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Chapter 1 – Description of Region

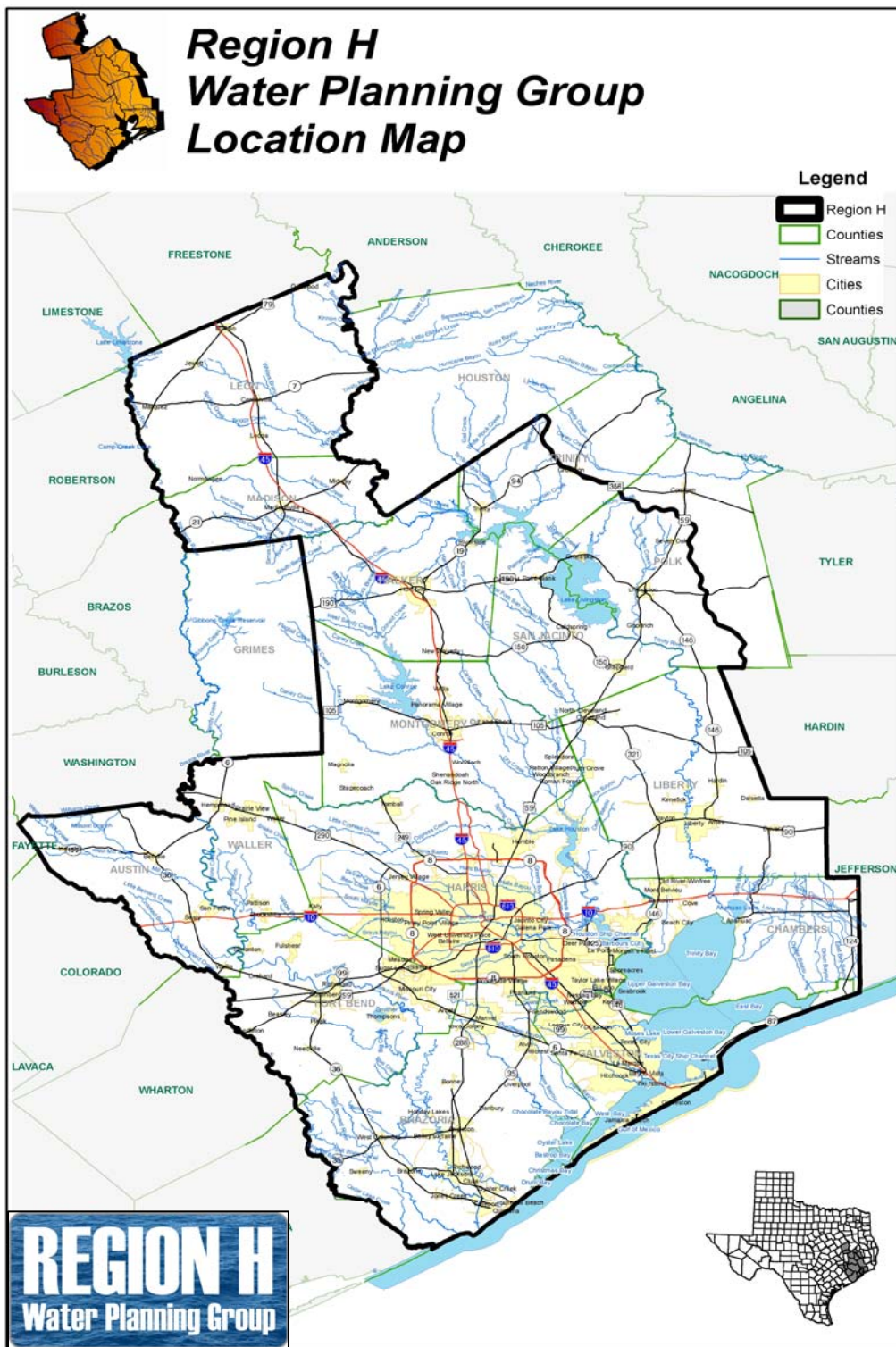
1.1 Regional Water Planning in Texas

In 1997 the State Legislature, through Senate Bill 1, determined that the Texas State Water Plan for the 2000 - 2050 time frame, would be developed through a regional water planning approach. To accomplish this task the Texas Water Development Board (TWDB) divided the state into 16 regional water planning areas and appointed representational Regional Water Planning Groups (RWPG) that have guided the development of each region's plan. In 2001 a new set of rules and guidelines from the TWDB were enacted through Senate Bill 2. With the help of the Senate Bill 2, the 2002 State Water Plan received enormous public involvement compared to previous plans. The planning process is cyclic, with updated Regional and State Water Plans produced every five years. The 2006 Region H Water Plan and the 2007 State Water Plan were created during the last planning cycle.

1.2 Description of Region H

Region H, located along the upper Texas coast, consists of all or part of 15 counties; 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. The Region spans three river and four coastal basins in southeast Texas. 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, the San Jacinto-Brazos, the Trinity-San Jacinto and the 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-Ft. 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 1-1 is a map of the Region H area. The Region H Water Planning Group (RHWPG) is a 25-member committee representing the diverse interests of the Region. Table 1-1 lists the RHWPG membership.

Figure 1-1
Region H Water Planning Area



**Table 1-1
Member Information for the Region H Water Planning Group**

Executive Committee	
Office	Incumbent
Chair	Mark Evans
Vice-Chair	Ron J. Neighbors
Secretary	Reed Eichelberger
At-Large	John R. Bartos
At-Large	C. Harold Wallace
Offices	
Office	Organization
Administrative	San Jacinto River Authority P.O. Box 329 Conroe, Texas 77305-0329 Phone: (936)-588-1111 Fax: (936) 588-1114
Political Subdivision	San Jacinto River Authority P.O. Box 329 Conroe, Texas 77305-0329 Phone: (936)-588-1111 Fax: (936) 588-1114
NOTES: Administrative Office manages records. Political Subdivision is the entity eligible to apply for State grant funds.	

