# TRANS-TEXAS WATER PROGRAM

**Austin Study Area**

**Phase I -
Interim Report**

**City of Austin**

**Texas Water
Development Board**

**August, 1994**

HDR

HDR Engineering, Inc.
in association with
Paul Price Associates, Inc.

# TRANS-TEXAS WATER PROGRAM
# AUSTIN STUDY AREA

## PHASE I
## INTERIM REPORT

Prepared for

City of Austin
Texas Water Development Board

by

HDR

HDR Engineering, Inc.
in association with
Paul Price Associates, Inc.

August, 1994

TRANS-TEXAS WATER PROGRAM

AUSTIN STUDY AREA

## TABLE OF CONTENTS

Page

## LIST OF FIGURES

## LIST OF TABLES

# TRANS-TEXAS WATER PROGRAM
# AUSTIN STUDY AREA

## 1.0 INTRODUCTION

The Texas Water Development Board (TWDB) is the state agency responsible for the preparation and maintenance of a comprehensive state water plan to be used as a flexible guide for the orderly development and management of the state's water resources in order that sufficient water will be available at a reasonable cost to further the economic development of the entire state (Texas Water Code; Sections 16.051 and 16.055). In its 1990 Texas Water Plan, the TWDB projections of population and water demand growth identified immediate water supply needs in the metropolitan areas of southeast and south central Texas (Houston, Corpus Christi, and San Antonio). The 1990 Water Plan also identified significant quantities of water supply in Toledo Bend Reservoir at the eastern borders of Texas that are available to Texas.

On May 7, 1992, the TWDB, city leaders of Houston, Corpus Christi, and San Antonio, leaders of water supply organizations, and other state officials met and initiated the Trans-Texas Water Program in an effort to address the water supply needs of these areas in a coordinated, logical, and environmentally responsible manner. The Trans-Texas water program is anticipated to become an integral part of the State Water Plan.[1]

The Trans-Texas Water Program planning studies are being conducted in multiple phases. 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 environmental advantages and disadvantages. From the results of the Phase I studies, the most attractive options will be selected for more detailed evaluations and costing 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 will be the remaining implementation phases which include:

---

[1] "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 document is the Phase I Study Report for the City of Austin.

## 1.1 The Study Area

The City of Austin study area includes portions of Travis, Williamson, and Hays counties. The study area is located in parts of the Colorado and Brazos River basins. In addition to the regular service area, the City provides stand-by service to some portions of Hays County on an as-needed emergency basis and to neighboring areas of Travis and Williamson counties (Figure 1-1).

Population of the study area was 463,757 in 1990, and is projected to grow at a compound annual rate of 1.75 percent to the year 2050, at which time the population of the area is estimated to be 1,315,327. The economy of the area is strong and is one of the leading growth areas in the country. The climate of the area is semiarid with average annual precipitation of 33 inches. The City obtains water of high quality from the Colorado river. Water supplies for the rural parts of the study area are obtained from aquifers and from the Colorado River and its tributaries.

## 1.2 Objectives

The objectives of the Phase I Trans-Texas Water Program study are to:

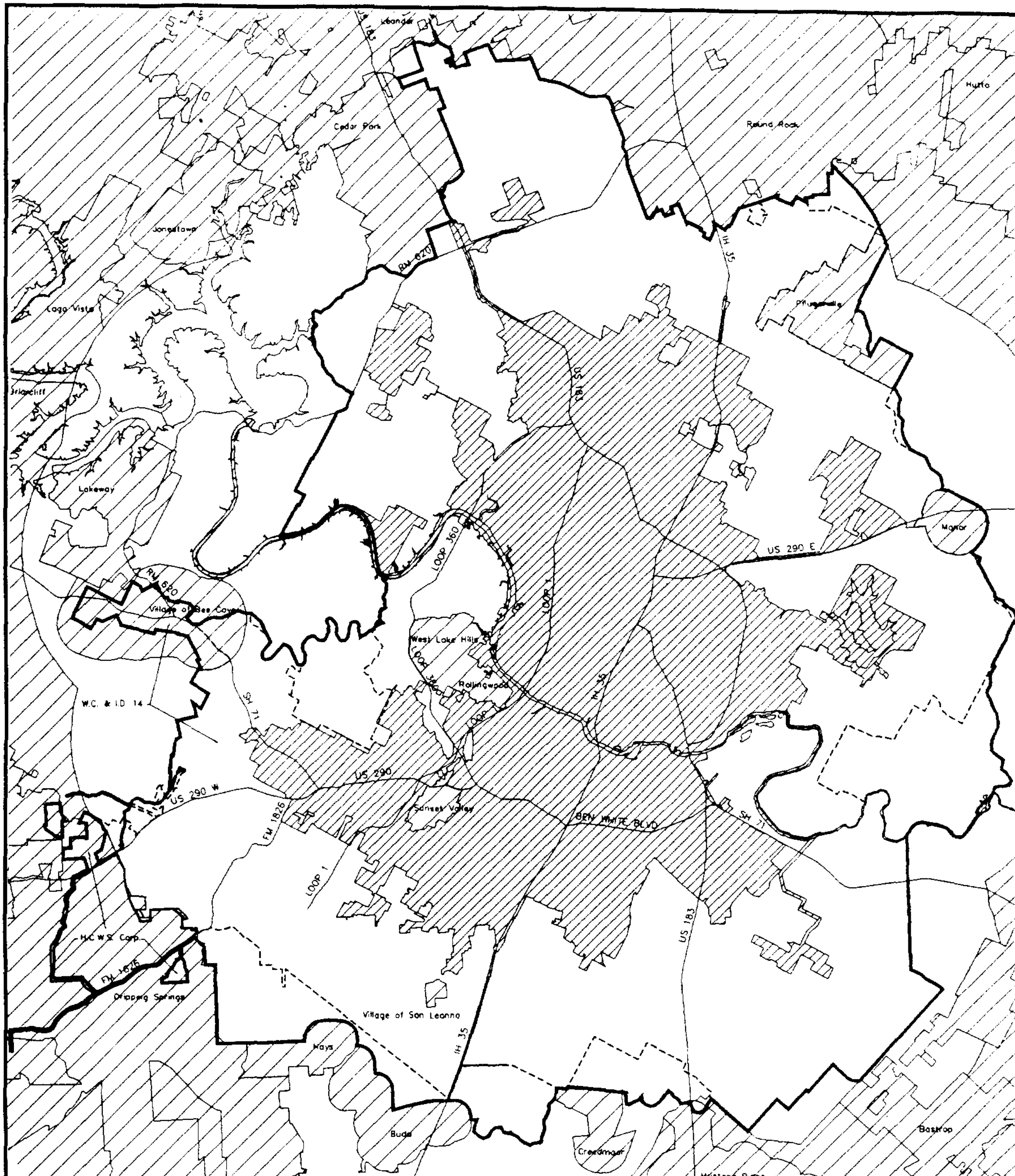
1) Present projections of populations and water demands of the study area for the period 1990 through 2050;

2) Identify potential water supply shortages and surpluses,

3) Identify water supply options if shortages exist in the study area; and

4) Provide a general assessment of the water supply potentials, and environmental advantages and disadvantages of each option. (Note: cost estimating for each alternative is to be provided in Phase II studies.)

The supply options considered for this area include additional purchases from the Lower Colorado River Authority (LCRA), transfers from the Brazos River Basin, and wastewater reuse.




**Legend**

- Area Outside of Austin E.T.J
- City of Austin Current Full Purpose Annexation Area
- Long-Range Water Planning Boundary

Courtesy of: City of Austin

HDR

HDR Engineering, Inc.

TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**WATER PLANNING AREA MAP**

FIGURE 1-1

## 2.0 POPULATION AND WATER DEMAND PROJECTIONS

The purpose of this section is to present population and water demand projections to the year 2050 for the City of Austin water service area, which includes the City and some neighboring areas outside the incorporated area. The population and water demand projections presented herein are the Texas Water Development Board's (TWDB) April, 1992 high case, with conservation projections, as specified by the TWDB for use in all Phase I Trans-Texas studies[2]. The TWDB projections to the year 2040 were extrapolated to 2050 at the same rate that was projected for the period 2030 to 2040[3].

### 2.1 Population Projections -- City of Austin and Travis, Williamson, and Hays Counties

The population of the City of Austin in 1990, as reported by the U.S. Bureau of the Census, was 463,757. In addition to the population of the City, the water utility supplied water to a population of 81,664 neighboring area residents, bringing the total service area population to 545,421 (Table 2-1 and Figure 2-1).

The high case population projection for the City's service area in 2050 is 1,460,446 with 90 percent located in the City and 10 percent located in adjacent areas[4]. Both the City and customers outside the City are projected to reside in Travis and Williamson Counties with those of Williamson County being in the neighboring Brazos Basin.

### 2.2 Water Demand Projections -- City of Austin and Travis, Williamson, and Hays Counties

Texas Water Development Board high case water demand projections, with conservation, are tabulated for the City of Austin service area and for Travis and Williamson Counties in which parts of the Austin service area are located. Projections are shown for each of Austin's

[2]Unpublished, "Scope of Work for South Central Trans-Texas Study", Trans-Texas Water Program, Texas Water Board, September 1992, Austin, Texas.

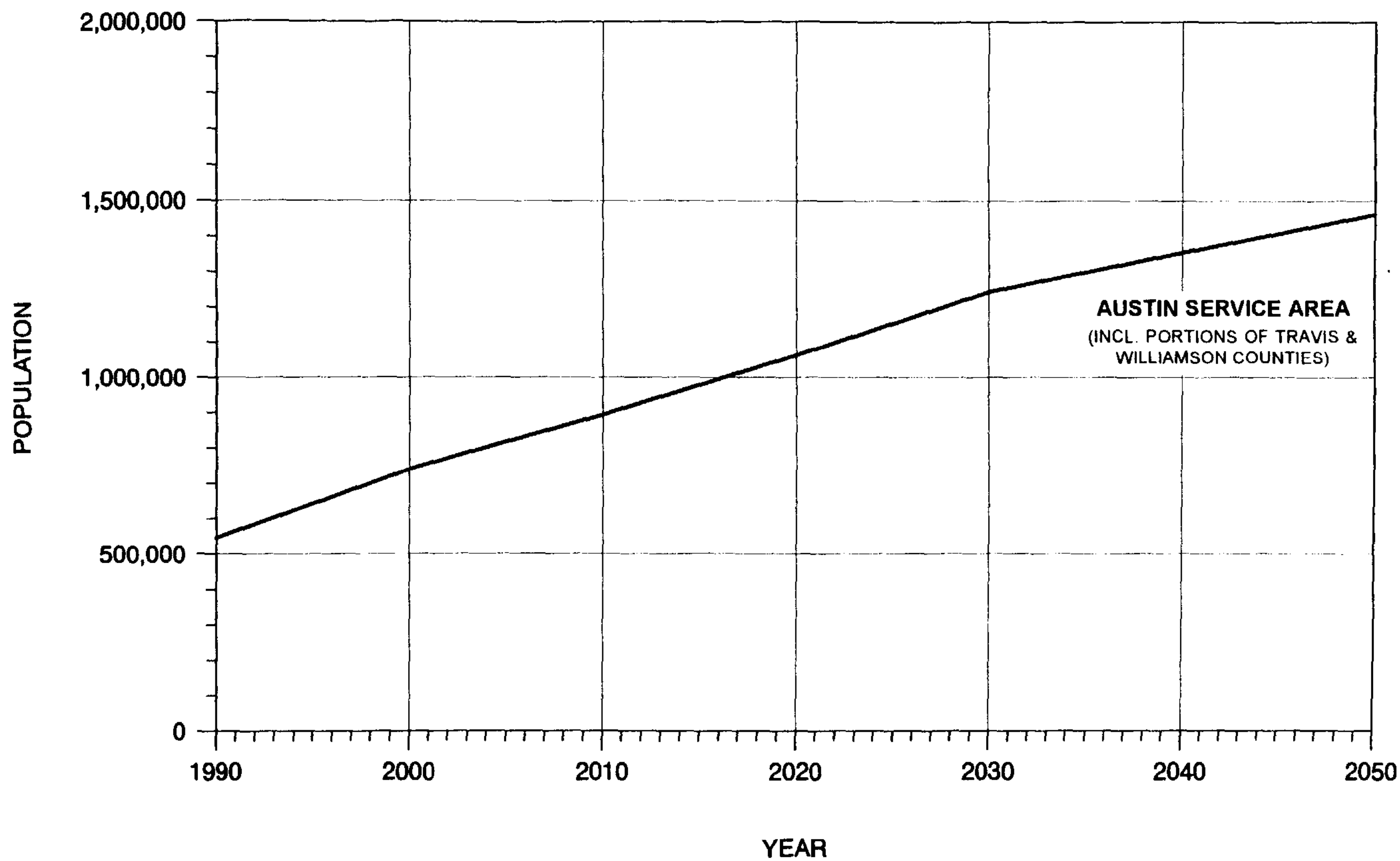
[3]Decision at February 10, 1992, Trans-Texas Coordination Meeting, Austin, Texas.

[4]The TWDB population projections methodology uses vital statistics of the county for which projections are being made, and net migration rates computed from the decennial censuses of the U.S. Bureau of the Census. This high case projection is based upon migration rates of the 1980's.

**Table 2-1**
**Population Projections -- Austin Service Area, and Travis, Williamson, and Hays Counties**
**Trans-Texas Water Program**

| Area City/County/Basin | 1990[1] | Projections[2] | | | | | | Growth Rate (%)* |
|---|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | |
| **Austin** | | | | | | | | |
| Within City | 463,757 | 626,745 | 767,655 | 923,886 | 1,094,328 | 1,204,365 | 1,314,042 | 1.75 |
| Outside City | 81,664 | 110,719 | 124,967 | 138,052 | 149,226 | 148,854 | 146,044 | 0.97 |
| **Austin Service Area** | 545,421 | 737,464 | 892,622 | 1,061,938 | 1,243,554 | 1,353,219 | 1,460,446 | 1.66 |
| **Travis County** | 576,407 | 747,012 | 906,601 | 1,083,814 | 1,273,733 | 1,397,285 | 1,520,837 | 1.63 |
| **Williamson County** | 139,551 | 225,008 | 311,795 | 403,388 | 558,821 | 658,572 | 758,323 | 2.86 |

[1]1990 Census, U.S. Bureau of the Census, U.S. Department of Commerce
[2]Texas Water Development Board, High Case for 1990 though 2040, with extrapolation to 2050 at same rate as projected for 2030-2040, April 1992, Austin, Texas.
[3]Estimated use using data from "Hays County Water and Wastewater Study", Hays County Water Development Board, San Marcos, Texas, May, 1989.
Note: Texas population in 1990 was 16,986,510. TWDB projections for 2000 are 20,257,960 and for 2050 are 36,308,602 (1.27% growth rate).




TRANS TEXAS WATER PROGRAM /
AUSTIN STUDY AREA

**POPULATION PROJECTIONS
AUSTIN SERVICE AREA**

HDR Engineering, Inc.

FIGURE 2-1

major water-using categories, as follows: (1) Municipal, (2) Manufacturing, and (3) Steam-Electric Power Generation. For the counties, projections are shown for municipal, manufacturing, steam-electric power, irrigation, mining, and livestock purposes. 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 using 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. |

The data required for projections of municipal water demand are population (P) and per capita water use (gpcd). The TWDB's population and per capita water use projections for Austin and Travis and Williamson counties were used by the TWDB to make municipal water demand projections for Austin and Travis and Williamson counties. High case population projections are shown in Section 2-1. The high case, dry weather condition, per capita water use projection was calculated by the TWDB from Austin's water use reports for the 1981 though 1990 period. For example, per capita water use was calculated for each year of the 1981 - 1990 period and, the highest of the annual per capita water use rates was selected for use in making the municipal water demand projections.

The water conservation effects of the 1991 Texas Plumbing Fixtures Act (Senate Bill 587, 1991 Texas Legislature) were incorporated into the per capita water use projections. The Act states that no fixture can be manufactured, imported, or sold that does not meet the criteria set forth in the bill (wall mounted flushometer toilets -- 2.0 gallons per flush; all other toilets -- 1.6 gallons per flush; shower heads -- 2.75 gallons per minute at 80 psi; urinals -- 1.0 gallons per flush; faucet aerators -- 2.2 gallons per flush at 60 psi; and drinking water fountains -- self closing). The 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 high case, dry year per capita water use rate by six gallons per decade between 1990 and 2020; i.e., high case, dry year per capita water use for Austin at the beginning of the projection period was 221 gallons per day; the rate for the year 2000 was 215 gallons per day, the rate for 2010 was 209 gallons per day, and the rate for 2020 and the following decades was 203 gallons per day. Projections of annual municipal water demand for 2000-2050 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 the Austin service area (Section 2.1) at the corresponding decadal point in time. County projections were made by summing the projections for the cities of each county and the projections for rural areas of the counties, with the later projections based upon rural area per capita water use.

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 were made of quantities of water needed at future decadal points by applying estimated growth rates of each respective industry. Industrial water conservation effects were 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, or 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 held constant at Austin's present power generation capacity, with electric power being obtained from power plants that are located outside the Austin water service area (Fayette and Matagorda counties).

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 estimates of acreages of each irrigated crop and estimates of the quantities of water required per acre irrigated.

Since some irrigation is done in Travis and Williamson counties, this category is included in the county projections in order to have the information available.

## 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.

As in the case of irrigation, mining water use and projected demands for Travis, and Williamson counties are included in the county projections in order to have the information available. The major mining activity of these counties is for building materials production, including sand, gravel, and stone products, all of which are needed for the City's growth. As these industries grow, their water use can be expected to increase demands upon the area's water supplies.

## 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.

As in the cases of irrigation and mining, livestock water use in Travis and Williamson counties is included for perspective and information purposes.

## Water Demand Projections

In 1990, water use in the Austin service area was reported at 115,374 acft, of which 103,235 acft (89%) was for municipal purposes, 6,003 acft (5%) was for industry, and 6,136 acft (6%) was for steam-electric power generation (Table 2-2).

(Note: Whereas municipal and industrial use is in terms of total water withdrawn from sources, stream-electric power use is in terms of quantity that is evaporated as it is used within the electric power generation plants, and is less than one percent of total water circulated and recirculated through the electric power generation plants.)

**Table 2-2**
**High Case, with Conservation, Water Demand Projections -- Austin Service Area**
**Trans-Texas Water Program**

| Service Area | 1990[1] | Projected Water Demands[2] -- Acft | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| **Austin Municipal** | | | | | | | |
| Within City | 88,782 | 150,920 | 179,708 | 210,091 | 248,850 | 273,872 | 298,895 |
| Outside City | 14,453 | 26,661 | 29,254 | 31,393 | 33,933 | 33,849 | 33,210 |
| Service Area | 103,235 | 177,581 | 208,962 | 241,484 | 282,783 | 307,721 | 332,105 |
| Neighbors Back-Up | -- | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Municipal Total | 103,235 | 180,581 | 211,962 | 244,484 | 285,783 | 310,721 | 335,105 |
| Industrial Total | 6,003 | 13,263 | 17,429 | 21,358 | 25,290 | 29,376 | 29,533 |
| Steam-Electric Power | 6,136 | 7,425 | 7,425 | 7,425 | 7,425 | 7,425 | 7,425 |
| Austin Service Area Total | 115,374 | 201,269 | 236,816 | 273,267 | 318,498 | 347,522 | 372,063 |
| **COA Projections[3]** | **115,374** | **133,297** | **159,060** | **192,664** | **232,989** | **284,516** | **347,245** |

[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] City of Austin water demand projections. These projections do not include water for steam-electric power. The projections include a 5 percent conservation savings by year 2000, and an additional 5 percent conservation by 2020.

Projected high case, with conservation, water demands to year 2000 for the Austin service area, for dry weather conditions, are 201,269 acft (Table 2-2), of which 90 percent (180,581 acft) is for municipal purposes, 6.6 percent (13,263 acft) is for industry, and 3.7 percent (7,425 acft) is for steam-electric power generation. Under average weather conditions, Austin service area municipal water use in year 2000 would likely be only 83 percent of that projected for dry weather conditions, or approximately 149,882 acft. (Note: This average weather condition projection for year 2000 is based upon average per capita water use for the 1981-1990 period, which is 180 gallons per person per day or 82 percent of the dry year per capita water use of 215 gallons per person per day in year 2000.)

