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**SECTION IV AGRICULTURAL IRRIGATION WATER DEMAND**



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**Abbreviations used in the Report**

| | |
|---|---|
| Ac-ft/yr | Acre-feet per year |
| BRA | Brazos River Authority |
| CLCND | Chambers-Liberty Counties Navigation District |
| COH | City of Houston |
| GBEP | Galveston Bay Estuary Program |
| GBF | Galveston Bay Foundation |
| GBFIG | Galveston Bay Freshwater Inflows Group |
| GCWA | Gulf Coast Water Authority |
| MGD | Million gallons per day |
| MWP | Major Water Provider |
| RWPG | Regional Water Planning Group |
| RHWPG | Region H Water Planning Group |
| SB1 | Senate Bill 1 from the 1997 State Legislature |
| SJRA | San Jacinto River Authority |
| TNRCC | Texas Natural Resource Conservation Commission |
| TPWD | Texas Parks and Wildlife Department |
| TRA | Trinity River Authority |
| TWDB | Texas Water Development Board |
| WUG | Water User Group |

**Water Measurements**

Acre-foot (AF) = 43,560 cubic feet = 325,851 gallons
Acre-foot per year (ac-ft/yr) = 325,851 gallons per year = 893 gallons per day
Gallons per minute (gpm) = 1,440 gallons per day = 1.6 ac-ft/yr
Million gallons per day (mgd) = 1,000,000 gallons per day = 1120 ac-ft/yr

**County Codes used in the Tables**

| | |
|---|---|
| 8 | Austin County |
| 20 | Brazoria County |
| 36 | Chambers County |
| 79 | Fort Bend County |
| 84 | Galveston County |
| 101 | Harris County |
| 145 | Leon County |
| 146 | Liberty County |
| 157 | Madison County |
| 170 | Montgomery County |
| 187 | Polk County |
| 204 | San Jacinto County |
| 228 | Trinity County |
| 236 | Walker County |
| 237 | Waller County |

**Basin Codes used in the Tables**

| | |
|---|---|
| 6 | Neches River Basin |
| 7 | Neches-Trinity Coastal Basin |
| 8 | Trinity River Basin |
| 9 | Trinity-San Jacinto Coastal Basin |
| 10 | San Jacinto River Basin |
| 11 | San Jacinto-Brazos Coastal Basin |
| 12 | Brazos River Basin |
| 13 | Brazos-Colorado Coastal Basin |

# SECTION I - INTRODUCTION

## A. Scope of Work

The overall project scope consists of preparing a regional water supply plan for the Region H Water Planning Group, representing 15 counties as shown in *Figure 2.1*. Region H is one of 16 state water supply planning regions defined by the Texas Water Development Board (TWDB). The regional water plans prepared by each Regional Water Planning Group (RWPG) will be combined into a comprehensive state water plan. The planning effort is part of a new consensus-based planning effort to include local concerns in the statewide planning effort.

This report summarizes the procedures and results of Task 2 of the project scope. The report presents updated population and water demand data for the region and outlines the guidelines and methodology used for the update. Also, to provide consistency and facilitate the compilation of the different regional plans, TWDB required the assimilation of this data into standardized table formats. These tables are identified below; and a discussion of the methodology for the tables is included in the *Appendices.*

- *Table 1*, Population by City and Rural County
- *Table 2*, Water Demand by City and Category
- *Table 2A*, Environmental Water Needs for Galveston Bay
- *Table 3*, Water Demand by Major Provider of Municipal and Manufacturing Water
- *Table 3A*, Water Demand by Major Provider of Municipal and Manufacturing Water, Assuming Extension of Existing Contracts in Region H

## B. Background[1]

The increased demand for water, combined with recent droughts, has increased awareness of water supply availability issues in Texas. According to the 1997 State Water Plan estimates, Texas population is projected to double, increasing from about 19 million (current population) to more than 36 million people by the year 2050. Statewide water use is anticipated to increase by about 11 percent by 2050. A projected decline in water used for agriculture needs offsets a considerable increase in water needs of municipal and manufacturing uses. Urban water use in Texas is projected to grow by about 52 percent in the next 50 years, despite anticipated savings from water conservation measures.

Water resource planning and management in Texas is a shared responsibility of local utilities, regional special purpose districts, and state agencies. Local and regional water development authorities and municipalities have had primary responsibility for financing and constructing

[1] Some of the information used for describing the background came from *Water for Texas*, published and distributed by the TWDB, August 1997, and referred to as the 1997 State Water Plan.

new water resource projects. The state's primary role has been providing guidance, regulatory insight, and limited financial assistance.

