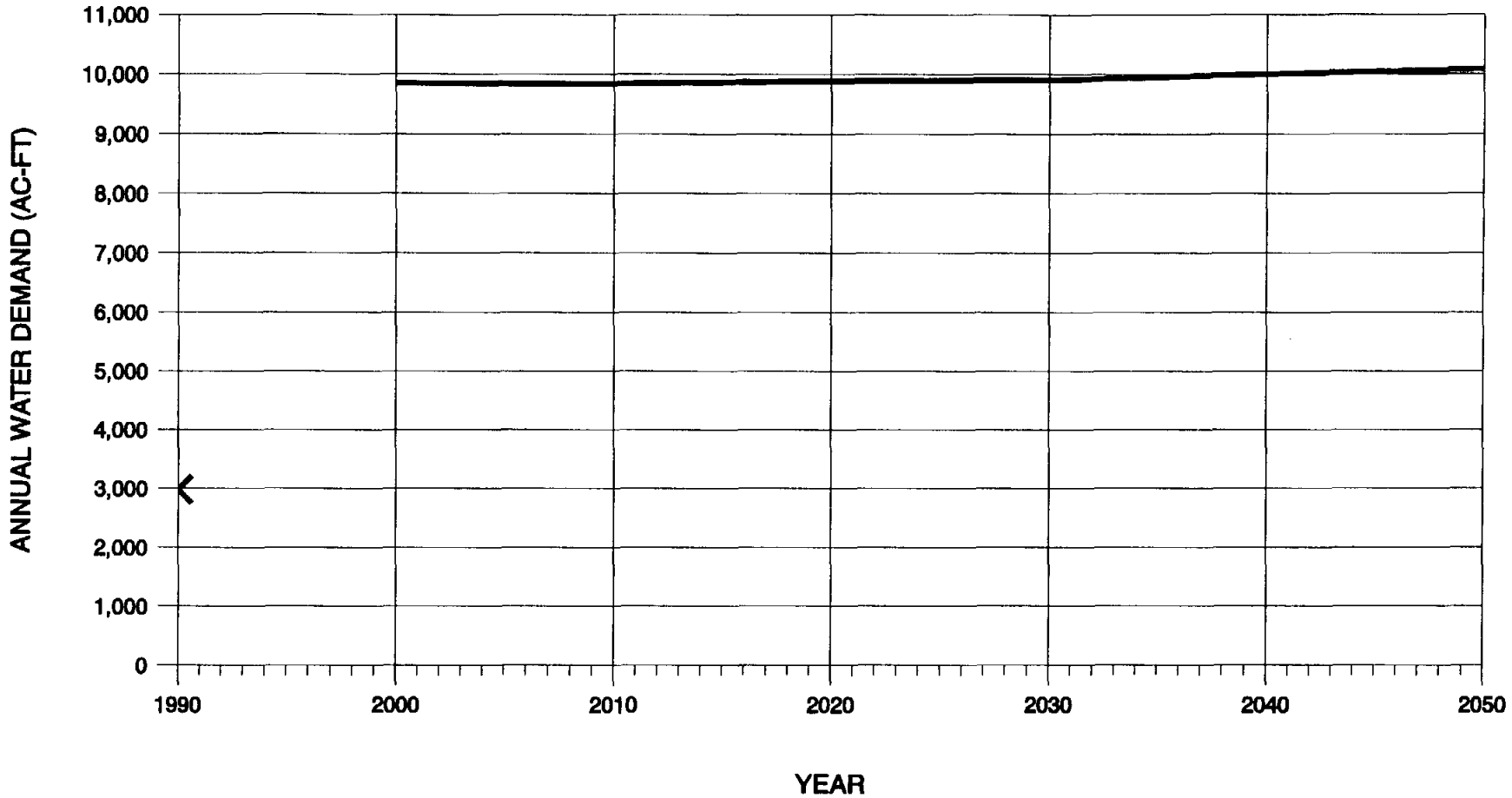
2.2.2.5 Mining Water Demand Projections for Counties of the Edwards Aquifer Area

The mining activities of the Edwards Aquifer area are primarily for quarrying of stone, clay, sand, and gravel materials. Reported water use within the area in 1990 was 2,979 acft, with projections of demand for these purposes being 9,852 acft in 2000, 9,892 acft in 2020, and 10,089 acft in 2050 (Table 2-15 and Figure 2-17). The largest concentrations of mining activities are projected for Bexar and Comal counties. Since the mining water demand is for stone and building materials, use in 1990 was lower than normal due to poor economic conditions in the construction industries. As the economy picks up, these industries will return to a higher level of employment and production and will use more water. The projections for 2000 and beyond reflect this.

## Table 2-15
## Mining Water Demand Projections for the Edwards Aquifer Area
## West Central Area -- Trans-Texas Water Program

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| BEXAR | 1,591 | 4,691 | 4,936 | 5,201 | 5,406 | 5,645 | 5,884 |
| MEDINA | 120 | 131 | 128 | 128 | 129 | 132 | 135 |
| UVALDE | 399 | 574 | 628 | 699 | 776 | 866 | 956 |
| COMAL[3] | 851 | 4,319 | 4,017 | 3,736 | 3,475 | 3,231 | 2,987 |
| HAYS[3] | 0 | 9 | 6 | 3 | 1 | 0 | 0 |
| GUADALUPE[3] | 5 | 117 | 118 | 120 | 121 | 124 | 127 |
| CALDWELL[3] | 13 | 11 | 9 | 5 | 2 | 0 | 0 |
| Total | 2,979 | 9,852 | 9,842 | 9,892 | 9,910 | 9,998 | 10,089 |

[1]As reported to the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Only a portion of these counties are located within the Edwards Aquifer area.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

**MINING WATER DEMAND PROJECTIONS**

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 17

2.2.2.6 Livestock Water Demand Projections for Counties of the Edwards Aquifer Area

Livestock production, including beef, goats, horses for pleasure, dairy and poultry is done throughout the Edwards Aquifer area. Estimated water use for livestock purposes within the area in 1990 was 5,180 acft, and is projected to increase to its maximum level of 6,976 acre feet annually in 2000 and for planning purposes is held constant at that level to 2050 (Table 2-16 and Figure 2-18).

**Table 2-16**
**Livestock Water Demand Projections for the Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| BEXAR | 1,376 | 1,245 | 1,245 | 1,245 | 1,245 | 1,245 | 1,245 |
| MEDINA | 1,560 | 2,001 | 2,001 | 2,001 | 2,001 | 2,001 | 2,001 |
| UVALDE | 994 | 1,869 | 1,869 | 1,869 | 1,869 | 1,869 | 1,869 |
| COMAL[3] | 158 | 234 | 234 | 234 | 234 | 234 | 234 |
| HAYS[3] | 169 | 194 | 194 | 194 | 194 | 194 | 194 |
| GUADALUPE[3] | 515 | 725 | 725 | 725 | 725 | 725 | 725 |
| CALDWELL[3] | 408 | 708 | 708 | 708 | 708 | 708 | 708 |
| Total | 5,180 | 6,976 | 6,976 | 6,976 | 6,976 | 6,976 | 6,976 |

[1]As reported to the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Only a portion of these counties are located within the Edwards Aquifer area.

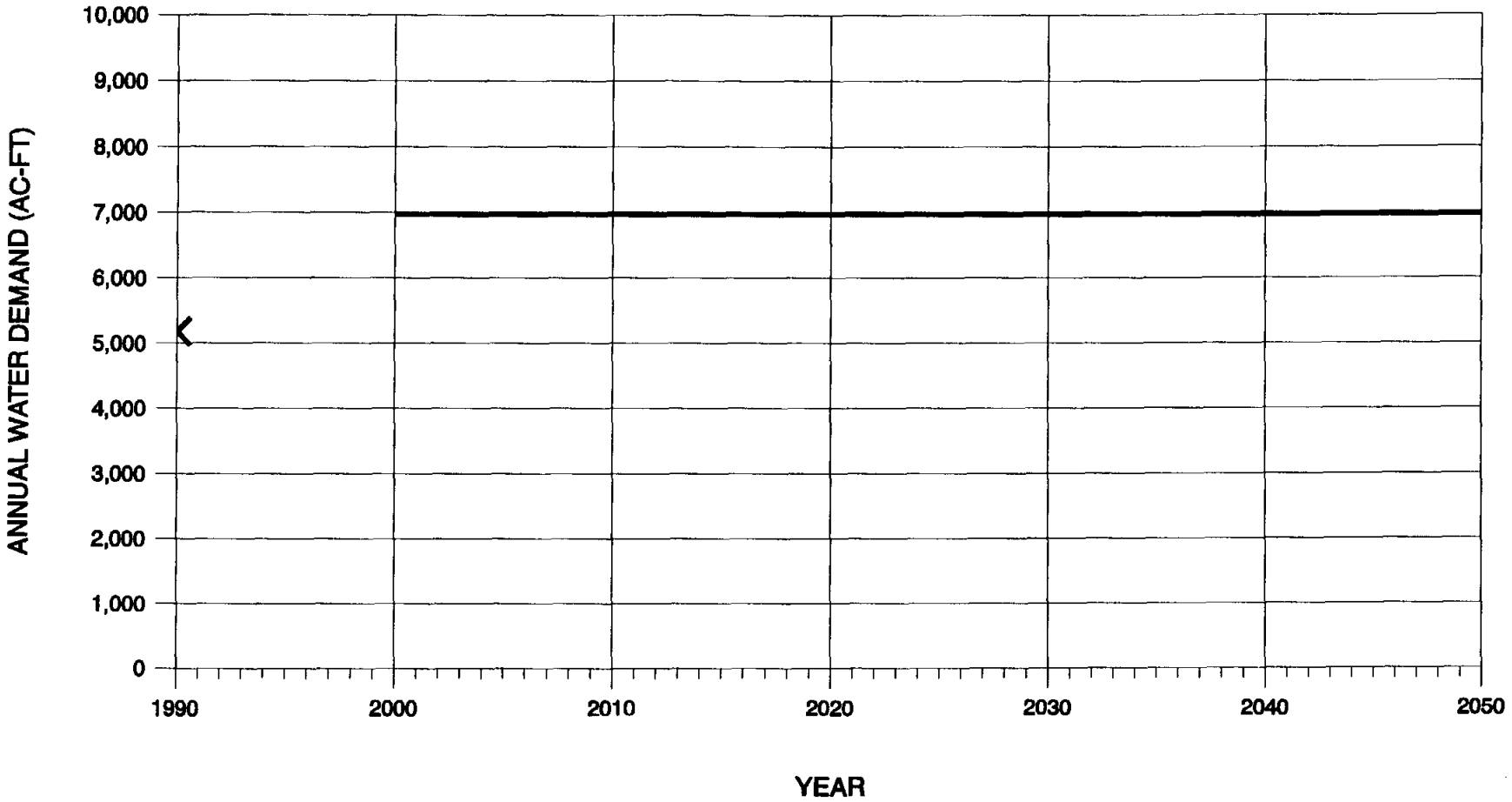
2.2.2.7 Total Water Demand Projections for Counties of the Edwards Aquifer Area

The sum of water used for all purposes within the Edwards Aquifer area in 1990 was 646,076 acft. TWDB projected total water demands for the area, with conservation, in 2000 is 730,808 acft, in 2020 is 853,245 acft, and in 2050 is 1,144,481 acft (Table 2-17 and Figure 2-19).

**Table 2-17**
**Total Water Demand Projections for the Edwards Aquifer Area**
**West Central Area -- Trans-Texas Water Program**

| County | 1990[1] Use | Projections in Acre-Feet[2] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| ATASCOSA | 336 | 446 | 508 | 554 | 613 | 670 | 727 |
| BEXAR | 303,348 | 419,304 | 473,415 | 537,486 | 635,411 | 720,569 | 805,727 |
| MEDINA | 164,600 | 119,240 | 114,839 | 115,193 | 115,699 | 115,990 | 116,281 |
| UVALDE | 147,897 | 140,334 | 131,412 | 132,341 | 132,648 | 135,116 | 136,584 |
| COMAL[3] | 11,218 | 20,362 | 22,951 | 25,317 | 28,092 | 29,652 | 31,210 |
| HAYS[3] | 7,882 | 13,923 | 17,163 | 20,113 | 23,030 | 24,712 | 26,394 |
| GUADALUPE[3] | 6,505 | 12,294 | 15,091 | 16,699 | 18,278 | 19,765 | 21,108 |
| CALDWELL[3] | 4,290 | 4,905 | 5,220 | 5,542 | 5,844 | 6,076 | 6,311 |
| TOTAL | 646,076 | 730,808 | 780,899 | 853,245 | 960,615 | 1,052,550 | 1,144,481 |

[1]As reported to and estimated by the Texas Water Development Board.
[2]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Only a portion of these counties are located within the Edwards Aquifer area.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

LIVESTOCK WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 18

### 2.2.3 Water Demand Projections for River Basins and Adjacent Areas

In Section 2.1.3, Table 2-3, the population projections for the 33-county study area were summarized and tabulated for each of the Nueces, San Antonio, Guadalupe, and Lower Colorado Basins. Since parts of some study area counties are located in areas adjacent to river basin boundaries, the adjacent areas were grouped with the appropriate study area river basin in order to include an appropriate portion of the water needs of these adjacent areas. In the following sections, the water demand projections of the 33 counties of the study area are grouped and presented for the respective study area river basins and their associated or adjacent areas (see Figure 2-1 for basin boundaries). In this way, the projected demands upon the individual basins can be compared to the respective basins' water supplies for purposes of calculating shortages and/or surpluses for the basins.

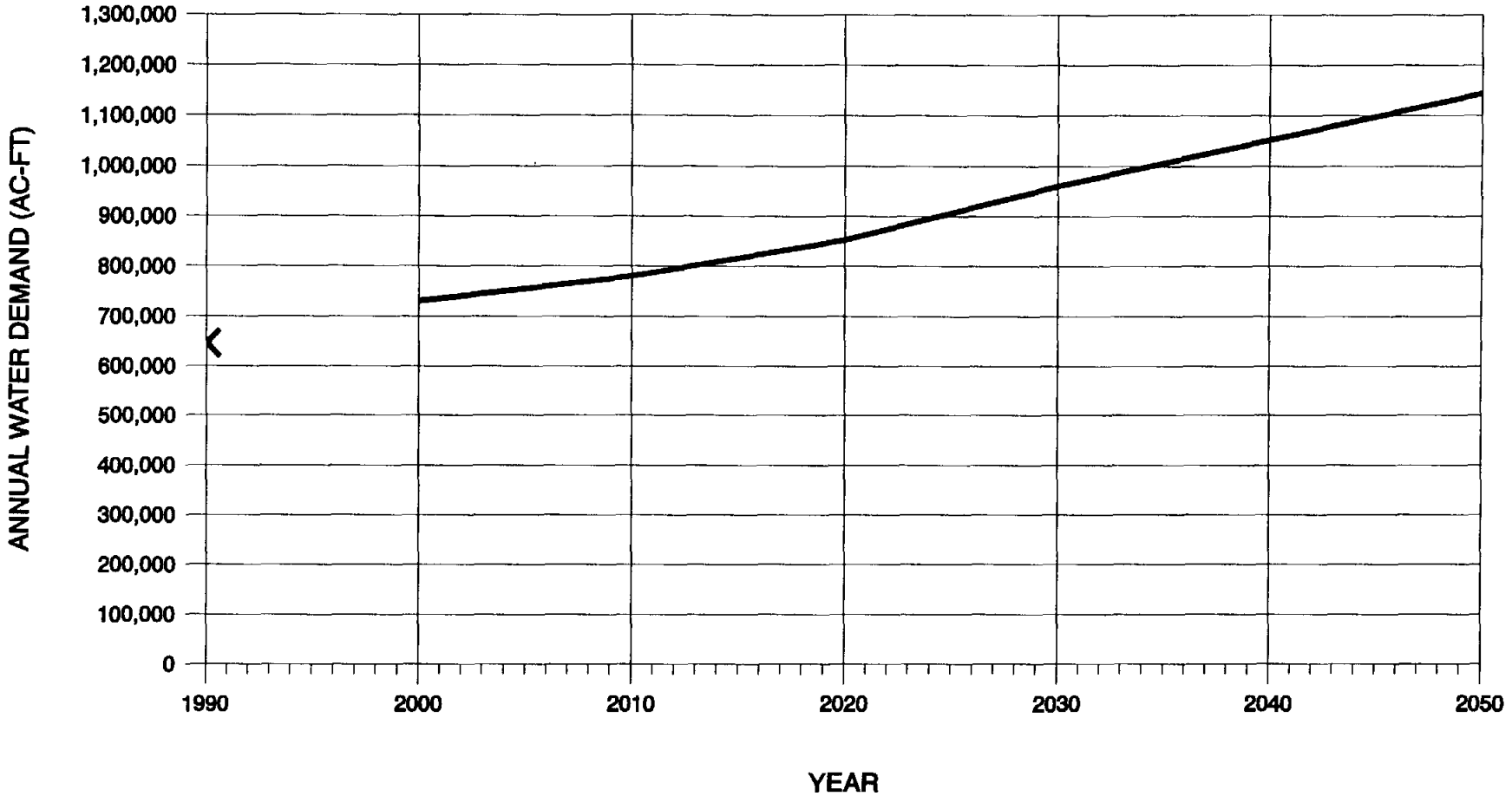
#### 2.2.3.1 Municipal Water Demand Projections for River Basins and Adjacent Areas

In 1990, municipal water use of the 33-county study area was 498,128 acft, of which 20,722 acft (4 percent) was located in the Nueces River Basin, 239,393 acft (48 percent) was used within the San Antonio Basin, 52,958 acft (11 percent) was used within the Guadalupe Basin, 138,203 acft (28 percent) was used within the Lower Colorado River Authority's service area within the Colorado Basin, and 46,852 acft (9 percent) was used in all other coastal and inland areas of the study area that are adjacent to the main river basin boundaries (Table 2-18, column one). Projected municipal water demands (high case with conservation) at year 2050 for the 33-county study area are 1,420,211 acft (Table 2-18). Projected municipal water demands (high case with conservation) at year 2050 for the San Antonio Basin are 708,223 acft (50 percent) (Figure 2-20). Projected municipal water demands for the area within the boundaries of the Lower Colorado Basin are 375,671 acft (26 percent). Within the Guadalupe and Nueces River Basins projected year 2050 demands total 120,219 acft (8 percent) and 40,777 acft (3 percent) respectively. Projected water use in all other coastal and inland areas of the study area total 175,321 acft (12 percent).