City of Austin service area projected water demands to year 2020 are 273,267 acft (high case with conservation) for dry weather conditions (Table 2-2). Projections to 2050 (high case with conservation) are 372,063 acft (Table 2-2) of which 335,105 acft or 90.1 percent are for municipal purposes, 7.9 percent or 29,533 acft are for industry, and 2.0 percent, or 7,425 acft are for steam-electric power generation. For average weather conditions, year 2050 use is estimated at about 315,095 acft.

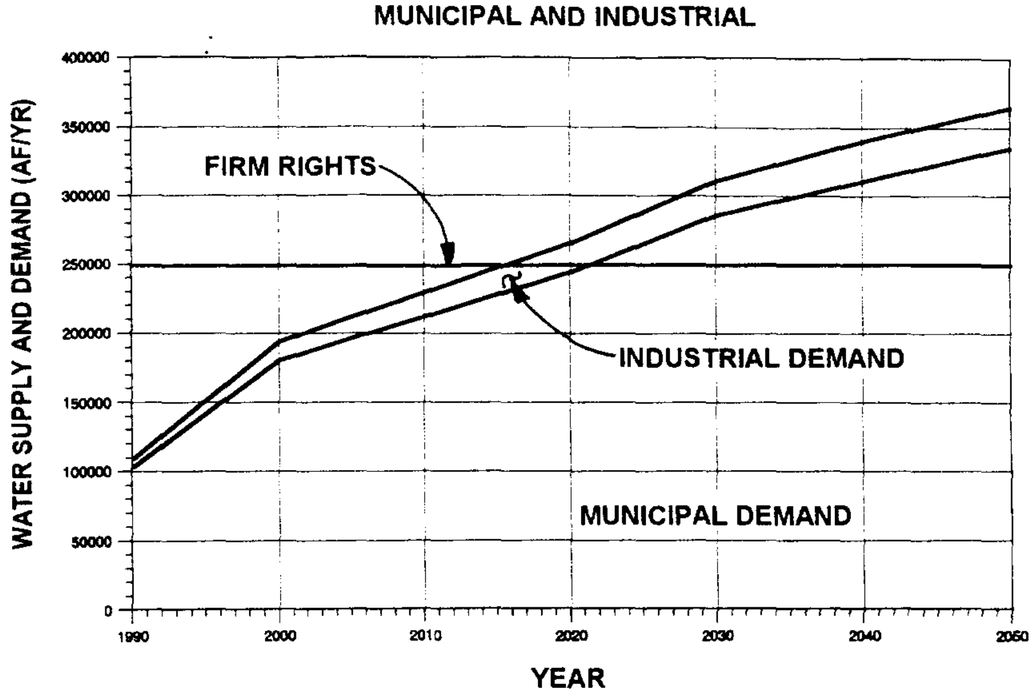
Water use in Travis County in 1990 was reported at 131,280 acft, while use in Williamson County was 28,189 acft (Table 2-3). Projections for Travis County to year 2050 (high case with conservation and dry weather) are 372,137 acft and for Williamson County are 153,163 acft.

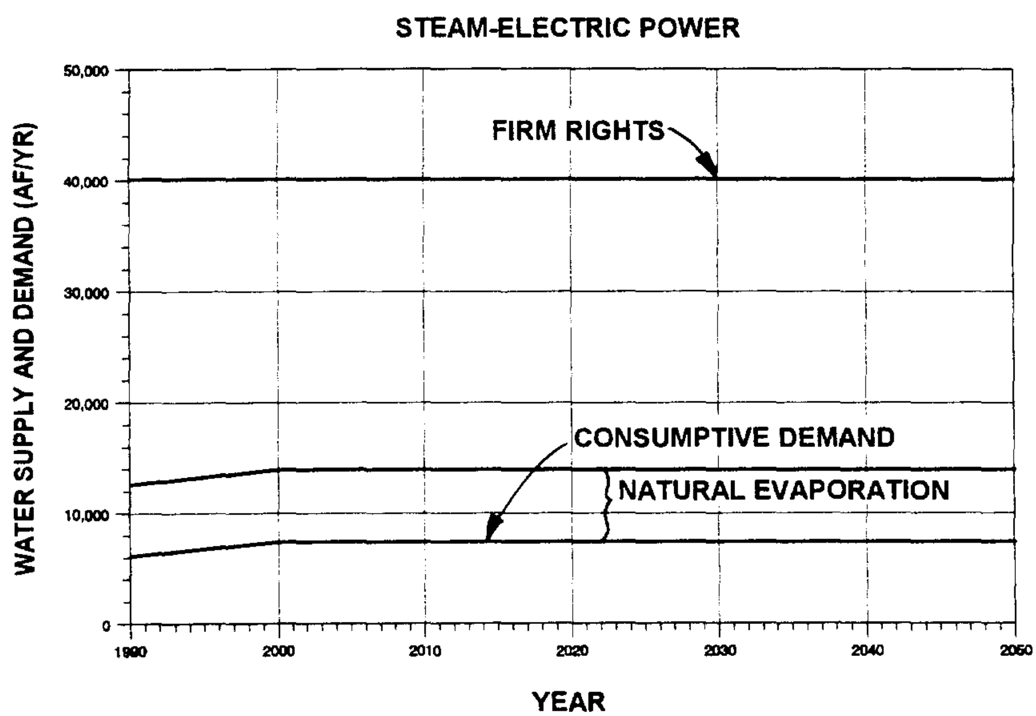
Projections for the City of Austin Service Area (Table 2-2) are shown in Figure 2-2 in a form that is easily related to water supply for purposes of showing projected growth in water demands, comparisons to supplies available, surpluses or shortages, and time at which shortages may occur (Section 4.0). The latter information is needed in order to develop plans and ways to meet future needs, including additional conservation programs to reduce overall demands.

**Table 2-3**
**High Case, with Conservation, Water Demand Projections -- Travis and Williamson Counties**
**Trans-Texas Water Program**

| Area | 1990[1] | Projected Water Demands[2] -- Acft | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| **Travis County** | | | | | | | |
| Municipal | 114,809 | 174,069 | 203,075 | 235,214 | 273,721 | 297,268 | 320,815 |
| Industrial | 6,243 | 13,803 | 18,139 | 22,227 | 26,379 | 30,569 | 34,759 |
| Steam-Electric | 6,198 | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 |
| Irrigation | 800 | 990 | 990 | 990 | 990 | 990 | 990 |
| Mining | 2,288 | 4,934 | 5,021 | 5,384 | 5,884 | 6,429 | 6,974 |
| Livestock | 942 | 1,099 | 1,099 | 1,099 | 1,099 | 1,099 | 1,099 |
| Total | 131,280 | 202,395 | 235,824 | 272,414 | 315,573 | 343,855 | 372,137 |
| **Williamson County** | | | | | | | |
| Municipal | 24,482 | 48,643 | 64,486 | 80,348 | 109,137 | 127,781 | 146,425 |
| Industrial | 326 | 457 | 596 | 731 | 876 | 1,029 | 1,182 |
| Steam-Electric | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation | 160 | 165 | 165 | 165 | 165 | 165 | 165 |
| Mining | 1,713 | 2,014 | 2,344 | 2,673 | 3,002 | 3,375 | 3,748 |
| Livestock | 1,508 | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 | 1,643 |
| Total | 28,189 | 52,922 | 69,234 | 85,560 | 114,823 | 133,993 | 153,163 |

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.




TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

HDR Engineering, Inc.

**WATER DEMAND PROJECTIONS - AUSTIN SERVICE AREA**

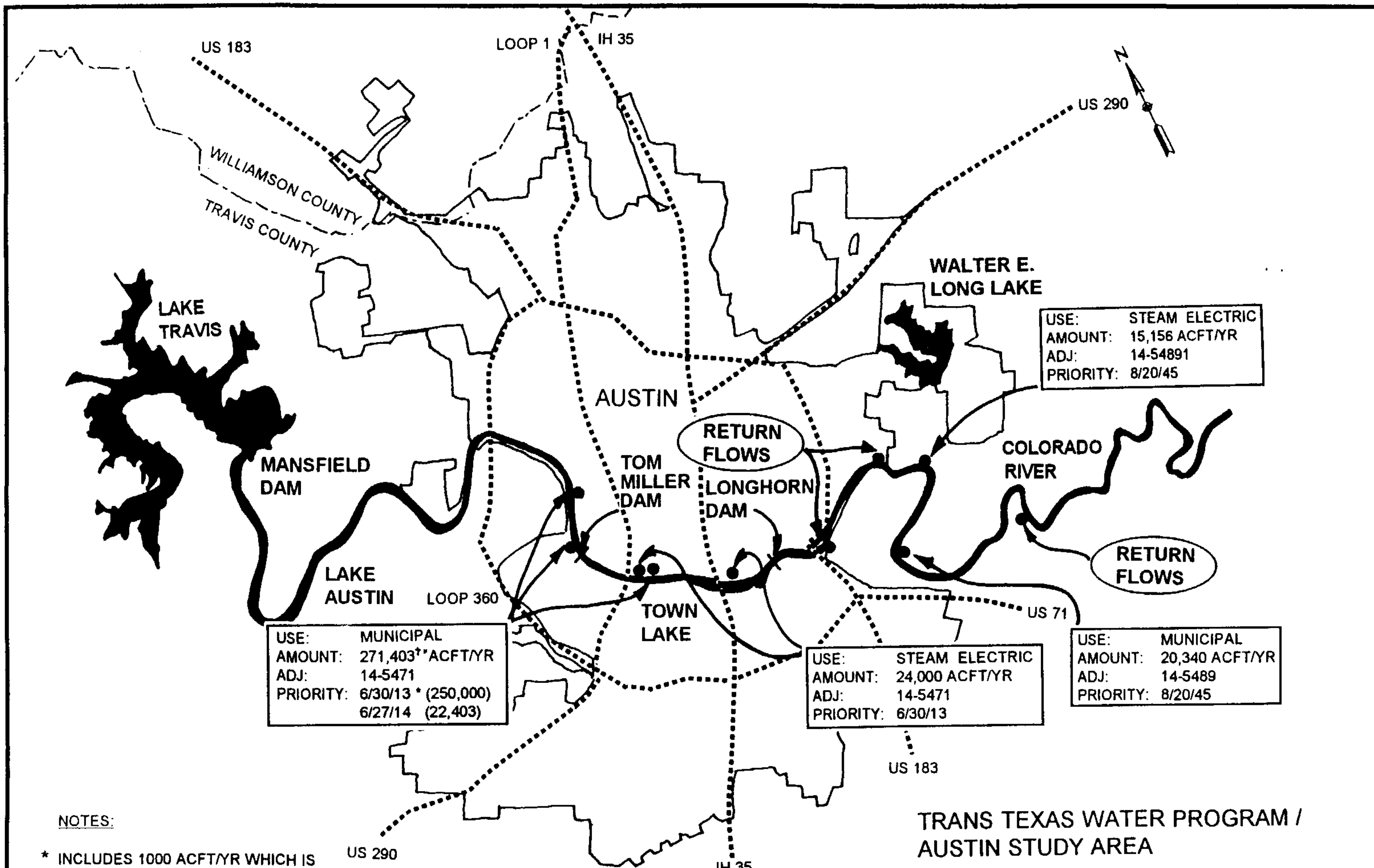
FIGURE 2-2

## 3.0 REVIEW OF CURRENT SUPPLY

The City of Austin (City) holds several water rights adjudicated by the TNRCC and has also entered into a settlement agreement with the Lower Colorado River Authority which adds terms and constraints beyond the water rights themselves. The availability of water under the conditions of these water rights and agreements has been reviewed based on prior simulations of the City of Austin's rights using LCRA's Daily Allocation Program (DAP) of the Colorado River. Section 3.1 and 3.3 discuss availability of water from the City's run-of-river rights and Section 3.3 describes how the City's water supply is backed up by storage in LCRA's reservoirs when run-of-river flows are not available.

### 3.1 Existing Rights

The City holds several water rights which are described in Certificates of Adjudication 14-5471A and 14-5489. The actual diversion points for these rights are situated along Lake Austin and Town Lake, with no limitation on the points of diversion, at the points located in Figure 3-1 and these rights are listed in Table 3-1. For purposes of this study, only municipal and steam electric supplies were evaluated (the City holds other minor rights for hydroelectric, recreational, and irrigation purposes). It is important to note that municipal water supply includes all demands of a municipal utility which may include residential, commercial, non-agricultural irrigation, and industrial uses.




NOTES:

* INCLUDES 1000 ACFT/YR WHICH IS TEMPORARILY USED FOR IRRIGATION

† IRRIGATION AND STORAGE RIGHTS OF LCRA ARE EXPLICITLY SUBORDINATED TO THIS RIGHT REGARDLESS OF PRIORITY DATE

HDR

HDR Engineering, Inc.

TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**EXISTING WATER RIGHTS WITH CURRENT DIVERSION LOCATIONS**

FIGURE 3-1

| Table 3-1<br>City of Austin Existing Water Rights | | | |
|---|---|---|---|
| **Permitted Use** | **Certificate of Adjudication** | **Priority Date** | **Quantity (acft/yr)** |
| Municipal | 14-5471 | June 30, 1913[1] | 250,000[2] |
| | 14-5471 | June 27, 1914 | 22,403 |
| | 14-5489 | August 20, 1945 | 20,300 |
| Total | | | 292,703 |
| Steam Electric | 14-5471 | June 30, 1913 | 24,000 |
| | 14-5489 | August 20, 1945 | 16,156 |
| Total | | | 40,156[3] |
| Irrigation | 14-5471 | June 30, 1913 | 150 |
| | 14-5471 | June 30, 1913 | 1,000[4] |
| Total | | | 1,150 |

[1] Irrigation and Storage rights of LCRA are explicitly subordinated to this right regardless of priority date.
[2] Includes the 1,000 acft/yr of water currently being used for irrigation.
[3] Permit limits consumptive use to quantity shown. There is no limit on diversion rate of pass-through diversions stated in the permit.
[4] This 1,000 acft/yr right is a temporary change of municipal use which expires after December 31, 2011.

### 3.1.1 Municipal Rights

The City currently holds cumulative rights to 292,703 acft/yr of municipal water rights from the Colorado River. Colorado River flows (i.e., run-of-river flows) at Austin can be diverted for municipal use provided that the water is not needed by senior downstream water rights. The first 250,000 acft/yr of the City's rights are the most senior of the City's rights and pursuant to the settlement agreement, this amount is senior to LCRA's rights. The only significant water rights within the Lower Colorado River Basin senior to these rights are the Garwood Irrigation Company (168,000 acft per year) and Pierce Ranch Limited (110,000 acft per year). However, as described in Section 3.3, LCRA and the City have an agreement in which the City's water rights (up to 250,000 acft/yr) are backed up by storage in LCRA's reservoirs at times when run-of-river flows are insufficient. Additionally, 55,000 acft/yr of Pierce Ranch rights is now subordinated to the City's rights under the LCRA/COA agreement. The portion of Certificate of Adjudication 14-5471 for 22,403 acft/yr is apparently junior to

| Table 3-1<br>City of Austin Existing Water Rights | | | |
|---|---|---|---|
| **Permitted Use** | **Certificate of Adjudication** | **Priority Date** | **Quantity (acft/yr)** |
| Municipal | 14-5471 | June 30, 1913[1] | 250,000[2] |
| | 14-5471 | June 27, 1914 | 22,403 |
| | 14-5489 | August 20, 1945 | 20,300 |
| Total | | | 292,703 |
| Steam Electric | 14-5471 | June 30, 1913 | 24,000 |
| | 14-5489 | August 20, 1945 | 16,156 |
| Total | | | 40,156[3] |
| Irrigation | 14-5471 | June 30, 1913 | 150 |
| | 14-5471 | June 30, 1913 | 1,000[4] |
| Total | | | 1,150 |

[1] Irrigation and Storage rights of LCRA are explicitly subordinated to this right regardless of priority date.
[2] Includes the 1,000 acft/yr of water currently being used for irrigation.
[3] Permit limits consumptive use to quantity shown. There is no limit on diversion rate of pass-through diversions stated in the permit.
[4] This 1,000 acft/yr right is a temporary change of municipal use which expires after December 31, 2011.

3.1.1 Municipal Rights

The City currently holds cumulative rights to 292,703 acft/yr of municipal water rights from the Colorado River. Colorado River flows (i.e., run-of-river flows) at Austin can be diverted for municipal use provided that the water is not needed by senior downstream water rights. The first 250,000 acft/yr of the City's rights are the most senior of the City's rights and pursuant to the settlement agreement, this amount is senior to LCRA's rights. The only significant water rights within the Lower Colorado River Basin senior to these rights are the Garwood Irrigation Company (168,000 acft per year) and Pierce Ranch Limited (110,000 acft per year). However, as described in Section 3.3, LCRA and the City have an agreement in which the City's water rights (up to 250,000 acft/yr) are backed up by storage in LCRA's reservoirs at times when run-of-river flows are insufficient. Additionally, 55,000 acft/yr of Pierce Ranch rights is now subordinated to the City's rights under the LCRA/COA agreement. The portion of Certificate of Adjudication 14-5471 for 22,403 acft/yr is apparently junior to

LCRA's downstream rights, but is senior to LCRA's storage rights in Lakes Travis and Buchanan. Although this right is not as dependable as the first 250,000 acft, it is a significant right.

The final 20,300 acft/yr municipal right (i.e. Certificate of Adjudication 14-5489) is junior to Lakes Travis and Buchanan, therefore, is limited to withdrawal of spills from Lake Travis and inflows to the Colorado River which occur downstream of Lake Travis and above the diversion point, that are not required by more senior rights holders. Water availability under this right is substantially less than that under the former two, particularly during periods of drought. Availability of this right under drought conditions was not modeled, but firm yield and drought conditions availability is estimated to be a very small percentage of the total right.

### 3.1.2 Steam Electric Rights

The City currently has 40,156 acft per year of water rights for consumptive use associated with steam electric power generation. Under the steam electric rights, the City may divert any quantity available as pass-through cooling without limit. The first 24,000 acft per year of the City's rights is the most senior portion with a priority date of June 30, 1913. This water may be diverted anywhere along the perimeter of Lake Austin or Town Lake and is utilized for the Seaholm and Holly Street power plants.

The second right is for 16,156 acft per year and has a priority date of August 20, 1945. The diversion point for this right is downstream of Longhorn Dam and downstream of both the Walnut Creek and the Govalle wastewater treatment plant discharge points. This right is used for cooling at the Decker power plant and to maintain the lake level of Walter E. Long Lake.

## 3.2 Water Availability from Existing Rights

Some of the City's water rights are of run-of-the-river rights and therefore are not necessarily available in each and every year. Water availability under these existing rights at specific diversion locations was determined using the Colorado River Daily Allocation Program (DAP). This computer model was developed by LCRA and LCRA staff applied the model at HDR's direction to determine water availability. The model uses flows from the historical 1941 to 1965 period and allocates water to significant diverters based on seniority of rights. Table

3-2 summarizes the senior water rights in the basin which are included in the model. The South Texas Nuclear Project is an additional large downstream right-holder, but is junior to the City's major rights.

**Table 3-2**
**Major Water Rights in the Lower Colorado Basin**

| Water Right Holder | Priority Date | Type of Use | Total Water Right (acft/yr) |
|---|---|---|---|
| Lakeside Irrigation Division - LCRA | | | |
| subordinated | 11/1987 | irrigation | 78,750 |
| unsubordinated | 11/1901* | irrigation | 52,500 |
| Total | | | 131,250 |
| Garwood Irrigation Co. | | | |
| A - Garwood | 11/1900 | irrigation | 133,000 |
| B - Corpus Christi | 11/1900 | municipal | 35,000 |
| Total | | | 168,000 |
| Pierce Ranch | | | |
| A - Pierce Estate | 9/1907 | irrigation | 55,000 |
| B - LCRA | 9/1907 | municipal | 55,000 |
| Total | | | 110,000 |
| Gulf Coast Irrigation Division - LCRA | | | |
| subordinated | 11/1987 | irrigation | 33,930 |
| unsubordinated | 12/1900* | irrigation | 228,570 |
| Total | | | 262,500 |

* This portion of the water rights has been subordinated to the City of Austin, but not to other more junior rights.
** The South Texas Nuclear Project is an additional large downstream right-holder, but is junior to the City's major rights and to the Highland Lakes.