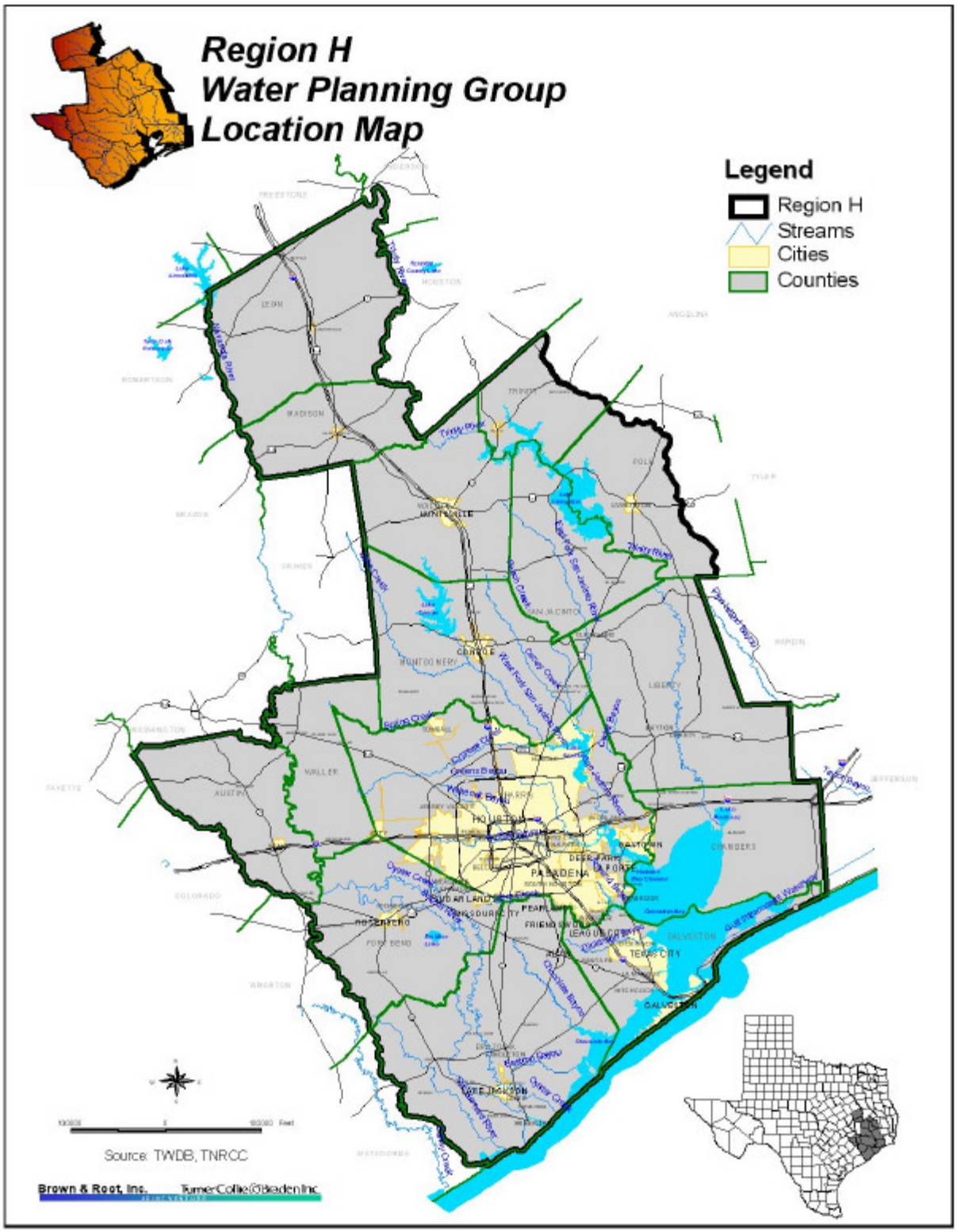
Senate Bill 1 (SB 1), 75th Texas Legislature, established a new approach to preparation of the state water plan consisting of local consensus on regional plans first. The Region H Water Planning Group is responsible for completing a consensus-based regional water supply management plan for submittal to the TWDB by January 5, 2001. The Region H Water Planning Group contracted with the Brown and Root/Turner Collie & Braden Joint Venture (Team) to develop technical data needed to prepare a regional water plan.

## C. Description of the Region[2]

Region H, located along the southeastern Texas coast, consists of all or part of 15 counties, including Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Leon, Liberty, Madison, Montgomery, Polk, San Jacinto, Trinity, Walker, and Waller. The eastern portions of Trinity and Polk counties are included in the Region I planning area. Region H encompasses the San Jacinto River basin, the lower portions of the Trinity and Brazos river basins, and includes part or all of the Brazos-Colorado, San Jacinto-Brazos, Trinity-San Jacinto, and Neches-Trinity coastal basins. This area includes the Galveston and Trinity Bay estuaries; the urbanized, rapidly growing Houston-Galveston Metropolitan Area, encompassing Brazoria, Harris, Galveston, Fort Bend, and Montgomery counties; the coastal port communities of Galveston and Freeport; and agricultural areas in Austin, Chambers, Leon, Liberty, Madison, Polk, San Jacinto, Trinity, Walker, and Waller counties. *Figure 2.1* is a map of the Region H area.

[2] *Region H Water Management Plan: Description of Region*, submitted by Team.

**Figure 2.1**


Region H
Water Planning Group
Location Map
Legend
Region H
Streams
Cities
Counties
Source: TWDB, TNRCC
Brown & Root, Inc.
Turner Collie & Braden Inc.

## SECTION II - GUIDELINES AND METHODOLOGY

### A. General

A key task in the preparation of the water supply plan for Region H is to determine current and future water demands within the region. Projections of future water demand are to be compared with estimates of currently available water supply to identify future water shortages. SB 1 and associated rules of the TWDB require that population and water demand projections from the current state water plan be used as the default for regional water planning unless there are substantiated reasons to revise those projections. The terms "default estimates" or TWDB projections are used throughout this report to refer to the 1997 State Water Plan consensus-based estimates developed by the TWDB in conjunction with the Texas Natural Resources Conservation Commission (TNRCC) and Texas Parks and Wildlife Department (TPWD). This section discusses the guidelines and methodology used to evaluate these projections and to select projections for use in the regional water plan for Region H.

TWDB rules require that the analysis of current and future water demands be performed for each water user group (WUGs) within Region H. Within the municipal category, each city with a population of 500 or more is considered a WUG, and all smaller communities and rural areas, aggregated at the county level, are considered a WUG and are referred to as "County-Other" for each county. For each county, manufacturing, irrigation, steam-electric power generation, mining, and livestock water use categories are each considered WUGs.

In addition, TWDB rules require the determination of demands associated with each of the Major Water Providers designated by the RWPG. Region H defines major providers of municipal and manufacturing water as entities selling and delivering significant amounts of water for municipal and/or manufacturing use or providing water supply to a significant portion of the region's population and/or industry and likely to be involved in the development of major water supply projects in the region. For Region H, the Major Water Providers are the Brazos River Authority, City of Houston, Gulf Coast Water Authority, San Jacinto River Authority, and Trinity River Authority.

