# TRANS-TEXAS WATER PROGRAM

SOUTHEAST AREA

**Planning Memorandum**

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# Planning Information Update

***September 27, 1996***

**Sabine River Authority of Texas**
**Lower Neches Valley Authority**
**San Jacinto River Authority**
**City of Houston**
**Brazos River Authority**
**Texas Water Development Board**

*Preface:*

*This document is a product of the Trans-Texas Water Program: Southeast Area. The program's mission is to propose the best economically and environmentally beneficial methods to meet water needs in Texas for the long term. The program's four planning areas are the Southeast Area, which includes the Houston-Galveston metropolitan area, the North-Central Area (including Austin), the South-Central Area (including Corpus Christi) and the West-Central Area (including San Antonio).*

*The Southeast Area of the Trans-Texas Water Program draws perspectives from many organizations and citizens. The Policy Management Committee and its Southeast Area subcommittee guide the program; the Southeast Area Technical Advisory Committee serves as program advisor. Local sponsors are the Sabine River Authority of Texas, the Lower Neches Valley Authority, the San Jacinto River Authority, the City of Houston and the Brazos River Authority.*

*The Texas Water Development Board is the lead Texas agency for the Trans-Texas Water Program. The Board, along with the Texas Natural Resource Conservation Commission, the Texas Parks & Wildlife Department and the Texas General Land Office, set goals and policies for the program pertaining to water resources management and are members of the Policy Management Committee.*

*This is the final version of this document.*

*Brown & Root and Freese & Nichols are consulting engineers for the Trans-Texas Water Program: Southeast Area. Blackburn & Carter and Ekistics provide technical support. This document was written by:*

Brown & Root — Jeff Taylor
Ann R. Wood, A.I.C.P.

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# 1. Planning Information

The first step in the development of a water resources management program is to evaluate the future need for water. Development decisions regarding future water management strategies, and ultimately system facilities, are based on projected future population and water demand.

Phase I of the Trans-Texas Water Program (TTWP) proposed future population and water demands for the 32-county TTWP Southeast Area, Figure 1.

The Southeast Area is further defined within eight river and coastal basins; Sabine, Neches, Neches-Trinity, Trinity, San Jacinto, Trinity-San Jacinto, Brazos and San Jacinto-Brazos. See Appendix A for a listing of the counties within each watershed basin. Phase I population and water demand estimates were based on forecasts developed by the Texas Water Development Board (TWDB) for the 1992 report, *Water for Texas—Today and Tomorrow*. This 1992 report was re-evaluated by the TWDB in preparation for the 1996 Texas Water Plan process. Several significant procedural and technical modifications were made to the projection methodology including:

- Establishing a more involved public input and review process;
- Involving other state water management agencies, including Texas Parks and Wildlife Department, and Texas Natural Resource Conservation Commission, in the process of forecast development and in establishing future water policy for the state;
- Recognizing the effects of generally lower population growth rates throughout the state in response to slower growth from 1990 through 1992;
- Including the projected impacts of the water conservation measures resulting from the 1991 State of Texas Plumbing Fixtures regulations.
- Revising projected water demands for various use categories based upon new national and local growth estimates.

These and many other modifications to the projection methodology were implemented resulting in the "consensus-based" planning process discussed below. The result of this process is represented by *Water for Texas—Today and Tomorrow: A 1996 Consensus—Based Update to the Texas Water Plan*.[1] The TTWP Policy Management Committee has adopted the consensus-based population and water demand projections and revised the Phase I water planning projections to remain in accordance with the proposed 1996 Texas Water Plan.

This technical memorandum summarizes the results of the revised population and water demand forecast for the TTWP Southeast Area. This revision incorporates all of the changes adopted within the Consensus Planning effort and updates previous Phase I planning projections. All

future TTWP water strategies and water system facility planning will be based on the population, water demand and water supply values contained within this memorandum.

## 1.1 The Consensus Water Plan and TTWP

The Texas Water Development Board initiated the consensus-based planning approach for the update of the 1996 Texas Water Plan. This Consensus Water Planning process broadens participation in the development of planning information and increases public acceptance of the Plan's recommended water management program through increased public participation in the process. The TWDB worked in cooperation with Texas Natural Resource Conservation Commission (TNRCC), and Texas Parks and Wildlife Department (TPWD). These three agencies are responsible for water resource management for the State of Texas. Their staffs assembled a broad based collaboration which included various other water interests and the general public. TWDB, TNRCC, and TPWD believe this collaborative process has: "Provide[d] Texas water planners, managers, and regulators with consensus-based population and water demand forecasts which consider water conservation and other demand management practices."[2]

These forecasts are the base data used to create several water use "scenarios" which incorporate various assumptions about water conservation, weather conditions, economic growth and their impacts on water use. A recommended "most likely" population and water demand forecast series was selected as representative of the population growth pattern most likely to occur for each county. These "most likely" series were approved by the TWDB Board of Directors in January 1995 to serve as a consistent basis for the planning and regulatory activities of the TWDB.

Population and water demand projections are aggregated and delineated to river and coastal basins, water resource planning regions, and metropolitan statistical areas. Data for the 32 county TTWP Southeast Area, has been extracted from the statewide data base and assembled for use in program analysis by watershed basin and county within each basin.

The following report details the planning information which will be used in Phase II of the TTWP. The population and water use projections developed through the Consensus Water Planning process and data developed on water supply presented in this report are the basic planning data used in the Trans-Texas Water Program Southeast Area study.

*Figure 1: Southeast Study Area*

# 2. Population Projections

Population increases pressure public service providers to adequately plan for future needs. Water resource planners require reliable population forecasts to accurately predict future needs and plan for sufficient quantities of water to meet the local and regional demands today and in the future. Population increases translate into increased water demand for residential and commercial uses. For this reason the TWDB prepares population projections when developing the Texas Water Plan. The Trans-Texas Water Program uses these same data as the basis for its water demand analysis.

## 2.1 Methodology

The TWDB based population projections on 1990 Census data and developed future population estimates using a cohort-component procedure. This procedure computes anticipated populations based on cohorts or segments of the population (age/sex/race groups), and components of cohort change (fertility rates, survival rates and migration rates). The sum of all separate cohort projections equals the total projected population.

TWDB staff defined cohort groups as single-year-of-age (0 to 75) by sex and race/ethnic groups. The race/ethnic groups include Anglo, Black, Hispanic and other. For each cohort (population group) the components of cohort change (fertility, survival, and migration rates) are incorporated into the projection procedure to calculate the number of births, deaths and migrations anticipated for the projection interval. For example, one cohort, 28-year old Hispanic females, would have specific fertility, survival and migration rates. Each cohort is computed for a time interval, *e.g.* 2000—2010, and added with all other cohort projections for that time interval for a projected total interval population. For each cohort, the population projection equation is:

Current population + Births - Deaths + Migrations = Future population

Key assumptions, with regard to cohort change components, used in developing the population projections were: Anglo female fertility rates trend downward through 2010 and are held constant at that level through 2050; Hispanic, Black, and Other female fertility rates trend downward through 2030 and hold constant at that level through 2050; and survival rates are assumed to follow national trends over the projection period

Three projection scenarios were developed. The basis for these population projection scenarios is the migration rates for each area between 1980 and 1990. The zero migration scenario assumed that only natural increases or decreases of population would occur over the 50 year time horizon. The second scenario, 0.5 migration, assumed an area would experience growth at a rate of one-half the 1980-1990 rate over the projection period. A third scenario, 1.0 migration, assumed the 1980-1990 migration rate would remain constant over the projection period.

The consensus planning Technical Advisory Committee selected a "most likely" scenario for each of the 254 Texas counties. This "most likely" scenario is county specific and reflects the rate of growth considered probable for that county over the projection period. This "most likely" scenario for each of the time intervals (2000 to 2050) is used for all TTWP projections.