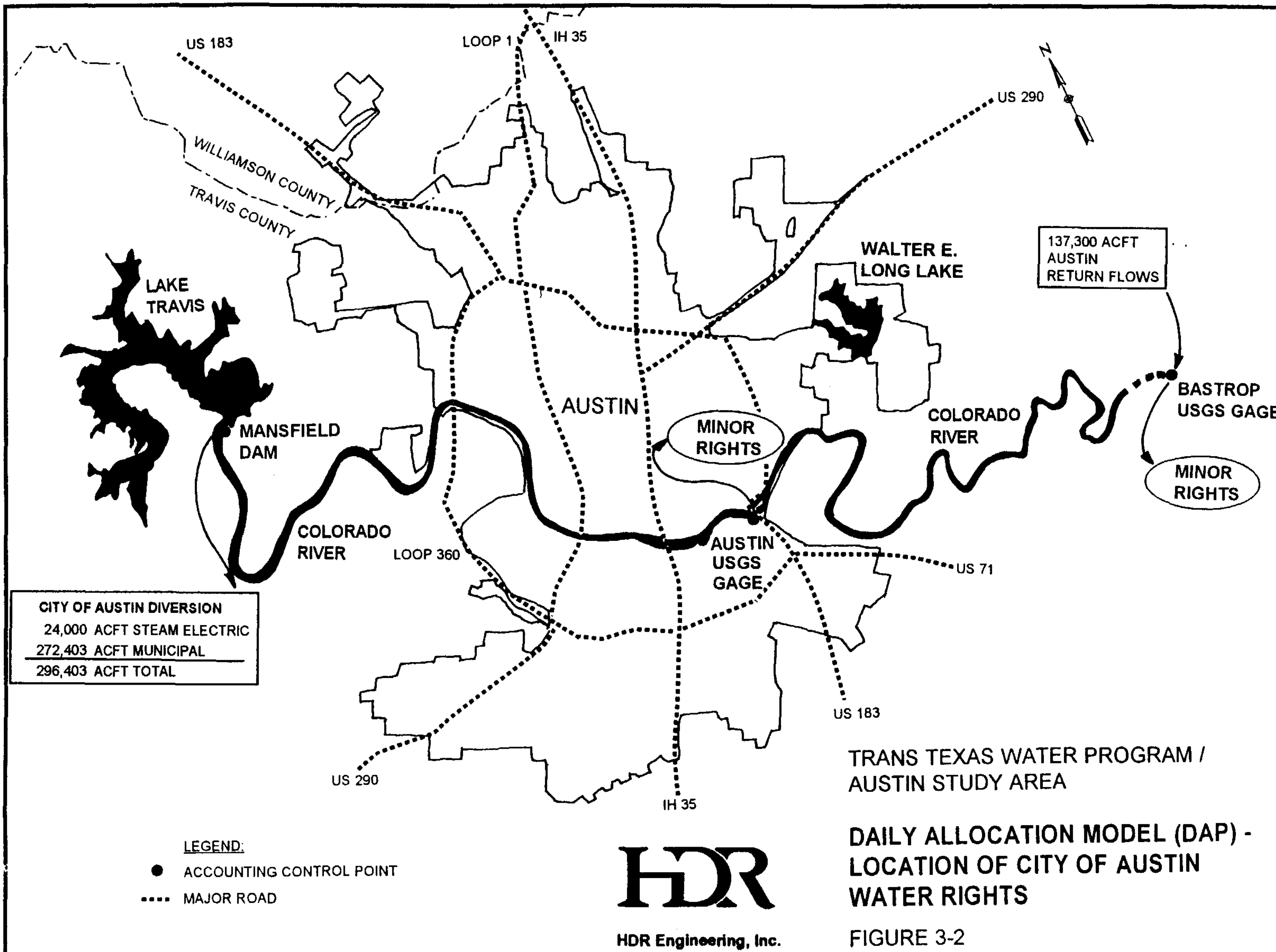
### 3.2.1 Assumptions and Limitations

The DAP model is currently the best available tool for evaluating run-of-the-river availability in the Lower Colorado River, however, as with all models, it includes some assumptions and limitations. One simplifying assumption is the assignment of water diversions and discharges to accounting points along the river in the model. In the DAP model, withdrawals and discharges for the City of Austin are assigned to one of two accounting points. One point is at the upstream boundary of the model (just downstream of Mansfield Dam) and the other is located at the Bastrop (Smithville) USGS gaging station. These locations are shown in Figure 3-2. Because the primary purpose of the model is to determine availability of run-of-the-river water to senior water rights, stored water in the Highland Lakes is not included. The DAP model determines the amount of un-met run-of-the-river demands, but does not make releases from stored water to meet needs. Additionally, because of the locations assigned in the model to the City's water rights, water availability is likely under estimated for the City's rights.

Another assumption is in the daily simulation of water right diversions. Run-of-the-river water rights are issued subject to specified maximum annual and instantaneous diversion rates. For the significant water rights on the Lower Colorado River, there are no apparent restrictions as to when within the year that water may be diverted or how much of it may be used consumptively. This situation is very flexible which makes it difficult to model. In the LCRA model, this situation is simplified by assigning each right a fixed diversion amount for each day of the year. The total of these daily diversion amounts exactly equals the total annual right. If any portion of a daily diversion amount cannot be met from run-of-the-river flows, the model does not allow for that deficit to be recovered at a later date. In actual practice a diverter could make up for the lack of availability by pumping on some later day when water became available. Therefore, the assumptions inherent in this modeling procedure may result in underestimation of water potentially available under each right.

Another simplification in the modeling is the provision for minor rights. The historical Colorado flows have been reduced by the permitted cumulative amount of minor water rights. Since some of these rights are junior to the City's rights, this simplification reduces the availability of water under the City's rights. Similarly, channel losses have not been modeled. This could increase or decrease estimated availability in any given month.

In the model, only the senior portion of the City's rights under Certificate of Adjudication 14-5471 has been modeled. This includes both the municipal rights (250,000 acft/yr and 22,403 acft/yr) and steam electric rights (24,000 acft/yr) for a total demand of 296,403 acft per year. It is not documented whether the City's junior rights under




TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**DAILY ALLOCATION MODEL (DAP) - LOCATION OF CITY OF AUSTIN WATER RIGHTS**

FIGURE 3-2

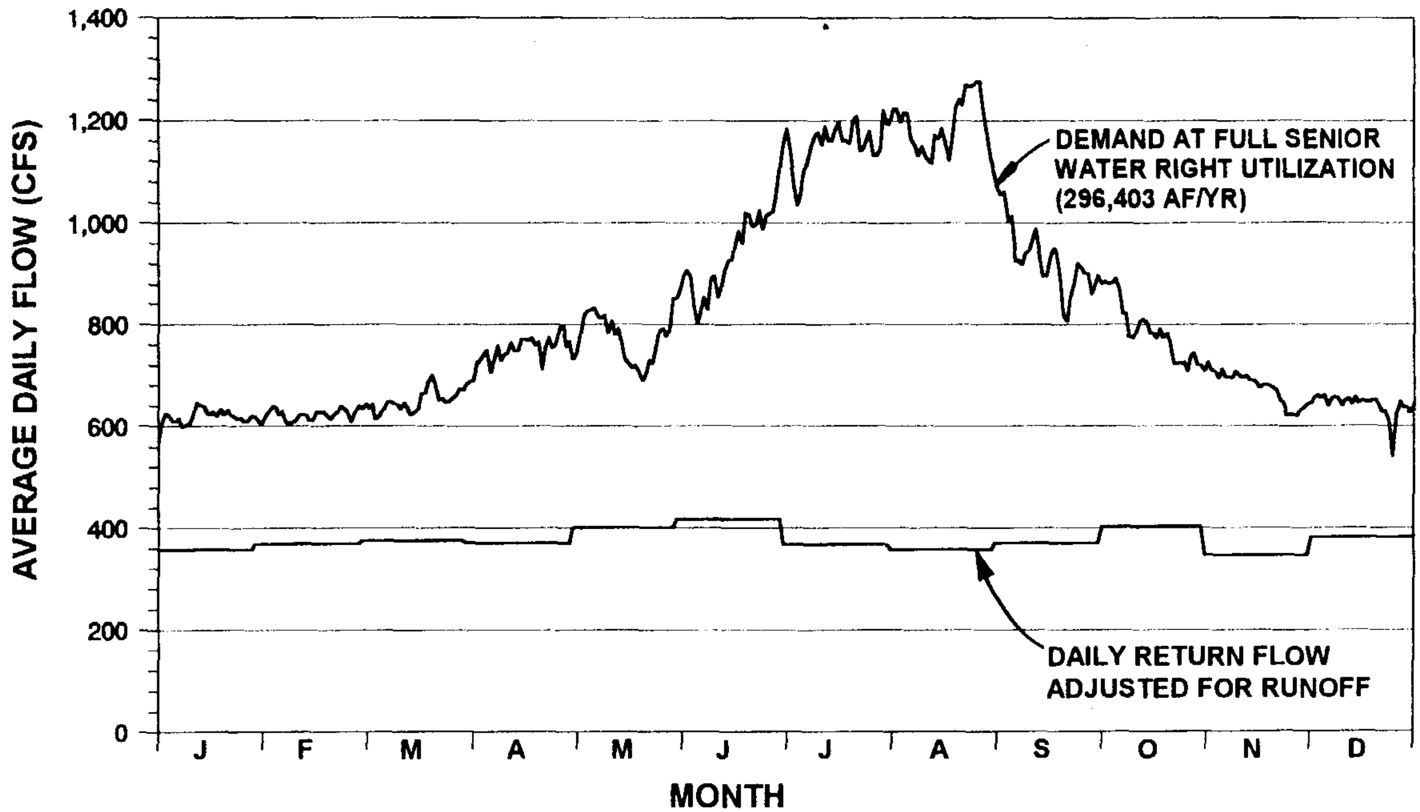
Certificate of Adjudication 14-5489 were subtracted from historical flows along with other minor rights prior to simulation. LCRA's water rights were subordinated to the City of Austin's rights in each case with the exception of the recent purchase of the unutilized portion of the right held by Pierce Ranch. The original seniority of this right was maintained to be conservative in case this right continues to be used for irrigation purposes.

The City's daily water demand pattern is based upon the City's historical use from 1976 to 1985 and the City's return flow pattern is based on a 55% return of the annual municipal demand. These return flows are distributed monthly according to the historical pattern from 1978 to 1987. These demand and return patterns are shown in Figure 3-3. Since the municipal use and steam electric use are not distinguished in the model, both are modeled with the same municipal usage pattern.

Finally, the model does not take into consideration the storage available to the City of Austin in Lake Austin and Town Lake. This is a reasonable assumption at this point in time since the reservoirs are operated at a mostly constant level. However, it is conceivable that in a drought situation an operating policy which would allow lowering of the reservoir levels could increase water availability.

### 3.2.2 Modeling Results

The DAP model was run with the assumption that all diverters are attempting to divert their full permitted rights. Water availability under the City's senior run-of-the-river rights (296,403) was determined from these model runs and is summarized in Figure 3-4. Model runs were made with City of Austin return flows included, as is the current operation, and without them, as could occur under a total reuse operation. In every case, the no-return flow scenario showed less water available to the City. This is because, without return flows, the downstream senior rights are more dependent on inflows to the Lakes Travis and Buchanan and, therefore, preempt the City's access to these inflows. The availability of rights in these model runs are summarized in Table 3-3 for maximum, average, drought, and minimum availability.

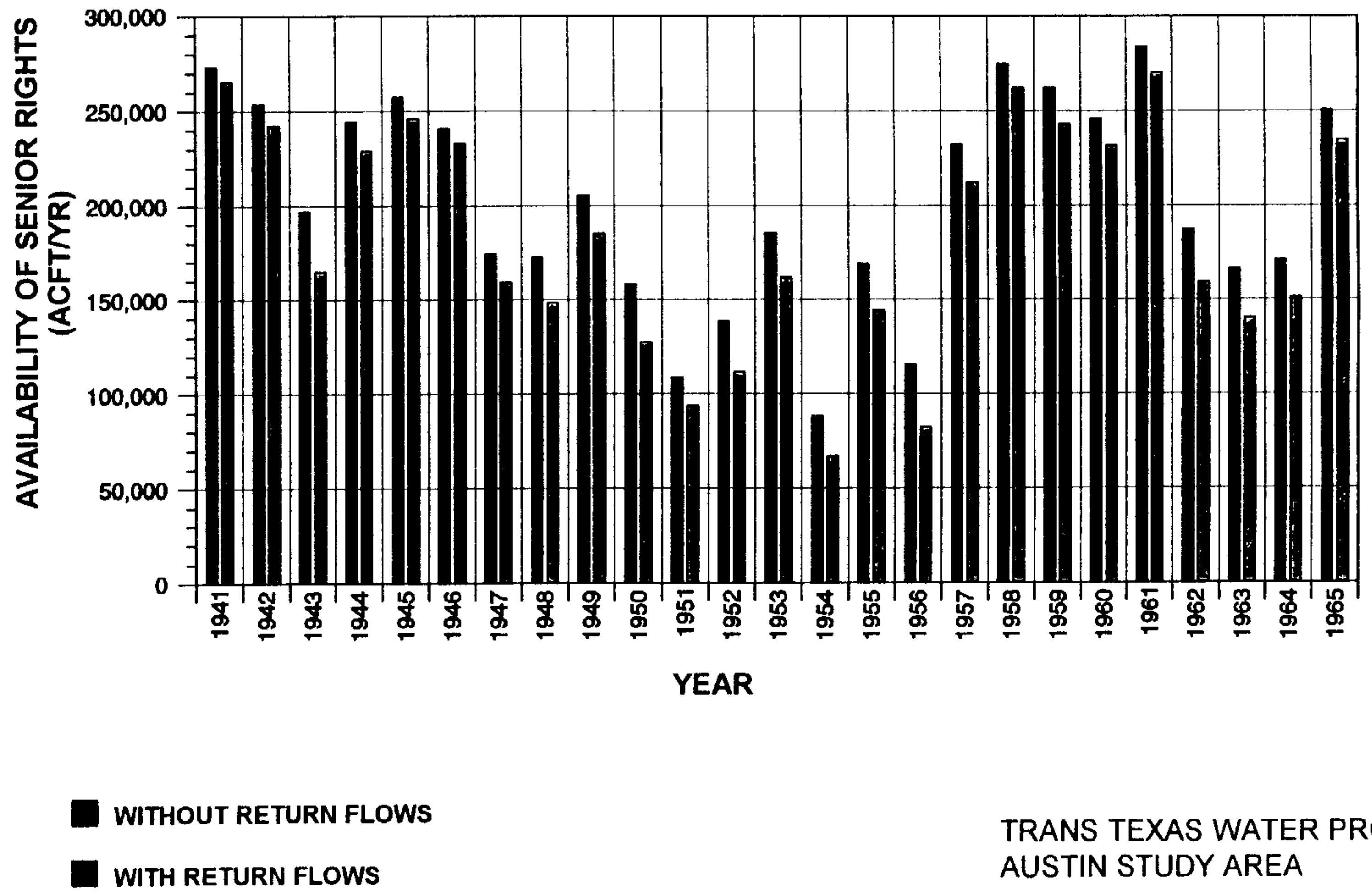



TRANS TEXAS WATER PROGRAM /
AUSTIN STUDY AREA

HDR Engineering, Inc.

**CITY OF AUSTIN DEMAND AND RETURN FLOW DISTRIBUTION - LCRA DAILY ALLOCATION PROGRAM**

FIGURE 3-3




SOURCE: LCRA DAILY ALLOCATION MODEL

HDR Engineering, Inc.

TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**AVAILABILITY OF COLORADO RIVER WATER AT LAKE AUSTIN**

FIGURE 3-4

| Table 3-3<br>Average Availability of City of Austin's<br>Senior Run-of-the-River Rights | | | |
|---|---|---|---|
| | | Availability of 296,403 acft/yr | |
| **Condition** | **Period** | **With Return Flow (acft/yr)** | **Without Return Flow (acft/yr)** |
| Minimum Yr. | (41-65) | 89,000 | 68,000 |
| Drought Average | (49-56) | 147,000 | 122,000 |
| Long-Term Average | (41-65) | 203,000 | 183,000 |
| Maximum Yr. | (41-65) | 284,000 | 271,000 |

Note: Based on LCRA DAP model with all rights holders attempting to divert full permitted amounts. Irrigation diversions are made at a typical peaked distribution pattern.

### 3.3 Terms and Conditions of Settlement Agreement

In 1987, the City of Austin, the LCRA, and the Texas Water Commission entered into a settlement agreement pertaining to the adjudication of water rights on the Colorado River. In the agreement, the City received the water rights previously described and summarized in Table 3-1, and the LCRA agreed to supply stored water, as necessary, to firm a supply up to 150,000 acft per year of municipal diversion at no cost. Further, LCRA agreed to supply an additional 100,000 acft/yr of municipal diversions for a payment. This results in 250,000 acft/yr of firm municipal supply water being available to the City (Article IV, B). Finally, LCRA agreed to firm up the City's steam electric rights of up to 40,156 acft/yr of consumptive use (Article IV, E & F) for no payment.

The 150,000 acft/yr of municipal diversion without payment is approximately the average amount that the City could have diverted during drought conditions without releases from Lakes Travis and Buchanan storage and without significant reuse of return flows. Under the terms of the agreement, municipal diversions by the City in excess of 150,000 acft/yr and diversions other than municipal and steam electric are to be charged LCRA's current rate for firm water regardless of whether stored water has to be released to satisfy the diversion (Article IV, H). The current rate for releases of firm water from storage is $105 per acre-foot.

## 4.0 COMPARISON OF PROJECTED WATER DEMAND AND SUPPLY

Water supply surpluses and deficits were determined based on projected demands in both the municipal and steam electric use categories in the service area and on the current firm water supply available to the City. Firm water supply is that supply which would have been available without interruption during the drought of record.

### 4.1 Municipal Water Use

#### 4.1.1 Ground Water Supply

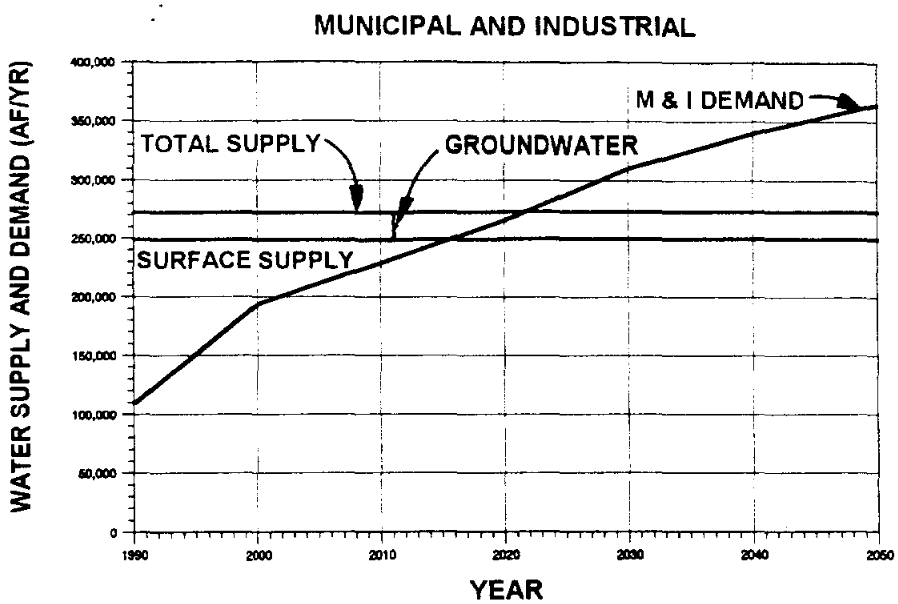
Municipal use of ground water in the Austin area is small in comparison to the City's requirements and is obtained primarily from private wells. Reported groundwater usage in 1990 was 8,551 acft. Based on projections of the TWDB, it is assumed that 8,855 acft/yr (8,000 acft from the Edwards Aquifer and 855 acft from the Trinity Group) is the firm supply of groundwater available in the area. For purposes of this study, it is assumed that this is the maximum quantity available for municipal use and remaining demand must be satisfied from surface water sources.