The regional water planning process includes developing a regional consensus of population and water demand estimates. Public involvement is a key element in this process. The Region H Water Planning Group held public meetings, local government workshops, and special interests meetings with environmental, agricultural, and manufacturing groups.

Public meetings were held at four locations in Region H. Since Region H is a large region, the locations were selected to provide the most convenient access to the meetings for members of the interested public. Sites selected were San Jacinto College-South (Houston and south), Bear Creek Park (Houston and west), White Memorial Park (east), and Walker County Courthouse (north). Meeting notices were placed in 12 newspapers in the region; press releases were sent to 42 papers, as well as radio and television stations. Region H Planning Group members also assisted by advising interested groups of the meetings.

Throughout this section, language excerpted directly from the TWDB published guidelines for changes to the 1997 Consensus Water Plan Projections appears in italics. The applicable TWDB criteria used to support and develop revisions to the TWDB numbers are designated in bold, italic type.

## B. TWDB Guidelines for Revisions to Population and Water Demand Projections

The TWDB established criteria and data requirements to be used in evaluating and developing revisions to the state consensus-based population and water demand projections. The criteria applied in developing revisions to the 1997 State Water Plan projections for Region H are displayed in bold, italic type below and are described in detail.

### 1. Population Projections

Combined with estimates of per capita water use and water conservation assumptions, population is the principal determinant for projected future municipal water demand. As such, emphasis has been placed on evaluating the state's default population projections and on developing revisions in accordance with the following criteria.

> ***Criteria:*** *One or more of the following criteria must be verified by the Regional Water Planning Group and the Executive Administrator of the TWDB for consideration of revising the consensus-based population projections.*
>
> ***a) The current population estimate of a county or city is greater than or equal to the year 2000 population projection for that respective county or city which was used in the preparation of the 1997 State Water Plan.***
>
> ***b) The population growth rate for a county or city over the latest period of record, beginning in year 1990, is greater than the 1997 State Water Plan projected growth rate for that county or city over the period 1990 to year 2000.***
>
> *c) If the Regional Water Planning Group disagrees with the long-term population projections (2000-2050) for a county or city that was used in preparation of the 1997 State Water Plan, historical growth rates will be used for comparison purposes and possible verification of changes to the population projections. Historical growth rates for cities must be calculated for the last 30 years of reported population data and the last 40 years of reported population data for counties. Specifically, historical growth rates will be calculated for each 10-year period over the 30- and 40-year periods.*
>
> ***d) Identification of areas that have been recently annexed by a city within the regional water planning area***

***e) Other criteria that the Regional Water Planning Group believes are important for consideration of revisions to the State Water Plan population projections***

***Data Requirements:*** *The Regional Water Planning Group must provide the following data associated with the identified criteria to the Executive Administrator of the Water Development Board for justifying any revisions to the consensus-based population projections that were used in the preparation of the 1997 State Water Plan.*

***1) Population estimates for counties and cities developed and published by the State Data Center will be used for verifying criteria (a) and (b).***

***2) If an entity disagrees with the State Data Center's most current population estimate for that entity, the Regional Water Planning Group must provide one or more of the following data sets along with the analysis and documentation used in estimating the entity's current population.***

*a) School enrollment information*

*b) Building permits information*

*c) Active residential water service information*

*d) Appraisal district information*

***e) Other information or current population estimates that the Regional Water Planning Group believes are appropriate and important***

*3) Census counts for cities and counties published by the U.S. Bureau of the Census will be used for verifying historical long-term population growth rates for cities and counties.*

***4) The population of an area that has been annexed by a city***

***5) Other data that the Regional Water Planning Group believes are important to justify any changes to the consensus-based population projections used in preparation of the State Water Plan***

## 2. Municipal Water Use

As indicated above, per capita water use rates and assumptions regarding water conservation are additional variables in municipal water demand projections.

Accordingly, the following criteria were applied in the evaluation of the state's municipal water demand projections and in the development of revisions to those projections.

> ***Criteria:*** *One or more of the following criteria must be verified by the Regional Water Planning Group and the Executive Administrator of the Texas Water Development Board for consideration of revising the consensus-based municipal water use projections that were used in the preparation of the 1997 State Water Plan:*
>
> ***a) Any changes to the population projections for an entity will require revisions to the municipal water use projections***
>
> *b) Errors identified in the reporting of annual municipal water use for an entity*
>
> *c) Differences identified between the Board's calculated per capita water use for a city and the per capita water use calculated by the respective city*
>
> *d) The consensus-based municipal water use projections include both the expected case and advanced case conservation savings for any specific municipality. Any requests for changing the conservation savings scenarios (expected or advanced) must be accompanied with complete documentation justifying the request*
>
> *e) Trends indicating that per capita water use for a city or a rural area of a county has increased over the latest period of record, beginning in 1980*
>
> *f) Other criteria that the Regional Water Planning Group believes are important for consideration of revisions to the State Water Plan municipal water use projections*

### 3. Other User Groups

The TWDB water demand projections were used for other categories of water users (e.g., manufacturing, irrigation, steam-electric power generation, mining, and livestock), except for those cases where more current or better data were provided. Revisions to the projections for these WUGs are described in *Section 3* of this report.

## C. Methodology

This section describes the methodology used to develop projections for population and for water demand for each municipal, manufacturing, irrigation, steam-electric power generation, mining, and livestock WUG in Region H.