## 2.2 Population Projections for the Southeast Area

The TTWP Southeast Area has a projected 2050 population of 9.8 million persons. This represents an increase of 104% (2% annualized) over the 1990 U.S. Census figure of 4.6 million. This rate of increase is slightly less than the State of Texas total population which is projected to increase 112% (2.2% annualized) over the 50 year time frame for a 2050 population of 36 million residents. Table 1 presents a summary of the total projected population for the Southeast Study Area. Details on the projections for each basin are in Appendix A.

As shown in Table 1, the Sabine basin is projected to have the least total number of residents (148,000) while the San Jacinto basin will have the highest population (5,783,000).

For basins within the Southeast Area, the population increases during the study period range from a low of 28% in the. Neches-Trinity Basin, to a high of 165%, in the San Jacinto-Brazos Basin. This represents annualized growth rates between .5% and 3% for each basin respectively. Highest rates of population growth are projected to occur in the San Jacinto-Brazos, Brazos and the Trinity-San Jacinto basins. Figure 2 illustrates the cumulative population growth for the Southeast Area.

## 2.3 Population Projections for the Houston Metro Region

The TTWP Phase I Report identified the Houston region as a particularly high growth center with a projected shortfall of available water supply. The Houston Metro region is again considered in detail in this analysis.

*Table 1: Population Projections for the Southeast Study Area, 1990—2050*

| | Population (Thousands) | | | | | | |
|---|---|---|---|---|---|---|---|
| ***River Basin*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| Sabine | 107 | 116 | 124 | 130 | 137 | 142 | 148 |
| Neches | 315 | 354 | 384 | 414 | 447 | 478 | 509 |
| Neches—Trinity | 194 | 210 | 220 | 231 | 238 | 244 | 249 |
| Trinity | 153 | 180 | 201 | 225 | 250 | 270 | 289 |
| Trinity—San Jacinto | 96 | 118 | 136 | 159 | 173 | 191 | 206 |
| San Jacinto | 2,771 | 3,208 | 3,737 | 4,389 | 4,839 | 5,365 | 5,783 |
| San Jacinto—Brazos | 705 | 857 | 1,034 | 1,247 | 1,459 | 1,675 | 1,874 |
| Brazos | 304 | 347 | 408 | 473 | 544 | 617 | 697 |
| Total, Southeast Area | 4,646 | 5,390 | 6,244 | 7,267 | 8,086 | 8,983 | 9,755 |


*Figure 2: Projected Total Population for the Southeast Area*

Within the 32 county Southeast Area of the TTWP, eight (8) counties make up the Houston Metro region. The counties are: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. These counties comprise all or part of seven of the eight river basins in the Southeast Area including the Neches, Neches—Trinity, Trinity, Trinity—San Jacinto, San Jacinto, San Jacinto—Brazos and Brazos Basins. No portion of the Houston Metro region is within the Sabine River watershed. Population projections for the Houston Metro region are calculated by determining the county/basin populations for each of the eight counties. These county/basin totals added together produce the Metro/basin populations for each basin in the Metro region. It should be noted that small portions of Brazoria and Fort Bend counties fall west of the Brazos River Basin and are therefore excluded from the TTWP Southeast Area and Houston Metro projections. These areas are included in the TTWP South-Central and West-Central study areas. Table 2 displays the projected population for the portion of the Metro

*Table 2: Population Projections for the Houston Metro Region*

| | Population (thousands) | | | | | | |
|---|---|---|---|---|---|---|---|
| ***BASIN*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| San Jacinto | 2744.4 | 3176.3 | 3700.2 | 4346.7 | 4791.1 | 5313.3 | 5727.4 |
| San Jacinto—Brazos | 705.4 | 857.3 | 1033.6 | 1246.7 | 1458.9 | 1674.6 | 1873.9 |
| Brazos | 94.1 | 112.2 | 142.7 | 180.1 | 224.7 | 273.9 | 327.6 |
| Neches | 1.9 | 2.1 | 2.3 | 2.5 | 2.8 | 3.1 | 3.3 |
| Neches—Trinity | 10.8 | 11.6 | 15.0 | 19.1 | 21.8 | 23.2 | 23.1 |
| Trinity | 39.4 | 44.3 | 50.1 | 58.0 | 65.8 | 72.2 | 78.7 |
| Trinity—San Jacinto | 95.8 | 118.0 | 136.4 | 159.3 | 172.6 | 191.3 | 206.3 |
| Metro TOTAL | 3691.7 | 4321.8 | 5080.4 | 6012.4 | 6737.8 | 7551.5 | 8240.3 |

region within each basin.

The projected 2050 population for the Houston Metro region is 8.2 million persons, an increase of four and one half million people across the 50-year time horizon. The largest component of this increase is in basins serving the City of Houston, specifically in the San Jacinto, San Jacinto - Brazos and Brazos basins. Projections indicate that the largest absolute growth in population occurs in Harris county (San Jacinto basin). The highest rate of population increase occurs in the Fort Bend County area of each of these three basins. These projections are illustrated in Figure 3. The eight county Houston Metro region accounts for over 80 percent of the 32 county Southeast Area population. The combined populations of three of the Houston Metro region counties, Harris, Montgomery, and Fort Bend, account for 70 percent of the total Southeast Area population. Detailed data on Metro region county/basin population projections are in Appendix B.

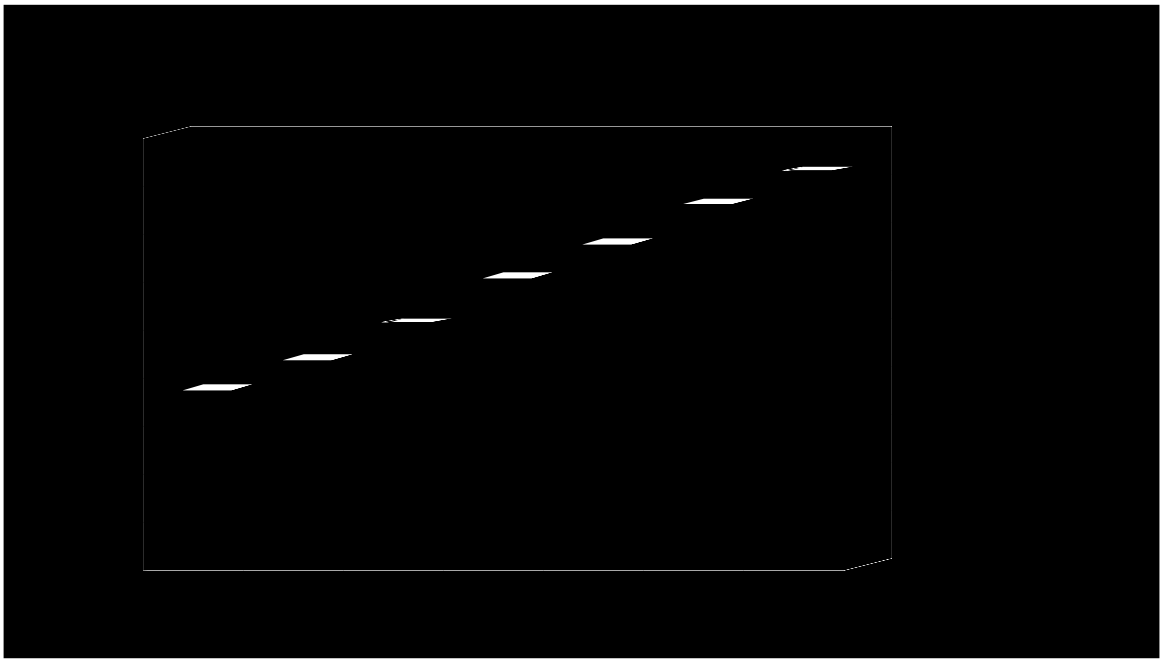

*Figure 3: Population Projections for the Houston Metro Region*

# 3. Water Use Requirements

Several water use categories have been defined for this study. Each category has specific variables affecting its demand function. Statewide water planning agencies define six water use classifications for planning purposes; municipal, manufacturing, irrigation, livestock, mining, and power. Population, weather conditions and water conservation measures in force in a community determine the amount of water required for municipal, residential and commercial purposes. Broader economic and technological factors determine manufacturing, irrigation, livestock, steam power generation, and mining water requirements.