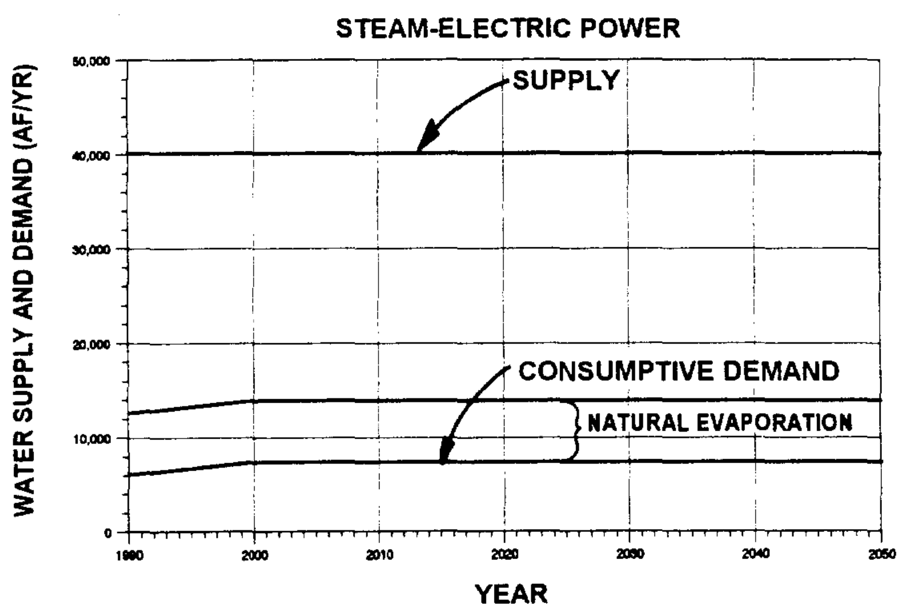
#### 4.1.2 Surface Water Supply

The firm annual surface water supply available was established in the LCRA/COA settlement agreement to be 250,000 acft/yr of water for municipal use. LCRA is obligated to reserve sufficient storage from the firm yield of the Lakes Travis and Buchanan to firm up this amount for use by the City of Austin.

#### 4.1.3 Projected Firm Surpluses and Deficits

Figure 4-1 is a graph of the projected water demand in the City's service area through the year 2050 and the City's firm water supply. Based on the projected water demand described in Section 2.2 and the City's firm surface supply of 250,000 acft per year, surplus and deficits were determined. In year 2000, the projected dry year municipal plus industrial water demand in the service area will be approximately 180,581 acft (Table 2-2). The City therefore will have a firm surplus of 69,419 acft in year 2000. This surplus may be available for sale, but currently no wholesale water rate is set by the City.




TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

HDR Engineering, Inc.

**WATER SUPPLY AND DEMAND PROJECTIONS - AUSTIN SERVICE AREA**

FIGURE 4-1

In about year 2015, the municipal plus industrial demand is projected to begin exceeding the firm surface water supply and by year 2050, the deficit is projected to be approximately 114,638 acft. If ground water sources were fully developed, the municipal plus industrial demand is projected to begin exceeding total supply by year 2021 and the projected deficit in 2050 would be approximately 105,783 acft/yr.

## 4.2 Steam Electric Use

### 4.2.1 Ground Water Supply

No ground water is currently used for steam electric purposes and it is not anticipated that it will be considered as a supply in the future.

### 4.2.2 Surface Water Supply

Under the terms of the settlement agreement, LCRA has committed to make water available in Town Lake as needed by the City for steam-electric purpose up to a total consumptive use of 24,000 acft/yr. Similarly, LCRA has committed to make available up to 16,156 acft/yr for diversion to Walter E. Long Lake (Decker Lake) for steam-electric and industrial cooling purposes. The effect of the agreement is to provide the City with 40,156 acft/yr of firm supply for steam-electric use exclusively.

### 4.2.3 Projected Firm Surpluses and Deficits

The City currently has an apparent surplus of 32,656 acft/yr surplus of firm supply for steam-electric use. This surplus is projected to remain through year 2050. However, the steam-electric requirement actually includes not only the consumptive demand from forced evaporation, but also the natural evaporation from the cooling impoundment. Since this impoundment must be maintained, the natural evaporation is an additional demand which is not included in the projection. For Walter E. Long Lake, which is an off channel impoundment, this natural demand can be up to 6,500 acft/yr under drought conditions. For Town Lake, which is an on channel impoundment, LCRA has agreed to maintain the level at no lower than five feet below the crest of the dam. Colorado flows required to meet the natural evaporation and temperature demands from Town Lake are not counted against the City's permitted supply. Therefore, the actual surplus is estimated at 26,156 acft/yr.

## 5.0 WATER SUPPLY ALTERNATIVES

Several alternatives for increasing the City's firm water supply or reducing water demand have been studied at a Phase I planning and screening level. Each of these alternatives was evaluated for water supply potential, environmental effects (if any), and implementation issues. For Phase 1, general cost information for each alternative supply has been reported, when available, from other sources. Total project costs will be estimated in Phase II.

The alternatives studied are:

| | |
|---|---|
| Alt. C-2: | Purchase of Stored Water in Lake Travis |
| Alt. C-3: | Purchase of Under-utilized Irrigation Water Rights in Lower Colorado River Basin |
| Alt. B-1: | Williamson County Raw Water Line |
| Alt. B-2: | Bosque Reservoir Delivered to Lake Waco (for delivery to Williamson County) |
| Alt. L-5: | Reclaimed Water Reuse |

## 5.1 Purchase of Stored Water in Lake Travis (C-2)

### 5.1.1 Description and Available Yield

Based on findings presented to the Texas Water Commission, it appears that there is approximately 50,000 acft/yr of uncommitted firm water potentially available from the combined firm yield of Lakes Travis and Buchanan[5]. This water could potentially be purchased by the City of Austin from LCRA to increase the City's firm water availability.

Delivery of the this water could be made either by release to Lake Austin for diversion into the two existing City of Austin intakes, or by construction of an intake on Lake Travis.

The current cost of stored water purchased from LCRA is $105/acft per year.

### 5.1.2 Environmental Issues

Purchase and diversion of 50,000 acft/year stored water in Lake Travis from the Colorado River at Lake Austin ( Alternatives C-2) would utilize one or both of two existing intakes, treatment sites and major distribution systems. The environmental issues associated with this alternative concern municipal consumptive use of water and increased effluent discharge to the Colorado River.

Previous planning studies of an intake on Lake Travis have included a water treatment plant and expansion of the City of Austin Service Area. A City of Austin treatment plant in the northwest sector of the Austin and a potential regional water plant with the City of Cedar Park were studied. The intake would have been located within the lake and transmitted water by a tunneled pipeline to a plant site near the intersection of SH 620 and FM 2222. Habitat for cave invertebrates and endangered bird species is located in the vicinity. Any proposed construction along the lake shore or in the Lake Travis Balcones Canyonland area will require geologic and endangered species surveys. Important species of the Balcones Canyonland in Travis County are included in Table 5-1.

### 5.1.3 Implementation Issues

[To be included in Phase II studies.]

---

[5]Texas Water Commission, "Order Approving LCRA's Water Management Plan and Amending Certificates of Adjudication Nos. 14-5478 and 14-5482," September 7, 1989.

**Table 5-1**
**Protected Endangered and Threatened Species in Travis County[1,2]**
Listed by the U.S. Department of the Interior (50 CFR 17.11 & 17.12, 16 April 1990)[3] Candidate Species (50 CFR 17, 6 January 1989; 21 February 1990; 21 November 1991) and Texas Parks and Wildlife Department (31 T.A.C. Sec. 65.171 - 174 & 65.181 - 184)

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Bald Eagle | *Haliaeetus leucocephalus* | Large bodies of water with nearby resting sites | E | E |
| Black-capped Vireo | *Vireo atricapillus* | Semi-open broad-leaved shrublands, oak-juniper woodlands with distinctive patchy, two-layered shrub - tree aspect | E | E |
| Golden-checked Warbler | *Dendroica chrysoparia* | Nesting in about 31 counties in central Texas; ashe juniper-oak woodlands of the Edward's Plateau ; adjacent areas with similar geology; Brazos and Colorado River basins | E | T |
| Interior Least Tern | *Sterna antillarum athalassos* | Nesting on large river sandbars | E | E |
| Peregrine Falcon, American | *Falco peregrinus anatum* | Open coastal areas | E | E |
| Peregrine Falcon, Arctic | *Falco peregrinus tundrius* | Open coastal areas | T | T |
| White-faced Ibis | *Plegadis chihi* | Freshwater marshes | C2 | T |
| Swallow-tailed Kite, American | *Elanoides forficatus* | Varied; open land, nesting in forested river bottoms | T | T |
| Wood Stork | *Mycteria americana* | Post-breeding; in wetlands of the coastal plain, major waterways, and lower Mississippi valley | E /T | T |
| Zone-tailed Hawk | *Buteo albonotatus* | Canyons and wooded river bottoms in Southwest U.S.A. | NL | T |
| Texas Tortoise | *Gopherus berlandieri* | Open brush with grass understory; open grass and bare ground are avoided; occupies shallow depressions at base of bush or cactus, underground burrows, under objects; active March-November | NL | T |
| Texas Horned Lizard | *Phrynosoma cornutum* | Open arid and semi-arid regions with sparse vegetation including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky, burrows in soil, enters rodent burrow, or hides under rocks when inactive | C2 | T |
| Indigo Snake | *Drymarchon corais erebennus* | Grass prairies and sand hills; usually thorn brush woodland and mesquite savannah of coastal plain | NL | T |
| Texas Garter Snake | *Thamnophis sirtalis annectens* | Moist pastures and vacant fields, varied habitats | C2 | NL |
| Texas Scarlet Snake | *Cemophora coccinea lineri* | Mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September | NL | T |
| Barton Springs Salamander | *Eurycea sosorum* | Barton Springs of the Edwards Aquifer; Balcones Escarpment | C2 | NL |

**Table 5-1 (continued)**
**Protected Endangered and Threatened Species in Travis County**

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Jollyville Plateau Salamander | *Eurycea sp. 1* | Springs below the Jollyville Plateau; Balcones Escarpment | C2 | NL |
| Texas Salamander | *Eurycea neotenes* | Springs of the Edwards Plateau | C2 | NL |
| Blue Sucker | *Cycleptus elongatus* | Large rivers throughout Mississippi River Basin south and west in major freshwater streams of Texas to Rio Grande River | C2 | T |
| Guadalupe Bass | *Micropterus treculi* | Streams and reservoirs of Eastern Edwards Plateau | C2 | NL |
| Smalleye Shiner | *Notropis buccula* | Large rivers and streams | C2 | NL |
| Bee Creek Cave Harvestman | *Texella reddelli* | Six caves in karst formations Balcones Escarpment | E | NL |
| Kretschmarr Cave Mold Beetle | *Texamaurops reddelli* | Sinkhole cave, karst formation Balcones Escarpment | E | NL |
| Tooth Cave Ground Beetle | *Rhadine persephone* | Sinkhole cave, karst formation Balcones Escarpment | E | NL |
| Tooth Cave Spider | *Neoleptoneta myopica* | Sinkhole cave, karst formation Balcones Escarpment | E | NL |
| Basin Bellflower | *Campanula reverchonii* | Edwards Plateau, granite rocky soils and thin limestone soils | C3 | NL |
| Bracted Twistflower | *Streptanthus bracteatus* | Gravely clays, clay loams over limestone; oak-juniper woods, canyon bottoms, sandy river margins | C2 | NL |
| Canyon Mock-orange | *Philadelphus ernestii* | On limestone bluffs of canyon lands in Edwards Plateau | C2 | NL |
| Correll's False Dragon-head | *Physostegia correllii* | In wet silty clay loams along streams, irrigation channels, and roadside drainage ditches | C2 | NL |
| Texana Croton | *Croton Alabamensis var texensis* | Loamy clay soils on rocky slopes in mesic limestone ravines; locally abundant on deeper soils | C2 | NL |

[1]Source for occurrence and Status: Texas Heritage Program Files, Unpublished July 1994. computer Database search, mapped locations, and reports. Texas Parks and Wildlife Department. Austin, Texas. Texas Parks and WilDlife, 05/09/88. potential for occurrence based on historic range. Dixon, James R. 1987. Amphibians and Reptiles of Texas, with keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M university press, College Station, Texas. Armstrong, David M., Jerry R. Choate, and J. Knox Jones, Jr. 1986. Distributional patterns of Mammals in the plains states. Occasional Papers, The Museum, Texas Tech University, No. 105, Texas Tech University Press, Lubbock, Texas.
[2]Symbols under listing agency are as follows: C1-USFWS Candidate Category C2-USFWS Candidate Category for protection; C3-USFWS no longer a candidate for protection; NL- not listed for protection; E-Endangered; T-Threatened.
[3]Not endangered in Texas Wood stork - listed Endangered populations Alabama, Florida, Georgia, North Carolina, South Carolina.

## 5.2 Purchase of Under-utilized Irrigation Water Rights in Lower Colorado River Basin (C-3)

### 5.2.1 Description

The possibility of purchasing portions of downstream run-of-river water rights on the Colorado River has been investigated for two purchase scenarios. The first scenario includes the purchase of portions of the four major downstream irrigation rights that have historically (i.e., within the past 10 years) remained unutilized and have not been committed to other users. The second scenario involved the acquisition of both the unutilized water rights as well as the purchase of water historically used to grow a second season rice crop. This purchase could necessitate the study of the possible economic impact of the lost opportunity to grow and sell a second crop.

The first purchase scenario investigated involved the acquisition of unutilized and otherwise uncommitted water rights from the four major downstream diverters. Water use over the past ten years by each of the diverters was reviewed and compared to their diversion rights. It was found that Lakeside utilized all of its right, Garwood used all but about 35,000 acft/yr of its right, Pierce Ranch used half of its right, or 55,000 acft/yr, and Gulf Coast utilized all but about 20,000 acft/yr of its right. The unutilized water at Garwood, however, is presently reserved by Corpus Christi and was not considered available in this analysis. The aggregate unutilized rights, therefore, represent potential water availability of about 75,000 acft/yr as indicated in Table 5-2. Unutilized rights at Pierce Ranch have recently been purchased by the LCRA and converted to municipal use, but have not yet been committed. For purposes of this study it has been assumed that this right would retain its original seniority date if purchased.

| Table 5-2<br>Unutilized Irrigation Water Rights | | | | | |
|---|---|---|---|---|---|
| **Diverter** | **Priority Date** | **Use** | **Utilized Water Right (acft)** | **Unutilized Water Right (acft)** | **Total Water Right (acft)** |
| Lakeside - LCRA | | | | | |
| subordinated | 11/1987 | irrigation | 78,750 | 0 | 78,750 |
| unsubordinated | 1/1901* | irrigation | 52,500 | 0 | 52,500 |
| Total | | | 131,250 | 0 | 131,250 |
| Garwood | | | | | |
| A - Garwood | 11/1900 | irrigation | 133,000 | 0 | 133,000 |
| B - Corpus Christi | 11/1900 | municipal | 35,000 | 0 | 35,000 |
| Total | | | 168,000 | 0 | 168,000 |
| Pierce Ranch | | | | | |
| A - Pierce Estate | 9/1907 | irrigation | 55,000 | 0 | 55,000 |
| B - LCRA | 9/1907 | municipal | 0 | 55,000 | 55,000 |
| Total | | | 55,000 | 55,000 | 110,000 |
| Gulf Coast -LCRA | | | | | |
| subordinated | 11/1987 | irrigation | 13,930 | 20,000 | 33,930 |
| unsubordinated | 12/1900* | irrigation | 228,570 | 0 | 228,570 |
| Total | | | 242,500 | 20,000 | 262,500 |
| **Totals** | | | 596,750 | 75,000 | 671,750 |
| *This portion of the water right has been subordinated to the City of Austin, but not to other more junior rights. | | | | | |

The second purchase scenario investigated included the acquisition of both unutilized water rights and water historically used for growing a second rice crop. Water use over the past ten years by each of the diverters was analyzed and showed that the second crop requirement averaged about 38 percent of historical use. As shown in Table 5-3, 213,550 acft of water per year of second crop water is potentially available for purchase. Combined unutilized rights and second crop rights account for a total potential water right purchase of 288,550 acft/yr.

| Table 5-3<br>Unutilized Irrigation Water Rights and Second Crop Water Purchase | | | | | | |
|---|---|---|---|---|---|---|
| **Diversion** | **Priority Date** | **Use** | **Utilized Water Right (acft)** | **Unutilized Water Right (acft)** | **Second Crop Purchase (acft)** | **Total Water Right (acft)** |
| Lakeside - LCRA | | | | | | |
| subordinated | 11/1987 | irrigation | 28,750 | 0 | 50,000 | 78,750 |
| unsubordinated | 1/1901* | irrigation | 52,500 | 0 | 0 | 52,500 |
| Total | | | 81,250 | 0 | 50,000 | 131,250 |
| Garwood | | | | | | |
| A - Garwood | 11/1900 | irrigation | 82,500 | 0 | 50,500 | 133,000 |
| B - Corpus Christi | 11/1900 | municipal | 35,000 | 0 | 0 | 35,000 |
| Total | | | 117,500 | 0 | 50,500 | 168,000 |
| Pierce Ranch | | | | | | |
| A - Pierce Estate | 9/1907 | irrigation | 34,100 | 0 | 20,900 | 55,000 |
| B - LCRA | 9/1907 | municipal | 0 | 55,000 | 0 | 55,000 |
| Total | | | 34,100 | 55,000 | 20,900 | 110,000 |
| Gulf Coast - LCRA | | | | | | |
| subordinated | 11/1987 | irrigation | 0 | 20,000 | 13,930 | 33,930 |
| unsubordinated | 12/1900* | irrigation | 150,350 | 0 | 78,220 | 228,570 |
| Total | | | 150,350 | 20,000 | 92,150 | 262,500 |
| **Totals** | | | 383,200 | 75,000 | 213,550 | 671,750 |
| *This portion of water right has been subordinated to the City of Austin but not to other more junior rights. | | | | | | |

5.2.2 Available Yield

Because these water right purchases are of run-of-the-river rights and not stored water, they are not necessarily available in each and every year. Furthermore, run-of-river rights which are purchased from downstream diverters are not completely transferable to diversion locations upstream since the opportunity to capture a portion of the intervening run-of-river flows is lost, hence, availability decreases as rights are transferred further upstream. Water availability under these rights at specific diversion locations was determined using the Colorado River Daily Allocation Program (DAP). The assumptions inherent in the modeling procedure may result in a conservative estimate of water availability (i.e., underestimation of water potentially available) from purchase of water rights.

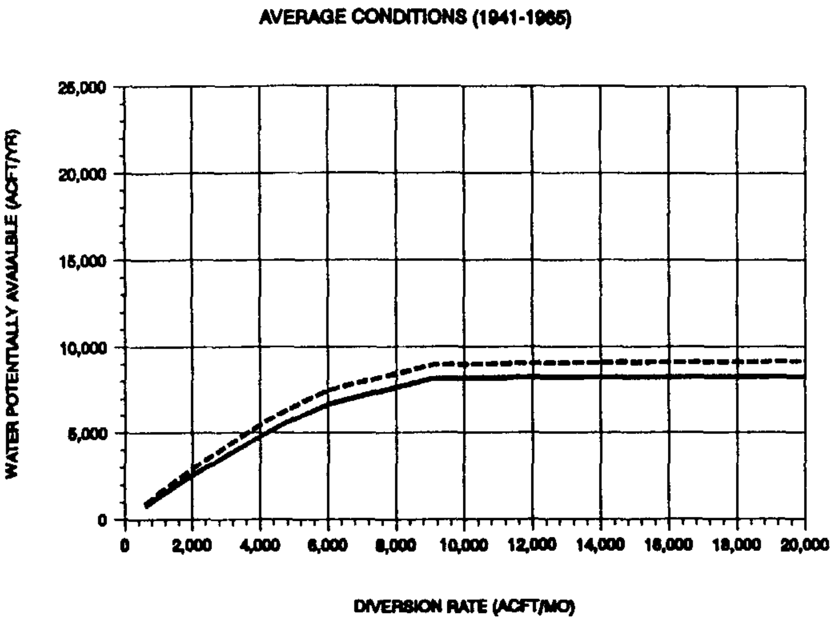
availability (i.e., underestimation of water potentially available) from purchase of water rights.