### 1. Population Projection Methodology

The following procedure was used to develop population projections for each city and County-Other:

a). **Identify the baseline projection:** The baseline population projection for SB1 regional water planning is the TWDB's "most likely" scenario for each county, each city of 500 population and greater, and cities of less than 500 population and rural areas (county-other). These projections are presented by decade from 1990 (actual reported from census) to 2050. These TWDB default projections are to be used unless revisions are justified per TWDB guidelines.

b). **Evaluate recent population growth trends:** As indicated in *Section A*, TWDB guidelines allow for adjustments of population projections if there is evidence that growth trends during the 1990s have been greater than originally projected by the TWDB. Using the 1990 census and a January 1998 population estimate provided by the State Data Center, the growth rate for this period was calculated and extrapolated to the year 2000. This extrapolated year 2000 population estimate was then used as the starting point for the development of a Team-SDC revised population projection through 2050, using the growth rates in TWDB's projections for each decade. For those cities and county-other areas where the modified year 2000 population estimate is greater than the TWDB year 2000 projection, the effect of the modification is to adjust the population projection upward for the planning period.

c). **Develop Subsidence District estimates:** Population and water demand estimates were developed in March 1996 by Turner Collie & Braden for the Harris-Galveston Coastal Subsidence District. The report, titled *Update of Population and Water Demand Forecasts*, 8 of the Region H counties and addressed was submitted to the TWDB for review of the projection methodology.

d). **Compare to the best available information:** In cases where better, more current information is available, that information is presented as the revised projection. Other information applied on a case-by-case basis are described by WUG in *Section III*.

e). **Select a proposed population projection:** For each city and county-other proposed population projections were determined after the TWDB, the Team-SDC revised, the Subsidence District estimates, and other available projections were compared. The higher of the projections was selected as the proposed projection, except in cases where better information was available. The revised population projections proposed and ultimately adopted by the TWDB are presented by county in *Appendix A* and in Table 1 of *Appendix B* in the TWDB standardized format.

## 2. Municipal Water Demand Projection Methodology

### a) Per Capita Water Use:

The second key variable in the TWDB's municipal water demand projections is per capita use, expressed as gallons of water used per person per day. TWDB estimates of per capita water use are derived from data provided by water suppliers annually, and are simply the total annual reported municipal water use divided by total estimated population, and then divided by 365 (days in a year). The starting point in TWDB's default projections is a per capita use estimate for a year with below-normal rainfall when water use is typically high. These per capita use values were taken from data from the 1982-1991 period.

TWDB guidelines for revisions to municipal water demand projections provide that adjustments in per capita use rates can be proposed if more recent data indicate that per capita use has increased. The guidelines also provide for the modification of TWDB conservation assumptions where justified. Given these guidelines (presented in *Section B2,* above), the following procedure was used to develop per capita water use rates.

i. **Identify TWDB projected per capita use rate:** Estimated per capita water use for the year 2000 under a "below-normal rainfall" and "no conservation" scenario was identified.

ii. **Identify reported 1996 per capita water use rate:** Using data provided by the TWDB, per capita water use for 1996 was calculated. This value was selected as a more recent measure of per capita use under below-normal rainfall conditions, as drought conditions affected the entire region for much of 1996. These values were comparable to the TWDB rate projections; therefore, the TWDB per capita use rate was used to calculate demands.

iii. **Apply TWDB water conservation assumptions:** TWDB's baseline or default projections of municipal water demand include a set of water conservation assumptions described as the most likely scenario. This includes the effects of state and federal plumbing fixture efficiency standards, reductions in seasonal water use (e.g., landscape irrigation), and savings in other uses (e.g., public education). These assumptions are applied in the TWDB projections in such a manner as to result in each city having a unique projection of water savings. In some of the cities and counties, an advanced conservation scenario was used by TWDB in response to anticipated shortages. This combination of expected and advanced conservation was used in Harris County.

**b) Municipal Water Demand:**

The municipal water demand projections are the product of the proposed population projections and the proposed per capita usage projections described above. These projections were adopted by the TWDB, and are presented for each municipal WUG by county and by decade in *Appendix A*; for all WUG, including non-municipal categories, they are presented by county, basin, and decade, in *Table 2* of *Appendix B* in the TWDB standardized format.

**3. Manufacturing Water Demand Projection Methodology**

For SB 1 regional water planning purposes, manufacturing water use is considered to be the cumulative water demand by county for all industries within specified standard industrial classifications (SICs) determined by the TWDB. The manufacturing water use projections that were developed by the TWDB and used in the 1997 State Water Plan were accepted for use by Region H Water Planning Group with no changes. These data were presented to representatives of the chemical manufacturing industry in a meeting on May 20, 1999.

**4. Irrigation Water Demand Projection Methodology**

The Region H Water Planning Group did not adopt the irrigation water use projections that were developed by the TWDB and used in the 1997 State Water Plan. The TWDB projections were determined with assistance from Texas A&M, and assume expected case water conservation practices and no reduction in federal farm program subsidies. They were based on projected future rice prices for 1996 through 2000 that have not followed the projected trends. Texas A&M is currently reviewing its previous estimates based on revised economic estimates and estimates of projected improvements in disease resistance and rice yield. Some of this information is presented in *Section IV*. Revisions to the TWDB projections were adopted for all counties as a result of the submission of better, more current projection information. These revisions are described in *Section III* and *Section IV*.

**5. Steam-Electric Water Demand Projection Methodology**

The steam-electric water use projections that were developed by the TWDB and used in the 1997 State Water Plan were accepted for use by Region H Water Planning Group with one exception: the Walker County steam-electric power demand was eliminated based upon current information regarding power plant development.

**6. Mining Water Demand Projection Methodology**

The TWDB mining water use projections that were used in the 1997 State Water Plan were developed based on projected future production levels by mineral category and expected water use rates. These production projections were derived from state and national historic rates, and were constrained by accessible mineral reserves in each region. The 1997 State Water Plan mining water demand projections were accepted for use by Region H Water Planning Group with no changes.