The Texas Water Development Board (TWDB) prepared projected water use estimates for 1990—2050 as part of the *1996 Consensus-Based Update to the Texas Water Plan*. The water use projections experienced the same broad local review and comment process as the population projections. The TWDB prepared several scenarios for each water use type based upon specific water use assumptions. Technical advisory committees selected a "most likely" series for each use type. The methodologies and the water use projections by use type are summarized in the following sections. For all use types, the Southeast TTWP will use the "most likely" projections for its analysis of water demand.

## 3.1 Methodology

Water demand projections were developed for each city and county within the State of Texas for each of the six water use categories listed above. The methodology employed for each use type incorporates specific key assumptions relative to that use. Projections for municipal water uses are developed at the city level using city-specific water use characteristics with county population projections used as control totals. Projections of future water use for all other water use types were developed at the county level.

Another assumption incorporated in these projections relates to the consumptive use of water. Since consumptive water use reduces the total quantity of available water supply, the reported water demand forecasts used in the TTWP are for consumptive uses only. Non-consumptive uses, such as water used for recreation purposes, are not included in the TTWP water demand forecasts.

While environmental water needs are generally considered to be non-consumptive, The *Texas Water Plan* considers environmental water needs in its planning. This is an area of on-going study by the three state water agencies but no planning model has been formally accepted. For planning purposes, the TWDB determined that "the needs of the environment will be met prior to the identification of any remaining *new* supplies for other useful purposes."[3] Environmental water needs will be identified and served during the deter-

mination of specific water resource management strategies.

### *3.1.1 Municipal Water Use*

There are three primary components to the municipal water use forecasting method used: population projections, per capita municipal water use, and forecasts of the efficiency of conservation measures for each area. Municipal demands include residential and commercial elements, both of which are dependent on population (number of persons being served). Population projections, discussed in the previous chapter, provide forecast populations for each city and rural area within the Southeast Area for the 2000—2050 time frame.

Per capita water use rates were developed for specific urban and rural areas based upon historic use data reported to the TWDB for each community. The reported annual water use divided by an annual population estimate yields a per capita water use. Since climatic conditions, principally annual rainfall patterns, affect the quantity of water used for municipal purposes, two forecast scenarios have been created. One scenario assumes below normal rainfall patterns, and the other assumes average weather rainfall patterns. The TTWP uses the below normal rainfall, or worst case, scenario based on "the highest per capita water use recorded by an entity over the last ten years of record with an upper limit of 25 per cent above the average condition per capita water use."[4]

The third component in the calculation adjusts for municipal water conservation practices. Estimated likely ranges of water savings from "expected" and "advanced" conservation over the 50 year planning period for each city with a population over 1000 and each county have been created. The "expected" range identifies the potential water savings anticipated from both market forces and regulatory requirements, particularly the 1991 State of Texas Water Efficiency Plumbing Act. The "advanced" conservation scenario reflects additional conservation reductions based on two conditions: expediting the timing of savings accruing from regulatory requirements; and, adopting more aggressive conservation programs instituted at the local level.

The "most likely" municipal water use forecast is based on a scenario of below average rainfall per capita water use. This scenario, adjusted for "expected" conservation savings, is applied to the "most likely" series population forecasts. The Southeast Area TTWP uses these forecasts for its projections of municipal water requirements.

### *3.1.2 Other Water Use Categories*

Projecting manufacturing water use requires information on several industry specific issues. These include national and statewide growth outlooks for various industry categories, regional and county shares of manufacturing output, historical water use records, and industry-specific water use efficiencies. TWDB expects reduced manufacturing water use due to lower rates of regional industrial growth. Additional savings are predicted to result from efficiencies due to the expansion of new plants or rehabilitation of older plant processes.[5] The methodology makes two assumptions regarding industry growth; 1)

industry growth reflects the expansion of existing capacity and new manufacturing locations, and 2) the historical relationship between the price of oil and industrial activity continues over the next 50 years. Several scenarios have been prepared reflecting these assumptions. The scenario that assumes that oil prices will remain stable in the $18—$23 per barrel range for West Texas Intermediate Crude has been selected as the "most likely" projection series. TTWP uses this series for its analysis.

Irrigation water demand projections are based on crop-specific prices, yields, production costs, water costs, acres under production; irrigation systems and improvements in water use efficiency; and federal farm policy. The TWDB, working with Texas A&M University, developed a model to evaluate and assess factors affecting irrigation water demand in Texas. The model maximized farm income based on the profitability of specific crops and resources needed to produce those crops. Again, several series of forecasts for various scenarios were developed. The "most likely" series used in Trans-Texas Water Program analysis assumes changes in crop yields and federal farm payments, and the adoption of advanced irrigation technology.

Steam power electric generation water demand projections are based on power generation demands and an estimate of the water needed to produce that demand capacity. Power demands are based on current per capita power demand by utility-specific sectors; residential, commercial, governmental and "other." Industrial power demands reflect utility sales records by standard industrial classification (SIC). Future demand estimates use information on historical water use patterns by power generating plants, planned plant expansions, ownership of fuel sources used for generation, plant operating characteristics and the impacts on demand of energy conservation. Two projection series were produced reflecting "high" and "low" water use scenarios. TTWP uses the "high" use series which assumes the use of existing plant technology with no change in electric power generation capacity and a water use rate equal to the average of water use between 1988 and 1991.

Calculations for livestock water demand multiply the number of livestock by the water consumption per unit of livestock. These consumption factors employ water use rates for each type of livestock. *Texas Agricultural Statistics* provided the current and historic number of various types of livestock. Water use for livestock is assumed to remain constant after the year 2000.

The mining category uses water for processing, leaching to extract ores, dust control and reclamation. Projected requirements are based on water coefficients for each type of mining operation, historical national and state trends in fuel and non-fuel production, and expected trends in the use of fuels for energy production. A single series of projections were produced due to the relatively small quantity of water consumed by mining use.

*Table 3: State of Texas Total Water Demand by Water Use Type*

| Water Use Types | Water Demand (Acre-Feet/Year) 1990 Texas | 1990 SE Area | 1990 % | 2050 Texas | 2050 SE Area | 2050 % |
|---|---|---|---|---|---|---|
| Municipal | 3,178,398 | 777,542 | 24.5% | 6,301,657 | 1,536,382 | 24.4% |
| Manufacturing | 1,560,047 | 900,037 | 57.7% | 2,564,547 | 1,435,446 | 56.0% |
| Irrigation | 10,123,335 | 721,092 | 7.1% | 8,177,217 | 469,917 | 5.7% |
| Livestock | 274,069 | 27,780 | 10.1% | 330,305 | 28,962 | 8.8% |
| Mining | 148,839 | 18,263 | 12.3% | 291,397 | 115,371 | 39.6% |
| Power | 434,116 | 110,477 | 25.4% | 937,900 | 253,500 | 27.0% |
| Total | 15,718,804 | 2,555,191 | 16.3% | 18,603,023 | 3,839,578 | 20.6% |

## 3.2 Water Requirements for the State of Texas

Reviewing total water demand for the State of Texas provides perspective in understanding the overall relationship between the state water requirements and the Southeast Area's demands, both in the total amount of water use and the amount of water by use type. Based on the Consensus Water Planning data, total water demands for the state increase 98% over the 50 year planning horizon. This increase and the distribution of demand by water use types is reflected in Table 3. Distribution of this demand by use types changes to reflect the changing population, and manufacturing and industrial activities predicted for the state over the next 50 years.