Table 1-1
(continued)

Voting Membership			
Category	Member	Organization	County (Location of Interest)
Agriculture	Pudge Wilcox Feb 2007 – Present	CLCND	Chambers
	Robert Bruner March 1998 – Present	Rancher	Walker
Counties	John Blount, P.E. Sept 2004 – Present	Harris County	Harris
	Mark Evans March 1998 – Present	Trinity County	Trinity
	(Temporarily Blank) Sept 2009 – Present	(Temporarily Blank)	(Temporarily Blank)
Electric Generating Utilities	Ted Long August 2008 – Present	NRG Energy	Harris
Environmental	John R. Bartos March 1998 – Present	Galveston Bay Foundation	Harris
Industries	Gena Leathers Sept 2009 – Present	Dow Chemical Company	Brazoria
	Glynn Leiper March 1998 – Present	Exxon-Mobil Corp.	Harris
Municipalities	Robert Istre July 2003 – Present	Gulf Coast Water Authority	Galveston
	Jun Chang Nov 2008 – Present	City of Houston	Harris, Fort Bend, Montgomery
Public	Roosevelt Alexander March 1998 – Present	Retired	Waller
River Authorities	Reed Eichelberger March 1998 – Present	San Jacinto River Authority	Montgomery (service in central portion of region)
	John Hoffmann Feb 2009 – Present	Brazos River Authority	McLennan (service in west and southwest portion of region)
	Danny F. Vance March 1998 – Present	Trinity River Authority	Tarrant (service in east and southeast portion of region)
Small Business	John Howard May 2007 – Present	Howard Farms	Austin
	Bob Herbert May 2007 - Present	Robert Hebert and Associates	Fort Bend
	Steve Tyler March 1998 – Present	Steve Tyler Creative Services	Trinity
Water Districts	Marvin Marcell July 1998 – Present	Fort Bend Subsidence District	Fort Bend
	Ron J. Neighbors March 1998 – Present	Harris-Galveston Coastal Subsidence District	Harris, Galveston
	Jimmie Schindewolf Nov 2005 – Present	North Harris County Regional Water Authority	Harris

Table 1-1
(continued)

Voting Membership (continued)			
Water Utilities	C. Harold Wallace March 1998 – Present	West Harris County WSC	Harris
	James Morrison March 1998 – Present	Walker County Rural WSC	Walker
	William Teer, P.E. March 1998 – Present	Retired	Leon

Non-Voting Membership	
Member	Organization
David Alders	East Texas Water Planning Group
Rick Gangluff	Lower Colorado Regional Water Planning Group
Wayne Wilson	Region G Water Planning Group
Danny Vance	Region C Water Planning Group
Jennifer Bailey	Texas Dept of Agriculture
Temple McKinnon	Texas Water Development Board
Robert Stroder	Lower Neches Valley Authority
Rebecca Hensley	Texas Parks & Wildlife Dept
Larry Jacobs	Montgomery County Soil & Water Cons Dist
Wayne Ahrens	West Harris County Regional Water Authority
Melinda Silva	North Fort Bend Water Authority

1.2.1 Governmental Authorities in Region H

While municipal and county governments are the primary governmental entities, there are three regional councils of government represented in the region. The Houston-Galveston Area Council of Governments represents thirteen counties in the central and eastern part of the planning area: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Wharton, Walker and Waller Counties. The Brazos Valley Council of Governments includes Leon and Madison counties, the two northwestern counties of the region. The Deep East Texas Council of Governments represents Trinity, Polk and San Jacinto counties located in the northeastern part of Region H.

In addition to these regional councils there are several other entities with regulatory or management authority of importance to long range water planning for the region. The State exercises certain responsibilities over water planning, supply and quality through the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), and Texas Department of Parks and Wildlife (TPWD). Points of contact for these state agencies are listed in Table 1-2. Three river authorities manage surface water supply in the region's three river basins: the Brazos River Authority, the San Jacinto River Authority and the Trinity River Authority. There are eleven soil and water conservation districts within Region H. Five groundwater conservation districts (GCD) in Region H have the authority to regulate groundwater withdrawals. The Harris-Galveston Coastal Subsidence District and the Fort Bend Subsidence District have existed for some time. Three new districts were formed in 2001: the Lone Star GCD in Montgomery County, the Bluebonnet GCD which includes Austin, Grimes and Walker Counties, and the Mid-East Texas GCD which includes Leon, Madison and Freestone Counties.

Two Regional Water Authorities existed in the 2006 Region H water Plan, the North Harris County Regional Water Authority and the West Harris County Regional Water Authority. Since 2006 two new Regional Water Authorities have been formed: the Central Harris County Regional Water Authority

and the North Fort Bend Water Authority. Municipalities have joined informally to study regional water supply facilities in Mid-Brazoria County.

Table 1-2
State Agencies with Oversight of Water Planning

Texas Water Development Board
J. Kevin Ward Executive Administrator PO Box 13231, 1700 N. Congress Ave., Austin, TX 78711-3231 (512) 463-7847
Carolyn Brittin Deputy Executive Administrator, Office of Planning PO Box 13231, 1700 N. Congress Ave., Austin, TX 78711-3231 (512) 475-0933
Texas Commission on Environmental Quality (plan review)
Mark R. Vickery Executive Director 12500 Park 35 Circle, Austin, TX 78753 (512) 239-3900
Texas Parks and Wildlife Department (plan review)
Carter Smith Executive Director 4200 Smith School Road, Austin, TX 78744-3291 (512) 389-4800

1.2.2 General Economic Conditions

Two thirds of all U.S. petrochemical production and almost a third of the nation's petroleum industries are located in Region H. The area provides some of the states most popular vacation spots that, in 1994, generated approximately \$390 million dollars. The Port of Houston handled 161.2 million tons in 2002, to make it the sixth busiest port in the world. In 2000, the Houston area employed 1.8 million people or 18 percent of the state's total employment. Region H is generally characterized by urbanizing land uses and broad-based economic development. In areas outside of the urban core agriculture dominates economic activities. The region supports six primary economic sectors: services, manufacturing, transportation, government, agriculture and fishing.