## Table 2-18
## Municipal Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Programs

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] 2000 | 2010 | 2020 | 2030 | 2040 | 20 |
|---|---|---|---|---|---|---|---|
| NUECES | | | | | | | |
| Total In-Basin | 32,450 | 41,412 | 44,834 | 47,205 | 50,815 | 54,241 | 57 |
| Study Area Subtotal[4] | 20,722 | 27,356 | 30,012 | 31,995 | 34,995 | 37,886 | 40 |
| Remainder of Basin | 11,728 | 14,056 | 14,822 | 15,210 | 15,820 | 16,355 | 16 |
| SAN ANTONIO | | | | | | | |
| Total In-Basin | 239,393 | 352,963 | 404,974 | 460,729 | 545,243 | 626,733 | 708 |
| Adjacent Area[5] | 59 | 80 | 83 | 84 | 90 | 96 | 102 |
| Study Area Subtotal | 239,452 | 353,043 | 405,057 | 460,813 | 545,333 | 626,829 | 708 |
| GUADALUPE | | | | | | | |
| Total In-Basin | 52,958 | 76,247 | 88,135 | 97,199 | 106,717 | 113,468 | 120 |
| Adjacent Area[6] | 8,165 | 9,458 | 10,342 | 10,922 | 11,590 | 12,126 | 12 |
| Study Area Subtotal | 61,123 | 85,705 | 98,477 | 108,121 | 118,307 | 125,594 | 132 |
| LOWER COLORADO | | | | | | | |
| Total In-Basin | 138,203 | 206,215 | 241,246 | 278,171 | 322,217 | 348,944 | 375 |
| Adjacent Coastal Area[7] | 10,904 | 14,231 | 14,842 | 15,190 | 16,091 | 16,866 | 17 |
| Study Area Subtotal | 149,107 | 220,446 | 256,088 | 293,361 | 338,308 | 365,810 | 393 |
| Adjacent Inland Area[8] | 27,724 | 51,358 | 66,612 | 81,708 | 109,000 | 126,958 | 144 |
| Study Area Subtotal | 176,831 | 271,804 | 322,700 | 375,069 | 447,308 | 492,768 | 538 |
| RIVER BASIN TOTALS[9] | 463,004 | 676,837 | 779,189 | 883,304 | 1,024,992 | 1,143,386 | 1,261 |
| STUDY AREA TOTALS[10] | 498,128 | 737,908 | 856,246 | 975,998 | 1,145,943 | 1,283,077 | 1,420 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 19 Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.



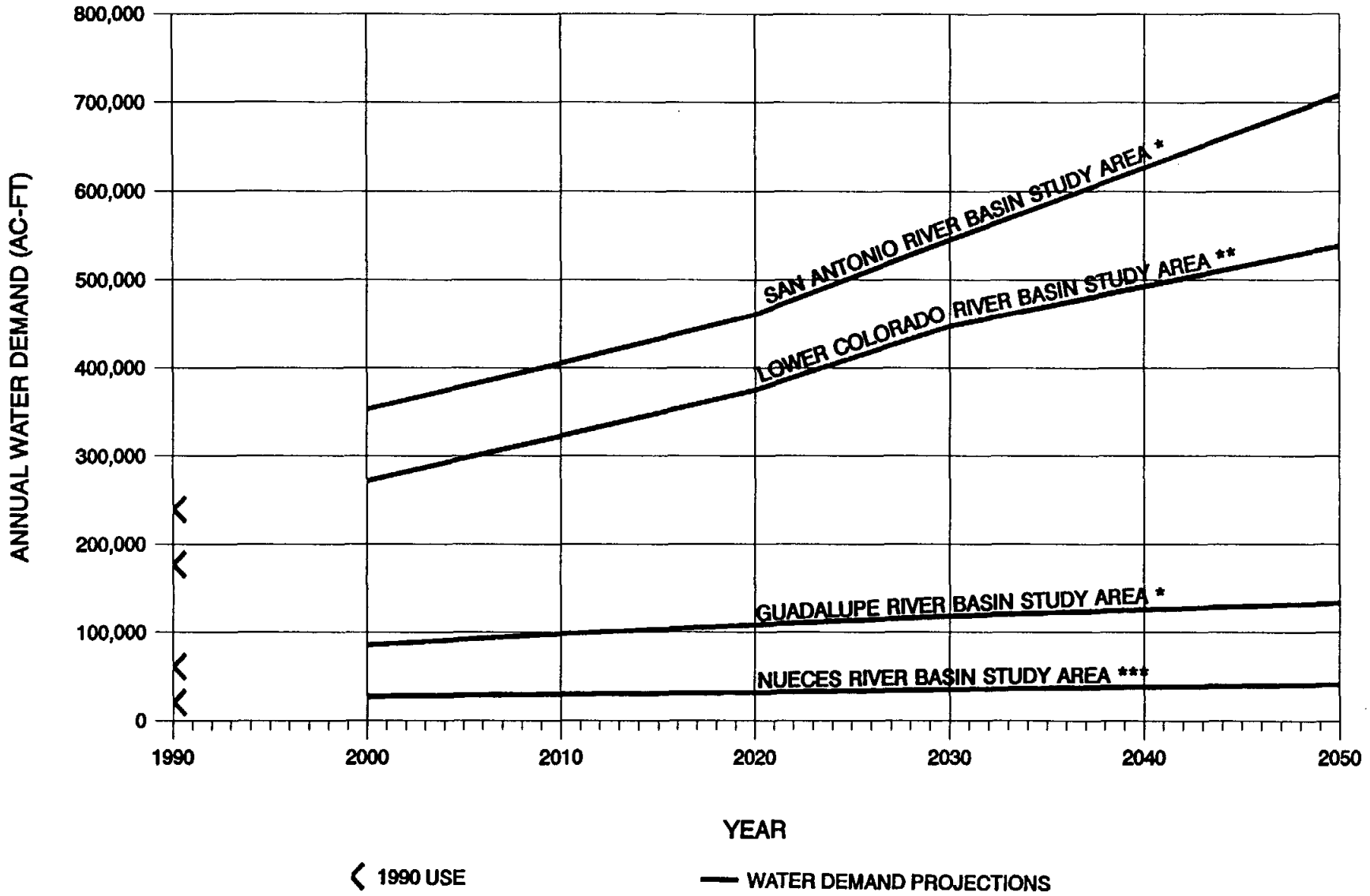

HDR Engineering, Inc.

TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## TOTAL WATER DEMAND PROJECTIONS

COUNTIES OF THE EDWARDS AQUIFER AREA

FIGURE 2 - 19




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

MUNICIPAL WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 20

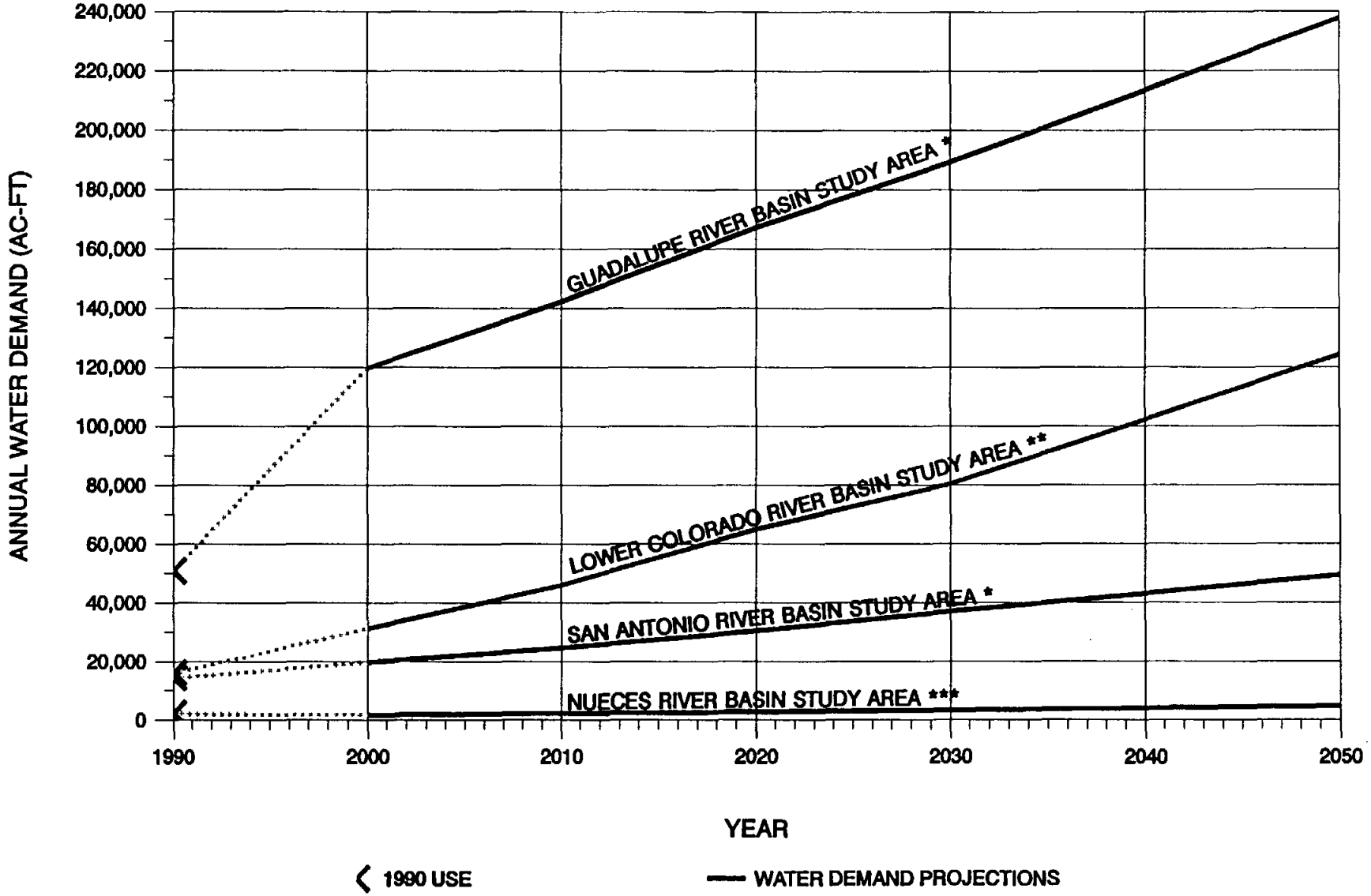
2.2.3.2 Industrial Water Demand Projections for River Basins and Adjacent Areas

In 1990, industrial water use was 83,307 acft in the 33-county study area, of which 58,467 acft (70 percent) was located within the boundaries of the Nueces, San Antonio, Guadalupe and Lower Colorado Basins (Table 2-19, column one). The high case, with conservation projections of industrial water demand for the period 2000 through 2050, are shown in Table 2-19 and Figure 2-21 for basins and areas adjacent to each basin for the 33-county study area.

## Table 2-19
## Industrial Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Programs

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 20 |
| NUECES | | | | | | | |
| Total In-Basin[9] | 4,306 | 4,263 | 4,980 | 5,875 | 6,911 | 8,027 | 9, |
| Study Area Subtotal[4] | 2,149 | 1,768 | 2,170 | 2,652 | 3,229 | 3,926 | 4, |
| Remainder of Basin | 2,157 | 2,495 | 2,810 | 3,223 | 3,682 | 4,101 | 4, |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 14,323 | 19,794 | 24,695 | 30,405 | 36,904 | 43,149 | 49, |
| Adjacent Area[5] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Study Area Subtotal | 14,323 | 19,794 | 24,695 | 30,405 | 36,904 | 43,149 | 49, |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 26,263 | 46,352 | 59,038 | 73,113 | 85,326 | 98,987 | 112, |
| Adjacent Area[6] | 24,539 | 73,297 | 83,156 | 94,154 | 103,934 | 114,509 | 125, |
| Study Area Subtotal | 50,802 | 119,649 | 142,194 | 167,267 | 189,260 | 213,496 | 237, |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 13,575 | 25,526 | 33,454 | 41,841 | 51,400 | 62,715 | 74, |
| Adjacent Coastal Area[7] | 2,082 | 5,022 | 11,666 | 22,137 | 27,651 | 38,052 | 48, |
| Subtotal | 15,657 | 30,548 | 45,120 | 63,978 | 79,051 | 100,767 | 122, |
| Adjacent Inland Area[8] | 376 | 638 | 836 | 1,044 | 1,297 | 1,509 | 1, |
| Study Area Subtotal | 16,033 | 31,186 | 45,956 | 65,022 | 80,348 | 102,276 | 124, |
| RIVER BASIN TOTALS[9] | 58,467 | 95,935 | 122,167 | 151,234 | 180,541 | 212,878 | 245, |
| STUDY AREA TOTALS[10] | 83,307 | 172,397 | 215,015 | 265,346 | 309,741 | 362,847 | 415, |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 19 Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

INDUSTRIAL WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 21

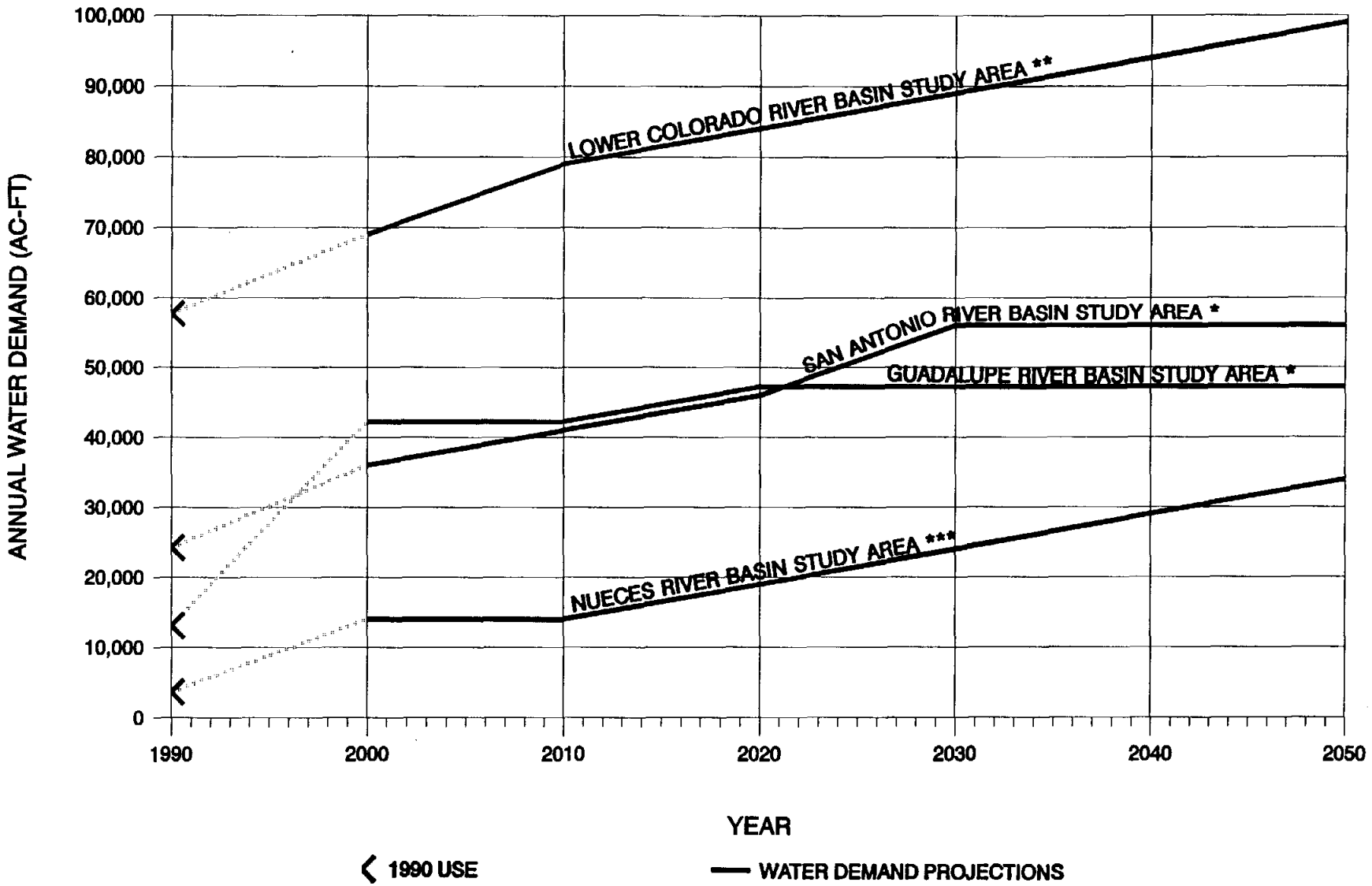
### 2.2.3.3 Steam-Electric Power Water Demand Projections for River Basins and Adjacent Areas

In 1990, 98,755 acft of water was used (consumed through evaporation) by steam-electric power plants located in the 33-county study area (Table 2-20). The distribution of use among river basins, together with projections of quantities (high case, with conservation) needed for electric power generation in the 2000 - 2050 projection period are shown in Table 2-20 and Figure 2-22.