In 1990, irrigation uses account for the largest portion of the State of Texas requirements, representing 64% of total demand. Based on the TWDB "most likely" series, the projected 2050 demand for irrigation use requires only 44% of the State's total water. This reduction in irrigation demand results from more efficient irrigation technology, conservation, and reduction of irrigated acreage. Reductions in irrigation demand are offset by increases in municipal and manufacturing categories. Population and economic growth over the 50 year study period supports projected increases in municipal and manufacturing water demand.

## 3.3 Water Requirements for the Southeast Area

Projected water demands for the Southeast Area have been extracted from the statewide projections. Data are arranged in tables by river basin with data on each county by water use type. Appendix C of this memorandum contains detailed water demand data tables. Table 4 is a summary of the Southeast Area's total water demand by basin. These projected demands represent only water requirements which must be satisfied through inland surface or ground water supplies.

The cumulative water demands for all eight basins in the Southeast Area increase 146% from the 2.6 million acre-feet/year required in 1990 to a projected need of 3.8 million acre-feet/year in 2050.

*Table 4: Water Requirements for the Southeast Area*

| | **Total Water Demand (thousands of acre-feet per year)** | | | | | | |
|---|---|---|---|---|---|---|---|
| ***River Basin*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| Sabine River Basin | 79.5 | 86.0 | 93.9 | 102.4 | 111.0 | 123.1 | 135.8 |
| Neches River Basin | 245.7 | 261.4 | 275.4 | 287.3 | 299.4 | 321.7 | 344.8 |
| Neches-Trinity Coastal Basin | 397.2 | 329.9 | 316.6 | 304.4 | 303.1 | 306.7 | 310.6 |
| Trinity River Basin | 141.3 | 138.5 | 141.0 | 144.0 | 148.1 | 159.3 | 174.5 |
| Trinity-San Jacinto Coastal Basin | 128.5 | 143.2 | 147.9 | 152.6 | 156.9 | 167.0 | 179.9 |
| San Jacinto River Basin | 786.4 | 949.7 | 1030.9 | 1128.7 | 1201.4 | 1298.3 | 1386.4 |
| San Jacinto-Brazos Coastal Basin | 405.1 | 464.2 | 497.8 | 529.7 | 567.7 | 617.9 | 668.4 |
| Brazos River Basin | 371.6 | 427.3 | 463.4 | 492.7 | 529.1 | 583.2 | 639.2 |
| Total, Southeast Area | 2555.3 | 2800.0 | 2967.0 | 3141.9 | 3316.8 | 3577.0 | 3839.6 |

By percentage, the largest predicted increases in

demand occur in the San Jacinto, Brazos and Sabine River basins. Figure 4 displays these increases in the total water demand, as well as the incremental increases for each basin as components of the Southeast Area's total water demand. Shifts in the distribution of the total water demand by use category occur in the Southeast Area. Municipal water demands increase as the area continues to urbanize. Reductions in irrigation demand follow statewide trends as a result of improvements in conservation and irrigation technology and the redevelopment of cultivated and grazing acreage for municipal or industrial purposes. Figure 5 illustrates these shifts in water use demand.

Reviewing the total Southeast Area water demands relative to total water demands for the State of Texas, there is an increase in the region's share over the 50 year TTWP time horizon. In 1990, the South-

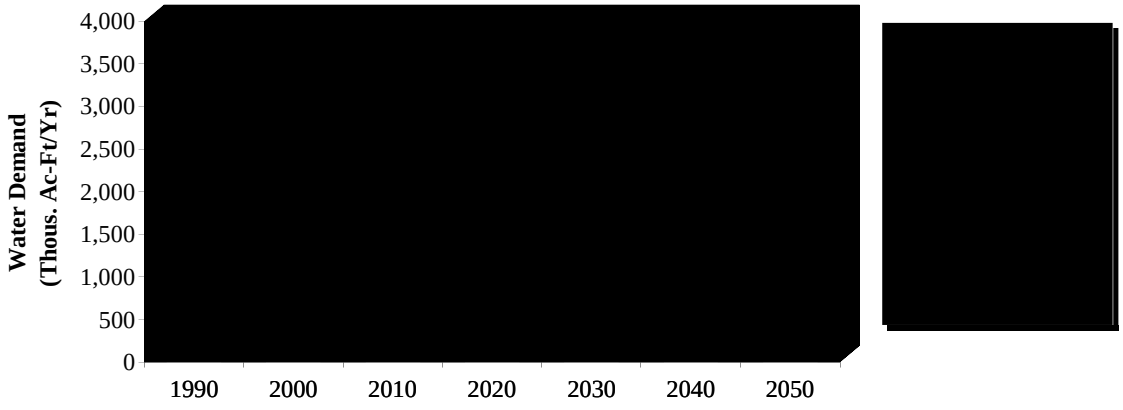


*Figure 4: Cumulative Water Requirements for the Southeast*

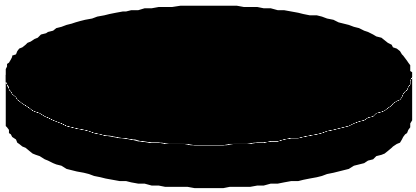

*Figure 5: Shifts in Southeast Area Water Requirements, 1990 & 2050*

east Area water requirements represent 16% of the total state water use in 1990. This percentage increases to 21% by the year 2050.

While irrigation is currently the predominant use category within Texas, municipal and manufacturing uses drive future water needs within the Southeast Area. More importantly, while irrigation continues as the largest future single water use statewide, the Southeast Area demand shifts significantly from irrigation to municipal water uses. Municipal uses are projected to surpass manufacturing as the highest use category as the Southeast Area undergoes a shift from a rural to an urban environment.

## 3.4 Water Requirements for the Houston Metro Region

The Houston Metro demand data represents 70 percent of the total Southeast Area demand in 1990 and is projected to account for 73 percent of the total Southeast Area demand by 2050. Based on the 1990 total water demand, an additional million acre-feet per year of water demand is projected for 2050. Detailed metro data tables are included in Appendix D of this memorandum. Table 5 and Figure 6 summarize these data and display the total Metro water demand by basin.

Water demand is distributed among water use types consistent with shifts noted in both the State and Southeast Area water demand projections. Increases in municipal and manufacturing uses and decreases in irrigation use are projected to occur.

## 3.5 West-Central Area Water Requirements

In addition to water demands within the Southeast study area, one of the objectives of the TTWP is to evaluate the potential for "surplus" supplies in the Southeast Area to be used to serve the other study

*Table 5: Water Requirements for the Houston Metro Area*

| | Water Demand (Thousands of Acre-Feet/Year) | | | | | | |
|---|---|---|---|---|---|---|---|
| ***River Basin*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| Neches | 9 | 7 | 6 | 6 | 6 | 5 | 5 |
| Neches-Trinity | 106 | 87 | 79 | 72 | 70 | 68 | 66 |
| Trinity | 116 | 109 | 101 | 97 | 97 | 96 | 96 |
| Trinity-San Jacinto | 128 | 143 | 148 | 153 | 157 | 167 | 180 |
| San Jacinto | 782 | 943 | 1,024 | 1,122 | 1,194 | 1,291 | 1,379 |
| San Jacinto-Brazos | 405 | 464 | 498 | 530 | 567 | 618 | 668 |
| Brazos | 262 | 302 | 326 | 342 | 358 | 387 | 416 |
| Total, Houston Metro | 1,808 | 2,056 | 2,183 | 2,321 | 2,449 | 2,632 | 2,810 |

areas. The boundary between the Southeast Area and the West-Central Area is basically along the Brazos River. One of the objectives of the TTWP is to evaluate the feasibility of supplying water needs that occur west of the Brazos using water from east of the Brazos. The PMC has developed three water demand scenarios for water needs west of the Brazos River based on the "management plan" developed by the TWDB for the Southern Edwards aquifer region. Specifically, three scenarios were developed for the West-Central water requirements as shown in Table 6

*Scenario 1*: Under this plan, transfer of additional water from the southeast would begin in 2010 and would increase to 600,000 acre-feet per year by 2050.