**7. Livestock Water Demand Projection Methodology**

The livestock water use projections developed by the TWDB and used in the 1997 State Water Plan were accepted for use by Region H Water Planning Group with no changes.

**8. Demand of Major Providers of Municipal and Manufacturing Water**

Designated major providers in the Region H area include Brazos River Authority, City of Houston, Gulf Coast Water Authority, San Jacinto River Authority and Trinity River Authority. Major providers are obligated to provide 1,306,547 acre-feet

of supply to meet the current (year 2000) requirements of long term contracts or retail commitments. TWDB guidance required consideration of active contracts only, which reduces major provider obligations to 786,620 acre-feet in year 2050. Region H major providers assume the continuation of municipal contracts across the 50-year planning period, at least to the level of existing obligations. Two tables were developed to reflect these two assumptions. *Table 3* in *Appendix B* provides the projected water demands by Major Providers of municipal and manufacturing water in the TWDB standardized format. *Table 3A* and *Appendix B* provides the projected water demands by Major Providers with the assumption that existing contracts will be continued at their current amount through 2050.

## SECTION III - POPULATION AND WATER DEMAND PROJECTIONS

This section discusses the projections for population and for municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for each of the fifteen counties in Region H. These projections were developed using the general methodology described in *Section II*, with any exceptions described by WUG for each county. *Figure 2.2*, at the end of this section, presents a summary of Region H's total revised water demand projections by water user category.

After the revised population and water demand projections were approved by the RWPG and adopted by the TWDB, the projections were incorporated into standardized tabular formats required by the TWDB. These tables and a description of the methodology used to create them are included in *Appendix B* and present the projections for each WUG by county and river basin, for each decade. *Tables 1, 2,* and *3* are part of the Task 2 deliverables required by TWDB. *Tables 2A* and *3A* were prepared at the request of the Region H RWPG.

*Table 1* presents Population by City and Rural County; *Table 2* presents Water Demand by City and Category; *Table 2A* presents the Environmental Needs for Galveston Bay; *Table 3* presents water Demand by Major Provider of Municipal and Manufacturing Water; *Table 3A* contains the same basic data as *Table 3*, with the exception that all existing contracts were assumed to be extended at the current amounts for all the decades 2000-2050.

### A. Regional Summary of Projections by Category

#### Population:

The revised population projections indicate that Region H's population will grow from 4,780,084 in 2000 to 9,700,277 in the year 2050. These projections represent an increase relative to the state default population projections by 11.06 percent, or 1,073,248 persons in the year 2050. *Appendix A* presents the revised projections by county and decade, as well as a comparison to the TWDB projections. *Table 1* in *Appendix B* presents these projections in the TWDB standardized format by county, river basin, and decade.

#### Municipal Water Demand:

Revised municipal water demand projections for Region H show an increase in projected demand from 897,209 acre-feet in the year 2000 to 1,485,639 acre-feet per year in the year 2050. These projections exceed the default TWDB projections by 5.37 percent in 2000 and by 8.11 percent in the year 2050. The revised projections by county for each municipal WUG are provided in *Appendix A* and in *Table 2*, *Appendix B*, in the TWDB standardized format, by county and by river basin. *Figure 2.3*, shown at the end of this section, presents the comparison of the TWDB default demand to the revised projections.

**Manufacturing Water Demand:**

The proposed manufacturing water demands for Region H are the TWDB default projections that are included in the 1997 State Water Plan. The proposed manufacturing water demand for Region H is projected to increase from 708,113 to 1,048,194 acre-feet per year from 2000 to 2050. The revised projections are provided in *Appendix A* and in *Table 2, Appendix B,* in the TWDB standardized format.

**Irrigation Water Demand:**

The TWDB default estimate for rice irrigation projects a sharp decline in irrigation water demand. This was based on a 1996 study prepared by Texas A&M. Texas A&M has prepared a revised rice irrigation projection based on the latest conditions that exist in the region. Projections for rice irrigation were also developed by the Team, as part of a consensus effort of local rice growers, agricultural businesses, Texas A&M University Agriculture Specialists, and local County Extension Agents; these projections are contained in *Appendix C*. This projection shows a slight decrease in irrigation water demand over current usage. *Figure 2.4*, shown at the end of this section, presents a comparison of the TWDB default demands to the Region H proposed revision. *Section IV* has been included to explain the methodology used to project agricultural water demands. Total irrigation water demand for the region is projected to decrease from 501,053 to 471,679 acre-feet per year between 2000 and 2050. The TWDB estimates were 461,625 acre-feet per year in 2000 and 350,213 acre-feet per year in 2050. The proposed change results in a 34.68 percent increase over the TWDB projections for the year 2050. The revised projections are provided in *Appendix A* and in *Table 2, Appendix B,* in the standardized TWDB format.

**Steam-Electric Water Demand:**

The steam-electric water demands for Region H were initially proposed to be the TWDB default projections. Those projections were adopted by Region H and the TWDB. However, during the public meeting process, it was determined that the steam-electric power facility within Walker County has actually occurred within Region G in Grimes County. Therefore, the steam-electric water demand for Walker county was eliminated.

As a result the proposed steam-electric water demand for Region H is 95,100 acre-feet per year in 2000 and 105,000 acre-feet per year in 2050. The revised projections are provided in *Appendix A* and in *Table 2, Appendix B,* in the standardized TWDB format.

**Mining Water Demand:**

The proposed mining water demands for Region H are the TWDB default projections that are included in the 1997 State Water Plan.

The proposed mining water demand by decade for Region H is 33,826 acre-feet per year in the year 2000 and 35,243 acre-feet per year in 2050. The revised projections are provided in *Appendix A* and in *Table 2, Appendix B*, in the standardized TWDB format.

**Livestock Water Demand:**

The proposed livestock water demands for Region H are the TWDB default projections that are included in the 1997 State Water Plan.