## Table 2-20
## Steam-Electric Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Program

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| NUECES | | | | | | | |
| Total In-Basin[9] | 6,007 | 17,000 | 17,000 | 22,000 | 27,000 | 32,000 | 37,000 |
| Study Area Subtotal[4] | 3,660 | 14,000 | 14,000 | 19,000 | 24,000 | 29,000 | 34,000 |
| Remainder of Basin | 2,347 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 24,263 | 36,000 | 41,000 | 46,000 | 56,000 | 56,000 | 56,000 |
| Adjacent Area[5] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Study Area Subtotal | 24,263 | 36,000 | 41,000 | 46,000 | 56,000 | 56,000 | 56,000 |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 13,052 | 42,000 | 42,000 | 47,000 | 47,000 | 47,000 | 47,000 |
| Adjacent Area[6] | 62 | 200 | 200 | 200 | 200 | 200 | 200 |
| Study Area Subtotal | 13,114 | 42,200 | 42,200 | 47,200 | 47,200 | 47,200 | 47,200 |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 57,718* | 43,000 | 53,000 | 58,000 | 63,000 | 68,000 | 73,000 |
| Adjacent Coastal Area[7] | 0 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 |
| Subtotal | 57,718 | 69,000 | 79,000 | 84,000 | 89,000 | 94,000 | 99,000 |
| Adjacent Inland Area[8] | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Study Area Subtotal | 57,718 | 69,000 | 79,000 | 84,000 | 89,000 | 94,000 | 99,000 |
| RIVER BASIN TOTALS[9] | 101,040* | 138,000 | 153,000 | 173,000 | 193,000 | 203,000 | 213,000 |
| STUDY AREA TOTALS[10] | 98,755 | 161,200 | 176,200 | 196,200 | 216,200 | 226,200 | 236,200 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.
*Includes quantity from Lower Colorado that was used in neighboring basin.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

HDR Engineering, Inc.

TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

STEAM-ELECTRIC POWER WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 22

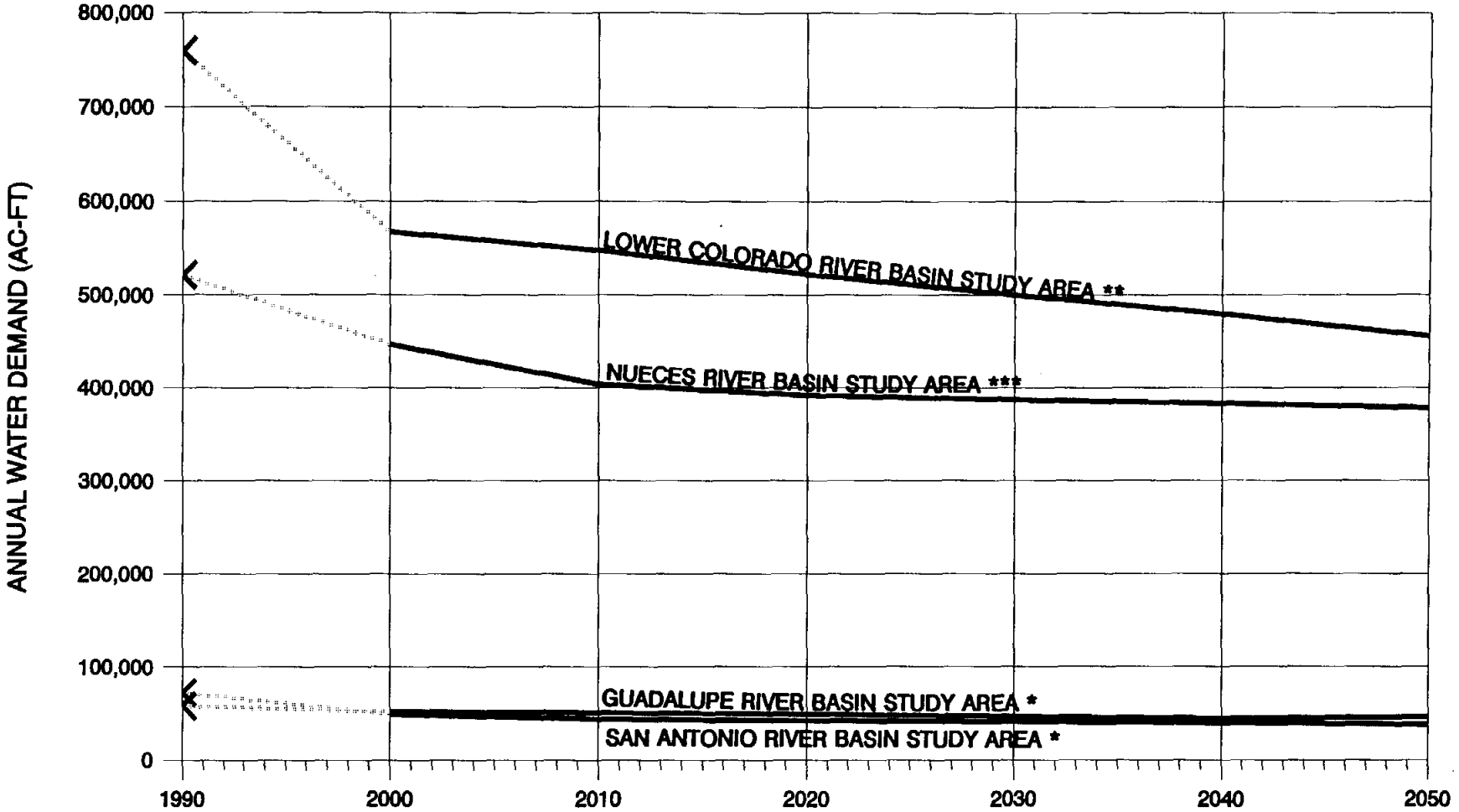
2.2.3.4. Irrigation Water Demand Projections River Basins and Adjacent Areas

Irrigation water use in 1990 was estimated at 1,411,579 acft for the 33-county study area (Table 2-21). Of this total, 521,282 acft (37 percent) were used in the Nueces Basin study area counties (Uvalde, Medina, Atascosa, Zavala, Frio, and parts of Karnes, Wilson, and Bexar counties), 72,393 acft (5 percent) were used in the San Antonio Basin, 58,400 acft (4 percent) were used in the Guadalupe and adjacent areas, and 759,504 acft (54 percent) were used in the Lower Colorado and adjacent areas (Table 2-21). The TWDB high case, with conservation, irrigation water demand projection in 2050 is 918,400 acft or 35 percent less than was used in 1990. The 2050 projections show 378,272 acft (41 percent) of irrigation water demand in the study area counties of the Nueces Basin, 38,298 acft (4 percent) in the San Antonio Basin and adjacent areas, 46,032 acft (5 percent) in the Guadalupe Basin and adjacent areas and 455,798 acft (50 percent) in the Lower Colorado Basin and adjacent areas (Table 2-21). The projections for the planning period 2000 through 2050 are shown in Table 2-21 and Figure 2-23 for each river basin and adjacent areas of the 33-county study area. The downward trend in irrigation water demand projections is due to both the projection of improved irrigation efficiency and declining irrigation acreages that are expected to result from poor economic conditions for irrigation agriculture.

## Table 2-21
## Irrigation Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Program

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| NUECES | | | | | | | |
| Total In-Basin[9] | 551,697 | 469,617 | 425,948 | 413,371 | 408,761 | 404,166 | 399,571 |
| Study Area[4] | 521,282 | 447,145 | 403,579 | 391,765 | 387,258 | 382,765 | 378,272 |
| Remainder of Basin | 30,415 | 22,472 | 22,369 | 21,606 | 21,503 | 21,401 | 21,299 |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 72,393 | 49,244 | 43,775 | 42,354 | 40,974 | 39,633 | 38,292 |
| Adjacent Area[5] | 0 | 6 | 6 | 6 | 6 | 6 | 6 |
| Study Area Subtotal | 72,393 | 49,250 | 43,781 | 42,360 | 40,970 | 39,639 | 38,298 |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 11,275 | 13,229 | 13,068 | 13,007 | 12,951 | 12,894 | 12,837 |
| Adjacent Area[6] | 47,125 | 38,784 | 37,513 | 36,316 | 33,989 | 33,592 | 33,195 |
| Study Area Subtotal | 58,400 | 52,013 | 50,581 | 49,323 | 46,940 | 46,486 | 46,032 |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 122,502 | 87,189 | 84,500 | 81,093 | 78,083 | 75,063 | 72,043 |
| Adjacent Coastal Area[7] | 636,449 | 465,536 | 450,041 | 427,983 | 409,183 | 392,372 | 371,481 |
| Subtotal | 758,951 | 552,725 | 534,541 | 509,076 | 487,266 | 467,435 | 443,524 |
| Adjacent Inland Area[8] | 15,553 | 14,440 | 13,231 | 13,171 | 12,848 | 12,307 | 12,274 |
| Study Area Subtotal | 759,504 | 567,165 | 547,772 | 522,247 | 500,114 | 479,742 | 455,798 |
| RIVER BASIN TOTALS[9] | 757,867 | 619,279 | 567,291 | 549,825 | 540,769 | 531,756 | 522,743 |
| STUDY AREA TOTALS[10] | 1,411,579 | 1,115,573 | 1,045,713 | 1,005,695 | 975,282 | 948,632 | 918,400 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

# IRRIGATION WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 23

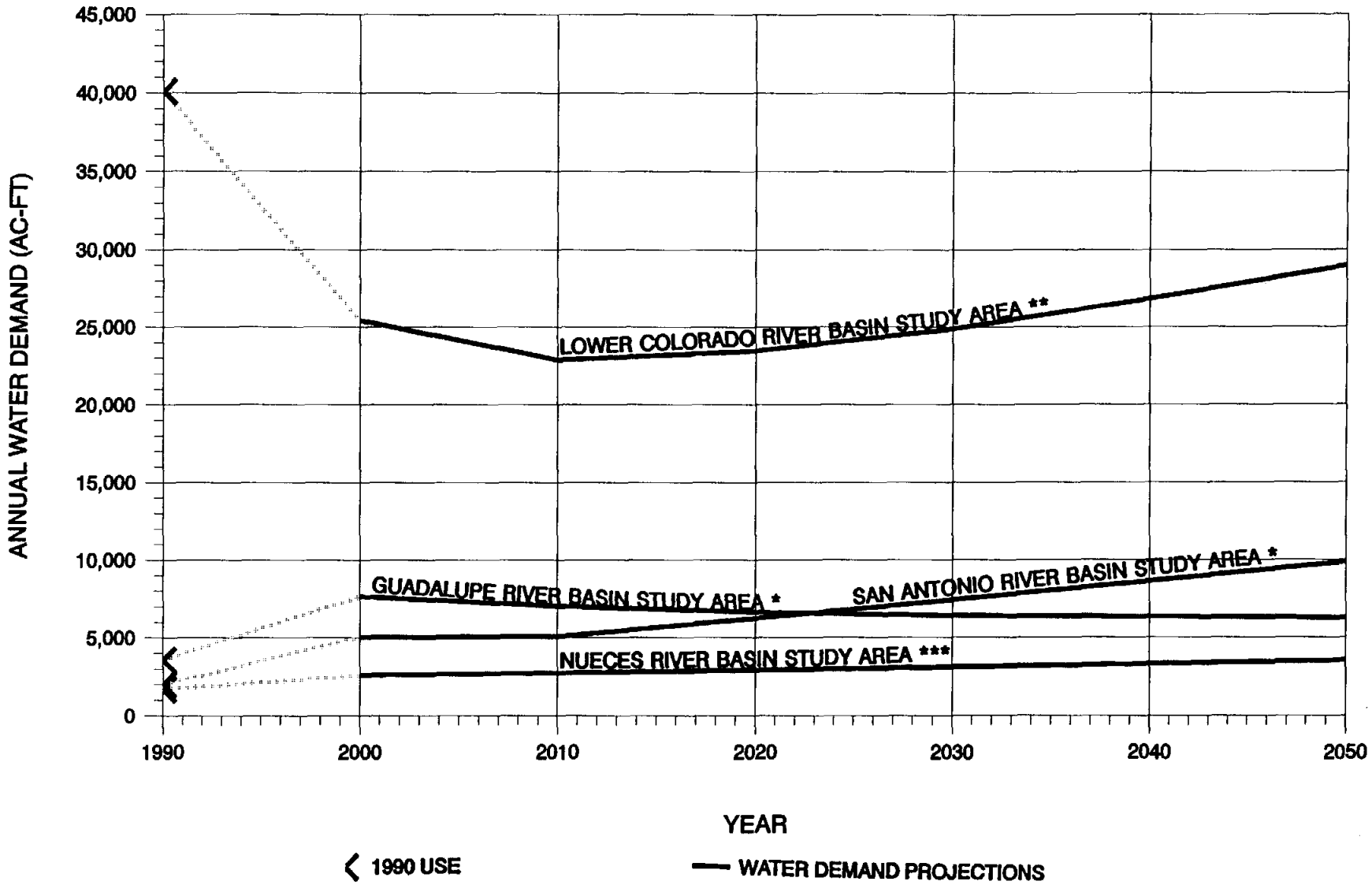
2.2.3.5 Mining Water Demand Projections for River Basins and Adjacent Areas

In 1990, water use in the 33-county study area for mining purposes was 47,360 acft. TWDB high case projections for 2050 mining water demand are 48,663 acft (Table 2-22). Over 85 percent of mining water use in the study area in 1990 was in the Lower Colorado Basin and adjacent areas. The 2050 projection of mining water demands shows 58 percent for the Lower Colorado Basin and adjacent areas, with the projections for the other basin areas increasing from the level of use in 1990 (Table 2-22 and Figure 2-24).

## Table 2-22
## Mining Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Program

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| NUECES | | | | | | | |
| Total In-Basin[9] | 6,183 | 8,507 | 8,454 | 8,702 | 8,955 | 9,284 | 9,622 |
| Study Area Subtotal[4] | 1,706 | 2,592 | 2,742 | 2,918 | 3,104 | 3,318 | 3,536 |
| Remainder of Basin | 4,477 | 5,915 | 5,712 | 5,784 | 5,851 | 5,966 | 6,086 |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 1,993 | 5,049 | 5,086 | 6,260 | 7,425 | 8,637 | 9,862 |
| Adjacent Area[5] | 0 | 5 | 3 | 1 | 1 | 0 | 0 |
| Study Area Subtotal | 1,993 | 5,054 | 5,089 | 6,261 | 7,426 | 8,637 | 9,862 |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 3,486 | 6,517 | 5,733 | 5,205 | 4,820 | 4,518 | 4,231 |
| Adjacent Area[6] | 89 | 1,131 | 1,288 | 1,440 | 1,601 | 1,830 | 2,064 |
| Study Area Subtotal | 3,575 | 7,648 | 7,021 | 6,645 | 6,421 | 6,348 | 6,295 |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 34,169 | 18,936 | 17,175 | 18,046 | 19,471 | 21,261 | 23,061 |
| Adjacent Coastal Area[7] | 4,079 | 4,278 | 3,195 | 2,650 | 2,316 | 2,177 | 2,114 |
| Subtotal | 38,248 | 23,214 | 20,370 | 20,696 | 21,787 | 23,438 | 25,175 |
| Adjacent Inland Area[8] | 1,841 | 2,219 | 2,499 | 2,787 | 3,076 | 3,431 | 3,795 |
| Study Area Subtotal | 40,086 | 25,423 | 22,869 | 23,483 | 24,863 | 26,869 | 28,970 |
| RIVER BASIN TOTALS[9] | 45,831 | 39,009 | 36,448 | 38,213 | 40,671 | 43,700 | 46,776 |
| STUDY AREA TOTALS[10] | 47,360 | 40,717 | 37,721 | 39,307 | 41,814 | 45,172 | 48,663 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