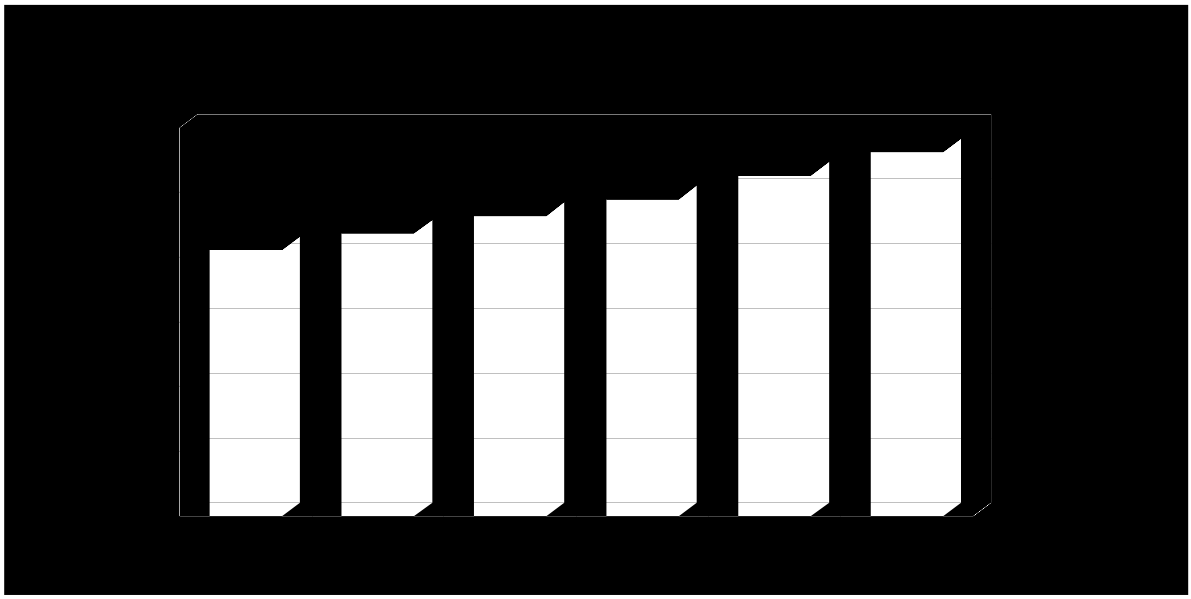

*Figure 6: Houston Metro Region Cumulative Water Demand*

*Scenario 2*: This plan begins transfers in year 2020 that increase in 2050 to 300,000 acre-feet per year.

*Scenario 3*: This scenario assumes zero transfers of water from the Southeast area west of the Brazos River.

Table 7 presents the total water requirements for the entire Trans-Texas Water Program study area by incorporating the Southeast area demand requirements with each of the above scenarios.

*Table 6: West-Central Area Water Requirements*

| | Water Demand (Thousand Acre-Feet/Year) | | | | | |
|---|---|---|---|---|---|---|
| ***Scenario*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| 1 | - | - | 150 | 300 | 450 | 600 |
| 2 | - | - | - | 100 | 200 | 300 |
| 3 | - | - | - | - | - | - |

*Table 7: Trans-Texas Program Water Requirements*

| | Water Demand (Thousand Acre-Feet/Year) | | | | | |
|---|---|---|---|---|---|---|
| ***Area*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| Scenario 1 | 2800 | 2967 | 3292 | 3617 | 4027 | 4440 |
| Scenario 2 | 2800 | 2967 | 3142 | 3417 | 3777 | 4140 |
| Scenario 3 | 2800 | 2967 | 3142 | 3317 | 3577 | 3840 |

# 4. Water Supply and Availability

Water resource planning balances a community's water requirements with its available water supply. An understanding of both current and future water requirements and of the current and future water supply are necessary in the planning process. The previous section of this report, "Water Use Requirements," discussed water demand projections for the river and coastal basins in the Southeast Area. This section defines the total available water supply for each basin in the Southeast Area. These two quantities, the available water supply and water requirements, are used to calculate the surplus or deficit water availability for each basin in the Southeast Area for the years 2000 through 2050.

Groundwater, surface water captured in reservoirs, and run-of-the-river sources comprise the available water supply within a river basin. Section 3.0 of the *Trans-Texas Water Program, Southeast Area Phase I Report*[6] defines, in detail, the sources and amounts of groundwater and surface water supplies in the Southeast Area. This information is summarized below. Additionally, some of this supply data has been revised for use in the Phase II analyses. Modifications of the original Phase I data are discussed in detail in the following sections.

## 4.1 Groundwater Supplies

The largest source of groundwater in the Southeast Area is the Gulf Coast aquifer. The other major aquifer in the study area is the Carrizo-Wilcox. There are also three minor aquifers in this part of the state; Sparta, Queen City and Brazos River Alluvium.

As explained in the *Phase I Report*, there are various constraints restricting the expanded use of groundwater including water quality, subsidence, and the location of the supply aquifers with respect to the

*Table 8: Estimated Groundwater Pumpage in the Southeast Area*

| | Amount of Pumpage (Thousand Acre-Feet/Year) | | | | | |
|---|---|---|---|---|---|---|
| ***River Basin*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
| Sabine | 23.3 | 23.3 | 23.3 | 23.4 | 23.5 | 23.6 |
| Neches | 110.5 | 111.6 | 112.8 | 114.6 | 116.3 | 118.3 |
| Neches-Trinity | 7.5 | 7.9 | 8.3 | 8.7 | 8.8 | 9.0 |
| Trinity | 34.3 | 36.6 | 38.7 | 41.2 | 43.8 | 46.7 |
| Trinity-San Jacinto | 26.6 | 25.7 | 31.1 | 27.9 | 29.6 | 30.1 |
| San Jacinto | 451.7 | 292.3 | 251.1 | 266.3 | 280.5 | 291.8 |
| San Jacinto-Brazos | 74.9 | 80.9 | 87.1 | 87.8 | 88.8 | 89.7 |
| Brazos | 130.5 | 141.9 | 156.1 | 169.4 | 181.1 | 197.3 |
| Total | 859.3 | 720.2 | 708.5 | 739.3 | 772.4 | 807.4 |

demand centers. The *Phase I Report* groundwater estimates for Harris and Galveston counties are based on by the Harris Galveston Coastal Subsidence District's (HGCSD) ground water conversion plan.

HGCSD is currently updating planning forecasts on future ground water pumpage though revised projections are not yet available. The TWDB has completed preliminary analysis of updated Houston-area water demands and the application of the HGCSD's current groundwater policy. The TWDB has produced preliminary estimates of projected ground water pumpage for the area. This *Phase II Planning Update* report revises the Phase I groundwater projections by including the TWDB's ground-water estimates for Harris and Galveston counties. Table 8 reflects the adjusted estimated groundwater pumpage in the study area for the fifty year planning period.

## 4.2 Surface Water Supplies

Surface water supply includes both reservoir and run-of-the-river sources. The *Phase I Report* provides an explanation of the current conditions in each basin with regard to surface reservoirs and run-of-the-river supplies. It should be noted that neither the Phase I nor Phase II analysis includes *future* water development projects, even when these projects are included in the Texas Water Plan. The estimated yields used in the Phase I analysis were obtained from the Texas Natural Resource Conservation Commission and from individual river authority reports. Phase II data incorporates several adjustments to these surface water supply estimates as detailed in the following sections.

### *4.2.1 Surface Reservoirs*

The estimated firm dependable yields available from existing reservoirs and reservoirs under construction in the study area are listed in Table 9 extracted from the *Phase I Report.* This table summarizes a detailed analysis of the surface water supply in each basin including information on specific reservoir and system yields found in Section 3 of the *Phase I Report.* One change in the Phase II surface water supply estimates occurs in the yield of the Lake Livingston and Wallisville reservoirs. Previous estimates did not account for the full permitted supplies of Lake Livingston and Wallisville reservoirs. They were based upon consideration of higher priority upstream water rights which have not yet developed. However the permitted values can be assumed to accurately represent the system's dependable yield and the Phase II analysis reflects the system's permitted rights of 1.345 million acre-feet per year, an increase of 190,500 acre-feet per year over the previously reported amount.