The proposed livestock water demand by decade for Region H is 13,038 acre-feet per year in the year 2000 and 13,038 acre-feet per year in 2050. The revised projections are provided in *Appendix A* and in *Table 2, Appendix B*, in the standardized TWDB format.

**Demand of Major Water Providers**

Designated major providers in the Region H area include Brazos River Authority, City of Houston, Gulf Coast Water Authority, San Jacinto River Authority and Trinity River Authority. Major providers maintain current customer contracts for 1,939,769 acre-feet of supply. TWDB guidance required consideration of active contracts only, which reduces major provider obligations to 788,670 acre-feet in year 2050. Region H major providers assume the continuation of municipal contracts across the 50-year planning period, at least to the level of existing obligations. Two tables were developed to reflect these two assumptions. *Table 3* in *Appendix B* provides the projected water demands by Major Providers of municipal and manufacturing water in the TWDB standardized format. *Table 3A* in *Appendix B* provides the projected water demands by Major Providers with the assumption that existing contracts will be continued at their current size through 2050.

## B. Projections for Austin County

1. Population

   The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Austin County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Austin County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

## C. Projections for Brazoria County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Brazoria County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Brazoria County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands differ only for 2040 and 2050 and represent the projections made by the Region H Water Planning Group Team.

## D. Projections for Chambers County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Chambers County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for Chambers County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

## E. Projections for Fort Bend County

1. Population

The population projection for the county total is based on the 1996 Subsidence District estimate. The Subsidence District population projections do not present estimates for individual cities; therefore, the Team-SDC estimates were used to develop population projections for the cities in Fort Bend County. Additional county growth identified in the Subsidence District Projections, but not accounted for in the Team-SDC numbers, was placed in County-Other. First Colony was removed as a separate entity since Sugar Land annexed it.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Fort Bend County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

## F. Projections for Galveston County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Galveston County. The population in Clear Lake Shores was capped at 2500 from 2030 until 2050 because of geographic location and lack of room for expansion.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for Galveston County. Municipal demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

## G. Projections for Harris County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Harris County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Harris County. Municipal demands deviate from the TWDB water demand projections. The irrigation values used are the ones projected by the Region H Water Planning Group, as adopted by the TWDB (explained in detail in *Section IV*).

## H. Projections for Leon County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and County-Other areas in Leon County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for Leon County. Municipal demands deviate from the TWDB water demand projections.

## I. Projections for Liberty County

1. Population

The population projection for the county total is based on the 1996 Subsidence District estimate. The Subsidence District population projections do not present estimates for individual cities; therefore, the Texas State Data Center estimates were used to develop population projections for the cities in Liberty County. Additional county growth identified in the Subsidence District Projections, but not accounted for in the Texas State Data Center numbers, was placed in County-Other. The maximum value between the Subsidence District projected population and the population projected using the methodology described in *Section II,* was chosen as the revised population number.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Liberty County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

## J. Projections for Madison County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Madison County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for Madison County. Municipal demands deviate from the TWDB water demand projections.

## K. Projections for Montgomery County

1. Population

The population projection for the county total is based on the 1996 Subsidence District estimate. The Subsidence District population projections do not present estimates for individual cities; therefore, the Team-SDC estimates were used to develop population projections for the cities in Montgomery County. Additional county growth identified in the Subsidence District Projections, but not accounted for in the Team-SDC numbers, was placed in county-other. The year 2000 population projection for The Woodlands reported by Interfaith Ministries replaced the TWDB population projection for year 2000. The new value increases the TWDB value by 32.39 percent. This value was projected at the TWDB growth rate for 2010. From year 2020, The Woodlands population was capped at 119,300.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for

Montgomery County. Municipal demands deviate from the TWDB water demand projections.

## L. Projections for Polk County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Polk County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for the portion of Polk County within Region H. Municipal demands deviate from the TWDB water demand projections.

## M. Projections for San Jacinto County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in San Jacinto County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for San Jacinto County. Municipal demands deviate from the TWDB water demand projections.

## N. Projections for Trinity County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Trinity County. For the county-other population, an adjustment was made after a review of TNRCC records. Total population of the identified public water systems in the TNRCC database is nearly 18,000, with a split of 80 percent in Region H and 20 percent in Region I. This split is different than the one indicated by the TWDB projection for the year 2000, which shows 55 percent for Region H and 45 percent for Region I. As a result, the TNRCC percentages were used instead of the TWDB projected values, for the Trinity county-other population. This application will increase the population in year

2000 from 4,902 to 6,886, and will be projected to year 2050 based on the TWDB projected growth rates.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for the portion of Trinity County within Region H. Municipal demands deviate from the TWDB water demand projections.

## O. Projections for Walker County

1. Population

The population projection methodology described in *Section II* was used to develop initial population projections for the cities and county-other areas in Walker County.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demand for Walker County. Municipal demands deviate from the TWDB water demand projections. During the public meetings the steam-electric power demand was eliminated based upon current information regarding power plant development. Therefore, the steam-electric demand for Walker County is zero.

## P. Projections for Waller County

1. Population

The population projection for the county total is based on the 1996 Subsidence District estimate. The Subsidence District population projections do not present estimates for individual cities; therefore, the Texas State Data Center estimates were used to develop population projections for the cities in Waller County. Additional county growth identified in the Subsidence District projections, but not accounted for in the Texas State Data Center numbers, was placed in "county-other." The maximum value between the Subsidence District projected population and the population projected using the methodology described in *Section II*, was chosen as the revised population number.

2. Water Demand

*Appendix A* presents the projections for population, municipal, manufacturing, irrigation, mining, livestock, and steam-electric water demands for Waller

County. Municipal and irrigation demands deviate from the TWDB water demand projections. The irrigation demands used are the ones projected by the Region H Water Planning Group Team, as adopted by the TWDB (explained in detail in *Section IV*).