**MINING WATER DEMAND PROJECTIONS**

RIVER BASIN STUDY AREAS

FIGURE 2 - 24

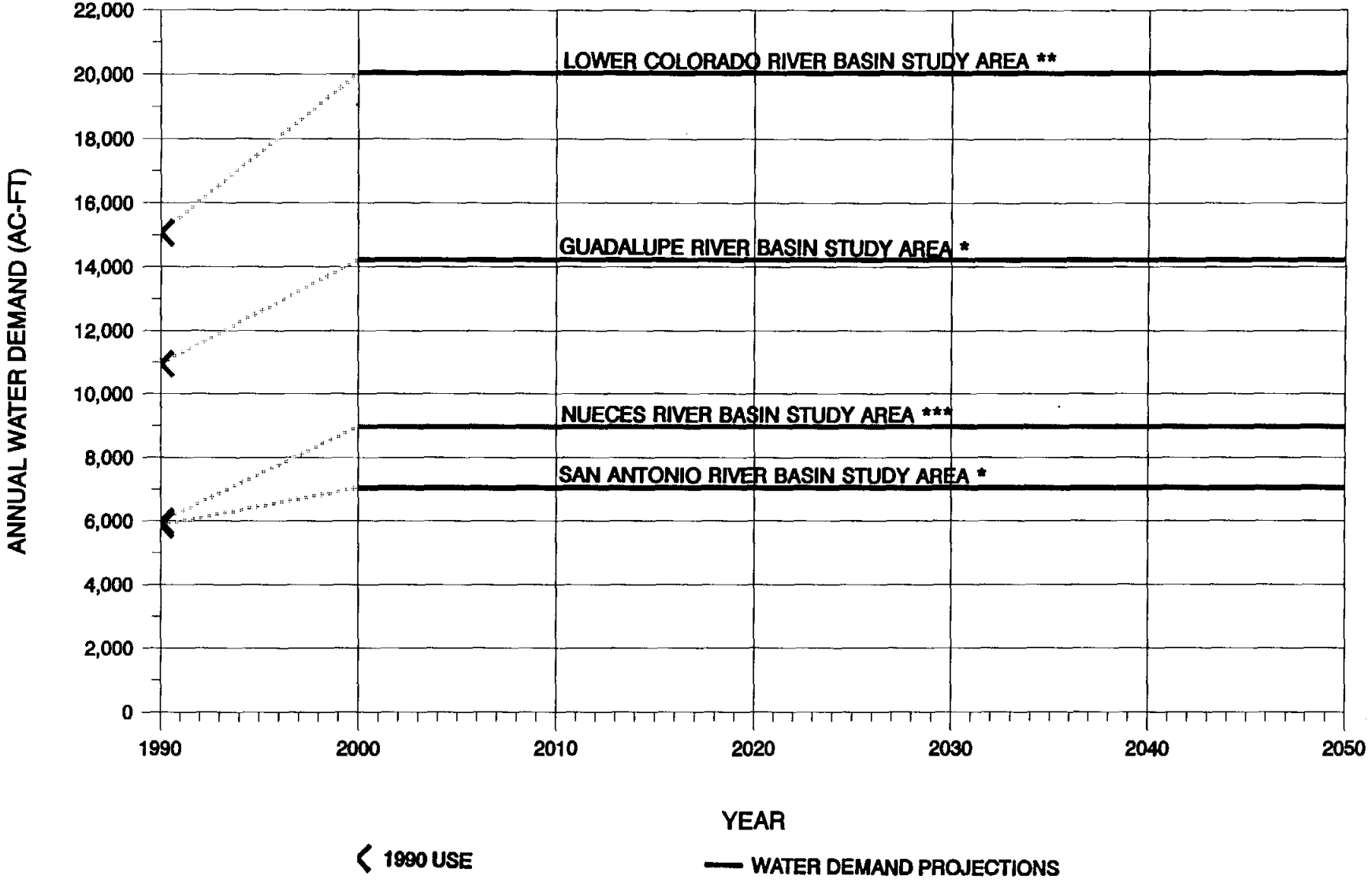
2.2.3.6 Livestock Water Demand Projections for River Basins and Adjacent Areas

Livestock water use in the 33-county study area in 1990 was estimated at 37,876 acft. TWDB high case projections for the period 2000 through 2050 is 50,282 acft, with 18 percent in the Nueces study area counties, 14 percent in the San Antonio Basin and adjacent areas, 28 percent in the Guadalupe Basin and adjacent areas, and 40 percent in the Lower Colorado and adjacent areas (Table 2-23 and Figure 2-25).

## Table 2-23
## Livestock Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Program

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| NUECES | | | | | | | |
| Total In-Basin[9] | 11,574 | 16,744 | 16,744 | 16,744 | 16,744 | 16,744 | 16,744 |
| Study Area Subtotal[4] | 5,984 | 8,965 | 8,965 | 8,965 | 8,965 | 8,965 | 8,965 |
| Remainder of Basin | 5,590 | 7,779 | 7,779 | 7,779 | 7,779 | 7,779 | 7,779 |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 5,536 | 6,554 | 6,554 | 6,554 | 6,554 | 6,554 | 6,554 |
| Adjacent Area[5] | 344 | 495 | 495 | 495 | 495 | 495 | 495 |
| Study Area Subtotal | 5,880 | 7,049 | 7,049 | 7,094 | 7,094 | 7,094 | 7,094 |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 9,485 | 12,131 | 12,131 | 12,131 | 12,131 | 12,131 | 12,131 |
| Adjacent Area[6] | 1,460 | 2,095 | 2,095 | 2,095 | 2,095 | 2,095 | 2,095 |
| Study Area Subtotal | 10,945 | 14,226 | 14,226 | 14,226 | 14,226 | 14,226 | 14,226 |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 8,492 | 11,516 | 11,516 | 11,516 | 11,516 | 11,516 | 11,516 |
| Adjacent Coastal Area[7] | 2,429 | 3,317 | 3,317 | 3,317 | 3,317 | 3,317 | 3,317 |
| Subtotal | 10,921 | 14,833 | 14,833 | 14,833 | 14,833 | 14,833 | 14,833 |
| Adjacent Inland Area[8] | 4,146 | 5,209 | 5,209 | 5,209 | 5,164 | 5,209 | 5,209 |
| Study Area Subtotal | 15,067 | 20,042 | 20,042 | 20,042 | 19,997 | 20,042 | 20,042 |
| RIVER BASIN TOTALS[9] | 35,087 | 46,945 | 46,945 | 46,945 | 46,945 | 46,945 | 46,945 |
| STUDY AREA TOTALS[10] | 37,876 | 50,282 | 50,282 | 50,282 | 50,282 | 50,282 | 50,282 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

HDR Engineering, Inc.

TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

LIVESTOCK WATER DEMAND PROJECTIONS
RIVER BASIN STUDY AREAS

FIGURE 2 - 25

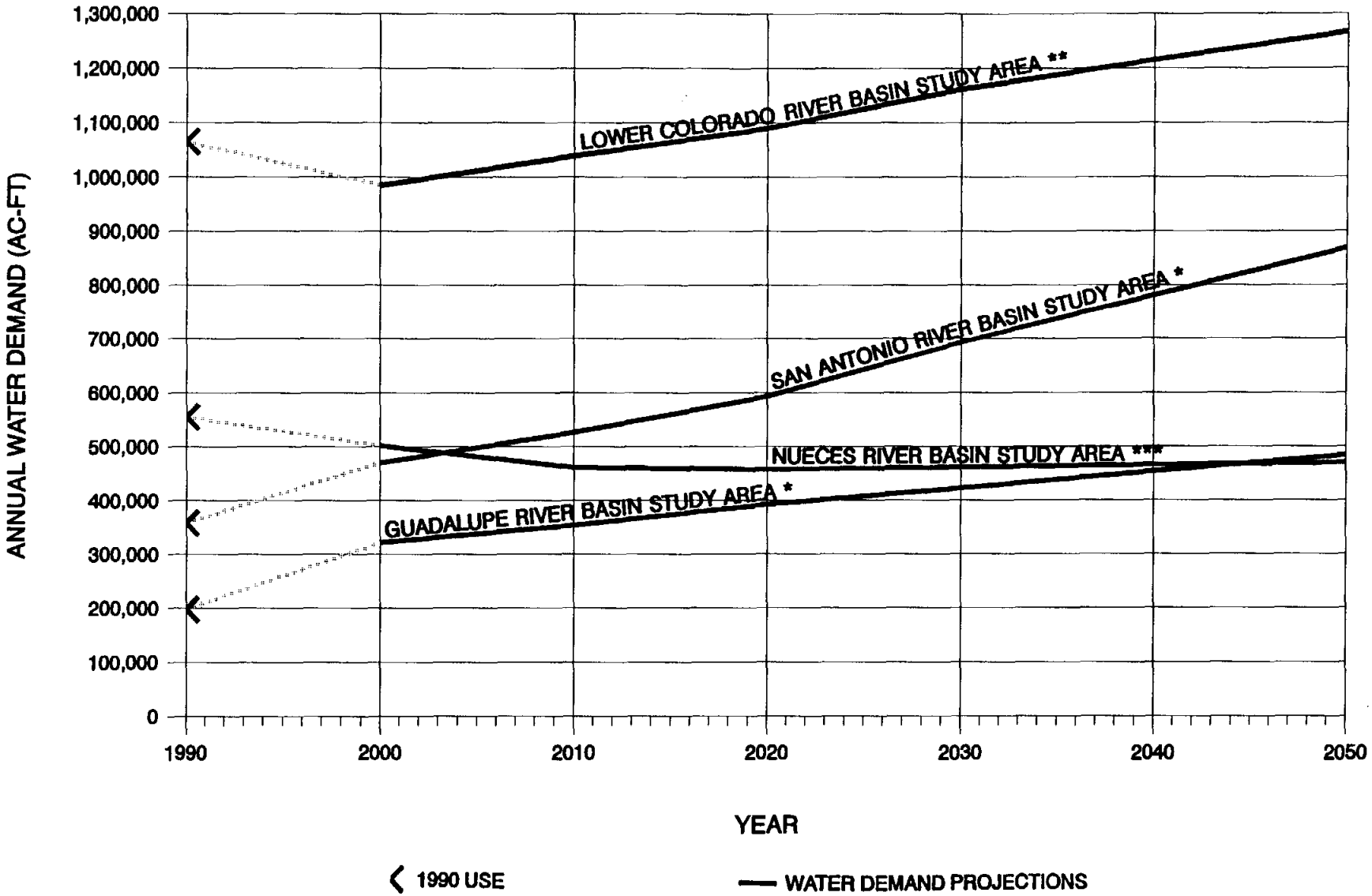
2.2.3.7 Total Water Demand Projections for River Basins and Adjacent Areas

Total water use in the 33-county study area in 1990 was 2,177,005 acft, of which 555,503 acft (26 percent) were in the Nueces Basin study area counties, 358,304 acft (16 percent) were in the San Antonio Basin and adjacent areas, 197,959 acft (9 percent) were in the Guadalupe Basin and adjacent areas, and 1,065,239 acft (49 percent) were in the Lower Colorado Basin and adjacent areas (Table 2-24). TWDB high case, with conservation, projected total water demands in 2050 are 3,089,709 acft for the 33-county study area, with 470,173 acft (16 percent) in Nueces Basin study area counties, 868,325 acft (28 percent) in the San Antonio Basin and adjacent areas, 484,366 acft (16 percent) in the Guadalupe Basin and adjacent areas, and 1,266,242 acft (41 percent) in the Lower Colorado Basin and adjacent areas (Table 2-24 and Figure 2-26). Projections for other decadal points within the 2000 - 2050 planning period are shown for the respective study area river basins and adjacent areas are shown in Table 2-24 and are graphed in Figure 2-26.

## Table 2-24
## Total Water Demand Projections for River Basins and Adjacent Areas
## West Central Area -- Trans-Texas Water Program

| BASIN[1] | 1990[2] Use | Projections in Acre-Feet[3] 2000 | 2010 | 2020 | 2030 | 2040 | 20 |
|---|---|---|---|---|---|---|---|
| NUECES | | | | | | | |
| Total In-Basin[9] | 612,217 | 557,543 | 517,960 | 513,897 | 519,186 | 524,462 | 529, |
| Study Area Subtotal[4] | 555,503 | 501,826 | 461,468 | 457,295 | 461,551 | 465,860 | 470, |
| Remainder of Basin | 56,714 | 55,717 | 56,492 | 56,602 | 57,635 | 58,602 | 59, |
| SAN ANTONIO | | | | | | | |
| Total In-Basin[9] | 357,901 | 469,604 | 526,084 | 592,302 | 693,100 | 780,706 | 868, |
| Adjacent Area[5] | 403 | 586 | 587 | 586 | 592 | 597 | 603 |
| Study Area Subtotal | 358,304 | 470,190 | 526,671 | 592,888 | 693,692 | 781,303 | 868, |
| GUADALUPE | | | | | | | |
| Total In-Basin[9] | 116,519 | 196,476 | 220,105 | 247,655 | 268,945 | 288,998 | 309, |
| Adjacent Area[6] | 81,440 | 124,965 | 134,594 | 145,127 | 153,409 | 164,352 | 175, |
| Study Area Subtotal | 197,959 | 321,441 | 354,699 | 392,782 | 422,354 | 453,350 | 484, |
| LOWER COLORADO | | | | | | | |
| Total In-Basin[9] | 374,659 | 392,382 | 440,891 | 488,667 | 545,687 | 587,499 | 629, |
| Adjacent Coastal Area[7] | 655,943 | 518,384 | 509,061 | 497,277 | 484,558 | 478,784 | 469, |
| Subtotal | 1,030,602 | 910,766 | 949,952 | 985,944 | 1,030,245 | 1,066,283 | 1,098, |
| Adjacent Inland Area[8] | 34,637 | 73,854 | 88,387 | 103,918 | 131,385 | 149,414 | 167, |
| Study Area Subtotal | 1,065,239 | 984,620 | 1,038,339 | 1,089,863 | 1,161,630 | 1,215,697 | 1,266, |
| RIVER BASIN TOTALS[9] | 1,461,296 | 1,616,005 | 1,705,040 | 1,842,521 | 2,026,918 | 2,181,665 | 2,336, |
| STUDY AREA TOTALS[10] | 2,177,005 | 2,278,077 | 2,381,177 | 2,532,828 | 2,739,262 | 2,916,210 | 3,089, |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
[3]Texas Water Development Board, High Case for 1990 through 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 19 Austin, Texas.
[4]Counties of Nueces Basin included in study area are: Uvalde, Medina, Zavala, Frio, Atascosa, and parts of Bexar, Wilson and Karnes.
[5]Part of Goliad County located in adjacent San Antonio-Nueces Coastal Basin.
[6]Part of Victoria County located in adjacent Lavaca-Guadalupe Coastal Basin, plus all of Refugio and Calhoun counties.
[7]Parts of Colorado, Wharton, and Matagorda counties located in adjacent coastal basins.
[8]Parts of Fayette, Lee, Williamson, and Burnet counties located in adjacent basins.
[9]Total for counties and parts of counties located within basin boundaries.
[10]Total for 33-county study area.




* In basin plus adjacent areas that obtain water from the basin.

** In basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

*** Includes only study area counties of the Nueces Basin.

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TRANS-TEXAS WATER PROGRAM WEST CENTRAL STUDY AREA

## TOTAL WATER DEMAND PROJECTIONS

RIVER BASIN STUDY AREAS

FIGURE 2 - 26

## 2.3 Water Supply Projections

In previous sections, population and water demand projections have been presented for each of the study area counties and for cities of the Edwards Aquifer area counties. In addition, the population and water demand projections have been summarized and tabulated for the river basins (Nueces, San Antonio, Guadalupe, and Lower Colorado) and their respective adjacent areas. In this section, the companion groundwater and surface water supply projections are presented.

### 2.3.1 Groundwater Supply Projections

In 1990, total water use in the 33-county study area was 2,177,005 acft, of which 1,126,762 acft or 51.75 percent was from groundwater sources (Table 2-25). Of the total groundwater use, 31.9 percent was for municipal purposes, 2.3 percent was for industrial purposes, 0.6 percent was for steam-electric power generation, 63.2 percent was for irrigation, 0.9 percent was for mining, and 1.0 percent was for livestock (Table 2-25).

Total surface water use in the 33-county study area in 1990 was 1,050,243 acft or 48.25 percent of total water use that year (Table 2-26). The distribution among uses for each of the study area counties can been seen in Table 2-25 and Table 2-26 for groundwater and surface water, respectively.

The Texas Water Development Board projects that the 33-county West Central Trans-Texas Study Area has an average annual groundwater supply of 1,144,946 acft for the 2000 through 2050 period, of which 400,000 acft or 35 percent is the supply available to the Edwards Aquifer area from the Edwards Balcones Fault Zone Aquifer, as specified in Senate Bill 1477, 1993 Regular Session, Texas Legislature (Table 2-27). The groundwater supply data are tabulated for each of the study area counties, however, the quantity (i.e., 450,000 acft per year till the year 2008 when use is limited to 400,000 acft) from the Edwards Balcones Fault Zone Aquifer is shown in the table as a lump sum, since it has not yet been allocated by the issuance of permits to individuals and cities of the Edwards Aquifer area, as specified by Senate Bill 1477. Thus, when viewing the groundwater supply table (Table 2-27), the reader should be aware that the entries for Atascosa, Bexar, Caldwell, Comal, Guadalupe, Hays, Medina, and Uvalde counties contain only the quantities

## Table 2-25
## 1990 Groundwater Use -- 33-County West Central Area
## Trans-Texas Water Program

| COUNTIES[1] | 1990 Use[2] (Acre-Feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Municipal | Industrial | Steam-Electric | Irrigation | Mining | Livestock | To |
| Atascosa | 5,670 | 0 | 3,622 | 47,208 | 664 | 160 | 57,3 |
| Bandera | 1,417 | 0 | 0 | 151 | 20 | 260 | 1,8 |
| Bastrop | 6,234 | 26 | 0 | 323 | 10 | 572 | 7,1 |
| Bexar | 224,762 | 13,911 | 1,408 | 27,399 | 1,319 | 137 | 268,9 |
| Blanco | 646 | 0 | 0 | 425 | 0 | 443 | 1,5 |
| Burnet | 1,240 | 8 | 0 | 114 | 174 | 410 | 1,9 |
| Caldwell | 3,589 | 0 | 0 | 674 | 27 | 81 | 4,3 |
| Calhoun | 515 | 1,812 | 62 | 1,984 | 1 | 175 | 4,5 |
| Colorado | 2,927 | 96 | 0 | 44,280 | 993 | 837 | 49,1 |
| Comal | 10,338 | 1,237 | 0 | 469 | 946 | 253 | 13,2 |
| DeWitt | 3,494 | 91 | 0 | 274 | 129 | 182 | 4,1 |
| Fayette | 3,397 | 32 | 0 | 80 | 7 | 203 | 3,7 |
| Frio | 3,045 | 0 | 38 | 81,568 | 313 | 109 | 85,0 |
| Goliad | 916 | 0 | 136 | 205 | 0 | 87 | 1,3 |
| Gonzales | 1,487 | 618 | 0 | 2,124 | 21 | 410 | 4,6 |
| Guadalupe | 4,949 | 131 | 0 | 1,376 | 8 | 102 | 6,5 |
| Hays | 11,635 | 293 | 0 | 0 | 0 | 66 | 11,9 |
| Karnes | 2,187 | 270 | 0 | 1,831 | 187 | 135 | 4,6 |
| Kendall | 1,734 | 2 | 0 | 274 | 0 | 312 | 2,3 |
| Kerr | 2,607 | 2 | 0 | 187 | 73 | 307 | 3,1 |
| Lee | 2,991 | 5 | 0 | 164 | 0 | 559 | 3,7 |
| Llano | 151 | 0 | 0 | 1,043 | 65 | 863 | 2,1 |
| Matagorda | 5,225 | 3,514 | 1,158 | 26,717 | 250 | 673 | 37,5 |
| Medina | 5,254 | 286 | 0 | 77,694 | 120 | 155 | 83,5 |
| Refugio | 1,227 | 0 | 0 | 0 | 77 | 56 | 1,3 |
| San Saba | 363 | 0 | 0 | 573 | 86 | 897 | 1,9 |
| Travis | 8,139 | 412 | 21 | 448 | 0 | 471 | 9,4 |
| Uvalde | 5,213 | 557 | 0 | 137,856 | 399 | 497 | 144,5 |
| Victoria | 11,545 | 489 | 865 | 13,151 | 2,409 | 763 | 29,2 |
| Wharton | 6,218 | 396 | 0 | 155,474 | 4 | 728 | 162,8 |
| Williamson | 14,787 | 233 | 0 | 18 | 1,654 | 150 | 16,8 |
| Wilson | 3,745 | 50 | 0 | 11,642 | 281 | 180 | 15,8 |
| Zavala | 2,349 | 1,306 | 0 | 76,296 | 116 | 71 | 80,1 |
| Total | 359,996 | 25,777 | 7,310 | 712,022 | 10,353 | 11,304 | 1,126,7 |

[1]Study Area.
[2]As reported to and/or estimated by the Texas Water Development Board.
Note: Source in unpublished planning data, Texas Water Development Board, 1992.