A second modification in this Phase II document has been made concerning surface water supplies within the San Jacinto-Brazos coastal basin. The Phase I report assumed that surface water supplied within the Southeast Area coastal basins did not reflect dependable yields and therefore were not included as available supplies. Review of the permitted yields within the lower Brazos River Basin indicates that two permits for Brazos River flow, the Chocolate Bayou Water Company and the Richmond Irrigation/Houston Lighting & Power, are backed-up through use of off-channel surface reservoirs within the San Jacinto-Brazos basin. These two permits total 40,000 and 17,784 acre-feet per year of dependable yield, respectively. The addition of these two permits will create a total supply of approximately 57,800 acre-feet per year within the San Jacinto-Brazos coastal basin.

Table 12, Southeast Area Water Supply Availability: 2000 - 2050, reflects the full permitted yield for Lake Livingston and Wallisville reservoirs and the additional

*Table 9: 2050 Surface Reservoir Yields*

| ***River Basin*** | ***Acre-Feet per Year*** |
|---|---|
| Sabine River Basin | |
| Toledo Bend | 1,043,300 |
| Neches River Basin | |
| Rayburn/Steinhagen Reservoir System | 664,300 |
| Other Reservoirs | 44,900 |
| Trinity River Basin | |
| Lake Livingston | 1,255,500 |
| Wallisville Salt Water Barrier (under construction) | 89,700 |
| Other Reservoirs | 11,200 |
| San Jacinto River Basin | |
| Lake Houston | 151,400 |
| Lake Conroe | 99,950 |
| Other Reservoirs | 6,300 |
| Brazos River Basin | |
| Brazos River Authority System | 188,100 |
| Lake Limestone | 63,400 |
| Other Reservoirs | 22,900 |
| San Jacinto-Brazos Coastal Basin | |
| Off-Channel Reservoirs* | 57,800 |
| Total Existing Surface Reservoir Yield Available in the Study Area | 3,698,750 |

*Based on Chocolate Bayou Water Company (40,000 af/y) and Richmond Irrigation/HL&P (17,784af/y) permits.

supply within the San Jacinto-Brazos coastal basin.

### *4.2.2 Run of River*

Run-of-the-river supplies are, in some river systems, significant sources of yield due to the appreciable amount of uncontrolled drainage area between the most downstream impoundment and the available diversion points near the mouth of the river. In general, the run-of-the-river yields are estimates based upon the best available data in each basin as established by previous analyses associated with water rights adjudication in the basin. An explanation of run-of-the-river supplies for the Sabine, Neches, Trinity and Brazos Rivers is included in the *Phase I Report* and summarized in Table 10.

The Phase I report listed run-of-river yield within the Trinity River Basin for the "fixed rights" permits downstream of Lake Livingston. This yield of 180,300 acre-feet per year is considered dependable yield because it is backed-up with storage yield from Lake Livingston. Since the yield of Lake Livingston is accounted for within the Surface Reservoir Yield category, the associated fixed rights run-of-river yield will be omitted from Phase II.

*Table 10: Run of River Yields*

| ***Basin*** | ***Yield (Acre-Feet/Year)*** |
|---|---|
| Sabine River | 147,100 |
| Neches River | 137,700 |
| Brazos River | 211,000 |
| Total, Run-of-the-River | 495,800 |

## 4.3 Water Supply Availability

The determination of water supply availability for specific basins and within specific time frames is computed by comparing total water demands and the dependable water supply for each area for each period. The water demand projections used in this analysis are extracted from Table 4: Water Requirements for the Southeast Area, in Section Three of this memorandum. Projected water supply estimates were derived from data on groundwater and surface water supplies in each basin.

Estimates of future groundwater supply are taken from Table 8. Predicted surface water supply is calculated by combining the reservoir and run-of-the-river yields as reported in Table 9 and Table 10. The total water supply reported for each basin at each time period is the combined quantity of ground and surface water supplies projected for the river basin.

In addition to in-basin supplies, imported and exported water supplies are reflected in the water availability calculations. The amount of these transfers is based upon current water rights and contractual agreements established by the primary water suppliers. Section Two of the *Phase I Report*[7] discussed these water imports and exports. Table 11 reflects specific existing interbasin transfer permits and contracts included in the analysis of available supply. The quantity of imported supply for the Sabine, Neches, Trinity and Brazos River Basins is determined by contract and permit records. For the coastal basins, Neches-Trinity, Trinity-San Jacinto,

and San Jacinto-Brazos and the San Jacinto River Basin, the quantity of imported supply is calculated as the difference between the total in-basin demand and the total in-basin supply. The level of imported supply is controlled by existing contracts and permits. This analysis assumes that exporting basins will honor existing contracts and permits. It further assumes that exporting basins will continue to export surface water but only after in-basin demands are satisfied.

Table 12: Southeast Area Water Supply Availability: 2000—2050, is the comparison of the projected future water demands and the estimated water supply for basins in the Southeast Area through the year 2050. Data is reported by river and coastal basins to indicate the approximate location and timing of water supply surplus or deficit conditions in the region. This table illustrates the total water demand, the amount of in-basin supply, the amount of transferred supply and the quantity of surface water available in each basin.

As shown, current existing Southeast Area water supplies can meet all projected demands through year 2010. The Brazos basin will experience the earliest water supply shortfalls, by year 2020. The basins within the Houston metro region will experience water supply shortfalls after approximately 2030.

*Table 11: Surface Water Imports and Exports*

**IMPORTS** *(Thousands of Acre-Feet/Year)*

| ***Basin*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
|---|---|---|---|---|---|---|---|
| Sabine | 2.6 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 |
| Neches | 1.0 | 1.4 | 2.0 | 2.6 | 4.1 | 4.6 | 5.1 |
| Neches-Trinity | 321.1 | 322.4 | 308.7 | 296.1 | 294.4 | 297.7 | 301.6 |
| Trinity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trinity-San Jacinto | 114.7 | 116.6 | 122.2 | 121.5 | 129.0 | 123.5 | 123.5 |
| San Jacinto | 400.9 | 300.3 | 540.9 | 679.9 | 726.2 | 710.9 | 710.9 |
| San Jacinto-Brazos | 206.4 | 331.5 | 359.1 | 384.8 | 422.1 | 460.8 | 476.3 |
| Brazos | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TOTAL | 1,046.8 | 1073.1 | 1333.9 | 1485.9 | 1576.8 | 1598.7 | 1618.5 |

**EXPORTS** ***(Thousands of Acre-Feet/Year)***

| ***Basin*** | ***1990*** | ***2000*** | ***2010*** | ***2020*** | ***2030*** | ***2040*** | ***2050*** |
|---|---|---|---|---|---|---|---|
| Sabine | 0.8 | 1.4 | 2.0 | 2.6 | 4.1 | 4.6 | 5.3 |
| Neches | 230.7 | 280.5 | 279.5 | 266.9 | 265.3 | 268.7 | 272.2 |
| Neches-Trinity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trinity | 672.6 | 582.5 | 839.2 | 993.4 | 1072.6 | 1075.3 | 1075.4 |
| Trinity-San Jacinto | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| San Jacinto | 54.1 | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 |
| San Jacinto-Brazos | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Brazos | 88.6 | 148.7 | 153.2 | 163.0 | 174.7 | 190.1 | 205.6 |
| TOTAL | 1,046.8 | 1073.1 | 1333.9 | 1485.9 | 1576.8 | 1598.7 | 1618.5 |

Table 13 represents the Southeast Area's potential impact on the overall Trans-Texas Water Program. Each scenario, discussed in Section 3.5 of this document, assumes a different level of water demand required for the other TTWP areas. Table 13 compares projected West-Central water demands to the existing Southeast Area available water supplies as defined in Table 12. It indicates that even assuming Scenario 1 export levels, the worst case situation for the West and South Central Areas, there would remain surplus Southeast Area supply of 70.4 thousand acre-feet per year. Surplus supplies available under Scenario 3 (no export of Southeast Area supply to other TTWP areas) are projected to be 670.4 thousand acre-feet per year.