The service sector employs the greatest number of people in Region H. Medical specialties are concentrated at the Texas Medical Center in Houston and the University of Texas Medical Branch in Galveston. Tourism is also a major industry for both Galveston and Houston.

The region's manufacturing industry is based on the historically important energy industries. Petroleum refining and chemical production are the largest two industries in the region. Technology and biotechnology firms have contributed to the diversification of the region's economic base. Petrochemical, chemical and pulp and paper industries are major employers outside of the urban core of the region.

The transportation industry includes the Port of Houston and the Houston Ship Channel, the second largest port in the nation. A well-developed highway system and rail connections support this activity. The Gulf Intracoastal Waterway connects the ports of Freeport, Galveston, Houston and Texas City.

Government sector jobs are disbursed throughout the region, with the Texas Department of Corrections a major employer at prisons located in the region. The Johnson Space Center has program management responsibility for the International Space Station, ensuring continued economic importance into the next decade. There are numerous colleges in the region, and local school districts continue to grow and expand as population increases.

The agricultural industry, while providing limited numbers of jobs, contributes significantly to the region's economy. Major agricultural crops in the region include rice, soybeans, vegetables and hay. Cattle are the principal livestock, followed by horses and hogs.

Fishing, both commercial and sport, within Galveston Bay and other major bodies of surface water including Lake Conroe, Lake Houston and Lake Livingston are major contributors to the local economic base. One third of the state's commercial fishing income and one half of the state's expenditures for recreation fishing come from Galveston Bay. Oysters, shrimp and finfish are important commercial species in the bay.

1.3 Population and Water Demand in Region H

Based on the 2000 census, the population for Region H was approximately 4,848,948 in the year 2000. Approximately 65% (3,170,496) of this population resides in 98 cities and towns with populations of over 500 persons; 16 of these cities have populations in excess of 25,000. By 2006 the population for Region H had increased to 5,62,7524 based on data from the Texas State Data Center as of July 1st, 2006. By 2010 to population in Region H is projected to increase to approximately 6,020,000.

Table 1-3 lists the cities with over 25,000 persons and their 2000 census population, 2006 reported population and associated reported municipal use in 2000 and 2006. The balance of the population resides in smaller communities or the unincorporated portions of the 15 counties of the region.

Table 1-3
Cities with Populations Over 25,000

City	2000 Census Population	2000 Reported Municipal Use (acre-feet/year)	2006 Population ¹	2006 Reported Municipal Use (acre-feet/year)
Baytown	66,430	10,938	70,943	9,866
Conroe	36,811	7,175	51,456	8,070
Deer Park	28,520	4,312	29,944	4,540
Friendswood	29,037	3,968	32,639	4,403
Galveston	57,247	16,228	57,951	-
Houston	1,953,631	347,947	2,112,671	346,393
Huntsville	35,078	5,108	36,999	6,075
La Porte	31,880	4,928	33,823	4,250
Lake Jackson	26,386	3,754	28,449	-
League City	45,444	6,617	63,087	8,491
Missouri City	52,913	10,239	73,748	-
Pasadena	141,674	18,567	152,037	17,716
Pearland	37,640	5,650	67,594	-
Sugar Land	63,328	15,677	84,622	14,883
Texas City	41,521	6,604	43,904	-
The Woodlands	55,649	13,714	-	-

Source: Texas Water Development Board

¹2006 Total Population Estimates for Texas counties as of July 1, 2006 from the Texas State Data Center.

The 2000 and 2006 total county populations and reported 2000 and 2006 water use is listed in Table 1-4. Detailed information on local, county and regional population estimates and projections for the 50-year planning period are included in the Chapter 2 of this plan. In 2006 municipal uses accounted for 48 percent of the region's total reported water use an increase from 41 percent in 2000. In addition to municipal water use, year 2000 estimates of other water use types were prepared by the TWDB for use in the planning process.

Table 1-4
County Population and Municipal Water Demand

County	2000 Census Population	2000 Reported Municipal Use (acre-feet/year)	2006 Population ¹	2006 Reported Municipal Use (acre-feet/year)
Austin	23,590	3,535	26,928	3,741
Brazoria	241,767	40,127	286,773	37,978
Chambers	26,031	3,908	32,383	3,240
Fort Bend	354,452	67,566	487,047	79,802
Galveston	250,158	44,544	282,126	42,931
Harris	3,400,578	598,596	3,830,130	598,977
Leon	15,335	1,880	16,218	2,079
Liberty	70,154	9,350	77,176	6,943
Madison	12,940	1,728	13,534	2,812
Montgomery	298,768	51,193	399,941	62,070
Polk ²	33,098	4,489	37,295	4,682
San Jacinto	22,246	2,698	24,739	2,540
Trinity ²	10,380	1,231	10,733	801
Walker	61,758	14,741	64,026	12,340
Waller	32,663	4,610	38,475	5,030
Region H Total	4,848,918	850,196	5,627,524	865,966

Source: Texas Water Development Board

¹2006 Total Population Estimates for Texas counties as of July 1, 2006 from the Texas State Data Center.

² Includes portion of the county in the Region H area

Manufacturing uses accounted for 33 percent of the region's total use in 2006, an increase from 30 percent in 2000. Irrigation uses represented 13 percent of the region's total 2006 reported use, a decline from the 22 percent reported in 2000. Figure 1-2 illustrates the distribution of 2000 water demand by use type. Total water demands for each county are listed in Table 1-5.