## Table 2-26
## 1990 Surface Water Use -- 33-County West Central Area
## Trans-Texas Water Program

| COUNTIES[1] | 1990 Use[2] (Acre-Feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Municipal | Industrial | Steam-Electric | Irrigation | Mining | Livestock | To |
| Atascosa | 0 | 0 | 0 | 0 | 0 | 1,453 | 1,4 |
| Bandera | 28 | 0 | 0 | 139 | 0 | 65 | 2 |
| Bastrop | 0 | 1 | 2,967 | 322 | 6 | 859 | 4,1 |
| Bexar | 295 | 138 | 22,855 | 9,613 | 272 | 1,239 | 34,4 |
| Blanco | 258 | 0 | 0 | 58 | 0 | 110 | 4 |
| Burnet | 2,286 | 1,108 | 0 | 186 | 762 | 410 | 4,7 |
| Caldwell | 1,342 | 0 | 0 | 701 | 0 | 735 | 2,7 |
| Calhoun | 3,401 | 22,727 | 0 | 33,437 | 0 | 116 | 59,6 |
| Colorado | 0 | 982 | 0 | 172,200 | 30,974 | 558 | 204,7 |
| Comal | 77 | 2,011 | 0 | 10 | 0 | 63 | 2,1 |
| DeWitt | 62 | 0 | 0 | 11 | 0 | 1,658 | 1,7 |
| Fayette | 0 | 0 | 11,701 | 320 | 0 | 1,834 | 13,8 |
| Frio | 0 | 0 | 0 | 1,665 | 0 | 988 | 2,6 |
| Goliad | 0 | 0 | 12,029 | 480 | 0 | 797 | 13,3 |
| Gonzales | 2,345 | 247 | 0 | 1,416 | 0 | 3,698 | 7,7 |
| Guadalupe | 4,678 | 1,530 | 0 | 1,270 | 0 | 929 | 8,4 |
| Hays | 74 | 0 | 0 | 320 | 0 | 610 | 1,0 |
| Karnes | 0 | 0 | 0 | 203 | 0 | 1,236 | 1,4 |
| Kendall | 396 | 0 | 0 | 106 | 0 | 77 | 5 |
| Kerr | 3,214 | 26 | 0 | 663 | 0 | 75 | 3,9 |
| Lee | 0 | 0 | 0 | 119 | 0 | 839 | 9 |
| Llano | 2,337 | 0 | 937 | 79 | 0 | 45 | 3,3 |
| Matagorda | 0 | 3,293 | 34,757 | 178,110 | 0 | 447 | 216,6 |
| Medina | 0 | 0 | 0 | 79,686 | 0 | 1,405 | 81,0 |
| Refugio | 0 | 0 | 0 | 0 | 0 | 507 | 5 |
| San Saba | 909 | 0 | 0 | 5,161 | 0 | 224 | 6,2 |
| Travis | 106,670 | 5,831 | 6,177 | 352 | 2,288 | 471 | 121,7 |
| Uvalde | 65 | 0 | 0 | 2,813 | 0 | 497 | 3,3 |
| Victoria | 0 | 19,543 | 22 | 548 | 0 | 508 | 20,6 |
| Wharton | 0 | 0 | 0 | 172,746 | 2,646 | 485 | 175,8 |
| Williamson | 9,695 | 93 | 0 | 142 | 59 | 1,358 | 11,3 |
| Wilson | 0 | 0 | 0 | 2,055 | 0 | 1,633 | 3,6 |
| Zavala | 0 | 0 | 0 | 34,626 | 0 | 643 | 35,2 |
| Total | 138,132 | 57,530 | 91,445 | 699,557 | 37,007 | 26,572 | 1,050,2 |

[1]Study Area
[2]As reported to and/or estimated by the Texas Water Development Board.
Note: Source in unpublished planning data, Texas Water Development Board, 1992.

## Table 2-27
## 1990 Water Use and Projected Groundwater Supplies -- 33-County West Central Area
## Trans-Texas Water Program

| COUNTIES[1] | 1990 Water Use (Acre-Feet)[2] | | | Projected Groundwater Supplies (Acre-Feet) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ground | Surface | Total | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Atascosa* | 57,324 | 1,453 | 58,777 | 47,134* | 47,134* | 47,134* | 47,134* | 47,134* | 47,134* |
| Bandera | 1,848 | 232 | 2,080 | 7,285 | 7,285 | 7,285 | 7,285 | 7,285 | 7,285 |
| Bastrop | 7,165 | 4,155 | 11,320 | 41,548 | 41,548 | 41,548 | 41,548 | 41,548 | 41,548 |
| Bexar* | 268,936 | 34,412 | 303,348 | 19,125* | 19,125* | 19,125* | 19,125* | 19,125* | 19,125* |
| Blanco | 1,514 | 426 | 1,940 | 7,737 | 7,737 | 7,737 | 7,737 | 7,737 | 7,737 |
| Burnet | 1,946 | 4,752 | 6,698 | 16,280 | 16,280 | 16,280 | 16,280 | 16,280 | 16,280 |
| Caldwell* | 4,371 | 2,778 | 7,149 | 10,383* | 10,383* | 10,383* | 10,383* | 10,383* | 10,383* |
| Calhoun | 4,549 | 59,681 | 64,230 | 2,940 | 2,940 | 2,940 | 2,940 | 2,940 | 2,940 |
| Colorado | 49,133 | 204,714 | 253,847 | 31,659 | 31,659 | 31,659 | 31,659 | 31,659 | 31,659 |
| Comal* | 13,243 | 2,161 | 15,404 | 1,800* | 1,800* | 1,800* | 1,800* | 1,800* | 1,800* |
| DeWitt | 4,170 | 1,731 | 5,901 | 15,866 | 15,866 | 15,866 | 15,866 | 15,866 | 15,866 |
| Fayette | 3,719 | 13,855 | 17,574 | 37,829 | 37,829 | 37,829 | 37,829 | 37,829 | 37,829 |
| Frio | 85,073 | 2,653 | 87,726 | 30,914 | 30,914 | 30,914 | 30,914 | 30,914 | 30,914 |
| Goliad | 1,344 | 13,306 | 14,650 | 12,809 | 12,809 | 12,809 | 12,809 | 12,809 | 12,809 |
| Gonzales | 4,660 | 7,706 | 12,366 | 46,560 | 46,560 | 46,560 | 46,560 | 46,560 | 46,560 |
| Guadalupe* | 6,566 | 8,407 | 14,973 | 12,583* | 12,583* | 12,583* | 12,583* | 12,583* | 12,583* |
| Hays* | 11,994 | 1,004 | 12,998 | 1,810* | 1,810* | 1,810* | 1,810* | 1,810* | 1,810* |
| Karnes | 4,610 | 1,439 | 6,049 | 18,780 | 18,780 | 18,780 | 18,780 | 18,780 | 18,780 |
| Kendall | 2,322 | 579 | 2,901 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 | 4,840 |
| Kerr | 3,176 | 3,978 | 7,154 | 9,810 | 9,810 | 9,810 | 9,810 | 9,810 | 9,810 |

(continued)

## Table 2-27
## 1990 Water Use and Projected Groundwater Supplies -- 33-County West Central Area
## Trans-Texas Water Program

| COUNTIES[1] | 1990 Water Use (Acre-Feet)[2] | | | Projected Groundwater Supplies (Acre-Feet) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ground | Surface | Total | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| Lee | 3,719 | 958 | 4,677 | 24,943 | 24,943 | 24,943 | 24,943 | 24,943 | 24,943 |
| Llano | 2,122 | 3,398 | 5,520 | 11,882 | 11,882 | 11,882 | 11,882 | 11,882 | 11,882 |
| Matagorda | 37,537 | 216,607 | 254,144 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 | 26,000 |
| Medina* | 83,509 | 81,091 | 164,600 | 7,826* | 7,826* | 7,826* | 7,826* | 7,826* | 7,826* |
| Refugio | 1,360 | 507 | 1,867 | 7,768 | 7,768 | 7,768 | 7,768 | 7,768 | 7,768 |
| San Saba | 1,919 | 6,294 | 8,213 | 30,224 | 30,224 | 30,224 | 30,224 | 30,224 | 30,224 |
| Travis | 9,491 | 121,789 | 131,280 | 8,855 | 8,855 | 8,855 | 8,855 | 8,855 | 8,855 |
| Uvalde* | 144,522 | 3,375 | 147,897 | 8,213* | 8,213* | 8,213* | 8,213* | 8,213* | 8,213* |
| Victoria | 29,222 | 20,621 | 49,843 | 41,130 | 41,130 | 41,130 | 41,130 | 41,130 | 41,130 |
| Wharton | 162,820 | 175,877 | 338,697 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| Williamson | 16,842 | 11,347 | 28,189 | 6,341 | 6,341 | 6,341 | 6,341 | 6,341 | 6,341 |
| Wilson | 15,898 | 3,688 | 19,586 | 60,597 | 60,597 | 60,597 | 60,597 | 60,597 | 60,597 |
| Zavala | 80,138 | 35,269 | 115,407 | 30,475 | 30,475 | 30,475 | 30,475 | 30,475 | 30,475 |
| Edwards Aquifer** | _____ | _____ | _____ | 450,000** | 400,000** | 400,000** | 400,000** | 400,000** | 400,000** |
| Total | 1,126,762 | 1,050,243 | 2,177,005 | 1,191,946 | 1,141,946 | 1,141,946 | 1,141,946 | 1,141,946 | 1,141,946 |

[1]Study Area

[2]As reported to and/or estimated by the Texas Water Development Board.

[3]Unpublished planning data, Texas Water Development Board, 1992.

*Does not include Edwards Balcones Fault Zone Aquifer.

**As specified in S.R. 1477; to be allocated among Bexar, Comal, Hays, Medina, Uvalde, and parts of Atascosa, Caldwell, and Guadalupe counties.

available from aquifers other than the Edwards Balcones Fault Zone Aquifer. When either the 450,000 or the 400,000 acft that is available from the Edwards Aquifer, as specified by S.B. 1477, is permitted, then the total of the permits of each Edwards Aquifer area county can be added to the quantities available from other aquifers in order to obtain the total quantity of groundwater supply for these Edwards Aquifer area counties.

The quantities of groundwater available in each study area county other than those of the Edwards Aquifer area can be viewed in Table 2-27. It should be noted that in 1990, groundwater use in eight of the non-Edwards Aquifer area counties was greater than the projected average long-term annual supply (Table 2-27), meaning that in these counties (i.e., Calhoun, Colorado, Frio, Matagorda, Travis, Wharton, Williamson, and Zavala) groundwater overdrafting or mining is occurring. However, in 16 of the non-Edwards Aquifer area counties (i.e., Bastrop, Blanco, Burnet, DeWitt, Fayette, Goliad, Gonzales, Karnes, Kendall, Kerr, Lee, Llano, Refugio, San Saba, Victoria, and Wilson) 1990 groundwater use was less than projected annual supply, which means that groundwater resources can perhaps meet some projected growth in water demands in some of these counties (Table 2-27), depending upon location of demands.

### 2.3.2 Surface Water Supply Projections

The existing surface water supplies of the West Central Trans-Texas Study Area include: (1) reservoirs that have a firm yield; (2) storage reservoirs for steam-electric cooling; (3) storage reservoirs for water supply management and recreation; and (4) run-of-river water rights to flows of the streams. Information about each of these surface water supply types is presented below.

**Lakes and Reservoirs**

Medina Lake is located on the Medina River at the boundaries of Medina and Bandera counties, with Diversion Lake on the Medina River downstream of Medina Lake. These lakes are owned by the Bexar-Medina-Atascosa Counties Water Control and Improvement District No. 1 and are used primarily to supply irrigation water to irrigation farms located in Bexar and Medina counties (Table 2-28). In addition to supplying

## Table 2-28
## Reservoirs and Surface Water Supplies -- West Central Study Area
## Trans-Texas Water Program*

| Reservoir | Owner | Firm Yield (acft/yr) | Average Supply[2] (acft/yr) | Permit (acft/yr) | Purposes |
|---|---|---|---|---|---|
| **San Antonio Basin** | | | | | |
| Medina Lake | Bexar-Medina-Atascosa District | 8,770[1] | 57,970 | 66,750 | Irrigation, municipal, domestic, livestock |
| Diversion Lake | Bexar-Medina-Atascosa District | --- | --- | --- | Irrigation, municipal, domestic, livestock |
| Applewhite Reservoir[4] | City of San Antonio | 7,700[5] | 47,060[5] | 57,700[5] | Municipal |
| Victor Braunig Lake | City Public Service Board of San Antonio | --- | --- | 12,000[6] | Steam-electric power generation |
| Calaveras Lake | City Public Service Board of San Antonio | --- | --- | 37,000[7] | Steam-electric power generation |
| **Guadalupe Basin**** | | | | | |
| Canyon Lake | Guadalupe-Blanco River Authority/USCOE | 50,000[3] | --- | 50,000[3] | Municipal, industrial, steam-electric & hydropower, irrigation, flood protection |
| Coleto Creek | Central Power and Light Company | --- | --- | 12,500 | Steam-electric power generation |
| **Colorado Basin** | | | | | |
| Highland Lakes*** | Lower Colorado River Authority | 445,266*** | --- | 1,500,000 | Municipal, industrial, steam-electric & hydropower, irrigation hydroelectric power, |
| Lake Austin | City of Austin | --- | --- | --- | Steam-electric power, water supply storage, rec. |
| Town Lake | City of Austin | --- | --- | --- | Steam-electric power, water supply storage, rec. |
| Decker Lake | City of Austin | --- | --- | 36,456 | Steam-electric power |
| Lake Bastrop | Lower Colorado River Authority | --- | --- | --- | Steam-electric power |
| Cedar Creek | Lower Colorado River Authority | --- | --- | --- | Steam-electric power |
| Eagle Lake | Lower Colorado River Authority | --- | --- | --- | Irrigation storage |
| South Texas Project | Houston Light & Power | --- | --- | --- | Steam-electric power |
| TOTAL | | 504,036*** | | | |

*See Table 2-29 for reference to run-of-river permits.
**Does not include Applewhite.
***Includes Lakes Travis, Marble Falls, LBJ, Inks and Buchanan.
[1]Maximum firm yield based on uniform monthly diversion directly from Medina Lake.
[2]Average supply based on the 1934-89 historical period.
[3]Based on subordination of GBRA hydropower rights to 600 cfs at Lake Dunlap.
[4]Reservoir permitted and partially constructed.
[5]Firm yield, average supply, and permit based on exclusion of Leon Creek diversion (12,300 acft/yr) to Applewhite Reservoir.
[6]Includes the rights to divert up to 12,000 acft/yr from the San Antonio River to Braunig Lake and to consume up to 12,000 acft/yr at Braunig Lake.
[7]Includes the rights to divert up to 60,000 acft/yr of reclaimed wastewater from the San Antonio River to Calavares Lake and to consume up to 37,000 acft/yr at Calaveras Lake.

irrigation water, percolation through the lake and river beds recharges the Edwards Aquifer. Although the maximum firm yield of Medina Lake is only about 8,770 acft/yr (Section 3.13), the computed average annual water supply of Medina Lake and Diversion Lake is 57,970 acft (Table 2-28).

Braunig and Calaveras Lakes are located in Bexar County to the southeast of San Antonio and are used for electric power plant cooling water (Table 2-28). Runoff from the watersheds above the lakes, diversion from the San Antonio River, and diversions of San Antonio reclaimed wastewater are used to maintain the necessary lake levels and meet the cooling water demands (24,263 acft in 1990 -- see Table 2-13).