*Table 12: Southeast Area Water Supply Availability: 2000—2050*

| | Amount (Thousands of Acre-Feet/Year) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Category*** | ***Sabine*** | ***Neches*** | ***Neches -Trinity*** | ***Trinity*** | ***Trinity-San Jacinto*** | ***San Jacinto*** | ***San Jacinto -Brazos*** | ***Brazos*** | ***Total Southeast*** |
| 2000 | | | | | | | | | |
| In-Basin Demands | 86.0 | 261.4 | 329.9 | 138.5 | 143.2 | 949.7 | 464.2 | 427.3 | 2800.2 |
| In-Basin Supplies | | | | | | | | | |
| Groundwater | 23.3 | 110.5 | 7.5 | 34.3 | 26.6 | 451.7 | 74.9 | 130.5 | 859.3 |
| Surface Water | 1190.4 | 846.9 | 0.0 | 1356.4 | 0.0 | 257.7 | 57.8 | 488.2 | 4197.6 |
| TOTAL | 1213.7 | 957.4 | 7.5 | 1390.7 | 26.6 | 709.4 | 132.7 | 618.7 | 5056.7 |
| Transfers | | | | | | | | | |
| Imported Supplies | 0.9 | 1.4 | 322.4 | 0.0 | 116.6 | 300.3 | 331.5 | 0.0 | 1073.1 |
| Export Demands | 1.4 | 280.5 | 0.0 | 582.5 | 0.0 | 60.0 | 0.0 | 142.9 | 1073.1 |
| In-Basin Reserves | 282.9 | 209.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 492.0 |
| **Net Surface Water Availability** | **844.3** | **207.8** | **0.0** | **669.7** | **0.0** | **0.0** | **0.0** | **42.7** | **1764.5** |
| 2010 | | | | | | | | | |
| In-Basin Demands | 93.9 | 275.4 | 316.6 | 141.0 | 147.9 | 1,030.9 | 497.8 | 463.4 | 2966.9 |
| In-Basin Supplies | | | | | | | | | |
| Groundwater | 23.3 | 111.6 | 7.9 | 36.6 | 25.7 | 292.3 | 80.9 | 141.9 | 720.2 |
| Surface Water | 1190.4 | 846.9 | 0.0 | 1356.4 | 0.0 | 257.7 | 57.8 | 487.6 | 4196.8 |
| TOTAL | 1213.7 | 958.5 | 7.9 | 1393.0 | 25.7 | 550.0 | 138.7 | 629.5 | 4917.0 |
| Transfers | | | | | | | | | |
| Imported Supplies | 1.0 | 2.0 | 308.7 | 0.0 | 122.2 | 540.9 | 359.1 | 0.0 | 1333.9 |
| Export Demands | 2.0 | 279.5 | 0.0 | 839.2 | 0.0 | 60.0 | 0.0 | 153.2 | 1333.9 |
| In-Basin Reserves | 282.9 | 209.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 492.0 |
| **Net Surface Water Availability** | **835.8** | **196.5** | **0.0** | **412.8** | **0.0** | **0.0** | **0.0** | **12.9** | **1458.1** |
| 2020 | | | | | | | | | |
| In-Basin Demands | 102.4 | 287.3 | 304.4 | 144.0 | 152.6 | 1,128.7 | 529.7 | 492.7 | 3141.9 |
| In-Basin Supplies | | | | | | | | | |
| Groundwater | 23.3 | 112.8 | 8.3 | 38.7 | 31.1 | 251.1 | 87.1 | 156.1 | 708.5 |
| Surface Water | 1190.4 | 846.9 | 0.0 | 1356.4 | 0.0 | 257.7 | 57.8 | 487.1 | 4196.3 |
| TOTAL | 1213.7 | 959.7 | 8.3 | 1395.1 | 31.1 | 508.8 | 144.9 | 643.2 | 4904.8 |
| Surface Water Transfers | | | | | | | | | |
| Imported Supplies | 1.0 | 2.6 | 296.1 | 0.0 | 121.5 | 679.9 | 384.8 | 0.0 | 1485.9 |
| Export Demands | 2.6 | 266.9 | 0.0 | 993.4 | 0.0 | 60.0 | 0.0 | 163.0 | 1485.9 |
| In-Basin Reserves | 282.9 | 209.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 492.0 |
| **Net Surface Water Availability** | **826.7** | **199.0** | **0.0** | **257.7** | **0.0** | **0.0** | **0.0** | **-12.5** | **1271.0** |

*Table 13: Trans-Texas Water Program Supply Availability: 2000-2050*

*Table 12: Southeast Area Water Supply Availability: 2000 2050, Continued.*

| Category | Amount (Thousands of Acre-Feet/Year) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000 | | 2010 | | 2020 | 2030 | | 2040 | 2050 |
| Category | Sabine | Neches | Neches-Trinity | Trinity | Trinity-San Jacinto | San Jacinto | San Jacinto-Brazos | Brazos | Total Southeast |
| Scenario 1 | | | | | | | | | |
| Available Southeast Supply | 1764.5 | | 1458.1 | | 1271 | 1126.5 | | 898.4 | 670.4 |
| West-Central Demand | - | | - | | 150 | 300 | | 450 | 600 |
| **Net Surface Water Availability** | **1764.5** | | **1458.1** | | **1121** | **826.5** | | **448.4** | **70.4** |
| Scenario 2 | | | | | | | | | |
| Available Southeast Supply | 1764.5 | | 1458.1 | | 1271 | 1126.5 | | 898.4 | 670.4 |
| West-Central Demand | - | | - | | - | 100 | | 200 | 300 |
| **Net Surface Water Availability** | **1764.5** | | **1458.1** | | **1271** | **1026.5** | | **698.4** | **370.4** |
| Scenario 3 | | | | | | | | | |
| Available Southeast Supply | 1764.5 | | 1458.1 | | 1271 | 1126.5 | | 898.4 | 670.4 |
| West-Central Demand | 0 | | 0 | | 0 | 0 | | 0 | 0 |
| **Net Surface Water Availability** | **1764.5** | | **1458.1** | | **1271** | **1126.5** | | **898.4** | **670.4** |
| 2050 | | | | | | | | | |
| In-Basin Demands | 135.8 | 344.8 | 310.6 | 174.5 | 179.9 | 1,386.4 | 668.4 | 639.2 | 3839.6 |
| In-Basin Supplies | | | | | | | | | |
| Groundwater | 23.6 | 118.3 | 9.0 | 46.7 | 31.0 | 291.8 | 89.7 | 197.3 | 807.4 |
| Surface Water | 1190.4 | 846.9 | 0.0 | 1356.4 | 0.0 | 257.7 | 57.8 | 485.4 | 4194.6 |
| TOTAL | 1214.0 | 965.2 | 9.0 | 1403.1 | 31.0 | 549.5 | 147.5 | 682.7 | 5002.0 |
| Surface Water Transfers | | | | | | | | | |
| Imported Supplies | 1.1 | 5.1 | 301.6 | 0.0 | 123.5 | 710.9 | 476.3 | 0.0 | 1618.5 |
| Export Demands | 5.3 | 272.2 | 0.0 | 1075.4 | 0.0 | 60.0 | 0.0 | 205.6 | 1618.5 |
| In-Basin Reserves | 282.9 | 209.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 492.0 |
| **Net Surface Water Availability** | **791.0** | **144.2** | **0.0** | **153.2** | **-25.4** | **-186.0** | **-44.6** | **-162.1** | **670.4** |

# 5. Conclusion

New planning information data and the subsequent analysis of these data indicate the need to reevaluate the projected long range water management objectives for the Trans-Texas Water Program, Southeast Area. This document presents the revised data being used in the TTWP Phase II analyses. A brief review of the differences between the Phase I and Phase II information and the primary conclusions drawn from the analysis of these data may be helpful in assessing the impacts of the data revisions on the overall program.