Figure 1-2
Percentage of 2006 Total Water Demand by Use

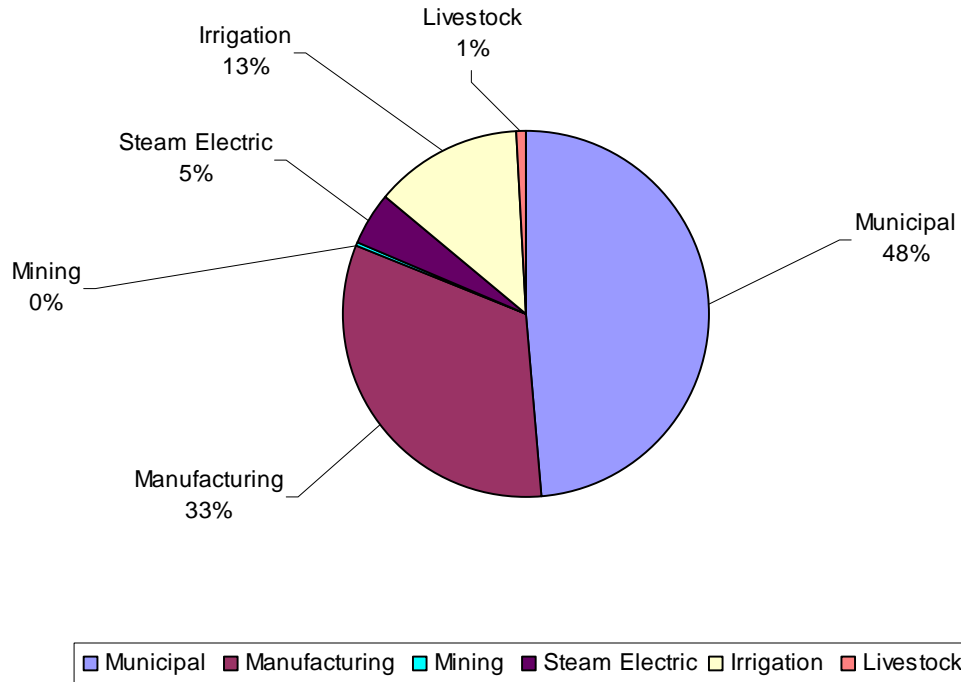


Table 1-5
Reported 2006 Non-municipal Water Use

County	MFR	IRR	MIN	POW	STK	Total
Austin	76	0	0	3,101	1,618	76
Brazoria	220,027	374	0	84,820	1,553	220,027
Chambers	13,450	5,281	631	54,594	561	13,450
Fort Bend	4,378	2	70,987	28,703	1,087	4,378
Galveston	18,592	0	158	2,072	255	18,592
Harris	321,469	84	10,076	3,082	1,747	321,469
Leon	799	50	0	242	1,671	799
Liberty	384	0	0	40,404	911	384
Madison	227	0	0	15	1,112	227
Montgomery	1,449	4	729	536	457	1,449
Polk ²	1	0	0	0	214	1
San Jacinto	11	0	0	0	433	11
Trinity ²	0	0	0	500	296	0
Walker	63	0	0	400	740	63
Waller	27	86	0	17,889	1,253	27
Region H Total	580,953	5,881	82,581	236,358	13,908	580,953

Source: Texas Water Development Board

² Includes the portion of the county in Region H.

Categories: Manufacturing (MFR), Irrigation (IRR), Mining (MIN), Steam Electric Power (STK)

1.3.1 Major Demand Centers

Major demand centers are locations of water uses that require a significant portion of the region's water supply. As would be expected major urban areas with large populations and major industrial development are typically major demand centers. In Region H major demand centers are defined for municipal, manufacturing and irrigation uses as having a reported use, by use type, exceeding 25,000 acre-feet for counties and 10,000 acre-feet for cities.

Harris County has the greatest overall water demand in the region, as was shown in Table 1-4. The next highest demands are Fort Bend, Montgomery, Galveston, and Brazoria counties. Harris County and the City of Houston dominate municipal water use in Region H. The City of Houston used 346,393 acre-feet in the year 2006 or approximately 40 percent of the total regional municipal use. As shown in Table 1-6, Brazoria, Fort Bend, Galveston and Montgomery Counties are major demand centers with reported use in excess of 25,000 acre-feet in both 2000 and 2006. In addition to the City of Houston, municipalities identified as major demand centers (reported municipal demands in excess of 10,000 acre-feet) include the cities of Pasadena, Galveston, Baytown and Sugar Land.

Table 1-6
Major Municipal Demand Centers

County/City	2000 Municipal Use (acre-feet)	2006 Municipal Use (acre-feet)
City of Houston	347,947	346,393
Harris County (excluding Houston)	250,649	252,584
Fort Bend	67,566	79,802
Galveston	44,544	42,931
Montgomery	51,193	62,070
Brazoria	40,127	37,978
City of Pasadena	18,567	17,716
City of Galveston	16,228	-
City of Baytown	10,938	9,866
City of Sugar Land	15,677	14,883

Source: Texas Water Development Board

The largest manufacturing demand center is Harris County, which used 321,469 acre-feet of water in 2006 (55 percent of the regional total). Two other major demand centers are identified; Brazoria County, with reported 2006 manufacturing use of 220,027 acre-feet, and Galveston County with a reported 2006 manufacturing use of 18,592 acre-feet. The principal water using industries in the region are Petroleum Refining, Chemical Products and Pulp and Paper Mills. The three largest manufacturing demand centers are shown in Table 1-7.