Canyon Lake in the Guadalupe Basin is located in Comal County on the main stem of the Guadalupe River. The purposes of the lake include water supply for municipal, industrial, steam-electric power generation, irrigation, hydroelectric power generation, flood protection, and recreation (Table 2-28). The firm annual water supply of 50,000 acft from Canyon Lake is permitted to the Guadalupe Blanco River Authority (GBRA) by the TNRCC and made available by GBRA to water users within the basin.

Lakes Dunlap, McQueeny, Placid, Nolte, H-4, and Wood form hydroelectric power generation pools and are the sites of hydroelectric power plants on the Guadalupe River in the reach from New Braunfels to about eight miles west of Gonzales (Table 2-28). The lakes and the water rights are owned by GBRA, and although hydroelectric power generation is a nonconsumptive use of water, these rights and permits to Guadalupe River flows for these purposes are being taken into account in the water supply analyses of the basin.

Coleto Creek Reservoir, owned by Central Power and Light Company is located at the borders of Victoria and Goliad counties in the lower Guadalupe Basin and is a cooling reservoir for steam-electric power generation. The source of water is drainage from the Coleto Creek watershed, with diversions from the Guadalupe River, backed by storage in Canyon Lake, when needed. The reservoir supplies water for steam-electric power generation at a power plant located in Goliad County (12,165 acft in 1990 -- Table 2-6).

The Highland Lakes (Travis, Marble Falls, LBJ, Inks, and Buchanan) located on the main steam of the Colorado River upstream of Austin are owned by the Lower Colorado River Authority (LCRA) (Table 2-28). The purposes of the Highland Lakes are water supply for municipal, industrial, steam-electric power generation, hydroelectric power generation, irrigation, flood protection, and recreation. The firm yield of the Highland Lakes, as reported by the TWDB[11] in the 1990 Texas water plan is 445,266 acft. The water supply of the Highland Lakes is made available by LCRA through contracts with various downstream water users for municipal, industrial, steam-electric power generation, and irrigation purposes within the Colorado River Basin and adjacent coastal basins. In addition, LCRA uses water released from the lakes for hydroelectric power generation.

Downstream of the Highland Lakes at Austin on the main steam of the Colorado River are Lake Austin and Town Lake, both owned by the City of Austin. The three City of Austin municipal water intakes are located on these lakes and Town Lake supplies steam-electric cooling water to Austin (Table 2-28). In addition to these main stem reservoirs, there are four steam-electric power cooling lakes (Decker, Bastrop, Cedar Creek, and the South Texas Project) and one irrigation storage reservoir (Eagle Lake in Colorado County) on tributaries to the Colorado River. These lakes are authorized to capture and store local runoff, with provisions for diversions from the Colorado River when needed. In the case of steam-electric power water demands, the Colorado River tributary cooling lakes are the sites of steam-electric power water use as projected for Bastrop, Fayette, Matagorda, and Travis counties (Table 2-6).

In the West Central Study Area, the estimated firm water supply from storage reservoirs is 504,036 acft per year (Table 2-28). Of this total, 8,770 acft are in the San Antonio Basin, 50,000 acft are in the Guadalupe Basin, and 445,266 acft are in the Colorado Basin (Table 2-28).

**Run-of-River Water Rights**

In addition to surface water from reservoirs, rights have been issued by the TNRCC and predecessor agencies to individuals, cities, industries, and water districts and authorities

[11]Water for Texas -- Today and Tomorrow, 1990, Texas Water Development Board, Austin, Texas, December, 1990.

for diversion from flowing streams of the West Central Study Area. Each right bears a priority date, location for diversion, dates for diversion, rates of diversion, annual quantity of diversion, river flow conditions below which diversions are not to be made, and perhaps other conditions. The principle of prior appropriation or "first-in-time-first-in-right" is applied, which means that the oldest rights (earliest date of permit) have first call on flows, with the second, third, and more recent rights having second, third, and later standings for diversions. This procedure gives senior rights holders priority when stream flows are low, as in periods of drought, and renders junior rights less reliable during droughts; i.e., the most junior rights holders may not be able to divert any water during critical droughts.

It is important to note that many run-of-river rights are for irrigation purposes, where chances are taken upon crop production failures, while more of the municipal, industrial, and steam-electric power demands are for more reliable supplies than are available from river flows and, thus, are placed upon reservoirs having firm yields, or, as in the case of Austin and the South Texas Project, run-of-river rights are firmed up through contracts and agreements with LCRA for stored water from the firm yield of the Highland Lakes. Similar agreements have been made in the Guadalupe Basin for stored water from Canyon Lake to firm up downstream run-of-river rights.

Run-of-river permits have been summarized for the streams of the West Central Study Area (Table 2-29). For the Nueces upstream of the Edwards recharge zone, the total is 18,095 acft/yr (Table 2-29). These quantities are available in that area to meet a part of the local area irrigation water demands as projected in Section 2.0. For the Nueces downstream of the Edwards recharge zone in Zavala, Frio, and Atascosa counties total run-of-river water rights are 35,302 acft, all of which are for irrigation purposes in those counties as projected in Section 2.0.

In the San Antonio Basin on the Medina River, upstream of Medina Lake, there are 1,083 acft of run-of-river rights, with 10,503 acft of such rights downstream of Medina Lake (Table 2-29). On the San Antonio River from San Antonio to Goliad, 35,222 acft of run-of-river rights have been awarded (Table 2-29). Most, if not all, of these rights are for irrigation and livestock water, and can be viewed as supply available to meet those needs

**Table 2-29**
**Summary of Run-of-River Water Rights**
**West Central Study Area**
**Trans-Texas Water Program**

| River Basin and Segment | Sum of Permits (acft) |
|---|---|
| Nueces Basin Study Area | |
| Upstream Edwards Recharge Zone | 18,095 |
| Downstream Edwards Recharge Zone | 35,302 |
| Subtotal | 53,397 |
| San Antonio Basin Study Area | |
| Medina Upstream Medina Lake | 1,083 |
| Medina Downstream Medina Lake | 10,503 |
| Downstream San Antonio to Goliad | 35,222 |
| | 46,808 |
| Guadalupe Basin Study Area | |
| Upstream of Canyon Lake | 13,229 |
| Downstream Canyon Lake to Victoria | 44,599[1] |
| Downstream Goliad and Victoria (consumptive) | 214,499[1] |
| Subtotal | 272,327 |
| Colorado Basin Study Area | |
| Upstream of Highland Lakes (Study Area) | 36,491 |
| City of Austin | 334,009[2] |
| Travis County to Colorado County | 34,146 |
| Gulf Coast Irrigation[3] | 262,500[4] |
| Garwood Irrigation[3] | 168,000[4] |
| Lakeside Irrigation[3] | 131,250[4] |
| Pierce Ranch Irrigation[3] | 110,000[4] |
| South Texas Project (HL&P/LCRA)[3] | 102,000[5] |
| Subtotal | 1,178,396 |
| TOTAL FOR STUDY AREA | 1,550,928 |

Source: Data from Water Rights Records of Texas Natural Resource Conservation Commission.
[1]Totals shown include only consumptive right for irrigation, industrial, and steam-electric cooling water. Does not include hydroelectric right of 600 cfs at Lake Dunlap, which is a non-consumptive right and, therefore, these flows can be used for other purposes downstream of the last hydroelectric power plant near Gonzales.
[2]Through agreement with LCRA for stored water 290,156 acft is firm supply during drought of record.
[3]Source: "LCRA Drought Management Plan," Lower Colorado River Authority, Austin, Texas, July, 1990.
[4]LCRA staff estimates that during the critical period of record (1946-1957), the dependable supply from all of these permits is about 350,921 acft annually. "Water Supply and Demand Assessment of Wharton County," Lower Colorado River Authority, Austin, Texas, October, 1991.
[5]Through agreement with LCRA for stored water, the 102,000 is firm supply during drought of record.

in areas along the Medina and San Antonio Rivers. (Note: the Medina Lake rights are shown in Table 2-28.)

Total run-of-river rights in the Guadalupe Basin upstream of Canyon Lake are 13,229 acft, and downstream of Canyon to Victoria are 44,599 acft. These are for irrigation, with some rights for municipal and industrial purposes. In addition, GBRA and Seguin have hydroelectric power generation rights -- 600 cfs at Dunlap for GBRA and 365 cfs at Seguin for Seguin. Since this is a nonconsumptive use, these flows can be used for other purposes once they have passed the most downstream hydroelectric plant, which in this case, is GBRA's plant at Lake Wood near Gonzales.

In the Guadalupe and San Antonio Basin downstream of Victoria and Goliad, respectively, total run-of-river rights are 214,499 acft/yr considering only consumptive rights for irrigation and industrial process water (Table 2-29).

In the Colorado Basin, run-of-river water rights holders include the City of Austin (334,009 acft), Gulf Coast Irrigation Division (262,500 acft), Garwood Irrigation Company (168,000 acft), Lakeside Irrigation Division (131,250 acft), Pierce Ranch Irrigation (110,000 acft), and the South Texas Nuclear Project (102,000 acft). Austin's right is for municipal and steam-electric power generation, the South Texas Project right is for steam-electric power generation, and the others are for irrigation. Within the study area upstream of the Highland Lakes there are 36,491 acft of run-of-river rights, and in the stretch from Austin to Colorado County there are 34,146 acft of such rights. The estimated dependable supply from Colorado River flows in the river stretch from Colorado County to the Gulf of Mexico is about 350,921 acft/yr during the critical drought of record[12].

In the West Central Study Area, the sum of the major consumptive run-of-river permitted water rights is 1,550,928 acft/yr (Table 2-29). The supply from run-of-river rights (1,550,928 acft/yr) plus the firm yield of reservoirs (504,036 acft/yr) is the existing surface water supply for the study area.

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[12]"Water Supply and Demand Assessment of Wharton County," Lower Colorado River Authority, Austin, Texas, October, 1991.

## 2.4 Water Demand and Supply Comparisons

In this section, projections of water demand presented in Section 2.2 are compared with projections of water supplies from existing sources presented in Section 2.3 for the following areas: (1) Edwards Aquifer area; (2) Nueces River Basin Study area; (3) San Antonio River Basin; (4) Guadalupe River Basin; and (5) Lower Colorado River Basin Study area. For purposes of this presentation, it has been assumed that the provisions of SB 1477 apply to quantities of water that can be withdrawn from the Edwards Aquifer; i.e., total pumpage will be limited to 450,000 acft annually through year 2007, and 400,000 acft annually thereafter. It is further assumed for purposes of this study only, that these totals will be allocated among eligible users by permits, on the basis of use as reported to the TWDB (estimated by TWDB for irrigation) for calendar year 1990. The TWDB 1990 water use information for counties was used to allocate the Edwards Aquifer pumpage of 450,000 acft and 400,000 acft among the counties of the Edwards Aquifer area (Table 2-30). The county estimates were allocated to the river basins in which each county or portion of a county is located (Table 2-31).

**Table 2-30**
**Edwards Aquifer Water Use**
**Edwards Aquifer Area**
**West Central Study Area**
**Trans-Texas Water Program**

| County | 1990 Use* | | Estimated Quantities as Provided by SB 1477 | |
|---|---|---|---|---|
| | Acre-Feet | Percent of Total | 450,000 acft limit | 400,000 acft limit |
| Uvalde | 144,522[1] | 27.80 | 125,117 | 111,215 |
| Medina | 83,509[1] | 16.06 | 72,296 | 64,264 |
| Atascosa | 336 | 0.06 | 271 | 241 |
| Bexar | 268,936[1] | 51.74 | 232,827 | 206,956 |
| Comal | 11,218 | 2.16 | 9,721 | 8,641 |
| Hays | 7,882 | 1.52 | 6,841 | 6,081 |
| Guadalupe | 2,970 | 0.57 | 2,566 | 2,281 |
| Caldwell | 423 | 0.08 | 361 | 321 |
| TOTAL | 519,796[1] | 100.00 | 450,000 | 400,000 |

*From water use reports to TWDB for all purposes except irrigation, which was estimated from the cooperative irrigation survey by the Texas State Soil and Water Conservation Board and the Texas Water Development Board.
[1]Estimates include small quantities of supply from other aquifers.

**Table 2-31**
**Edwards Aquifer Water Use by River Basin**
**West Central Study Area**
**Trans-Texas Water Program***

| County | 450,000 acft Pumpage Limit | | | | 400,000 acft Pumpage Limit | | | |
|---|---|---|---|---|---|---|---|---|
| | Total (acft/yr) | River Basin (acft/yr) | | | Total (acft/yr) | River Basin (acft/yr) | | |
| | | Nueces | San Antonio | Guadalupe | | Nueces | San Antonio | Guadalupe |
| Uvalde | 125,117 | 125,117 | --- | --- | 111,215 | 111,215 | --- | --- |
| Medina | 72,296 | 55,957 | 16,339 | --- | 64,264 | 49,741 | 14,523 | --- |
| Atascosa | 271 | 271 | --- | --- | 241 | 241 | --- | --- |
| Bexar | 232,827 | --- | 232,827 | --- | 206,956 | --- | 206,956 | --- |
| Comal | 9,721 | --- | 149 | 9,572 | 8,641 | --- | 132 | 8,509 |
| Hays | 6,841 | --- | --- | 6,841 | 6,081 | --- | --- | 6,081 |
| Guadalupe | 2,566 | --- | 709 | 1,857 | 2,281 | --- | 630 | 1,651 |
| Caldwell | 361 | --- | --- | 361 | 321 | --- | --- | 321 |
| TOTAL | 450,000 | 181,345 | 250,024 | 18,631 | 400,000 | 161,197 | 222,241 | 16,562 |

*Allocated to counties in same proportions as reported and estimated use in 1990. Allocated to river basins on basins of location of counties and parts of counties in each river basin, using best estimates of location of water using entities and irrigated acreages.

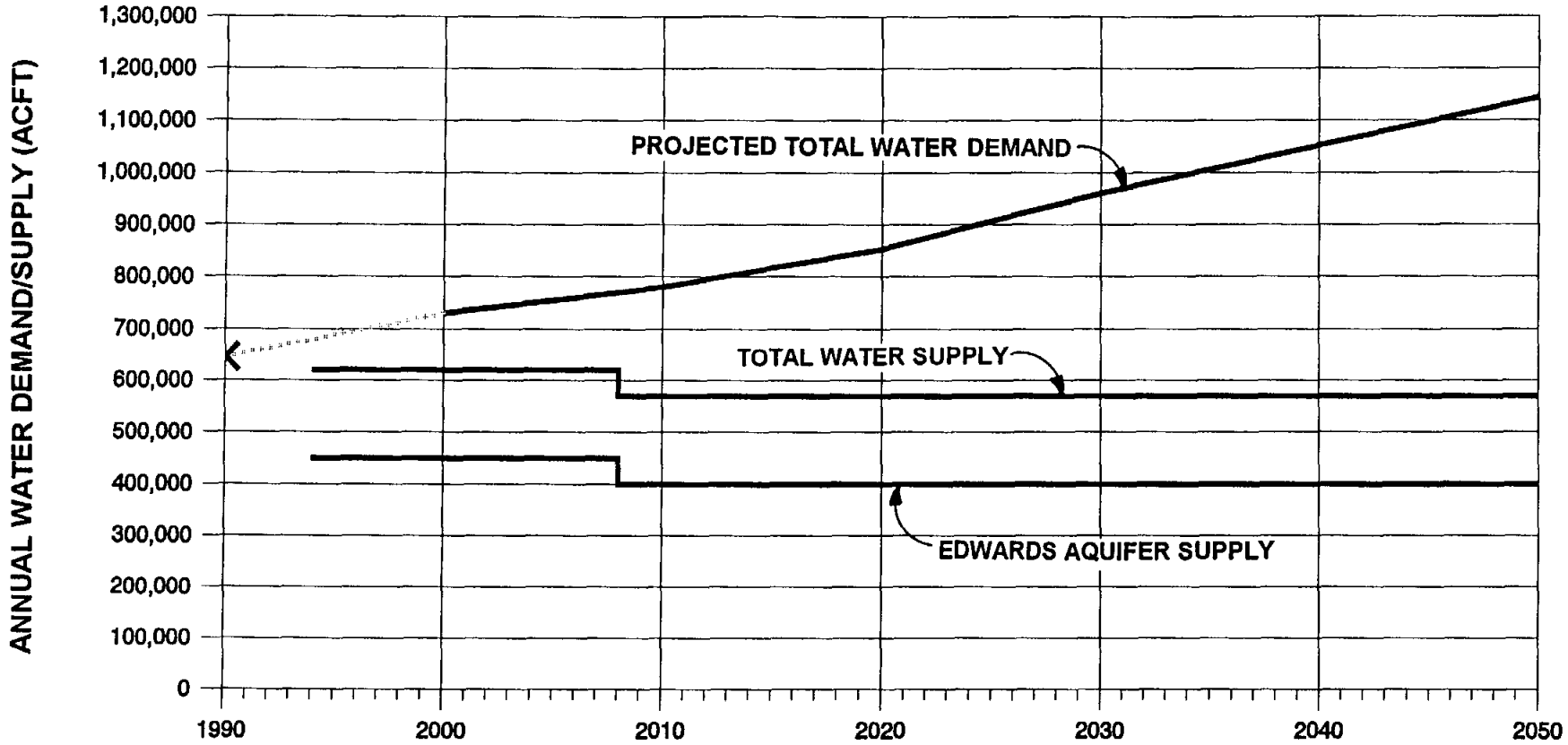
For purposes of this analysis, the quantity of groundwater from the Carrizo and other aquifers is set at the TWDB estimates of long-term dependable supplies (estimated average annual recharge). It should be noted that this water is widely distributed beneath the surface of privately owned land in all or parts of the 33 counties of the study area, with a large proportion being from the Carrizo Aquifer which underlies all or parts of nine study area counties.