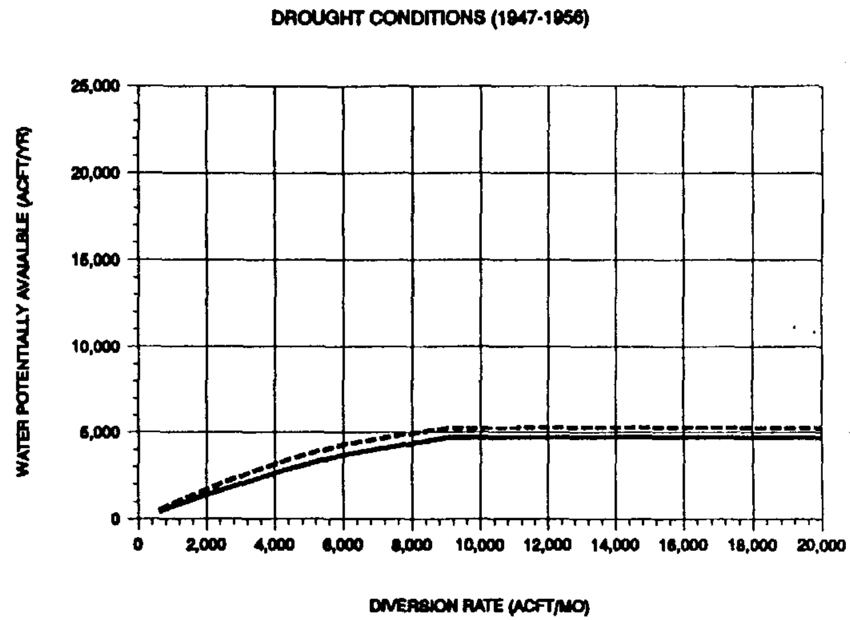
In order to obtain estimates of water availability, the daily allocation program was used to determine water availability in the Colorado River. In this Phase I analysis, purchased water rights were subordinated to the existing City of Austin rights, while maintaining their priority to other water rights. The model was used to determine water availability at Lake Austin with existing downstream rights reduced by the purchased amount. An estimate of water made available at Lake Austin by the purchase could then be determined by examining the increase in availability on a daily basis. Additional analyses of model results were performed to obtain estimates of water availability for a range of maximum monthly diversion rates at Austin. This procedure was repeated for simulations with and without return flows from the City of Austin.

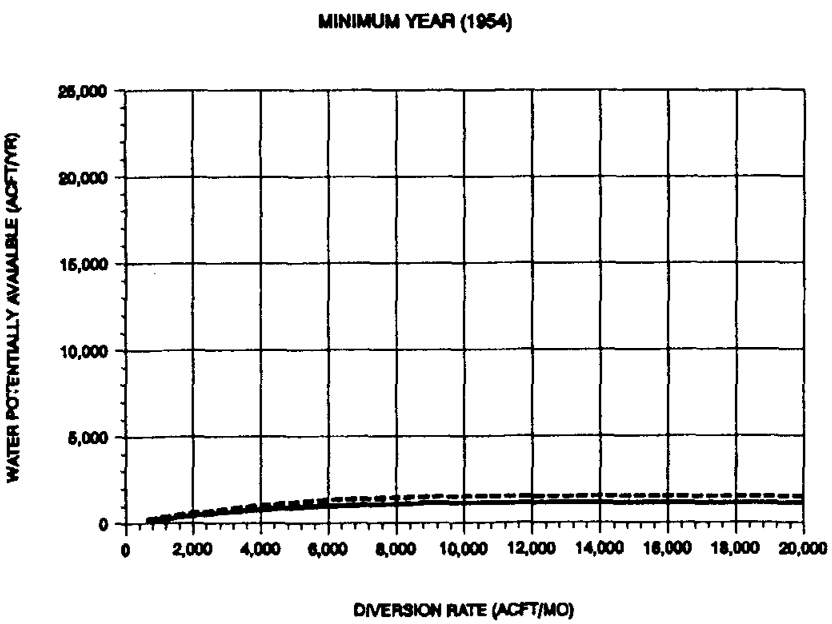
Daily diversions were simulated and summarized for average conditions (1940-65 period) and the period 1947-1956, as well as the minimum year diversion. Figure 5-1 shows that water available from a purchase of 75,000 acft/yr of unutilized rights yields only 9,000 acft/yr during average conditions and 5,000 acft/yr during the ten year period. Similarly, Figure 5-2 shows that water available from the combined purchase of 288,550 acft of unutilized rights and second crop use is less than 20,000 acft/yr under average conditions even at large diversion rates and less than 12,000 acft/yr during the ten year period. In either case, the effect of City of Austin return flow on water availability is small at this diversion point which is upstream of the effluent discharge locations. It is apparent that the loss of intervening run-of-river flows due to locating the diversion point at Lake Austin greatly reduces the availability of water purchased from water rights owners located some 230 river miles downstream. Therefore, water availability at Lake Austin is dramatically less than the purchased rights.

### 5.2.3 Environmental Issues

This alternative encompasses municipal use of water currently designated for agricultural irrigation. Unutilized irrigation water rights are held in the Colorado basin, see Section 5.2.1 and Table 5-2.




**LEGEND**

—— WITH AUSTIN RETURN FLOWS

– – – WITHOUT AUSTIN RETURN FLOWS

ASSUMPTIONS:

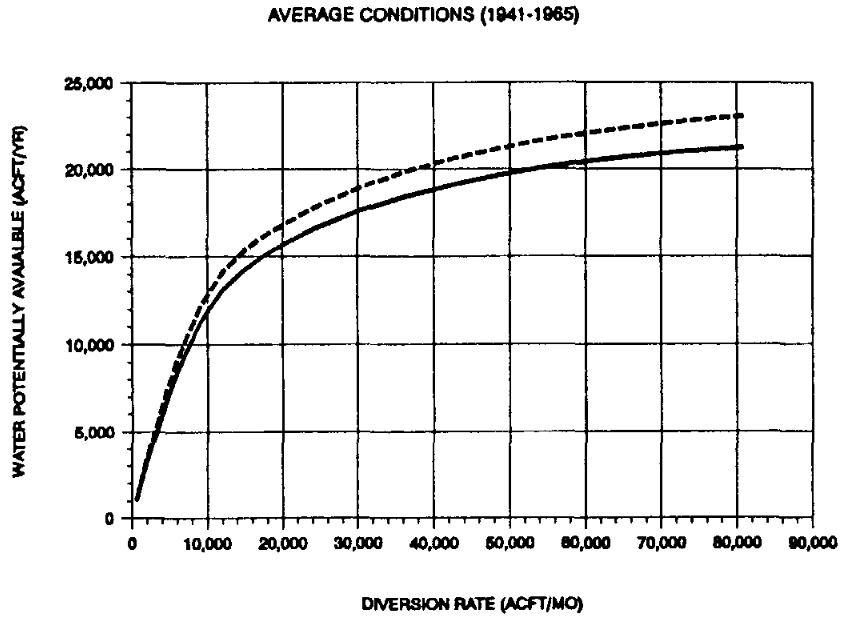
1. PURCHASE OF 75,000 ACFT/YR OF RUN-OF-RIVER RIGHTS
2. AVAILABILITY REPRESENTS A CONSERVATIVE (I.E., LOW) ESTIMATE

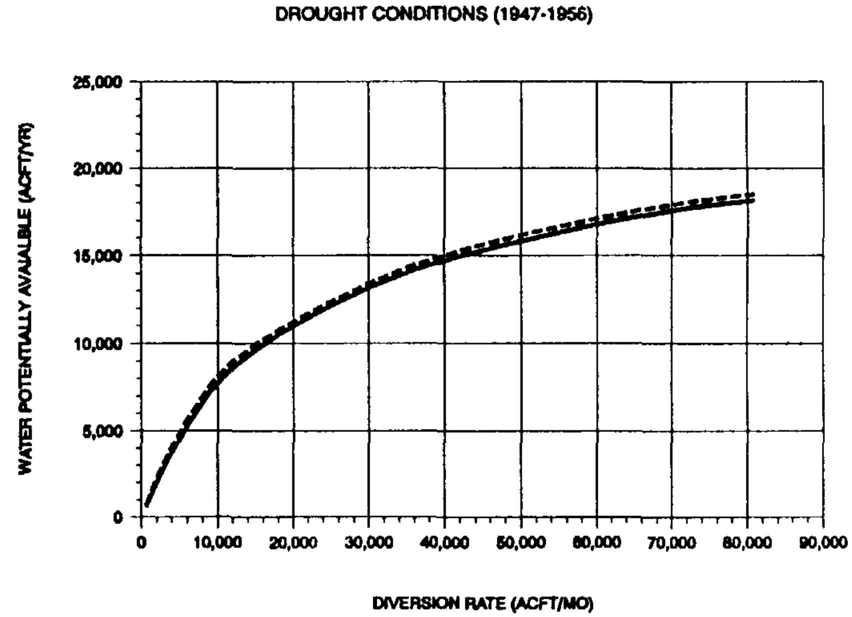
HDR Engineering, Inc.

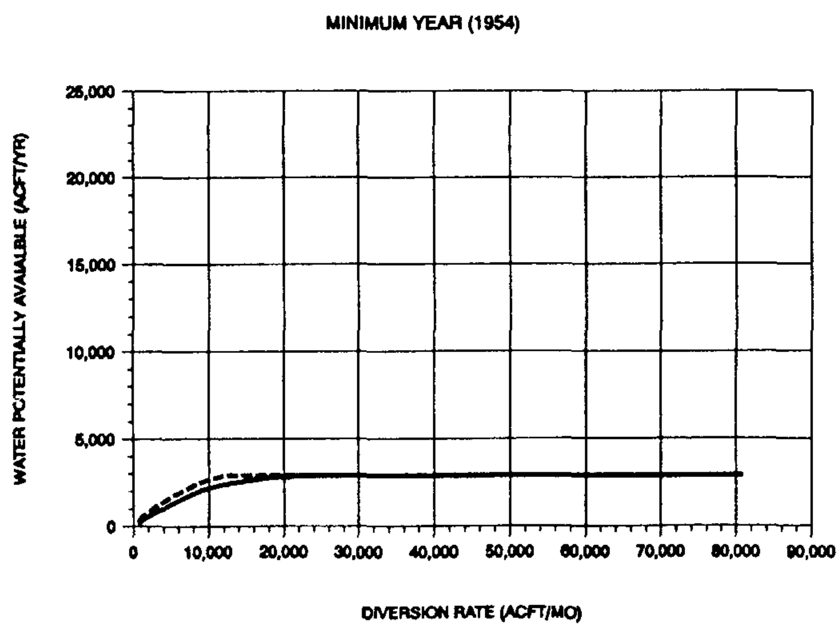
TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**DIVERSION OF UNUTILIZED MAJOR RIGHTS AT LAKE AUSTIN**

FIGURE 5-1




**LEGEND**

WITH AUSTIN RETURN FLOWS

WITHOUT AUSTIN RETURN FLOWS

ASSUMPTIONS:

1. PURCHASE OF 288,550 ACFT/YR OF RUN-OF-RIVER RIGHTS
2. AVAILABILITY REPRESENTS A CONSERVATIVE (I.E., LOW) ESTIMATE

HDR Engineering, Inc.

TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

**DIVERSION OF UNUTILIZED MAJOR RIGHTS AND SECOND CROP IRRIGATION AT LAKE AUSTIN**

FIGURE 5-2

The second purchase scenario is acquisition of both unutilized water rights and water historically used for growing a second rice crop. Removal of some lands from irrigation farming may be a prerequisite for this scenario and potential agricultural landuse changes, if significant, may need to be considered. Both of these alternative scenarios utilize existing water utility systems and the environmental issues associated with this alternative concern municipal consumptive use of water and increased effluent discharge to the Colorado River.

### 5.2.4 Implementation Issues

The transfer of existing water rights will require TNRCC approval for amendments to the right to reflect the new water use and diversion point. The estimated cost of purchasing the water rights has not yet been estimated.

## 5.3 Williamson County Raw Water Line (B-1)

### 5.3.1 Description

The Williamson County Raw Water Line is a proposed regional project to supply water to three entities in Williamson County[6]. The project would be sponsored by the Brazos River Authority, and the three entities receiving water would be the cities of Round Rock and Georgetown, and Jonah Water Supply Corporation. The project would deliver water from Stillhouse Hollow Reservoir on the Lampasas River to Lake Georgetown on the San Gabriel River. A water treatment plant would be built at Lake Georgetown and treated water transmission lines would be built to points of delivery at each sponsoring entity. The raw water transmission line from Stillhouse would provide uniform delivery and Lake Georgetown would be used as a balancing reservoir to meet peak daily demands. The proposed route of the waterline is shown on Figure 5.3-1.

To provide water to the City of Austin service area in southern Williamson County, Austin would need to construct a treatment plant near Lake Georgetown, possibly in association with other entities, and install transmission lines to the service area. A possible route for this water supply system is shown in Figure 5.3-2.

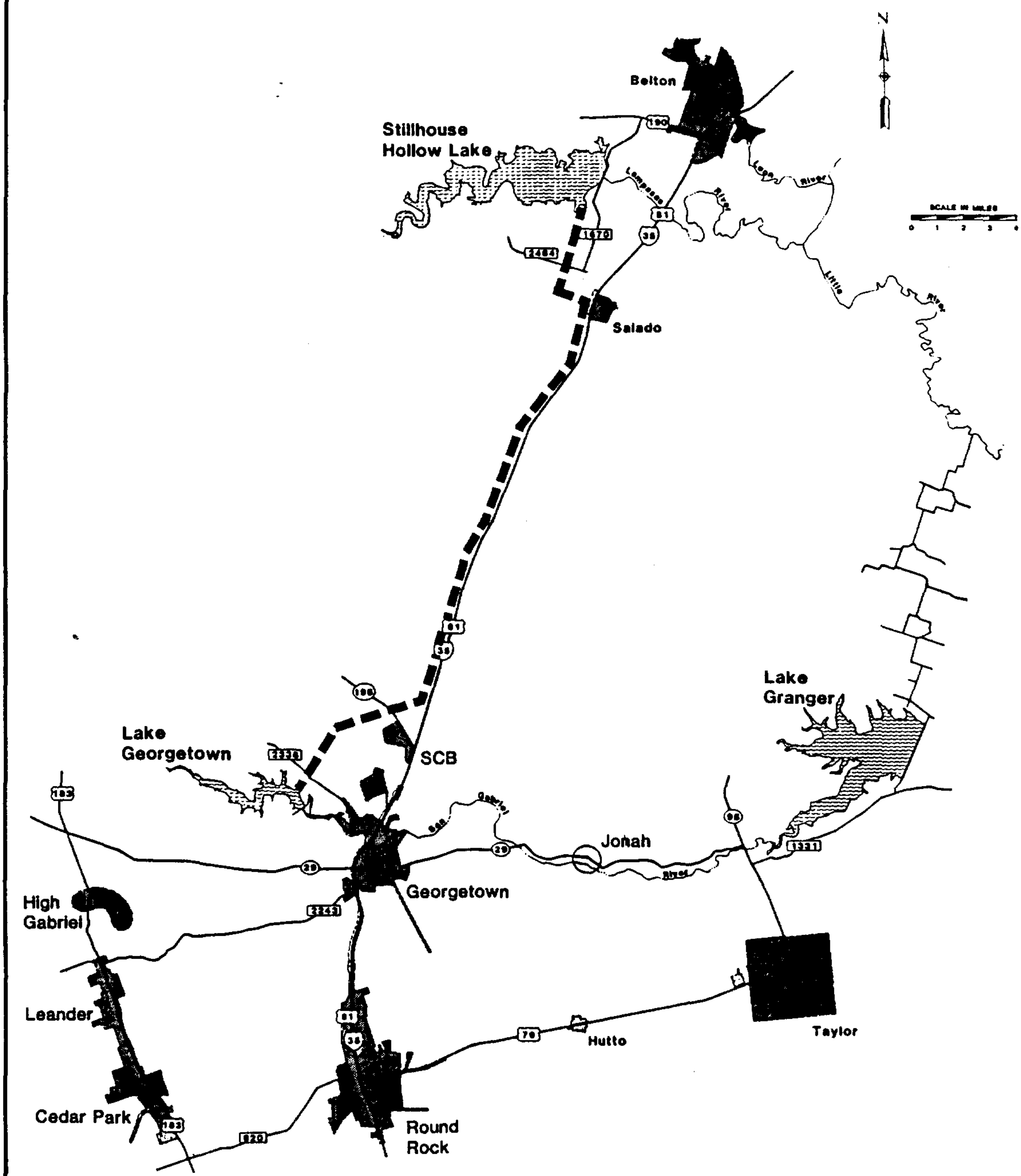
### 5.3.2 Available Yield

BRA currently has 35,500 acft/yr uncommitted firm yield of Stillhouse Hollow Reservoir water available for purchase. As currently proposed, the purchased water would be delivered to Lake Georgetown in a 33 inch diameter pipeline with a capacity of 21.3 mgd.

The current cost to purchase water from BRA is $19.15/acft. The delivery system from Stillhouse Hollow to Lake Georgetown is expected to cost about $16.6 million (1994 dollars). The cost of treatment and delivery to the City of Austin service area will be estimated in Phase II studies.

---

[6]HDR Engineering, Inc., "Williamson County Raw Water Line, Preliminary Engineering Report," Brazos River Authority, December 1988.




TRANS TEXAS WATER PROGRAM / AUSTIN STUDY AREA

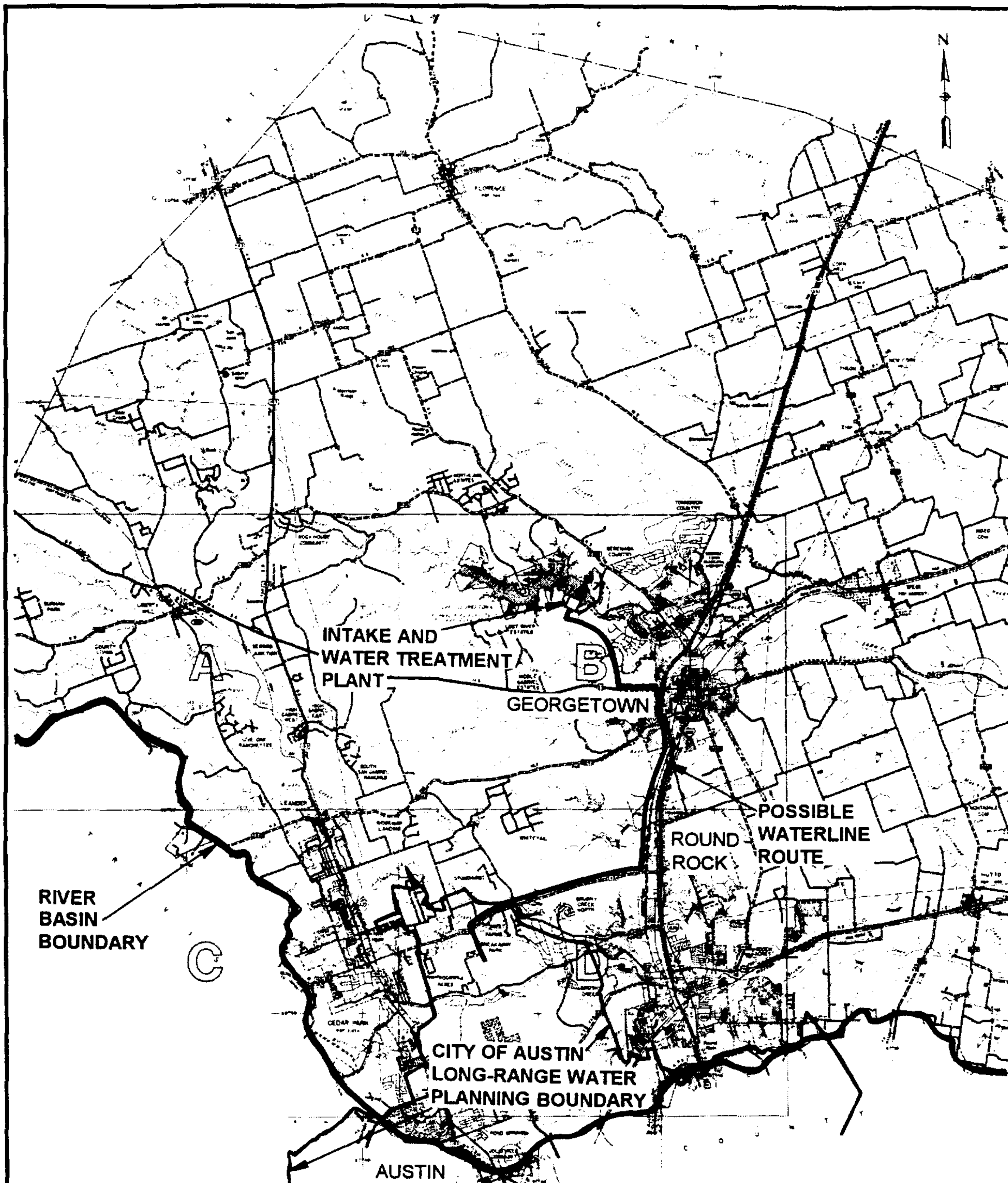
Source: HDR, Inc., "Williamson County Raw Waterline Preliminary Engineering Report", for Brazos River Authority, Dec., 1985.