**Table 1-7
Major Manufacturing Demand Centers**

County	2000 Manufacturing Use (acre-feet per year)	2006 Manufacturing Use (acre-feet per year)
Brazoria	221,930	220,027
Galveston	35,381	18,592
Harris	349,420	321,469

Source: Texas Water Development Board

The four largest irrigation demand centers are Brazoria, Chambers, Liberty and Fort Bend counties. Table 1-8 highlights each county's reported 2000 and 2006 irrigation use. The major irrigated crops in the region are rice, soybeans, vegetables and cotton.

Table 1-8 Major Irrigation Demand Centers

County	1996 Irrigation Use (acre-feet per year)	2006 Irrigation Use (acre-feet per year)
Chambers	117,777	54,594
Brazoria	149,188	84,820
Liberty	82,901	40,404
Fort Bend	53,455	28,703

Source: Texas Water Development Board

Livestock and mining water use represent smaller demands in the Region H area. Mining water demands in Region H are associated primarily with oil and gas production.

1.3.2 Water User Group (WUG) Updates

The 2011 Region H Water Plan was updated to include additional Water User Groups (WUGs) based on changes in population estimates. Three new cities were added to the WUG list based on population estimates for the year 2010 that were greater than 500 residents and two additional regional water authorities: the Central Harris County Regional Water Authority (CHCRWA) and the North Fort Bend Water Authority (NFBWA) were added. Descriptions of the new WUGs are presented below.

Kendleton, TX

Kendleton is located in Fort Bend County, Texas. The 2000 census reported 466 residents in the City of Kendleton; however, the current population according to the Census Bureau is 525. According to the United States Census Bureau, the city has a total area of 1.1 square miles in which all of it is land.

Montgomery, TX

Montgomery is a city located in Montgomery County, Texas. Montgomery is located at the junction of Texas 105 and FM 149, near the southwestern edge of Sam Houston National Forest in western Montgomery County. Its population is approximately 576 residents. According to the United States Census Bureau, the city has a total area of 4.6 square miles which includes 4.5 square miles of land and 0.1 square miles of water.

Stagecoach, TX

Stagecoach is a town in Montgomery County, Texas within Region H boundaries. The last recorded population for Stagecoach was 507 residents in 2007. According to the United States Census Bureau the city has a total land area of 1.14 square miles and a water area of 0.05 square miles.

Central Harris County Regional Water Authority

The Central Harris County Regional Water Authority (CHCRWA) was created in June 2005 by C.S.H.B. 3181 and is comprised of 11 MUDs primarily located north of the City of Houston, east of SH 249, south of FM 1960 and west of I-45.

The CHCRWA replaces the following WUGs in the 2006 Plan:

Fallbrook UD, Harris County MUD #150, Harris County MUD #200, Harris County MUD #300

The CHCRWA is authorized to:

- Provide for the conservation of groundwater and facilitate compliance with the Harris-Galveston Coastal Subsidence District requirements;
- Acquire or develop surface water and groundwater supplies from sources inside and outside of the Authority and to store, transport, treat, distribute, sell, and allocate water to persons inside and outside of the authority;
- Enter into contracts with persons inside or outside of the Authority;
- Acquire water rights.

North Fort Bend Regional Water Authority

The North Fort Bend Water Authority (NFBWA) was created by the 79TH Texas Legislature, with the passage of Senate Bill 1798 in May 2005 and by establishing Chapter 8813 of the Special District Local Laws Code.

The NFBWA replaces the following WUGs in the 2006 Plan:

Big Oaks MUD, Cinco MUD #2, Cinco MUD#6, Cinco MUD #7, Cinco MUD #8, Cinco MUD #9, Cornerstones MUD, Fort Bend County MUD #2, Fort Bend County MUD #30, Fort Bend County MUD #37, Fort Bend County MUD #41, Grand Lakes MUD #4, Kingsbridge MUD, Northmission Glen MUD

The Authority's mission includes:

- Acquiring and providing water for residential, commercial, industrial, agricultural, and other uses;
- Reducing groundwater withdrawals;
- Conserving, preserving, protecting, and recharging of groundwater and of groundwater reservoirs or their subdivisions;
- Preventing waste of groundwater; and,
- Controlling subsidence caused by the withdrawal of water from groundwater reservoirs.

- The Authority has the right to establish fees/charges, necessary to:
- Achieve water conservation;
- Prevent waste of water;
- Serve as a disincentive to pumping groundwater;
- Develop, implement or enforce a groundwater reduction plan (GRP);
- Accomplish the purposes of the Act creating the Authority; and,
- Enable the Authority to meet its expenses.

1.4 Region H Water Supply Sources and Providers

Groundwater, surface water captured in reservoirs and run-of-river sources comprise the available water supply within a river basin. Reused and recycled water and saline sources are additional supply sources utilized in Region H.

1.4.1 Groundwater Sources

Four aquifers supply groundwater within the Region H area. The aquifer that furnishes the most groundwater within the area is the Gulf Coast aquifer. This aquifer is composed of the Evangeline, Chicot and Jasper formations and extends from near the shoreline to approximately 100 to 120 miles inland, to Walker and Trinity counties. The other major aquifer in the study area is the Carrizo-Wilcox, which begins 115 to 125 miles inland and extends beyond the northern boundary of the region. There are also three minor aquifers in this part of the state; the Sparta and Queen City aquifers occur in Leon County, the southern part of Madison County and northern parts of Walker and Trinity Counties. In Leon and Madison Counties, they lie above the Carrizo-Wilcox Aquifer. The Brazos River alluvium occurs along the main stem of the Brazos as it passes through the region, except in Brazoria County. Figure 1-3 and Figure 1-4 illustrate these groundwater sources. Groundwater use is regulated in Harris, Galveston and Fort Bend Counties due to the potential for over-drafting the Gulf Coast Aquifer. Groundwater Management Plans have been published for Austin, Leon, Madison Montgomery and Walker Counties. Groundwater withdrawals accounted for approximately 34 percent of the total regional water supply in 2000 and approximately 30 percent in 2004.