*Table 2.1* is a reference table that summarizes which methodology was used for each water demand category in each county within Region H.

*Table 2.1 - Summary of Methodology Used for Revised Projections*

| | *Category* | *Team-SDC Methodology* | *TWDB Default* | *Other* | *Notes* |
|---|---|---|---|---|---|
| Austin | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the Region H Water Planning Group (RHWPG) on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Brazoria | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on TWDB projections through 2030 and flat after that point. Demands after 2030 developed using the method described in *Section IV* and adopted by the RHWPG on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Chambers | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |

*Table 2.1 - Summary of Methodology Used for Revised Projections (Continued)*

| | *Category* | *Team-SDC Methodology* | *TWDB Default* | *Other* | *Notes* |
|---|---|---|---|---|---|
| Fort Bend | Municipal | X | | X | Used Subsidence District Projections and removed First Colony. |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Galveston | Municipal | X | | X | Clear Lake Shores capped at 2,500 in 2030. |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 8/24/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Harris | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 8/24/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |

*Table 2.1 - Summary of Methodology Used for Revised Projections (Continued)*

| | *Category* | *Team-SDC Methodology* | *TWDB Default* | *Other* | *Notes* |
|---|---|---|---|---|---|
| Leon | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Liberty | Municipal | X | | X | Maximum of Subsidence District projections and the Team-SDC methodology was used. |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Madison | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |

*Table 2.1 - Summary of Methodology Used for Revised Projections (Continued)*

| | *Category* | *Team-SDC Methodology* | *TWDB Default* | *Other* | *Notes* |
|---|---|---|---|---|---|
| Montgomery | Municipal | X | | X | Maximum of Team-SDC and Subsidence District projections and cap on The Woodlands. |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Polk | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| San Jacinto | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |

*Table 2.1 - Summary of Methodology Used for Revised Projections (Continued)*

| | *Category* | *Team-SDC Methodology* | *TWDB Default* | *Other* | *Notes* |
|---|---|---|---|---|---|
| Trinity | Municipal | X | | X | Used TNRCC percent split for county-other population projections. |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Walker | Municipal | X | | | |
| | Livestock | | X | | |
| | Irrigation | | X | | |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |
| Waller | Municipal | X | | X | Maximum of Subsidence District projections and Team-SDC methodology was used. |
| | Livestock | | X | | |
| | Irrigation | | | X | Irrigation demand based on revised projections developed using the method described in *Section IV* and adopted by the RHWPG on 6/2/99. |
| | Manufacturing | | X | | |
| | Mining | | X | | |
| | Steam-Electric | | X | | |

## SECTION IV - AGRICULTURAL IRRIGATION WATER DEMAND

### A. Basis for Revision

The basis for requesting a revision to the agricultural irrigation water demands is described in detail herein.

***Criteria:*** *One or more of the following criteria must be verified by the Regional Water Planning Group and the Executive Administrator of the Texas Water Development Board for consideration of revising the State Water Plan irrigation water demand projections:*

*a.* *Based on the production period of record (last 20 years), regional irrigated acreage for crops grown in the region has increased at a faster rate or declined at a slower rate than the State Water Plan projected regional irrigated crop acreage for the period 1990 to the year 2000.*

*b.* *Based on the production period of record (last 20 years), regional irrigation water use has increased at a faster rate or declined at a slower rate than the consensus-based projected regional irrigation water use for the period 1990 to the year 2000.*

*c.* *Differences identified between the Board's annual irrigation water use estimates for a region or county and estimates provided by the Regional Water Planning Group*

***d.*** ***Other criteria that the Regional Water Planning Group believes are important for consideration of revisions to the State Water Plan projections***

***Data Requirements****: The Regional Water Planning Group must provide the Executive Administrator of the Texas Water Development Board the following data associated with the identified criteria for justifying any revisions to the consensus-based State Water Plan irrigation water demand projections.*

***1.*** ***Historical irrigated acreage data for major crops grown in a region as published by the Texas Agricultural Statistics Service, the Texas Agricultural Extension Service, or the Farm Service Agency (USDA) certified acreage***

***2.*** ***Historical annual estimated quantities of water used for irrigation purposes in a region or a county***

***3.*** ***Historical irrigation application rates per acre for crops grown in a region***

### *4. Other data that the Regional Water Planning Group believes are important to justify revisions to the State Water Plan projections*

## B. Supporting Data

The Region H Water Planning Group expressed concern about the decline in irrigation predicted by the Texas Water Development Board since the inception of the water planning process. A review of the TWDB usage data showed that the majority of irrigation practiced is for rice irrigation, and that the decline in total irrigation is largely in the rice area. A series of tables of acreages were developed, representing certified acreage for the various crops for the area from the Texas Agricultural Statistics Service (TASS) and from the Farm Services Agency (FSA). The irrigation projections are contained in *Appendix C. Table C-1* shows the rice acreage for the past eight years for the rice-producing counties in Texas. This table, developed using data from interviews with FSA directors in the rice-producing counties, and agrees with TWDB data through 1996. *Table C-2* is from TWDB records and shows rice production through 1996.

With the acreages shown, the participants then developed estimated quantities of water that are used in irrigation of the crops shown. For rice, the area has both surface water and groundwater irrigation, with surface water irrigation predominant. Acreages that are used for these calculations are the highest acreage from the 1996, 1997, and 1998 records for each county. It should be noted that total rice acreage for the Region H counties increased each year from 1996 to 1998, as shown in *Table C-12*. The acreage determined in this fashion was then multiplied by the 1996 usage factor per acre determined from *Table C-2*. This represents the use of below-normal rainfall demand conditions. This factor includes demands from both the main crop and the rattoon, or second, crop. *Table C-11* shows the regional totals.