HDR

HDR Engineering, Inc.

**WILLIAMSON COUNTY RAW WATERLINE ROUTE**

FIGURE 5.3-1




TRANS TEXAS WATER PROGRAM /
AUSTIN STUDY AREA

**POSSIBLE WATER SUPPLY SYSTEM FROM LAKE GEORGETOWN**

HDR

**HDR Engineering, Inc.**

FIGURE 5.3-2

5.3.3 Environmental Issues

The Williamson County Raw Water Line would transfer water from the Stillhouse Hollow Reservoir on the Lampasas River in Bell County to an outfall in Lake Georgetown located on the San Gabriel River in Williamson County, a distance of about 25 miles (Figure 5.3-1). An intake structure would be located on the north side of the overflow spillway at Stillhouse Hollow Reservoir. The intake ports would be set at a range of pool elevations in Stillhouse Hollow Reservoir. At Lake Georgetown, the outfall would be located about 50 ft below the conservation pool elevation in a small cove on the north shore about 1500 ft from existing City of Georgetown municipal water intake. Both the intake structure and the outfall would be sited on parkland managed by the U.S. Army Corps of Engineers (USCE).

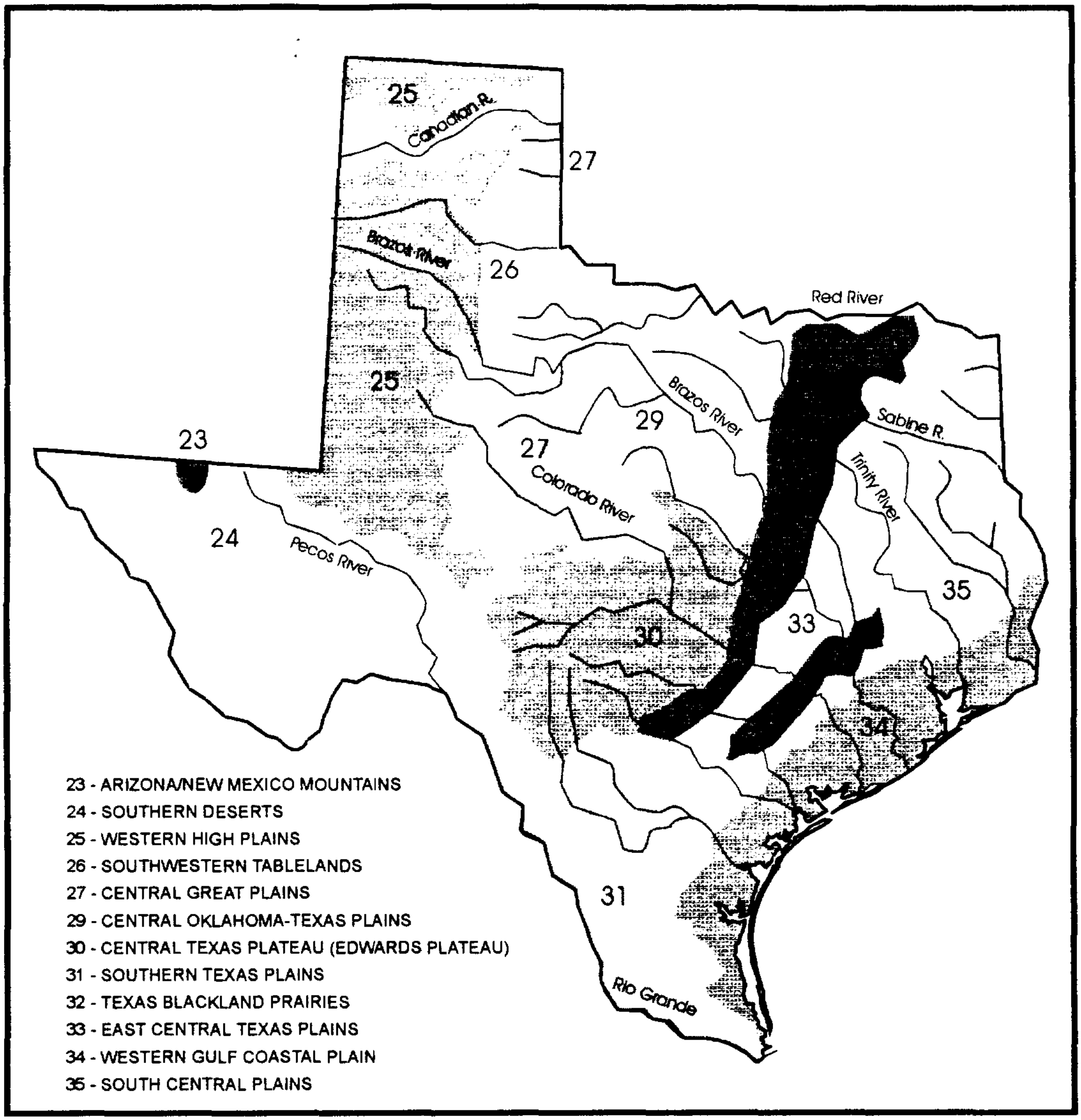
The proposed Williamson County Raw Water Line would originate at Stillhouse Hollow Reservoir on the eastern Edwards Plateau and run eastward to IH-35 in the Blackland Prairie Ecoregion (Figure 5.3-3). The water line easement would parallel the IH-35 ROW southward to the vicinity of Florence, where it would turn west to Lake Georgetown, again on the eastern Edwards Plateau (Figure 5.3-3). The corridor width required for construction would be about 80 ft, and the permanent maintenance corridor would be 30 ft wide. A new water treatment plant would be built near Lake Georgetown and treated water transmission lines would deliver water to the participants. Lake Georgetown would function as a balancing reservoir to meet peak demands while allowing transfer from Stillhouse Hollow at relatively constant rates.

The land use and habitats in the area traversed by the Williamson County Raw Water Line reflect its location adjacent to the Balcones Escarpment, a topographic feature sharply demarking the eastern edge of the Edwards Plateau. This feature, a low-lying plateau underlain by Cretaceous limestones exhibits a physiography, soils, vegetation, and fauna more or less distinct from the Blackland prairies immediately to the east. The Balcones Escarpment marks a relatively sharp transition between the Central Texas Plateau and the Texas Blackland Prairie Ecoregions (Figure 5.3-3)[7]; the Edwards Plateau and the

---

[7]Omernik, James M. 1987. Ecoregions of the Conterminous United States. Annals of the Association of American Geographers, 77(1): pp.118-125.

0140\ECOREGIO.CDR 8-15-94




Map Source: After Omernik, 1986

200 MILES
300 KILOMETERS

N

Figure 5.3-3

Ecoregions of Texas
Trans Texas Water Program
Austin Study Area

Paul Price Associates, Inc.

**ECOLOGY, WATER QUALITY, CULTURAL RESOURCES, PLANNING**

Blackland Prairie Vegetational Area (Figure 5.3-4)[8]; and the Balconian and Texan Biotic Provinces (Figure 5.3-5)[9]

The Edwards Plateau is mostly underlain by horizontally bedded hard to soft dolomitic limestone and marl from shallow, marine Cretaceous sediments. Extensive faulting throughout the Edwards formation is an important feature in the development of local physiographic features, groundwater aquifers, and springs. Solution, or Karst, features, including sinkholes, caves and smaller cavities along bedding planes and fractures are found throughout the Edwards formation, and springs commonly occur at its base. The eastern margin of the Edwards Plateau (and its northeastern extension, the Lampasas Cut Plane) is dissected into deep, steep-walled canyons occupied by streams flowing in an easterly or southeasterly direction. Mosaics of liveoak woodlands and grasslands, often invaded by ashe juniper or mesquite, are typical of Edwards Plateau upland vegetational habitats. Undisturbed canyon slopes tend to exhibit a more mesic woodland formation dominated by mature ashe juniper, deciduous oaks and a variety of other hardwoods including black cherry, Texas ash, Mexican persimmon, Arizona walnut, Bumilia, and a variety of understory species[10,11].

Soils along the IH-35 corridor are moderately deep to very shallow, calcareous, clayey, cobbly, and stony soils formed over fractured limestone suited for rangeland, crops, and pastures[12,13]. Blackland Prairie soils are fairly uniform, dark-colored calcareous clays interspersed with some gray acid sandy loams. Most of this fertile area has been cultivated, although a few native hay meadows and grazing land remains. Little bluestem is the dominant grass of the native assemblage. Other important grasses include big bluestem, Indian grass, switchgrass, tall dropseed, silver bluestem and Texas wintergrass. Under heavy

---

[8]Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, Texas.

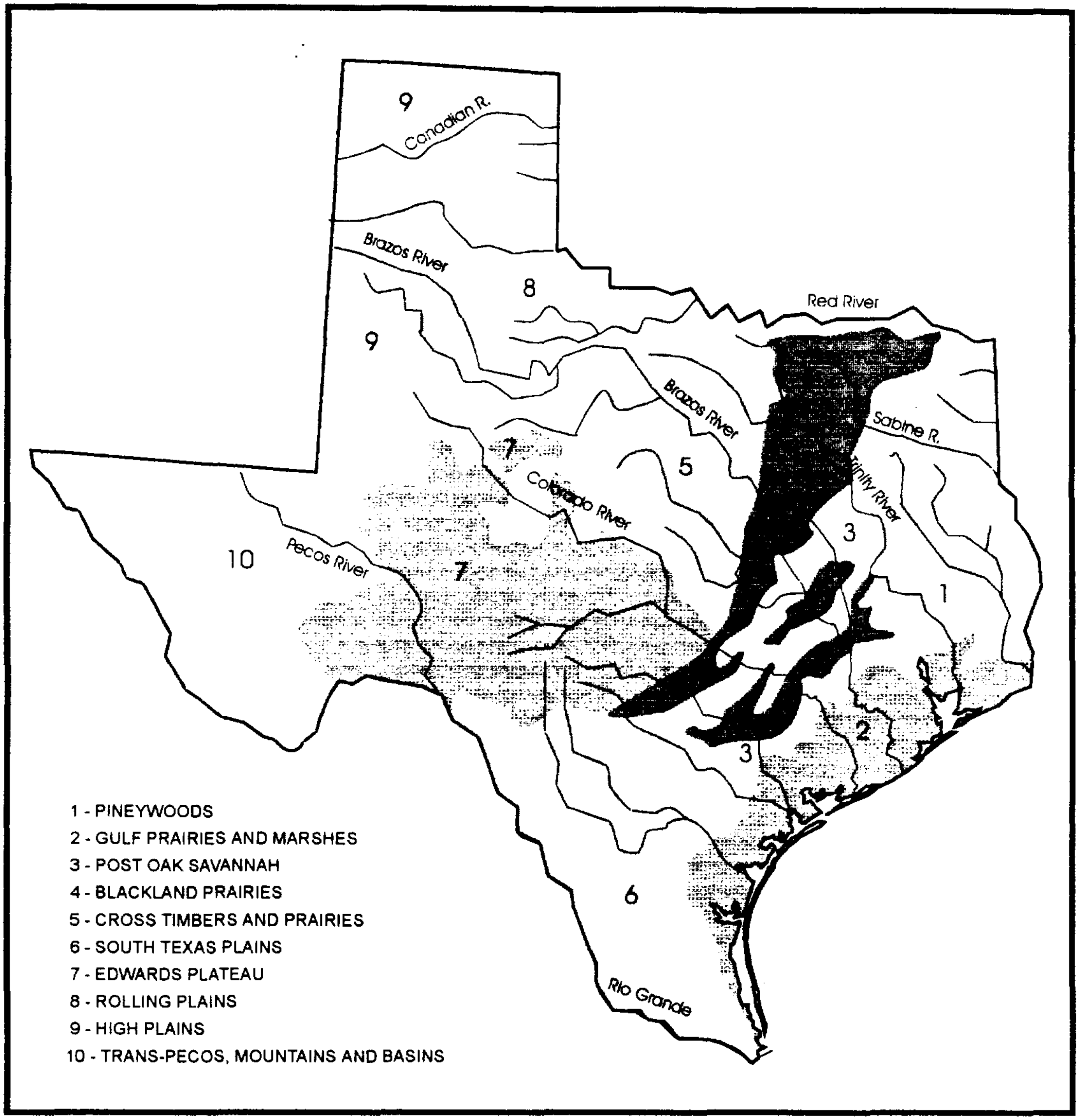
[9]Blair, W.F. 1950. The Biotic Provinces of Texas. Texas Journal of Science, 2(1): pp. 93-117.

[10]Texas Parks and Wildlife Department, Unpublished 1994. Data and map files of the Natural Heritage Program.

[11]McMahan, C.A., R.G. Frye, K.L. Brown. 1982. The Vegetation Types of Texas Including Cropland. Texas Parks and Wildlife Department, Austin, Texas.

[12]Soil Conservation Service. 1983. Soil Survey of Williamson County Texas. U.S. Department of Agriculture.

[13]Soil Conservation Service. 1977. Bell County Texas. U.S. Department of Agriculture.




Map Source: After Gould, 1962.

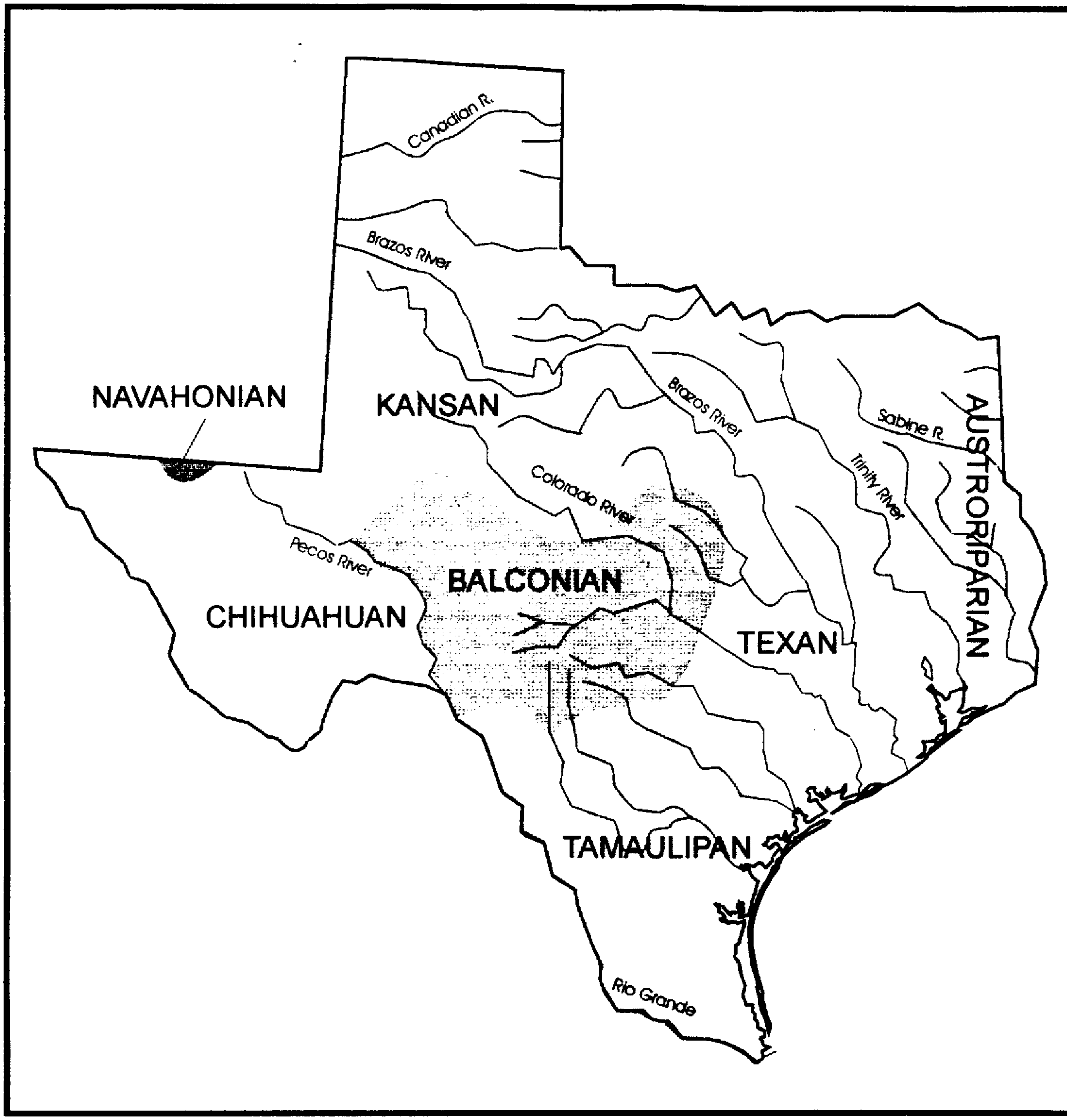
200 MILES
300 KILOMETERS
N

Figure 5.3-4

Vegetational Areas of Texas
Trans Texas Water Program
Austin Study Area

Paul Price Associates, Inc.

**ECOLOGY, WATER QUALITY, CULTURAL RESOURCES, PLANNING**




Map Source: After W. Frank Blair, 1950.

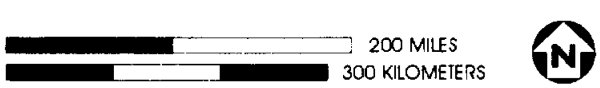



Figure 5.3-5

Biotic Provinces of Texas
Trans Texas Water Program
Austin Study Area

Paul Price Associates, Inc.

ECOLOGY, WATER QUALITY, CULTURAL RESOURCES, PLANNING grazing pressure, buffalo grass, Texas grama, smutgrass and many annuals increase or invade native pastures. Mesquite, post oak and blackjack oak also invade or increase under these conditions.

Stillhouse Hollow Reservoir impounds the Lampasas River in its canyon on the eastern margin of the Edwards Plateau about 12 miles above its confluence with the Leon River in Bell County. It was completed in 1968 by the U.S. Army Corps of Engineers (USCE) for water supply, flood control and recreation. The reservoir occupies 6,430 surface acres, impounds 235,703 acft of water, has a maximum depth of 107 ft, and an average depth of 37 ft at conservation elevation[14,15]. The reservoir is managed for bass sport fishing by Texas Parks and Wildlife Department. Abundant fish species in the reservoir include largemouth bass, spotted bass, longear sunfish, bluegill sunfish, redear sunfish, white crappie, gizzard shad, longnose gar, channel catfish, and common carp[16,17]. Rainbow trout have been introduced at the reservoir tailrace, and walleye were stocked in the reservoir during initial filling for sport fishing. Neither fish are reproducing. TPWD plans to continue stocking white bass and white crappie which do reproduce in this reservoir[18].

Lake Georgetown impounds another major tributary of the Brazos River, the North Fork San Gabriel River in Williamson County, also located in an Edwards Plateau canyon. The 1,310 acre surface area lake impounds 37,100 acft at conservation elevation 791 ft MSL. The maximum depth is about 85 ft. The lake was completed in 1980 by the USCE for water supply, flood control and recreation. Like Stillhouse Hollow Reservoir, the lake shores are typically steep

---

[14]Texas Parks and Wildlife Department. 1987. Statewide Freshwater Fisheries Monitoring and Management Program, Federal Aid in Sport Fish Restoration Act Project F-30-R, Survey Report for Stillhouse Hollow Lake. TPWD, Austin, Texas.

[15]U.S. Geological Service and Texas Water Commission. 1980-1991. Water Data for Water Years October 1989 to September 1990, Brazos River Basin , 08104050 Stillhouse Hollow Lake Near Belton, TX. Texas Water Commission, Austin, Texas.

[16]Texas Parks and Wildlife Department. 1987. Statewide Freshwater Fisheries Monitoring and Management Program, Federal Aid in Sport Fish Restoration Act Project F-30-R, Survey Report for Stillhouse Hollow Lake. TPWD, Austin, Texas.