## 5.1 Population

Phase II projected populations for the Southeast Area were slightly increased, about 2%, for most of the study time periods. These increases result from stronger growth in the Houston Metro region. Populations in the San Jacinto, San Jacinto-Brazos and Brazos basins, the high-growth Houston Metro Region, are projected to grow at rates higher than previously expected. The Phase II 2050 population for those areas is increased by over 3%. Decreased rates of growth are predicted for the Sabine, Neches, Neches-Trinity and Trinity basins. Figure 7 illustrates the difference between the Phase I and Phase II population projections for the Southeast Area.

## 5.2 Water Requirements

Projected Phase II water demand are reduced from Phase I projections by 18% through the year 2050. Figure 8 displays

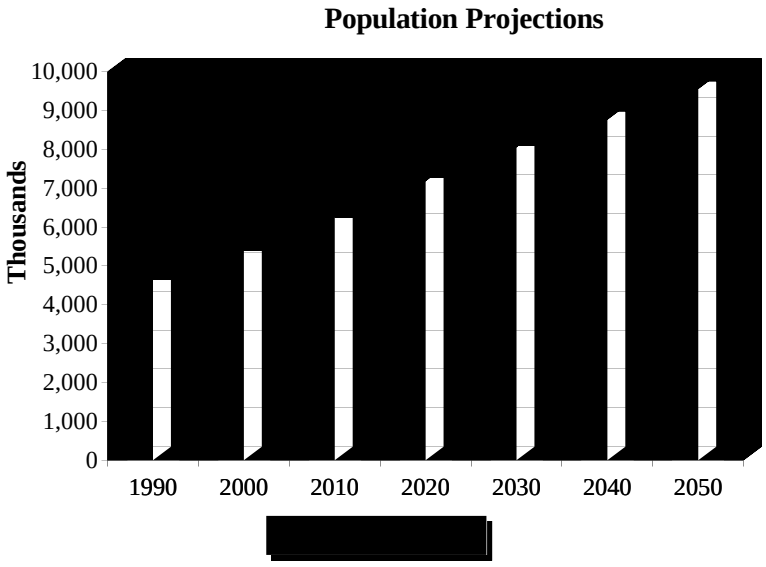


*Figure 7: Comparison of Population Projections*

the variance between the revised water demand projections. These reductions reflect the revised population projections; but the primary reason for the changes in the water demand projections is the application of different assumptions regarding per capita water use projections for municipal demand and regional industrial growth for manufacturing demands. Additional reductions in demand result from water conservation savings and lower irrigation demands for the area.

The Phase II projections assume lower rates for per capita water use. The new rates reflect a methodology which employed shorter periods of historical records to predict per capita use. While population projections for the Houston area indicate an increase over the Phase I estimates, the rate of per capita water use declines.

The assumption regarding manufacturing demand reflects a lower rate of regional industrial growth predicted for the Houston area by the federal Bureau of Economic Analysis in figures released in early 1990. Application of this assumption results in significant reductions to the manufacturing water demand for the Houston area over the project period. Higher levels of conservation savings in the irrigation use category is expected due to technological improvements, market forces and shifts in land use from rural to urban.

Water demand for irrigation uses is reduced significantly, from 28% of total demand in 1990 to 12% by the year 2050, while municipal uses increase from 30% to 40% over the same time frame. There will be fewer acres under cultivation as the region undergoes a shift from rural, agriculturally centered land use to more urbanized development. This shift, coupled with the improved efficiency of irrigation technologies, results in the reduced projected irrigation demand.

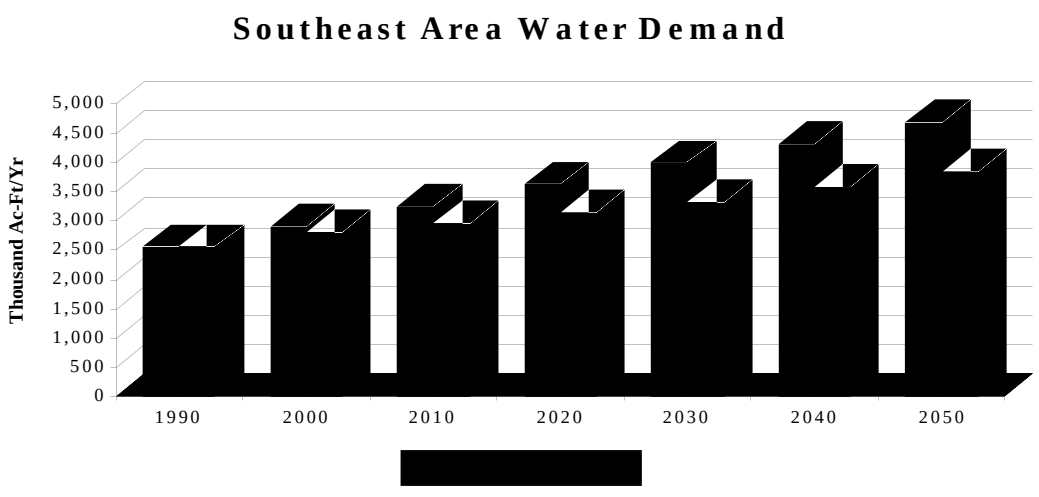


*Figure 8: Comparison of Water Demand*

## 5.3 Water Supply

In comparison to the information within the *Phase I Report*, existing ground water and surface water conditions within the Southeast Area result in a net decrease of 82,100 acre-feet per year in total supply. Estimates of the 2050 surface water supply increased by 68,000 acre-feet per year. principally as a result of larger available surface water supplies in the San Jacinto - Brazos River Basin. Estimates of the 2050 available groundwater in Harris and Galveston counties decreased by 150,100 acre-feet per year.

## 5.4 Impacts of Data Revision

These revised Phase II data indicate a different picture of the long term water availability for the Southeast Area in comparison to the previous Phase I report.

- The revised water demands indicate that current water supplies will be adequate to satisfy the Southeast Area's needs for a longer period of time than previously expected.
- The eight county Houston Metro Region, while requiring significantly less water than previously predicted, will continue to be the major water demand center for the Southeast Area. The region will experience supply shortages by approximately 2030, twenty five years later than previously expected. While there are surplus water supplies in the Southeast Area localized shortages are still expected to occur before the end of the project period.
- Substantial surplus surface water supplies will be available through the next fifty year period in the Sabine, Neches, and Trinity River Basins. Sabine Basin supplies will be over eight times larger than projected in-basin demands in the year 2050.
- After all Southeast Area needs are met there are adequate surplus water supplies in the Southeast Area to serve all of the projected Trans-Texas Water Program projected demand requirements, including the West-Central Area.
- In the year 2050, after all of the TTWP Scenario 1 (worst case) water demands are met with existing Southeast Area supplies, an additional 70,400 acre-feet per year of supply will continue to be available. Existing Southeast Area water supplies are sufficient to serve approximately one third of the State of Texas' future water demands, over the fifty year planning period.
- Environmental water requirements are still undefined. The supply needed to provide for environmental water demands will be allocated from available supply. This additional water demand will reduce the volume of supply available.

# 6. References

[1]Water Demand/Drought Management Technical Advisory Committee of the Consensus-Based State Water Plan, *Water for Texas—Today and Tomorrow A 1996 Consensus-Based Update to the Texas Water Plan, Volume III, Water Use Planning Data Appendix,* January 1995.

[2]*Ibid*, page 3.

[3]*Ibid*, page 8.

[4] *Ibid*, page 13.

[5] *Ibid*, page 19.

[6]*Trans-Texas Water Program Southeast Area Phase I Report*, Brown & Root and Freese & Nichols, February 1995.

[7]*Ibid*, pages 2-19—2-20 and Appendix J.