1.4.2 Surface Water Sources

Surface water sources in Region H are reservoir storage and run-of-river supply for the three rivers in the area, the Trinity, the San Jacinto and the Brazos. There are no major springs located within Region H, although small springs and seeps supply based flows for some streams. Historically there were numerous small seeps identified throughout the region. Many of these have ceased flowing due to land use changes and groundwater pumping. The most significant spring was Gold Springs in San Jacinto County, above the town of Coldspring, with recorded flows of 32 gpm (50 ac-ft/yr) into the 1960's.

The following discussion of each basin's surface water supply is based upon information in *Water for Texas* (1997) and (2002). Water availability estimates come from the TCEQ Water Availability Models. Figure 1-5 illustrates the region's surface water sources. A selected bibliography of related references is included in Appendix 1A.

Figure 1-3
Region H Major Groundwater Sources

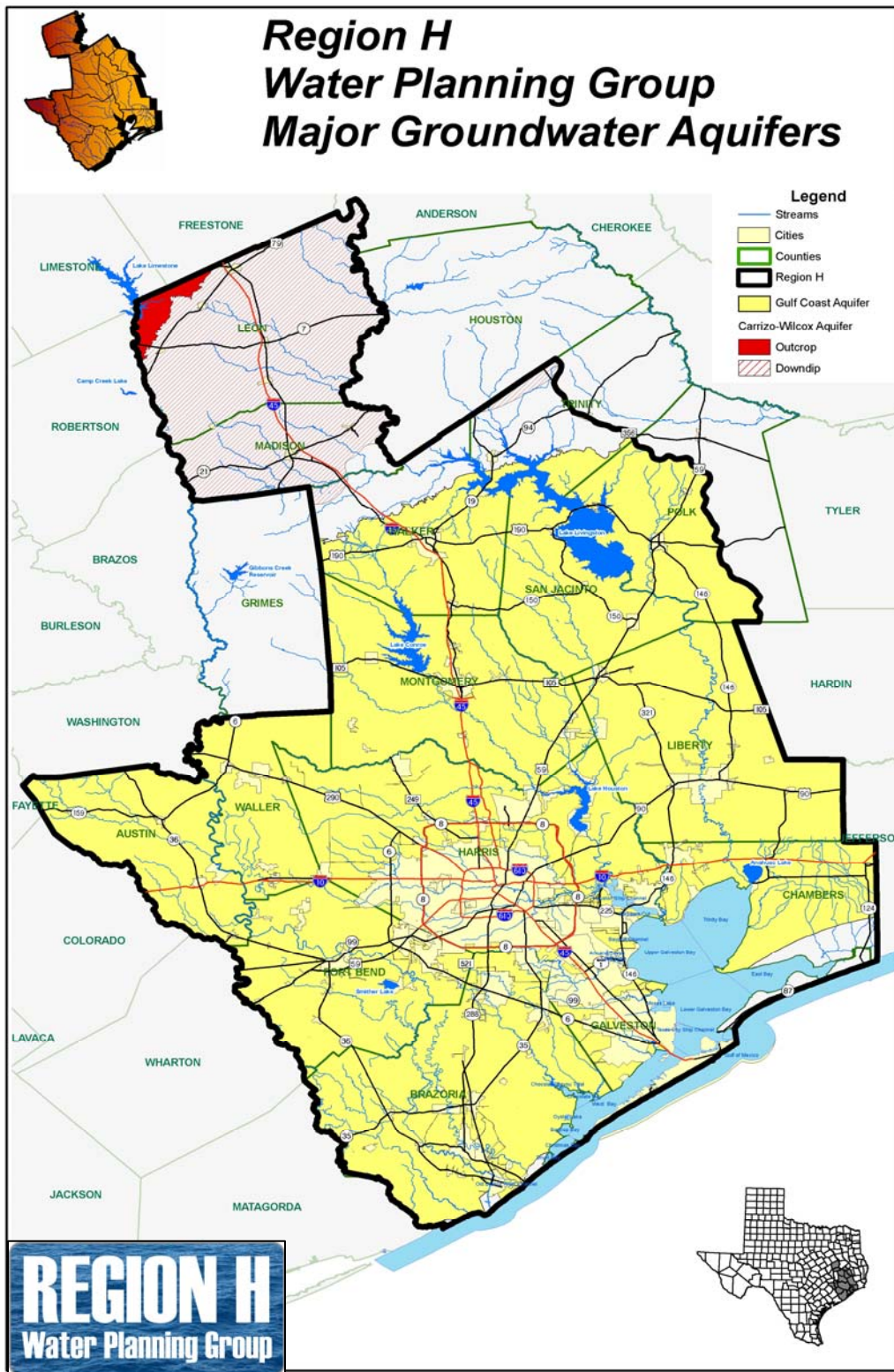


Figure 1-4
Region H Minor Groundwater Sources

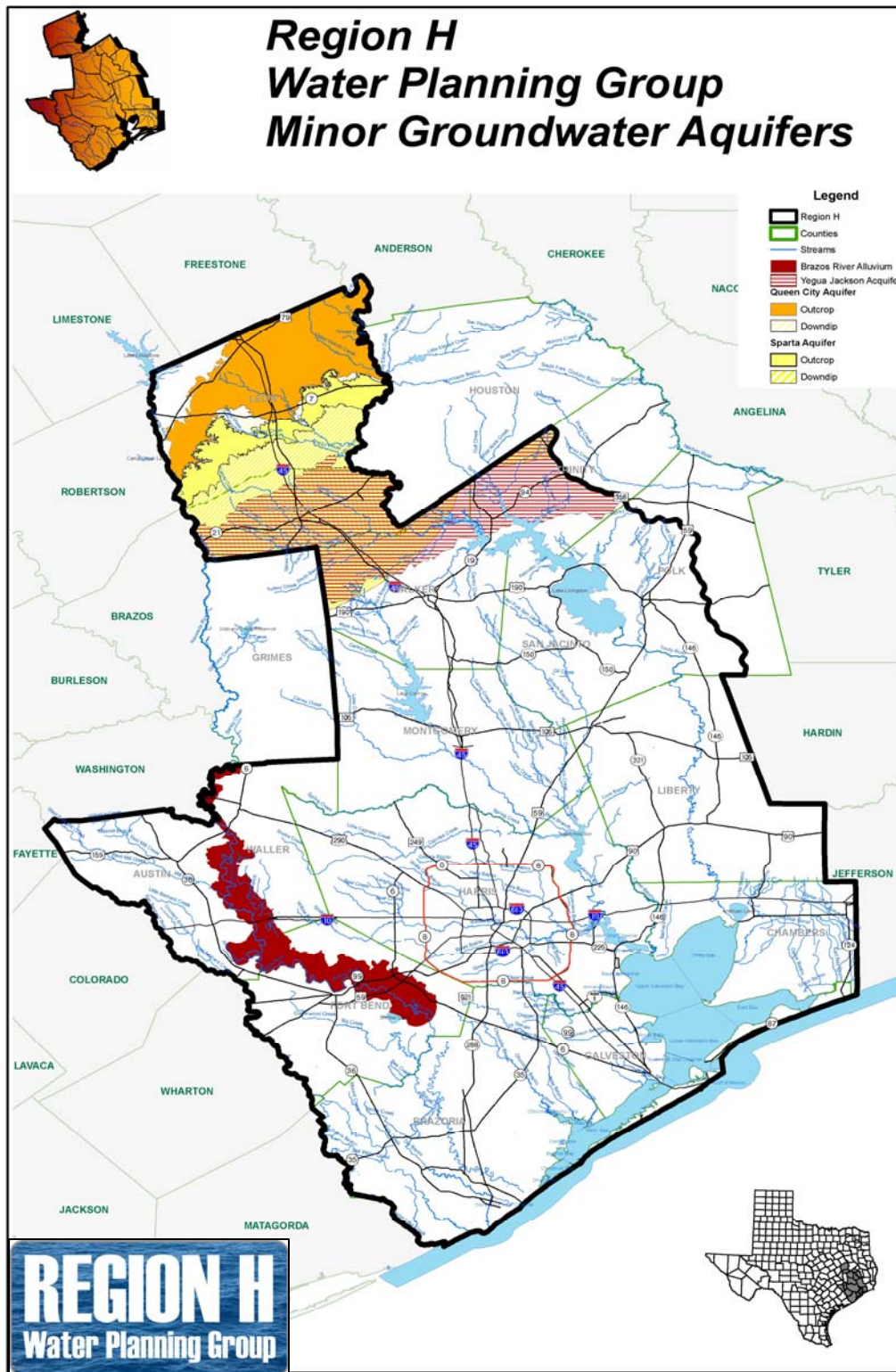
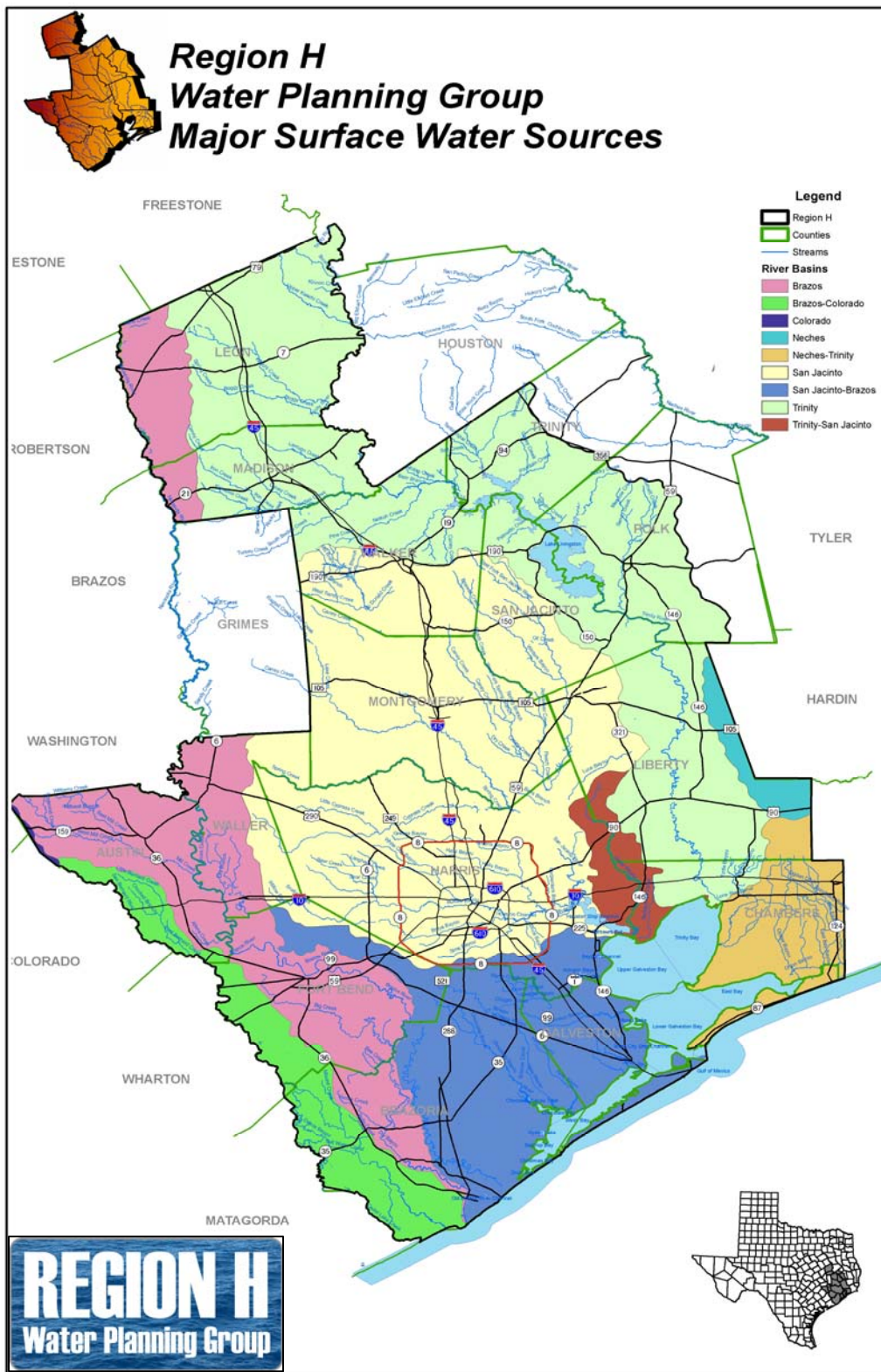