[17]Texas Parks and Wildlife Department. 1989. Statewide Freshwater Fisheries Monitoring and Management Program, Federal Aid in Sport Fish Restoration Act Project F-30-R, Survey Report for Stillhouse Hollow Lake. TPWD, Austin, Texas.

[18]Ibid.

and rocky. Within the USCE property at Lake Georgetown, vegetational coverage ranges from brush and grassland on the lake margin to juniper-oak woodland. Mature trees, both oak and junipers, dominate the overstory while the understory is denser and more diverse than on the private rangeland north of the USCE parkland[19]. TPWD also manages a popular bass sport fishery at Lake Georgetown. Both lakes are relatively young. Fishery management recommendations noted lack of nutrients and the need for more vegetational cover as limitations to sportfish production in both reservoirs.

Although chloride levels in Stillhouse Hollow are well below recommended maximum concentrations, USGS water data from 1980 through 1991 shows that the water in Lake Stillhouse Hollow has a significantly higher chloride content than does Lake Georgetown. Water in Lake Georgetown is slightly harder than Stillhouse Hollow, but less alkaline.[20,21] Both reservoirs stratify and experience low dissolved oxygen levels at about the same time, mid to late summer[22]. The preliminary engineering report recommended a final design that would increase the dissolved oxygen level of water flowing to Lake Georgetown[23].

Construction of the intake and outfall structures would affect a total of less than 0.15 acres of lake bottom in each reservoir. No substantial impacts to fish spawning, nursery or feeding areas are expected. Effects of operation on the aquatic environment may result from changes in the frequency and extent of fluctuations in water surface elevations in both reservoirs, and in changes in streamflow in response to diversions from Stillhouse Hollow Reservoir. Hydrologic modeling that would show the effect of the proposed diversion on streamflows below Stillhouse Hollow Reservoir have not been performed. Since this alternative involves the sale of existing, stored water, the instream flow provisions that presently govern the operation at Stillhouse

---

[19]HDR Engineering, Inc. 1988. Williamson County Raw Water Line, Preliminary Engineering Report. Prepared for Brazos River Authority.

[20]Ibid.

[21]U.S. Geological Service and Texas Water Commission. 1980-1991. Water Data for Water Years October 1989 to September 1990, Brazos River Basin, 08104050 Stillhouse Hollow Lake Near Belton, TX.; 082104650 Lake Georgetown near Georgetown, TX. Texas Water Commission, Austin, Texas.

[22]HDR Engineering, Inc. 1988. Williamson County Raw Water Line, Preliminary Engineering Report. Prepared for Brazos River Authority.

[23]Ibid.

Hollow Reservoir would appear to continue to apply. The flow regime below Lake Georgetown would not be affected by the implementation of this alternative.

National Wetland Inventory Maps covering a landuse study corridor of about one mile width show predominately uplands dotted with farm ponds and traversed by perennial or intermittent streams with persistent pools[24,25,26,27,28]. Slightly more than one third of stream-associated (palustrine) wetlands exhibit emergent vegetation and almost one-third consists of forested intermittent streambeds (Table 5-4). The remaining wetlands are isolated, man-made farm ponds and a single, large perennial stream, Salado Creek.

Most of the water line corridor lies in previously disturbed pasture and cropland of the Blackland Prairie (Table 5-5). Woodlands are located primarily within the USCE properties surrounding both reservoirs, along Salado Creek and the other minor creeks crossed by the corridor over the Edwards Plateau portion of the corridor. Woodlands generally consist of variable mixtures of liveoak, mesquite, and juniper. Woodlands on private ranchlands along FM 2338 between Berry Creek and the USCE property at Lake Georgetown are generally sparse savannahs occupied by widely spaced small to medium sized cedar elms, Texas oaks and live oaks with little shrub growth, and in improved pasture grassland. A single area near the southern margin of the corridor exhibited some deciduous brushland.

A review of Texas Parks and Wildlife Department Natural Heritage Program files indicate the Edwards Plateau portion of the project area has numerous small springs, solution features and associated species. These include the terrestrial invertebrates

---

[24]U.S. Fish and Wildlife Service. 1992. National Wetland Inventory Map Series, Belton Quadrangle. U. S. Department of the Interior, Albuquerque, NM.

[25]_Salado Quadrangle. U. S. Department of the Interior, Albuquerque, NM.

[26]_Jarrell Quadrangle. U. S. Department of the Interior, Albuquerque, NM.

[27]_Cobbs Cavern Quadrangle. U. S. Department of the Interior, Albuquerque, NM.

[28]_Georgetown Quadrangle. U. S. Department of the Interior, Albuquerque, NM.

| Table 5-4<br>Wetlands in the Proposed Project[1] | | |
|---|---|---|
| **Wetland Type** | **Vegetation** | **Acres** |
| Reservoir | | 10 |
| Palustrine, permanent, diked ponds | | 23 |
| Palustrine, temporary ponds | emergent vegetation | 17 |
| Riverine, lower perennial | | 3 |
| Riverine, intermittent with temporary pools: | | |
| Palustrine, pools in streambeds | bottomland hardwood | 24 |
| Palustrine, temporary ponds | emergent vegetation | 18 |
| Total acreage in wetland | | 95 |
| Total acreage in study corridor | | 2,870 |

[1]USFWS. 1992. National Wetland Inventory Map Series. U.S. Department of the Interior, Albuquerque, NM.

| Table 5-5<br>Landuse and Habitat in Study Corridor | | |
|---|---|---|
| **Habitat Type** | **Approximate Acres** | **Percent** |
| Woodland and Savannah | 178 | 6 |
| Pasture or Cropland | 2,288 | 79 |
| Developed | 344 | 12 |
| Wetland | 95 | 3 |
| Total Study Area | 2,870 | 100 |

inhabiting shallow cavities in the areas of karst geology on the Edwards Plateau, and the salamanders found in the springs of the Balcones Escarpment. The Georgetown Salamander (*Eurycea sp. 5*) has been found in the project vicinity and other species could potentially occur in the project area.

The Golden-cheeked Warbler and Black-capped Vireo, both listed as endangered by the U.S. Fish and Wildlife Service (USFWS), nest in the USCE park at Lake Georgetown and other areas with appropriate .habitats (Table 5-5). Both species are known to nest in Bell and Williamson counties.[29]

The three reptiles listed in Table 5-6 are found in the project vicinity, and could occur within areas that would be disturbed by construction activities. The Texas horned lizard is a denizen of open, well-drained habitats with sparse cover. Ants, spiders, and isopods are included in their diets. The habitat requirements of this lizard species could be met on parts of the project area in both the Edwards Plateau and the Blackland Prairie regions. The Texas garter snake prefers wet or moist habitats with an abundance of frogs and other aquatic-associated prey. Farms ponds and ephemeral pools could harbor individuals of this species. The Texas garter snake's East Central Texas range includes habitats commonly found in the Blackland Prairie portion of the project area[30,31]. The timber rattlesnake is found in dense bottomland woodlands and extensive thickets of East Central to East Texas[32]. Wooded bottomlands in lower perennial streams may provide cover for this reclusive species. The project area is at the western edge of the timber rattlesnake's range. Widely distributed across the eastern third of Texas, this snake is generally uncommon near populated areas, nocturnal, and thinly distributed even in its preferred densely wooded habitat.[33]

In summary, although a number of protected species have geographic ranges that include the proposed project, the Golden-cheeked Warbler and the Black-capped Vireo and the federal "Category 2" Georgetown salamander may occupy portions of the study corridor. Two federal "Category 2" species, the Texas Horned Lizard and the Texas Garter Snake, could occur in the proposed project area as well as on land areas throughout the region.

---

[29]Texas Parks and Wildlife Department, Unpublished 1994. Data and map files of the Natural Heritage Program.

[30]Tennant, Alan. 1985. A Field Guide to Texas Snakes, Texas Monthly Field Guide Series. Texas Monthly Press, Austin, Texas.

[31]Dixon, James R. 1987. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas.

[32]Ibid.

[33]Tennant, Alan. 1985. A Field Guide to Texas Snakes, Texas Monthly Field Guide Series. Texas Monthly Press, Austin, Texas.

**Table 5-6**
**Protected Endangered and Threatened Species in the Project Area[1,2]**
Listed by the U.S. Department of the Interior (50 CFR 17.11 & 17.12, 16 April 1990)[3] Candidate Species (50 CFR 17, 6 January 1989; 21 February 1990; 21 November 1991) and Texas Parks and Wildlife Department (31 T.A.C. Sec. 65.171 - 174 & 65.181 - 184)

BELL COUNTY, TEXAS

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Arctic Peregrine Falcon | *Falco peregrinus tundrius* | Open coastal plains | E | T |
| Bald Eagle | *Haliaeetus leucocephalus* | Large bodies of water with nearby roosting and resting sites | E | E |
| Black-capped Vireo | *Vireo atricapillus* | Semi-open broad-leaved shrublands, oak-juniper woodlands with distinctive patchy, two-layered shrub - tree aspect | E | E |
| Golden-Cheeked Warbler | *Dendroica chrysoparia* | Woodlands with oak and mature juniper | E | T |
| Interior Least Tern | *Sterna antillarum athalassas* | Nesting on large river sandbars | E | E |
| Swallow-tailed Kite, American | *Elanoides forficatus* | Varied; open land, nesting in forested river bottoms | T | T |
| Wood Stork | *Mycteria americana* | Post-breeding; in wetlands of the coastal plain, major waterways | E/T | T |
| White-faced Ibis | *Plegadis chihi* | Freshwater marshes | C2 | T |
| Texas Garter Snake | *Thamnophis sirtalis annectans* | Varied; especially moist habitats; East Central TX | C2 | NL |
| Timber Rattlesnake | *Crotalus horridus* | Bottomland woodlands; dense thickets; abandoned fields | NL | T |
| Texas Horned Lizard | *Phrynosoma cornutum* | Open arid and semi-arid regions with sparse vegetation including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky, burrows in soil | C2 | T |
| Guadalupe Bass | *Micropterus treculi* | Streams of Eastern Edwards Plateau | C2 | NL |

[1]Source for Occurrence and Status: Texas Heritage Program Files, Unpublished 1994. Computer Database Search, Mapped Locations, and Reports. Texas Parks and Wildlife Department. Austin, Texas. Texas Parks and Wildlife, 05/09/88. Potential for Occurrence Based on Historic Range. Dixon, James R. 1987. Amphibians and Reptiles of Texas, with Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M University Press, College Station, Texas. Armstrong, David M., Jerry R. Choate, and J. Knox Jones, Jr. 1986. Distributional Patterns of Mammals in the Plains States. Occasional Papers, The Museum, Texas Tech University, No. 105, Texas Tech University Press, Lubbock, Texas.
[2]Symbols Under Listing Agency are as Follows: C1-USFWS Candidate Category C2-USFWS Candidate Category for Protection; C3-USFWS no Longer a Candidate for Protection; NL- Not Listed for Protection; E-Endangered; T-Threatened.
[3]Not Endangered in Texas Wood Stork - Listed Endangered Populations Alabama, Florida, Georgia, North Carolina, South Carolina

## Table 5-6 (continued)

WILLIAMSON COUNTY, TEXAS

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Arctic Peregrine Falcon | *Falco peregrinus tundrius* | Open coastal plains | E | T |
| Bald Eagle | *Haliaeetus leucocephalus* | Large bodies of water with nearby roosting and resting sites | E | E |
| Black-capped Vireo | *Vireo atricapillus* | Semi-open broad-leaved shrublands, oak-juniper woodlands with distinctive patchy, two-layered shrub - tree aspect | E | E |
| Golden-Cheeked Warbler | *Dendroica chrysoparia* | Woodlands with oak and mature juniper | E | T |
| Interior Least Tern | *Sterna antillarum athalassas* | Nesting on large river sandbars | E | E |
| Swallow-tailed Kite, American | *Elanoides forficatus* | Varied; open land, nesting in forested river bottoms | T | T |
| Wood Stork | *Mycteria americana* | Post-breeding; in wetlands of the coastal plain, major waterways, and lower Mississippi valley | E/T | T |
| White-faced Ibis | *Plegadis chihi* | Freshwater marshes | C2 | T |
| Texas Garter Snake | *Thamnophis sirtalis annectans* | Varied; but especially moist habitats; east central Texas primarily | C2 | NL |
| Timber Rattlesnake | *Crotalus horridus* | Bottomland woodlands | NL | T |
| Texas Horned Lizard | *Phrynosoma cornutum* | Open arid and semi-arid regions with sparse vegetation including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky, burrows in soil, enters rodent burrow, or hides under rocks when inactive | C2 | T |
| Georgetown Salamander | *Eurycea sp. 5* | Georgetown vicinity springs of the Balcones Escarpment | C2 | NL |
| Jollyville Plateau Salamander | *Eurycea sp. 1* | Springs below the Jollyville Plateau; Balcones Escarpment | C2 | NL |
| Guadalupe Bass | *Micropterus treculi* | Streams of Eastern Edwards Plateau | C2 | NL |
| Bee Creek Cave Harvestman | *Texella reddelli* | Six caves in karst formations Balcones Escarpment | E | NL |
| Kretschmarr Cave Mold Beetle | *Texamaurops reddelli* | Sinkhole cave, karst formation Balcones Escarpment | E | NL |
| Tooth Cave Ground Beetle | *Rhadine persephone* | Sinkhole cave, karst formation Balcones Escarpment | E | NL |

Other endangered and candidate species associated with karst formations of the Balconies Escarpment may be present.

With respect to cultural resources, both prehistoric and historic sites are known in the vicinity of the proposed reservoirs and pipeline corridor project areas.

Adverse impacts to wetlands, endangered species and cultural resource sites can largely be avoided or minimized by using field surveys to select final pipeline alignments and associated facility locations, and by choosing appropriate construction methods and schedules. Unavoidable impacts would have to be compensated for. This is generally accomplished by setting aside some appropriate acreage to be managed to regain the habitat values lost through project implementation. The project sponsor would be responsible for development of a management plan, and for providing funding to implement the management plan for the life of the project. The project sponsor may retain ownership of compensation lands, or they may be transferred to a mutually agreeable public agency (generally TPWD) for management.

### 5.3.4 Implementation Issues

1. Necessary permits:
   a. U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for stream crossings.
   b. GLO Sand and Gravel Removal permits.
   c. TPWD Sand, Gravel and Marl permit for river crossings.
2. Right-of-way and easement acquisition.
3. Crossings:
   a. highways and railroads
   b. creeks and rivers
   c. other utilities

## 5.4 Bosque Reservoir Delivered to Lake Waco (for delivery to Williamson County) (B-2)

### 5.4.1 Description

Bosque Reservoir is a proposed water supply reservoir planned on the Bosque River at a point about 45 miles northwest of Waco in Bosque County. The project is being sponsored by the Brazos River Authority. To potentially provide water to the City of Austin service area, water in the reservoir would be released from the dam and captured in Lake Waco. From Lake Waco, the water would be pumped in a transmission line to Stillhouse Hollow Reservoir, from which the Williamson County Raw Water Line Project (see Section 5.3), or a similar project, would be constructed to deliver the new water supply to Williamson County. The project features are shown in Figure 5.4-1.

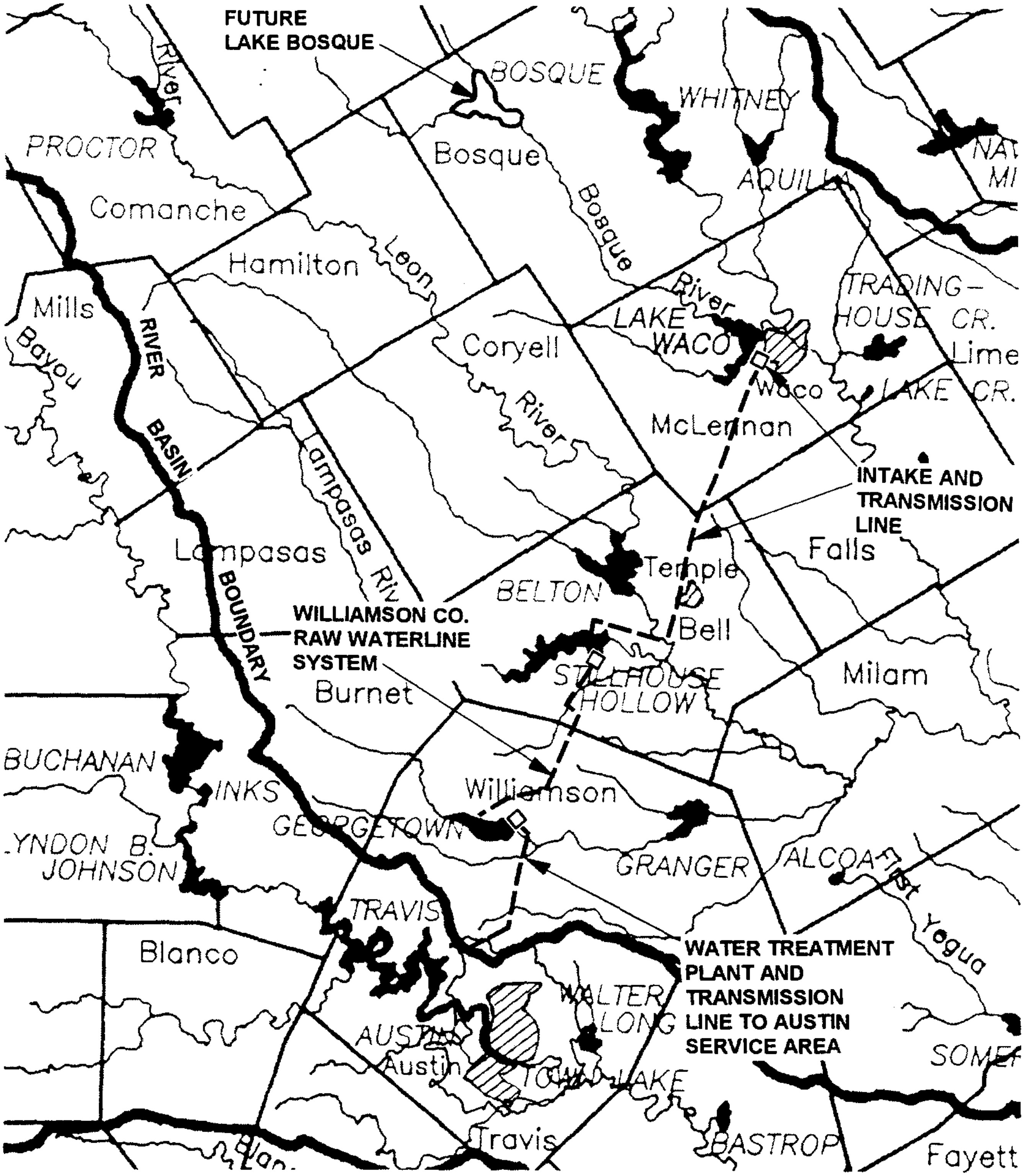
The cost of the Bosque Dam and Reservoir is estimated to be $59.2 million (1994 dollars). No cost estimate of the delivery system from Lake Waco to Stillhouse Hollow Reservoir has been made.

### 5.4.2 Available Yield

The firm yield of Bosque Reservoir is about 17,900 acft/yr. However, if the project is constructed, a portion of this yield may be needed for local sponsors of the project located in Bosque and McClennan Counties.

### 5.4.3 Environmental Issues

Alternative B-2 considers the use of Bosque Reservoir water in Williamson County through connection with the Williamson County Raw Water Line discussed in Section 5.3. The water supply system diagrammed in Figure 5.4-1 includes an intake located on Lake Waco and a water transmission line to Stillhouse Hollow Reservoir, where the Williamson County Raw Water Line intake would be located. Water released from the proposed Bosque reservoir would flow down the North Bosque River to Lake Waco, from which it would be diverted and transmitted to Stillhouse Hollow Reservoir in an approximately 50 mile long pipeline. The Williamson County Raw Water Line Project, or another delivery system, would divert and distribute water for treatment and use within the service area.




TRANS TEXAS WATER PROGRAM /
AUSTIN STUDY AREA

HDR

HDR Engineering, Inc.

**LAKE BOSQUE**
**WATER SUPPLY SYSTEM**

FIGURE 5.4-1

The proposed Bosque Reservoir on the North Bosque River would have a surface area of approximately 4,882 acres at conservation elevation, and a contributing drainage area of about 707 square miles. Firm yield of Bosque Reservoir is estimated at 17,900 acft/year. Below the Bosque dam site, the North Bosque River flows to Lake Waco at City of Waco. The dam impounding Lake Waco is located 4.6 river miles above the confluence of the Bosque River and Brazos River in the City of Waco[34,35].