Surface water supplies include firm yield of reservoirs and run-of-river supplies authorized for use through permits issued by the Texas Natural Resource Conservation Commission (TNRCC). Using these and groundwater data, as described above, water demand and water supply comparisons are presented below.

### 2.4.1 Edwards Aquifer Area

For the Edwards Aquifer area, total water use in 1990 was 646,076 acft and the high case, with conservation projection in 2050 is 1,144,481 acft (Table 2-17). Under SB 1477 the supply that could be obtained from the Edwards Aquifer would be 450,000 acft per year until year 2008, at which time it would be decreased to 400,000 acft per year. Supply for the area from the Carrizo and other aquifers is estimated at 39,750 acft per year (Table 2-27 and Figure 2-27). For the Edwards Aquifer area, supplies of firm yield surface water from Canyon Lake are 11,720 acft per year (New Braunfels and San Marcos contracts for canyon water). Average annual supply from Medina Lake under full diversion rights could be 57,970 acft per year (Table 2-28).

In addition to supplies listed above, there are 10,503 acft of run-of-river rights within the Edwards Aquifer area (Table 2-29), and 49,000 acft of permits (Braunig and Calaveras Lakes) for diversions of runoff and wastewater flows from the San Antonio River for steam-electric cooling water at San Antonio's power plants. Although the run-of-river rights, average supply from Medina Lake and a part of the steam-electric permits are not firm supplies, when these are added to the groundwater quantities stated above (489,750 acft until 2008 and 439,750 acft thereafter), the totals for the period 1994 through 2007 are 618,943 acft, and for the period beginning in 2008 are 569,125 acft per year. These quantities of supply from existing sources for the period 1994 through 2007 (618,943 acft per




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| WATER SOURCE | THRU 2007 | AFTER 2007 |
| EDWARDS AQUIFER | 450,000 | 400,000 |
| OTHER AQUIFERS | 39,750 | 39,750 |
| CANYON LAKE (NEW BRAUNFELS CONTRACT) | 6,720 | 6,720 |
| CANYON LAKE (SAN MARCOS CONTRACT) | 5,000 | 5,000 |
| MEDINA LAKE - AVERAGE SUPPLY | 57,970 | 57,970 |
| MEDINA RIVER - RUN-OF-RIVER RIGHTS | 10,503 | 10,503 |
| BRAUNIG LAKE | 12,000 | 12,000 |
| CALAVERAS LAKE | 37,000 | 37,000 |
| TOTAL | 618,943 | 569,125 |

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**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS EDWARDS AQUIFER AREA**

FIGURE 2-27

year) are 27,133 acft less than the 1990 use of 646,076 acft, and the projected 2050 supply from sources existing in 1994 (569,125 acft) is 575,356 acft less than the projected 2050 demands of 1,144,481 acft per year.

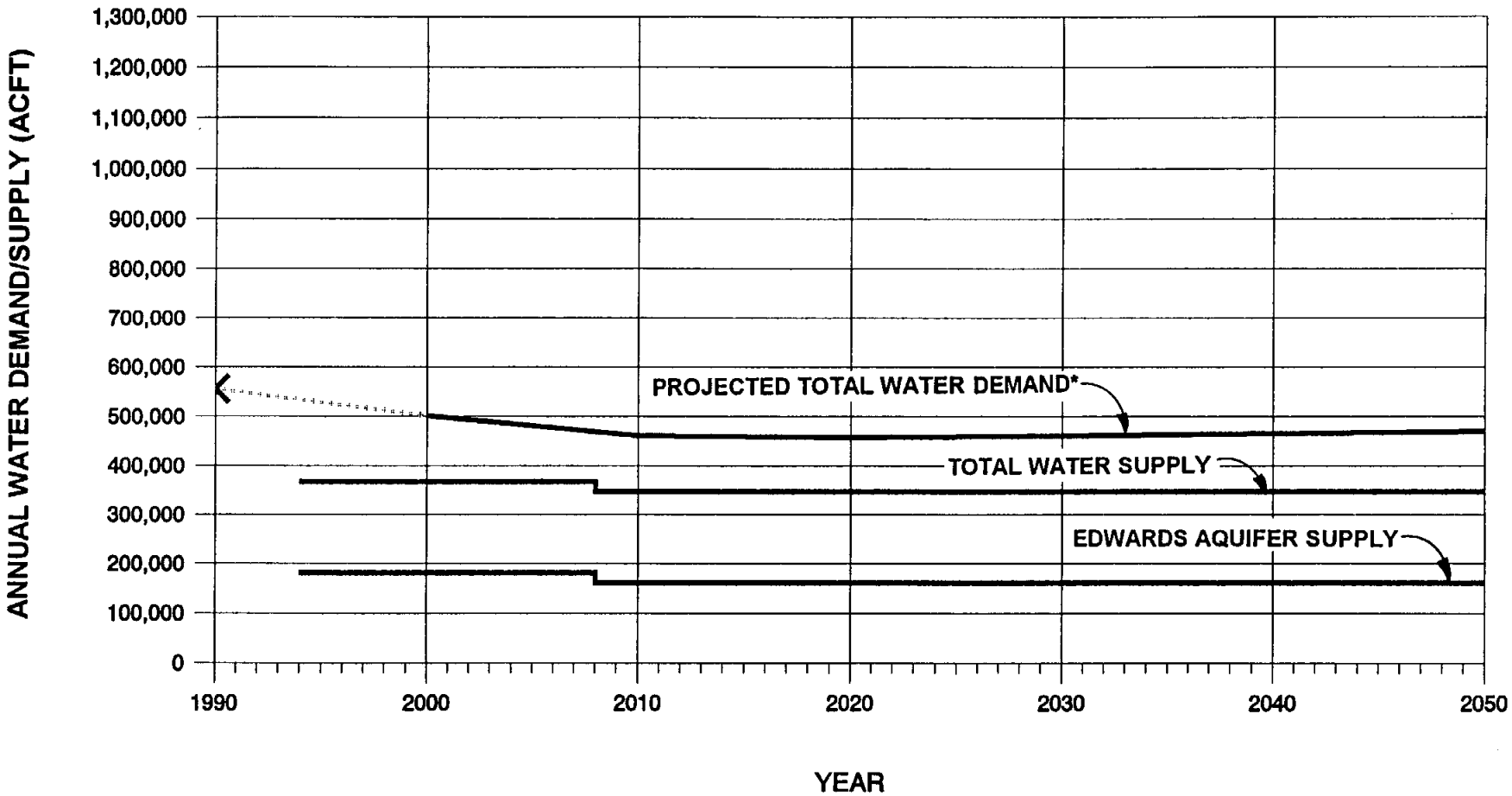
### 2.4.2 Nueces River Basin Study Area

The present water supplies of that part of the Nueces River Basin which is included in the West Central Study Area include water from the Edwards Aquifer, the Carrizo and other aquifers, and surface water that can be diverted from streams of the area under run-of-river permits. Estimated supplies for the Nueces Basin from the Edwards Aquifer through year 2007 are 181,300 acft per year, with supplies from other aquifers of 133,200 acft per year and run-of-river rights of 52,700 acft per year, giving a total of 367,200 acft per year (Figure 2-28). After 2007, supply from the Edwards Aquifer would be reduced to 161,200 acft per year, giving a total supply of 347,100 acft per year (Figure 2-28). In 1990, Nueces Basin Study area water use was 555,503 acft, with projected 2050 demands (high case with conservation) of 470,173 acft (Table 2-24). Projected demands decrease due to increased water conservation in irrigation. Projected Nueces Basin Study area demands in year 2000 are 501,826 acft which are 134,626 acft greater than the 367,200 acft of supply from existing sources. The projected deficit in 2050 would be 123,073 acft per year.

In the Nueces Basin, overdrafting or mining of groundwater is occurring, which explains the condition of 1990 water use being greater than supplies tabulated here. If groundwater mining continues, the supplies would be higher in the near term than those shown here and lower in later years (Figure 2-28). Thus, the deficits in 2050 would be greater than computed here (Figure 2-28).

### 2.4.3 San Antonio River Basin

Water use in the San Antonio Basin in 1990 (reported and estimated) was 358,304 acft with projections (high case, with conservation) to 2050 of 868,928 acft (Table 2-24). Water supplies from existing sources for the period 1994 through 2007 are estimated at 512,920 acft per year, of which 250,020 acft are from the Edwards Aquifer, 109,200 acft are from the Carrizo and other aquifers, 46,800 acft are run-of-river permits, and 57,970 acft is




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| WATER SOURCE | THRU 2007 | AFTER 2007 |
| EDWARDS AQUIFER | 181,300 | 161,200 |
| OTHER AQUIFERS | 133,200 | 133,200 |
| RUN-OF-RIVER RIGHTS | 52,700 | 52,700 |
| TOTAL | 367,200 | 347,100 |

* Includes only study area counties of the Nueces Basin.

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**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS NUECES BASIN STUDY AREA**

FIGURE 2-28

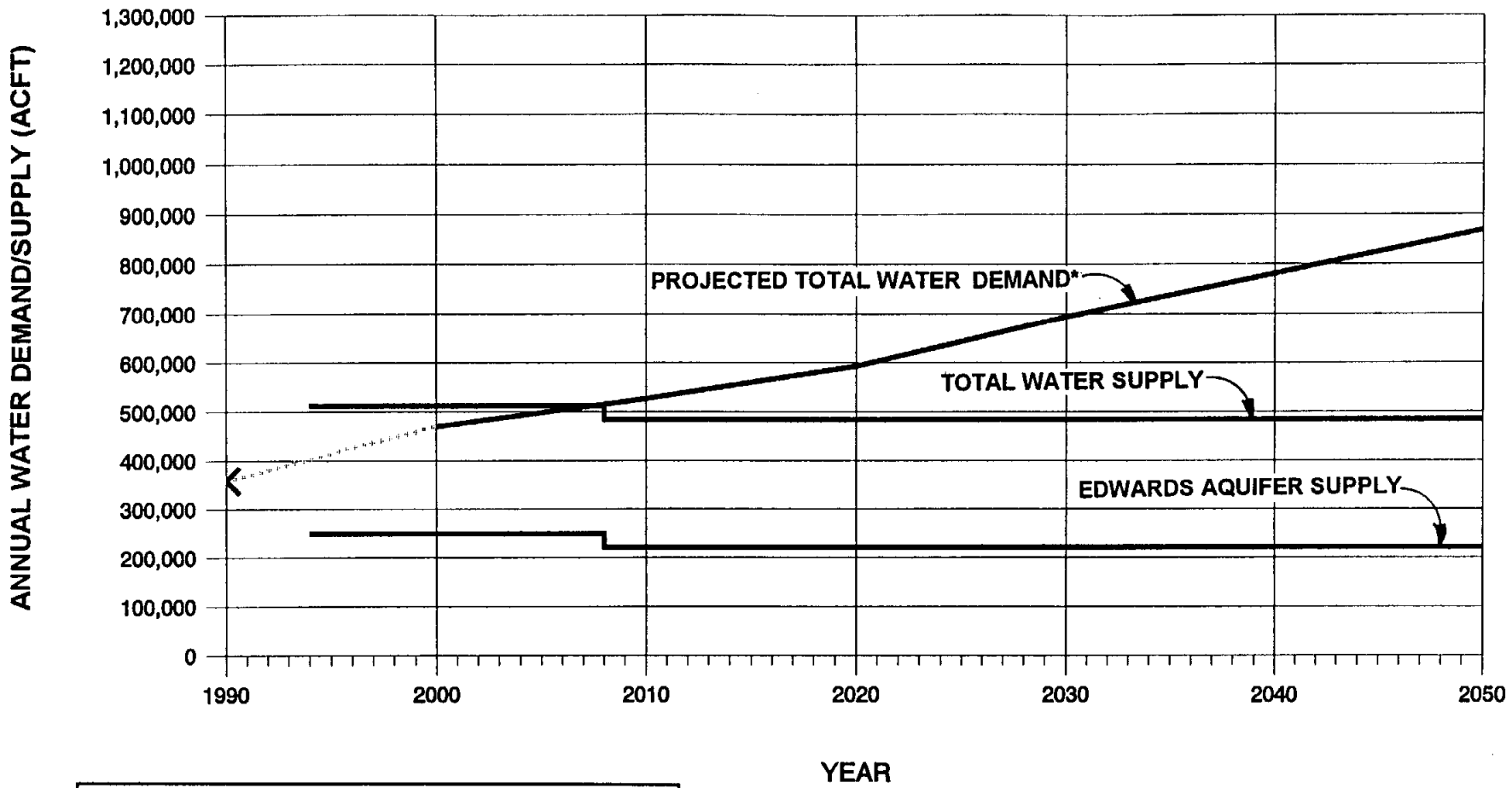
the average supply from Medina Lake (Figure 2-29).

In addition to supplies listed above, City Public Service Board has permits for river diversions and wastewater reuse resulting in the consumptive use of 49,000 acft per year (Braunig and Calaveras Lakes). With these permits, total supply available to the basin from existing sources for the period 1994 through 2007 could be 512,920 acft, which is equal to high case projected demands in about the year 2008 (Figure 2-29). However, at year 2050 projected demands of 868,928 acft are almost 1.8 times projected supplies from sources existing in 1994 (485,140 acft). The projected deficit in year 2050 would be 383,788 acft per year, if high case demands occur and if no new supplies are developed (Figure 2-29).

### 2.4.4 Guadalupe River Basin

In 1990, water use in the Guadalupe Basin and adjacent coastal areas that obtain water from the Guadalupe was 197,959 acft, with high case projections of 484,366 acft of demand in 2050 (Table 2-24). At the present time, available supplies from existing sources are as follows: 18,630 acft from the Edwards Aquifer under SB 1477, 144,700 acft from the Carrizo and other aquifers, 50,000 acft of firm yield from Canyon Lake, and run-of-river permits of 259,100 acft for consumptive use (irrigation and industrial process water) (Figure 2-30). In addition, there are non-consumptive run-of-river hydroelectric power rights at Lake Dunlap of 600 cfs. Since hydroelectric power generation is a nonconsumptive use, these flows can be used to meet several hydroelectric permits downstream of Lake Dunlap and can be used for other purposes downstream of the last hydroelectric power plant at Lake Wood near Gonzales. Thus, the hydroelectric power permits are recognized in the tabulations but are not included in either the demand or supply totals.

A comparison of projected water demands and supplies from existing sources for the Guadalupe Basin show that supply exceeds demand throughout the projection period (Figure 2-30), when groundwater and run-of-river rights are included; i.e., the total of permits, groundwater, and Canyon Lake permits is 472,430 acft per year (1,059,930 acft if once through cooling water is included), which exceeds projected demands through about year 2046. According to these projections, total supplies from existing sources, as expressed above, exceed projected demands by 150,989 acft in 2000, and 77,578 acft in 2020 (Figure




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| WATER SOURCE | THRU 2007 | AFTER 2007 |
| EDWARDS AQUIFER | 250,020 | 222,240 |
| OTHER AQUIFERS | 109,200 | 109,200 |
| RUN-OF-RIVER RIGHTS | 46,800 | 46,800 |
| MEDINA LAKE - AVERAGE SUPPLY | 57,900 | 57,900 |
| BRAUNIG LAKE | 12,000 | 12,000 |
| CALAVERAS LAKE | 37,000 | 37,000 |
| TOTAL | 512,920 | 485,140 |

* In-basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

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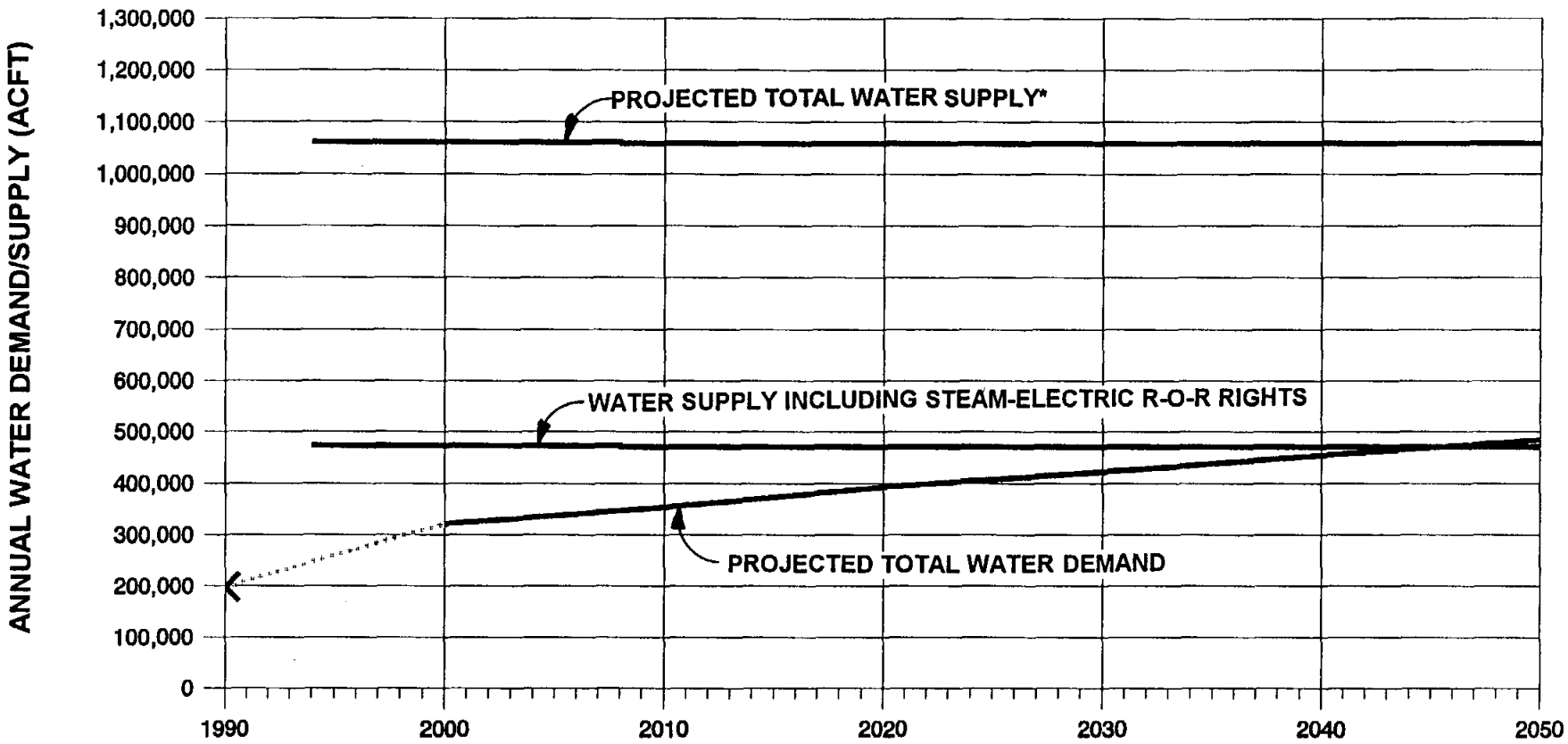
**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS SAN ANTONIO BASIN STUDY AREA**

FIGURE 2-29




| ESTIMATED WATER SUPPLY (ACFT/YR) | | |
|---|---|---|
| **WATER SOURCE** | **THRU 2007** | **AFTER 2007** |
| EDWARDS AQUIFER | 18,630 | 16,560 |
| OTHER AQUIFERS | 144,700 | 144,700 |
| CANYON LAKE | 50,000 | 50,000 |
| CONSUMPTIVE RUN-OF-RIVER RIGHTS | 259,100 | 259,100 |
| **SUBTOTAL** | 472,430 | 470,360 |
| PASS-THROUGH INDUSTRIAL AND STEAM ELECTRIC RUN-OF-RIVER RIGHTS | 587,500 | 587,500 |
| **TOTAL** | 1,059,930 | 1,057,860 |
| NOTE: HYDROELECTRIC RIGHT AT DUNLAP IS 600 CFS. | | |

* In-basin plus adjacent areas that obtain water from the basin.