## C. Regional Concerns

The first concern is the TWDB Year 2000 irrigation projection for Region H. This projection shows approximately 461,625 acre-feet of irrigation use. The 1990 recorded irrigation use is shown as 498,513 acre-feet. The calculated rate of decline from those numbers is approximately 7 percent for the 10-year period overall. The year 2000 demand estimated from the consensus numbers presented in the tables above for irrigation is 471,261 acre-feet, which is based on acreages and usages noted above. This estimate includes estimates of rice, corn, and soybean irrigation based on estimated percentages of total acres planted.

The second concern is the TWDB projection of a long-term decline in irrigation demands throughout the 50-year planning horizon. This decline was projected based on information developed by Texas A&M University through the Agricultural and Food Policy Center (AFPC), and information from the Food and Agricultural Products Research Institute (FAPRI).

The projected declines were based on a number of factors that pertained to the profitability of rice production in the Texas Gulf Coast area. Costs of production in this area were relatively high. The cost of surface water was expected to increase throughout the planning period as

competition for scarce resources intensified. In addition, the AFPC December 1995 baseline report, published in February 1996, predicted certain impacts of the modifications contained in the 1996 Farm Bill. These impacts were that landowners who leased land to tenant farmers would be able to collect support payments for rice without growing rice or taking any of the normal risks associated with farming. It was assumed that many of these landowners would opt for the payments and would not farm. This report predicted loss in real equity for Texas farms, as rice prices were predicted to be low, and the high costs of production in this area would continue. It should be noted, however, that, even under this scenario, the moderate-sized Texas farm was projected to experience a small increase (under 10 percent) in real earned equity. It should also be reemphasized that the total acreage for the Region H rice counties increased in both 1997 and 1998, as shown in *Table C-12*.

A review of the prices projected for rice for 1996, 1997, and 1998 versus the prices paid to farmers in the Gulf Coast area is shown in *Table 2.2* below:

**TABLE 2.2 COMPARISONS OF ACTUAL AND PROJECTED PRICES FOR RICE**

| *Year* | *AFPC Projection $/cwt.* | *Actual Price on Farm $/cwt.* | *Percent Difference* |
|---|---|---|---|
| 1996 | $7.29 | $10.58 | 45 |
| 1997 | $7.23 | $10.82 | 50 |
| 1998 | $7.30 | $9.69 | 33 |

Prices paid to farmers are shown as reported by local farmers, and represent an average for the year.

As a result of the higher-than-anticipated prices and experience following the implementation of the 1996 Farm Bill, a January 1997 baseline update of the FAPRI study was done to look at the Representative Farms Economic Outlook. This study, entitled *AFPC Working Paper 97-1, Appendix D,* again ranked the farms in the various states. In this study, the moderate Texas rice farm was predicted to experience a real equity gain of 53 percent over the 1996 to 2002 planning horizon. The following statement is excerpted from the report. "Average cash expenses as a percent of receipts range from 74 percent on the moderate Texas Farm (TXR2118) to 91 percent for the moderate Missouri operation (MOR1900)." This statement indicates that the Texas operations are not at a disadvantage, in comparison to rice farms in California, Arkansas, Louisiana, and Missouri. The analysis also states that all of the rice farms would see a net decrease in real equity if net cash farm income as a percent of receipts were to decline by as much as 10 percent. A review of the FAPRI 1999 Briefing Book shows that rice prices are expected to dip slightly during the next three years, but will remain within 90 percent of the 1998 price for all but one year of the next five years. Beginning in 2003, prices are expected to be above $9.00 per cwt. through the remainder of the study period to 2009.

In addition to the improved economic picture presented by the information above, members of Texas Agricultural Extension Service at Texas A&M University have provided further information on the long-term viability of the rice industry in Texas. Their information is incomplete, but major points that were made at a meeting on April 1, 1999, at Bear Creek

Park in Houston further reinforced the economic viability of the rice industry. To summarize, Texas A&M University extension personnel believe that there are significant advances in rice varieties and disease resistance that will significantly reduce costs of production. Of particular note is the projected development of disease-resistant plant varieties that can be planted on the same ground every second year instead of every third year, as is currently practiced. This development alone could result in an increase of 50 percent in total acres in production. At the same time, there is a growing segment of the population in Texas that is of either Asian or Hispanic ethnicity. Both of these ethnic groups are rice users, and the long-term prediction is for the per capita consumption of rice in Texas to increase as these population groups increase. The FAPRI 1999 Briefing Book similarly shows exports decreasing as a greater proportion of U.S.-grown rice is consumed domestically. Projected harvested area for the entire U.S. increases slightly, returns to just below the 1999 level by 2005, and declines after that.

As a result of the predicted increase in production and the increasing demand for rice in Texas, Texas A&M University presented a table recommending that water be set aside for irrigation of rice acreage at levels well above the approximately 350,000 acre feet projected for 2050.

In view of the uncertainty in yield increases and improved disease resistance predicted by Texas A&M University, the Region H Water Planning Group is requesting only that demands for rice irrigation and other row crops be held steady throughout the planning period. *Table C-13* shows the comparisons between the year 2000 TWDB and year 2000 Team irrigation water demands. The revised composite water demand was developed using the higher of the Team or TWDB estimates. The stated intent of the Region H Water Planning Group is to hold irrigation levels steady throughout the planning period, so only those counties where the Team estimate was higher were adopted. In other counties where TWDB default demand estimates were used, irrigation demands were allowed to decrease at the TWDB decrease rate until they equaled the Team demand projection. The demand projections were held constant at the Team projection beyond that point. The only county where this applies is Brazoria County. The TWDB demands were higher for Harris and Galveston Counties also, but the lower Team demands were used by agreement with TWDB and Region H Water Planning Group. These demands were then held constant throughout the planning period.