The proposed reservoir site in Bosque County is located within the Lampasas Cut Plain, the highly dissected northern extension of the Edwards Plateau (Figure 5.3-3)[36]. This physiographic region is a broad, level to rolling plain with wide valleys separated by steep sided, flat topped divides capped by the resistant Edwards Limestone. Characteristic of the Edwards formation, there is a line of seeps and springs at its base that increases erosion activity on the underlying Commanche Peak and Trinity formations and contributes to perennial streamflows in the region[37].

An estimated 57 percent of the proposed Bosque Reservoir 100-year flood pool, dam and spillway (6,143.26 acres) is presently (1988) in native and improved pastureland. Cropland in sorghum, wheat and oats cover another 20% of the proposed reservoir. Almost 15% is (non wetland) bottomland hardwood. The North Bosque Channel is the largest wetland formation (about 3%) within the reservoir footprint. Remaining wetlands occurs as old river meanders, beaver impoundments and farm ponds[38].

Lake Waco, built in 1956, is located at river mile 4.6 on the Bosque River on the west side of City of Waco in McLennan County. The lake shoreline is mostly grassland in open park

---

[34]Paul Price Associates, Inc. 1987. Environmental Assessment for Lake Bosque Project, Bosque County, Texas, Prepared for Brazos River Authority. Paul Price Associates, Inc., Austin, Texas.

[35]HDR Engineering, Inc. 1994. Communications concerning Proposed Lake Bosque Project for Brazos River Authority. HDR Engineering, Inc., Austin, Texas.

[36]Omernik, James M. 1987. Ecoregions of the Conterminous United States. Annals of the Association of American Geographers, 77(1): pp.118-125.

[37]Paul Price Associates, Inc. 1987. Environmental Assessment for Lake Bosque Project, Bosque County, Texas, Prepared for Brazos River Authority. Paul Price Associates, Inc., Austin, Texas.

[38]Ibid.

recreational land. There are some willow and cottonwood in the floodplain with a small amount of live oaks, elm and pecans[39].

The operation of Lake Bosque and Lake Waco as a system will cause a reduction in the Brazos River discharge, with the combined yield of 17,900 acft/year diverted, and adjusting for return flows[40]. No hydrologic evaluation has been made of firm yield from a system operation with the Trans-Texas environmental criteria in place as instream flows would be governed by provisions within the permit issued by the TNRCC[41]. With respect to bay and estuary requirements, the effect of the diversions would be less than 1% of the annual discharge of the Brazos River near its mouth[42].

The proposed raw waterline corridor from Lake Waco will follow the IH-35 corridor south and then west to Stillhouse Hollow Reservoir. The corridor is primarily within the Blackland Prairie Ecoregion's western edge that abuts the Edwards Plateau (Figure 5.3-4)[43]. A one mile wide landuse study corridor was examined for wetland types and habitats (Tables 5-7 and 5-8). Landuse in the portions of the pipeline corridor adjacent to roadways tends to be urban developed, pasture and cropland similar to the Williamson County Raw waterline[44,45]. Stream crossings along the water transmission line corridor are primarily intermittent streams, with the exception of the Leon River below Lake Belton and the South Cow Bayou. Most of the streams exhibit narrow riparian bands of woodland. The various

---

[39]Ibid.

[40]HDR Engineering, Inc. 1994. Communications concerning Proposed Lake Bosque Project for Brazos River Authority. HDR Engineering, Inc., Austin, Texas.

[41]Ibid

[42]Ibid

[43]Gould, F.W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, Texas.

[44]McMahan, C.A., R.G. Frye, K.L. Brown. 1982. The Vegetation Types of Texas Including Cropland. Texas Parks and Wildlife Department, Austin, Texas.

[45]U.S. Geological Services. 1990. Aerial Photographic Series. EROS Data Center, Sioux Falls, SD.

**Table 5-7**
**Wetland Types in Study Corridor**

| Wetland Type | Vegetation | Acres |
|---|---|---|
| Reservoir | | 7 |
| Palustrine, permanent, diked ponds | | 45 |
| Palustrine, temporary ponds | emergent vegetation | 61 |
| Riverine, lower perennial | | 1 |
| Riverine, intermittent | | 19 |
| Riverine, intermittent with temporary pools: | | |
| Palustrine, pools in streambeds | bottomland hardwood | 65 |
| Palustrine, temporary ponds | bottomland hardwood | 4 |
| Palustrine, temporary ponds | shrubs | 2 |
| Total acreage in wetland | | 159 |
| Total acreage in study corridor | | 4,430 |

**Table 5-8**
**Landuse and Habitat in Study Corridor**

| Habitat Type | Approximate Acres | Percent |
|---|---|---|
| Woodland and Savannah | 354 | 8 |
| Pasture or Cropland | 3,430 | 77 |
| Developed | 487 | 11 |
| Wetland | 159 | 4 |
| Total Study Area | 4,430 | 100 |

stream crossings constituted about 53% of the total study corridor wetlands and 2% of the total corridor area[46,47,48,49,50,51,52,53].

Little habitat for protected species is apparent within the corridor studied, except for those portions of the project located on the Edwards Plateau. The habitats or concern in the Stillhouse Hollow Reservoir area discussed in Section 5.3.3. The Black-capped vireo and the Golden-cheeked warbler, both considered endangered by the U.S. Fish and Wildlife Service, are upland wood-/brushland species which could potentially occur on the Edwards Plateau portion of the project area. The both species have been recorded in Bell, Bosque, McLennan, and Williamson counties[54]. The Brazos River snake is found in the waters of the Brazos River basin frequently feeding in riffle areas. Intensive surveys in its range indicate that it is highly unlikely to be found in the Bosque River[55]. The remaining reptiles listed in Table 5-9, Texas horned lizard, Texas garter snake, and timber rattlesnake, are found in the project vicinity, and could occur within areas that would be disturbed by construction activities. The Texas horned lizard is a denizen of open, well-drained habitats with sparse cover. Ants, spiders, and isopods are included in their diets. The habitat requirements of this lizard species could be met on parts of the project area in both the Edwards Plateau and the Blackland Prairie regions. The Texas garter snake prefers wet or

---

[46]USFWS. 1992. National Inventory of Wetlands Series, Crawford Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[47]_ Lorena Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[48]_ Bruceville Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[49]_ Moody Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[50]_ Troy Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[51]_ Temple Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[52]_ Belton Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[53]_ Nolanville Quadrangle, U.S. Department of the Interior, Albuquerque, NM.

[54]Texas Parks and Wildlife Department, Unpublished 1994. Data and map files of the Natural Heritage Program.

[55]Scott, N.J.,Jr., and L.A. Fitzgerald. 1985. Final report: status survey of Nerodia harteri, Brazos and Concho-Colorado rivers, Texas. Unpublished report, office of Endangered Species, USFWS, Albuquerque, NM.; Maxwell,T.C. 1982. Status and distribution of Nerodia harteri harteri. Unpublished report, Office of Endangered Species, USFWS, Albuquerque,NM.

## Table 5-9

## Protected Endangered and Threatened Species in the Project Area[1,2]

Listed by the U.S. Department of the Interior (50 CFR 17.11 & 17.12, 16 April 1990)[3] Candidate Species (50 CFR 17, 6 January 1989; 21 February 1990; 21 November 1991) and Texas Parks and Wildlife Department (31 T.A.C. Sec. 65.171 - 174 & 65.181 - 184)

BOSQUE COUNTY, TEXAS

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Black-capped Vireo | *Vireo atricapillus* | Semi-open broad-leaved shrublands, oak-juniper woodlands with distinctive patchy, two-layered shrub - tree aspect | E | E |
| Golden-checked Warbler | *Dendroica chrysoparia* | Nesting in about 31 counties in central Texas; ashe juniper-oak woodlands of the Edward's Plateau ; adjacent areas with similar geology; Brazos and Colorado River basins | E | T |
| Interior Least Tern | *Sterna antillarum athalassos* | Nesting on large river sandbars | E | E |
| Peregrine Falcon, American | *Falco peregrinus anatum* | Open coastal areas | E | E |
| Peregrine Falcon, Arctic | *Falco peregrinus tundrius* | Open coastal areas | T | T |
| White-faced Ibis | *Plegadis chihi* | Freshwater marshes | C2 | T |
| Swallow-tailed Kite, American | *Elanoides forficatus* | Varied; open land, nesting in forested river bottoms | T | T |
| Whooping Crane | *Grus americana* | Coastal wetlands; Matagorda & Aransas Islands | E | E |
| Wood Stork | *Mycteria americana* | Post-breeding; in wetlands of the coastal plain, major waterways, and lower Mississippi valley | E/T | T |
| Brazos Water Snake | *Nerodia harteri harteri* | Waters of the Brazos River Basin; feeding in riffles | C2 | T |
| Timber Rattlesnake | *Crotalus horridus* | Bottomland woodlands | NL | T |
| Smalleye shiner | *Notropis buccula* | Large rivers and streams | C2 | NL |

1 Source for occurrence and Status: Texas Heritage Program Files, Unpublished 1994. Computer Database Search, Mapped Locations, and Reports. Texas Parks and Wildlife Department. Austin, Texas. Texas Parks and Wildlife, 05/09/88. Potential for Occurrence Based on Historic Range. Dixson, James R. 1987. Amphibians and Reptiles of Texas, with Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M University Press, College Station, Texas. Armstrong, David M., Jerry R. Choate, and J. Knox Jones, Jr. 1986. Distributional Patterns of Mammals in the Plains States. Occasional Papers, The Museum, Texas Tech University, No. 105, Texas Tech University Press, Lubbock, Texas.
2 Symbols Under Listing Agency are as Follows: C1-USFWS Candidate Category C2-USFWS Candidate Category for Protection; C3-USFWS no Longer a Candidate for Protection; NL - Not Listed for Protection; E-Endangered; T-Threatened.
3 Not Endangered in Texas Wood Stork - Listed Endangered Populations Alabama, Florida, Georgia, North Carolina, South Carolina.

**Table 5-9 (continued)**

MCLENNAN COUNTY, TEXAS

| Common Name | Scientific Name | Habitat Preference | Listing USFWS | Agency TPWD |
|---|---|---|---|---|
| Bald Eagle | *Haliaeetus leucocephalus* | Large bodies of water with nearby resting sites | E | E |
| Black-capped Vireo | *Vireo atricapillus* | Semi-open broad-leaved shrublands, oak-juniper woodlands with distinctive patchy, two-layered shrub - tree aspect | E | E |
| Golden-checked Warbler | *Dendroica chrysoparia* | Nesting in about 31 counties in central Texas; ashe juniper-oak woodlands of the Edward's Plateau ; adjacent areas with similar geology; Brazos and Colorado River basins | E | T |
| Interior Least Tern | *Sterna antillarum athalassos* | Nesting on large river sandbars | E | E |
| Peregrine Falcon, American | *Falco peregrinus anatum* | Open coastal areas | E | E |
| Peregrine Falcon, Arctic | *Falco peregrinus tundrius* | Open coastal areas | T | T |
| White-faced Ibis | *Plegadis chihi* | Freshwater marshes | C2 | T |
| Swallow-tailed Kite, American | *Elanoides forficatus* | Varied; open land, nesting in forested river bottoms | T | T |
| Whooping Crane | *Grus americana* | Coastal wetlands; Matagorda & Aransas Islands | E | E |
| Wood Stork | *Mycteria americana* | Post-breeding; in wetlands of the coastal plain, major waterways, and lower Mississippi valley | E/T | T |
| Guadalupe Bass | *Micropterus treculi* | Streams and reservoirs of Eastern Edwards Plateau | C2 | NL |
| Texas Horned Lizard | *Phrynosoma cornutum* | Open arid and semi-arid regions with sparse vegetation including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky, burrows in soil, enters rodent burrow, or hides under rocks when inactive | C2 | T |
| Timber Rattlesnake | *Crotalus horridus* | Bottomland woodlands; dense thickets | NL | T |

moist habitats with an abundance of frogs and other aquatic-associated prey. Farms ponds and ephemeral pools could harbor individuals of this species. The Texas garter snake's East Central Texas range includes habitats commonly found in the Blackland Prairie portion of the project area[56,57]. The timber rattlesnake is found in dense bottomland woodlands and extensive thickets of East Central to East Texas[58]. Wooded bottomlands in lower perennial streams may provide cover for this reclusive species. The project area is at the western edge of the timber rattlesnake's range. Widely distributed across the eastern third of Texas, this snake is generally uncommon near populated areas, nocturnal, and thinly distributed even in its preferred densely wooded habitat[59].

In summary, although a number of protected species have geographic ranges that include the proposed project, the Golden-cheeked Warbler and the Black-capped Vireo and the federal " Category 2" Georgetown salamander may occupy portions of the study corridor. Two federal " Category 2" species, the Texas Horned Lizard and the Texas Garter Snake, could occur in the proposed project area. Other endangered and candidate species associated with karst formations of the Balconies Escarpment may be present in the lower waterline or outfall corridor.

With respect to cultural resources, both prehistoric and historic sites are known in the vicinity of the proposed reservoirs and pipeline corridor project areas.

Adverse impacts to wetlands, endangered species and cultural resource sites can largely be avoided or minimized by using field surveys to select final pipeline alignments and associated facility locations, and by choosing appropriate construction methods and schedules. Unavoidable impacts would have to be compensated for. This is generally accomplished by setting aside some appropriate acreage to be managed to regain the habitat values lost through project implementation. The project sponsor would be responsible for development of a management plan, and for providing funding to implement the management plan for the life of the project. The project sponsor may retain ownership of compensation lands, or they may be transferred to

---

[56]Tennant, Alan. 1985. A Field Guide to Texas Snakes, Texas Monthly Field Guide Series. Texas Monthly Press, Austin, Texas.

[57]Dixon, James R. 1987. Amphibians and Reptiles of Texas. Texas A&M University Press, College Station, Texas.

[58]Ibid.

[59]Tennant, Alan. 1985. A Field Guide to Texas Snakes, Texas Monthly Field Guide Series. Texas Monthly Press, Austin, Texas.

a mutually agreeable public agency (generally Texas Parks and Wildlife Department) for management.

5.4.4 Implementation Issues

1. Construction of the reservoir will require these permits:
   a. TNRCC Water Right and Storage permits. (Permit is presently in appeals.)
   b. TNRCC Interbasin Transfer Approval. (Only if water is transported to Travis County.)
   c. U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for the reservoir and pipelines.
   d. GLO Sand and Gravel Removal permits.
   e. GLO Easement for use of state-owned land.
   f. Coastal Coordinating Council review.
   g. TPWD Sand, Gravel, and Marl permit
2. Permitting, at a minimum, will require these additional studies:
   a. habitat mitigation plan.
   b. cultural resource studies.
3. Land will need to be acquired through either negotiations or condemnation.
4. Relocations for the reservoir include:
   a. highways
   b. other utilities

For the pipelines:

1. Necessary permits:
   a. U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for stream crossings.
   b. GLO Sand and Gravel Removal permits.
   c. Coastal Coordinating Council permit.
   d. TPWD Sand, Gravel and Marl permit for river crossings.
2. Right-of-way and easement acquisition.
3. Crossings:
   a. highways and railroads
   b. creeks and rivers
   c. other utilities

## 5.5 Reclaimed Water Reuse (L-5)

### 5.5.1 Description

In their 1992 report[60], CH2M-Hill studied a number of potential water reuse options to reduce raw water demand, provide alternative effluent disposal methods, and to help satisfy permit renewal requirements of the city of Austin. The most viable water reuse strategies identified were:

> Urban Irrigation Systems to reduce the demand for potable water or provide lower-cost water for irrigation of golf courses, airport land, state-owned land, community gardens, and possibly park land.
>
> Industrial/Commercial Systems associated with the electronics industry, specifically the Tracor and Motorola plants near the Walnut Creek WWTP.
>
> Recycled Water/Water Supply Augmentation Systems which postpone, eliminate, or reduce the requirements for major water and/or wastewater system improvements.

CH2M-Hill identified 32 potential water reuse projects and chose 12 projects for qualitative evaluation of market, economic, social, and environmental considerations. The evaluation resulted in three projects being selected for more in-depth study. The three projects considered most likely for implementation are:

> Central Reuse System Extension and Supply Augmentation. Using reclaimed water from the Walnut Creek WWTP, the proposed irrigation system would be extended from Morris Williams Golf Course to Mueller Airport, Hancock Golf Course, Community Gardens, the State Land Complex, and Lions Golf Course. This system would also potentially serve Tracor and Motorola. An alternative included in this project is the possible water supply augmentation of Lake Austin and Town Lake .
>
> South Reuse System Extension. Using reclaimed water from the South Austin Regional WWTP, the existing irrigation system would be extended to the Bergstrom Air Base Complex and Jimmy Clay Golf Course. This system would also serve Advanced Micro Devices, Lockheed, the Industrial Park areas of South Austin, and Capitol Metro bus maintenance facilities. Potential alternatives include a new dual-distribution system at the proposed City of Austin Airport at Bergstrom.
>
> Northwest Water Reclamation Plant. This plant would provide capacity for an undetermined portion of the service area of the proposed Brushy Creek Regional Wastewater Treatment Plant. Reclaimed water would be used to irrigate area golf courses, provide cooling or process water to industries such as Texas Instruments and Motorola, and to service dual-distribution systems in developing subdivisions.

---

[60] CH2M-Hill, "Master Planning for Recycled Water", City of Austin, March, 1992.

5.5.2 Available Yield

CH2M-Hill estimates[61] of the market potential for each of the three reuse projects is contained in Table 5-10.

**Table 5-10**
**Potential Annual Market for Reuse Projects[1]**

| Project | Annual Market Potential (acft/yr) |
|---|---|
| Central Reuse System Extension and Supply Augmentation | 1,900 |
| South Reuse System Extension | 1,000 |
| Northwest Water Reclamation Plant | 1,000 |

[1]Source: CH2M-Hill, "Master Planning for Recycled Water," City of Austin, March 1992, Table 6-1.

5.5.3 Environmental Issues

Master planning for recycled water use was studied[62] to provide alternative effluent disposal methods and to satisfy permit renewal requirements. The goal of this alternative is to reduce demand on City of Austin water supplies and provide for water use through the year 2050. Reuse issues concern efficient use of existing water sources and reduction of demand on regional water supplies. Water use without reducing demand on regional water supplies may reduce water supply for future municipal, industrial, wildlife, and recreational needs.

The City of Austin Master Plan for Recycled Water concluded that barriers to water reuse are institutional, economic and technical. Although an environmental assessment was beyond the master plan scope, environmental concerns were briefly noted. The City of Austin Master Plan for Recycled Water concluded that educational programs could remove public concerns about irrigation with reclaimed water and technological developments could expand direct and indirect uses of reclaimed water. Using treated effluent to irrigate existing golf courses and institutional landscapes is included in each of the three projects identified in Section 5.5.1. This type of irrigation is now in use and generally accepted by the Austin area public as a means to dispose of effluent. However, current irrigation sites are located near the wastewater treatment plant site

[61]Ibid.

[62]Ibid.

and have not required extensive distribution line construction. Effluent from City wastewater treatment plants already meets most State standards for unrestricted-use[63]. Recycled water for golf course irrigation could be a source of non-point pollution depending on the irrigation water treatment and grounds management of the golf course. Public education about this use is needed since the public may not differentiate between the disposal of effluent and meeting irrigation needs with recycled water[64].

Landuse issues arise from the utility easements required for distribution systems. Existing lines for potable water could not be used by reclaimed water that is not potable. Dual distribution systems may require a larger utility easement than a conventional system to keep the lines separate from potable and wastewater lines. An expansion of utility easement would be necessary in the three project areas for lines and auxiliary systems. A distribution system of reclaimed potable or nonpotable water would be necessary because there is no single major water user or geographically concentrated group that significantly effects regional water use.

Reclaimed water treatment for water supply augmentation of Lake Austin and Town Lake may result in some increase in the quantity of sludge and a corresponding increase in land application or sludge disposal programs.

### 5.5.4 Implementation Issues

Because no potential large users of recycled water have been identified, the growth rate of demand for recycled water is expected to be gradual and the cost of the system may have to be subsidized. Amendment may be required of current direct discharge permits to a Chapter 309 permit (Use of Reclaimed Wastewater without Sale), or a Chapter 310 (Use of Reclaimed Wastewater with Sale) permit.

---

[63]Ibid.

[64]Ibid.