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TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

# TOTAL WATER DEMAND AND SUPPLY PROJECTIONS GUADALUPE BASIN STUDY AREA

FIGURE 2-30

2-30). When once through industrial cooling water permits are included, projected supplies exceed projected demands through 2050.

### 2.4.5 Colorado River Basin Study Area

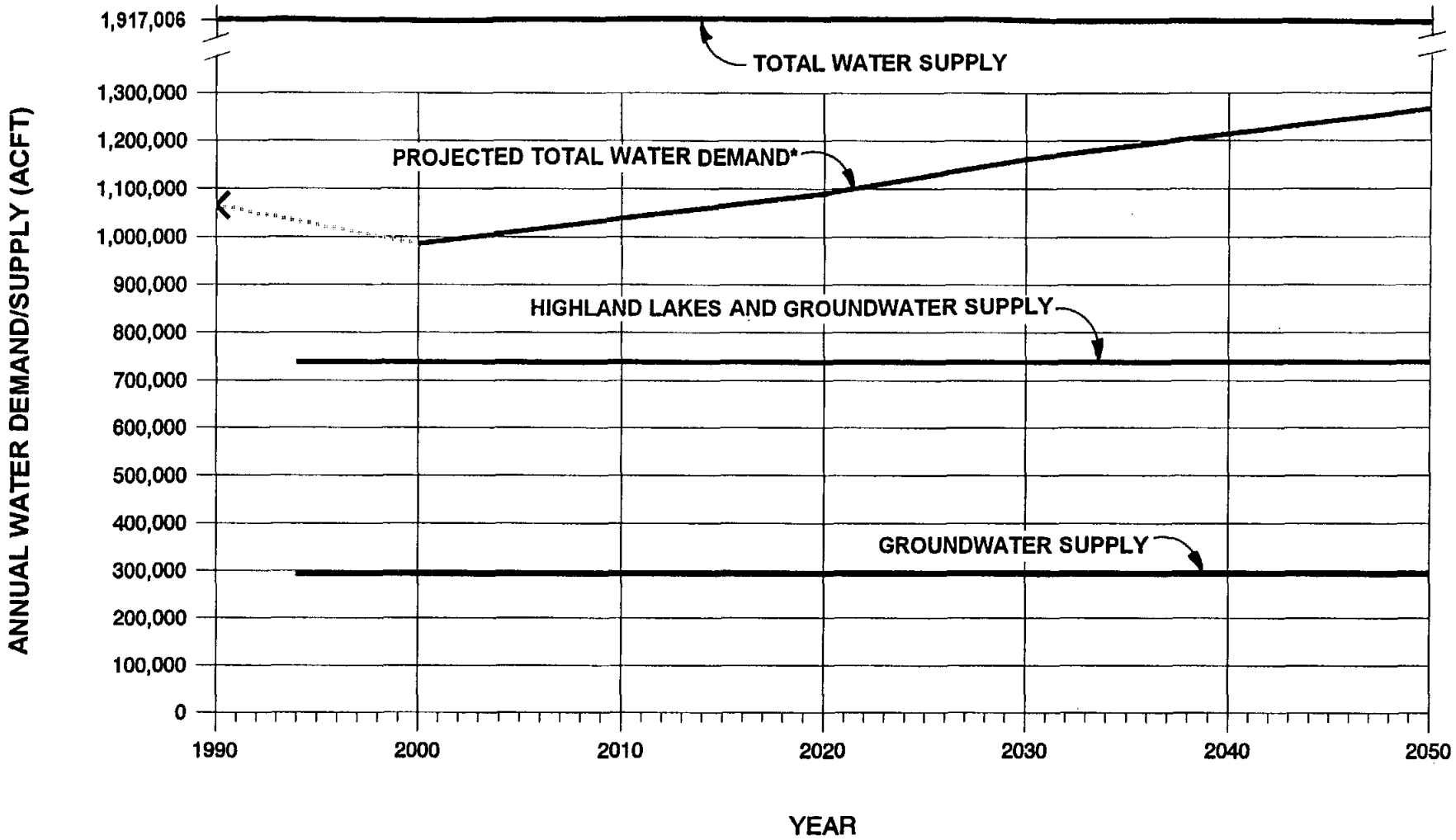
The Lower Colorado Basin Study area includes the counties of the Lower Colorado River Authority and adjacent coastal and inland areas that obtain water from the Colorado River. In 1990, water use of this area was estimated at 1,065,239 acft and is projected at 1,266,242 acft in 2050 (high case with conservation) (Table 2-24). Rice irrigation in the coastal counties is a major water user, reporting more than 636,000 acft of use in 1990 and with increased conservation is projected to use 371,000 acft in 2050 (Table 2-21).

Total supply available from existing sources includes 293,300 acft from the Carrizo and other aquifers, including the Barton Springs Edwards Aquifer which is not included in the boundaries established by SB 1477, 445,300 acft of firm yield from the Highland Lakes, and 1,178,396 acft of run-of-river permits (Figure 2-31). Of the latter, 671,750 acft are for irrigation in Colorado, Wharton, and Matagorda counties near the Gulf Coast (Table 2-29). Groundwater together with firm yield from the Highland Lakes gives a supply of 738,600 acft per year for the projection period, which is less than projected demands in 2000 by 246,020 acft, and in 2050 by 527,642 acft (Figure 2-31). When run-of-river rights are included, the totals of groundwater, firm yield from lakes, and run-of-river permits exceed demand in 2000 by 932,386 acft and in 2050 by 650,764. However, if the run-of-river supplies in the coastal counties yield a critical period supply of 350,921 acft, as estimated by LCRA staff (Section 2.3.2), then dependable supply from existing sources of the Lower Colorado Basin would be approximately 1,089,521 acft per year, which exceeds projected high case, with conservation, demand to about year 2020, and would be about 176,721 acft below projected demands in 2050.

### 2.4.6 Summary of Water Demand and Water Supply Projections

Water Demand Projections

The Texas Water Development Board has made water demand projections for the period 1990 through 2050. High case water demand projections, with conservation, were




| ESTIMATED WATER SUPPLY | |
|---|---|
| WATER SOURCE | ESTIMATED SUPPLY (ACFT/YR) |
| GROUNDWATER | 293,300 |
| HIGHLAND LAKES | 445,300 |
| RUN-OF-RIVER RIGHTS | 1,178,406 |
| TOTAL | 1,917,006 |

* In-basin plus adjacent coastal areas that obtain water from the Colorado Basin. Does not include parts of study area counties located in the Brazos Basin.

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TRANS TEXAS WATER PROGRAM / WEST CENTRAL STUDY AREA

**TOTAL WATER DEMAND AND SUPPLY PROJECTIONS COLORADO BASIN STUDY AREA**

FIGURE 2-31

specified by the TWDB for use in all Trans-Texas studies, and are tabulated and shown in various figures for each of the following areas: (a) 33-county West Central Study Area; (b) Edwards Aquifer area; and (c) river basins and adjacent areas.

In 1990, total water use in the 33-county study area was 2.2 million acft, of which 646,000 acft (30 percent) was in the Edwards Aquifer area. Projected year 2050, total water demand for the 33-county study area is 3.1 million acft (a 41 percent increase), of which 1.1 million acft is in the Edwards Aquifer area (a 70 percent increase). In the Edwards Aquifer area, the two major water use categories are municipal and irrigation. Municipal use is projected to increase from 260,000 acft in 1990 to 765,000 acft in 2050, a 195 percent increase. Conversely, irrigation use is projected to decline from 335,000 acft in 1990 to 240,000 acft in 2050, a 28 percent decrease.

Table 2-32 contains a summary of total water demand projections through year 2050 for the study area, Edwards Aquifer area, river basins, and selected cities. Table 2-33 contains a summary of current and projected water demand by type of use.

**Table 2-32**
**Total Water Demand Projections[1]**
**(in Acre-Feet[2])**

| Area | 1990 | 2020 | 2050 |
|---|---|---|---|
| 33 Counties | 2,177,005 | 2,532,828 | 3,089,709 |
| Edwards Aquifer Area[3] | 646,076 | 853,245 | 1,144,481 |
| River Basin Study Areas | | | |
| Nueces | 555,503 | 457,295 | 470,173 |
| San Antonio | 358,304 | 592,888 | 868,928 |
| Guadalupe | 197,959 | 392,782 | 484,366 |
| Colorado | 1,065,239 | 1,089,836 | 1,266,242 |

[1]Source: Texas Water Development Board; High Case Projection with Conservation.
[2]One acre-foot equals 325,851 gallons.
[3]As defined by SB 1477.

**Table 2-33**
**Water Demand Projection by Type of Use[1]**

| Type of Water Use | 1990 Use | | | | 2050 Projections | | | |
|---|---|---|---|---|---|---|---|---|
| | 33-County Study Area | | Edwards Aquifer Area | | 33-County Study Area | | Edwards Aquifer Area | |
| | Acft | % | Acft | % | Acft | % | Acft | % |
| Municipal | 498,128 | 22.9 | 259,330 | 40.1 | 1,420,211 | 45.9 | 765,017 | 66.8 |
| Industrial | 83,307 | 3.8 | 19,263 | 3.0 | 415,953 | 13.5 | 66,519 | 5.8 |
| Steam-Elec. | 98,755 | 4.5 | 24,263 | 3.8 | 236,200 | 7.6 | 56,000 | 4.9 |
| Irrigation | 1,411,579 | 64.8 | 335,061 | 51.9 | 918,400 | 29.7 | 239,880 | 21.0 |
| Mining | 47,360 | 2.2 | 2,979 | 0.4 | 48,663 | 1.6 | 10,089 | 0.9 |
| Livestock | 37,876 | 1.7 | 5,180 | 0.8 | 50,282 | 1.7 | 6,976 | 0.6 |
| TOTAL | 2,177,005 | 100.0 | 646,076 | 100.0 | 3,089,709 | 100.0 | 1,144,481 | 100.0 |

[1]Source: Texas Water Development Board; High Case Projection with Conservation.

Water Supply Information

Water supply information is listed in Table 2-34 for the Edwards Aquifer Area, and in Tables 2-35 through 2-38 for the river basins of the study area. Water supplies from the Edwards Aquifer are based on SB 1477 (450,000 acft/yr thorough 2007 and 400,000 acft/yr thereafter).

**Table 2-34**
**Estimated Edwards Aquifer Area Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 450,000 | 400,000 |
| Other Aquifers | 39,750 | 39,750 |
| Canyon Lake (New Braunfels Contract) | 6,720 | 6,720 |
| Canyon Lake (San Marcos Contract) | 5,000 | 5,000 |
| Medina Lake - Average Supply | 57,970 | 57,970 |
| Medina River - Run-of-River Rights | 10,503 | 10,503 |
| Braunig Lake | 12,000 | 12,000 |
| Calaveras | 37,000 | 37,000 |
| Total | 618,943 | 569,125 |

**Table 2-35**
**Estimated Nueces River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 181,300 | 161,200 |
| Other Aquifers | 133,200 | 133,200 |
| Run-of-River Rights | 52,700 | 52,700 |
| Total | 367,200 | 347,100 |

**Table 2-36**
**Estimated San Antonio River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 250,020 | 222,240 |
| Other Aquifers | 109,200 | 109,200 |
| Run-of-River Rights | 46,800 | 46,800 |
| Medina Lake - Average Supply | 57,900 | 57,900 |
| Braunig Lake | 12,000 | 12,000 |
| Calaveras | 37,000 | 37,000 |
| Total | 512,920 | 485,140 |

**Table 2-37**
**Estimated Guadalupe River Basin Water Supply (acft/yr)**

| Water Source | Thru 2007 | After 2007 |
|---|---|---|
| Edwards Aquifer | 18,630 | 16,560 |
| Other Aquifers | 144,700 | 144,700 |
| Canyon Lake | 50,000 | 50,000 |
| Consumptive Run-of-River Rights | 259,100 | 259,100 |
| Subtotal | 472,430 | 470,360 |
| Pass-Through Industrial and Steam Electric Run-of-River Rights* | 587,500 | 587,500 |
| Total | 1,059,930 | 1,057,860 |

*Does not include hydroelectric right of 600 cfs at Lake Dunlap, which is a nonconsumptive right and, therefore, these flows can be used for other hydroelectric permits downstream of Lake Dunlap and for other purposes downstream of the last power plant near Gonzales.

| Table 2-38<br>Estimated Lower Colorado River Basin Water Supply | |
|---|---|
| **Water Source** | **Estimated Supply (acft/yr)** |
| Groundwater | 293,300 |
| Highland Lakes | 445,300 |
| Run-of-River Rights | 1,178,406* |
| Total | 1,917,006 |
| *Estimated supply during critical drought -- 350,921 acft | |

Water supply information for the 33-county study area is summarized below:

- Water supply from the Edwards Aquifer, as specified in SB 1477, is as follows:
  - Through 2007, 450,000 acft; and
  - Beginning in 2008, 400,000 acft.

- Groundwater supply information for the Carrizo and other aquifers of the 33-county study area:
  - Recharge (long-term dependable supply), 680,400 acft;
  - Overdrafting is occurring in nine counties;
  - Significant underdevelopment is present in seven counties. (Note: this groundwater is beneath private land and in many cases is more than 50 miles from municipal and industrial users.)

- Annual surface water supply of the 33-county study area are as follows:
  - Nueces Basin Study Area Firm Yield 0 acft
  - San Antonio Basin (Medina Lake) Firm Yield 8,770 acft
  - San Antonio Basin (Medina Lake) Average Supply 57,900 acft
  - Guadalupe Basin (Canyon Lake) Firm Yield 50,000 acft
  - Colorado Basin (Highland Lakes) Firm Yield 445,266 acft
  - Nueces Basin Run-of-River Permits 53,397 acft
  - San Antonio Basin Run-of-River Permits 46,808 acft
  - San Antonio Basin Reuse Permit (Calaveras) 37,000 acft
  - San Antonio Basin Cooling Lake Permit (Braunig) 12,000 acft
  - Guadalupe Basin Run-of-River/Consumptive Permits 272,327 acft
  - Colorado Basin Run-of-River Permits 1,178,406 acft

Comparison of Supply and Demand

The projected water demands are compared with water supplies from existing sources for the Edwards Aquifer area and each of the river basins of the West Central Study Area, as follows:

- Shortages are projected for the Edwards Aquifer area in the immediate future:
  - Year 2000 shortage of 111,865 acft; and
  - Year 2050 shortage of 575,356 acft.

- Shortages are projected for the Nueces Basin Study area in the immediate future:
  - Year 2000 shortage of 134,626 acft; and
  - Year 2050 shortage of 123,073 acft.

- Shortages are projected for the San Antonio Basin after year 2008:
  - Year 2010 shortage of 41,531 acft; and
  - Year 2050 shortage of 383,788 acft.

- For the Guadalupe Basin and adjacent areas, projected demands are less than projected supplies to year 2046, when run-of-river consumptive permits are considered. When once-through industrial and electric power permits of 587,500 acft are included as available supplies for downstream diversion, then supplies exceed demand through 2050.

- For the Lower Colorado Basin and adjacent areas, projected demands are less than the sum of firm yields from lakes, groundwater, and run-of-river surface water rights throughout the planning period (surplus of 932,386 acft in 2000 and 650,764 acft in 2050). However, for drought-of-record conditions (when 1,178,396 acft of run-of-river rights are estimated to yield 350,921 acft), supply equals projected demands in year 2020 and there would be a shortage of 176,721 acft for projected demands in year 2050.