Figure 1-5
Region H Surface Water Sources



1.4.3 Trinity River Basin

The Trinity River basin contains two water projects in Region H, Lake Livingston and the Wallisville Salt Water Barrier. The City of Houston and the Trinity River Authority (TRA) sponsored Lake Livingston's construction. It is operated by the TRA to meet the service demands of the City of Houston and other local users in the Trinity Basin and in the Neches-Trinity Coastal Basin. The U.S. Army Corps of Engineers recently completed the Wallisville Saltwater Barrier. These two projects are operated as a system, Livingston primarily to store water and Wallisville to control the migration of salt water from Trinity Bay. Lake Livingston and Wallisville computed yields are 1,255,500 acre-feet/year and 89,700 acre-feet/year respectively. The sum of these permitted yields is the combined yield of the system (1,345,200 acre-feet per year). Additional permitted run-of-the-river water supplies downstream of Lake Livingston total 220,230 acre-feet per year. These supplies are associated with the water rights agreements established at the time of Lake Livingston permitting.

1.4.4 San Jacinto River Basin

The San Jacinto River Basin has two major public water supply reservoirs, Lake Houston and Lake Conroe. Lake Houston, with a permitted yield of 168,000 acre-feet/year, is owned and operated by the City of Houston for use in its service area. The City of Houston and San Jacinto River Authority (SJRA) jointly own Lake Conroe, with the City holding two-thirds of the permitted rights (66,667 acre-feet/year) and SJRA holding one-third (33,333 acre-feet/year). SJRA manages Lake Conroe, providing supply to the City of Houston and other local users. The SJRA has an additional run-of-the-river water right of 55,000 acre-feet per year and an indirect reuse water right of 14,944 acre-ft per year that is physically diverted out of Lake Houston.

1.4.5 Brazos River Basin

The Brazos River Authority (BRA) manages the water supply resources from 13 reservoirs within this basin. Several of these reservoirs are operated by BRA as a System Operation where commitments made to downstream demands can be met from any upstream reservoir storage available in the system. The U.S. Army COE owns nine of these reservoirs, the City of Lubbock owns one reservoir and BRA owns three reservoirs within the basin. In addition to the BRA water supply reservoirs, there are several other reservoirs in the basin. While none of these reservoirs are located within the Region H area, supply from the "system" is committed in Region H.

The total Brazos Basin supply is estimated at over 1,200,000 acre-feet per year and the estimated yield from BRA's reservoirs is almost 700,000 acre-feet per year. Over 450,000 acre-feet per year is committed under contracts to various entities upstream of Region H with approximately 155,030 acre-feet per year used in the Region H area. Lower-Brazos River Basin run-of-river permits in excess of 450,000 acre-feet per year have been granted.

1.4.6 San Jacinto - Brazos Coastal Basin

There are several significant water users within the San Jacinto-Brazos Coastal Basin supported by the run-of-river water supplies from the Brazos Basin. Suppliers include the Gulf Coast Water Authority (57,500 acre-feet per year purchased from the Chocolate Bayou Water Company), Dow Chemical (280,000 acre-feet per year), and the Richmond Irrigation Company (40,000 acre-feet per year). Each of these entities diverts surface water from the Brazos River and enhances the reliability of their supplies through off-channel surface reservoirs.

1.4.7 Use by Source

TWDB reports that Region H used 2,087,514 acre-feet of water in 2000. Of that, 709,990 acre-feet (34%) came from groundwater wells, and 1,377,524 acre-feet (46%) came from rivers and other

surface sources. Similarly, the most recent water use estimates of groundwater and surface water use available from the TWDB show that in 2004, groundwater use declined under 600,000 acre-feet, approximately 30% of the water used in Region H. Surface water use increased to approximately 1,420,000 acre-feet, approximately 70% of the total Region H water use. The three counties with the largest decline in groundwater use were Brazoria, Fort Bend, and Liberty Counties.

Industrial water users (principally chemical industry users) in the region used approximately 1,000,000 acre-feet of saline (sea) water in the year 2000 and the petroleum industry reported the reuse of just over 3,000 acre-feet of treated effluent. Table 1-9 summarizes the groundwater and surface water usage for each county. Table 1-10 lists the estimated year 2060 reliable yields available from existing sources to Region H. Further information regarding the yield of major surface water rights in Region H is available in Chapter 3 – Analysis of Current Water Supplies.

Table 1-9
County Water Use by Source

County	2000 Groundwater (acre-feet)	2000 Surface Water (acre-feet)	2000 Total Use (acre-feet)	2004 Groundwater (acre-feet)	2004 Surface Water (acre-feet)	2004 Total Use (acre-feet)
Austin	15,928	48	15,976	11,156	1,492	12,648
Brazoria	50,397	365,792	416,189	20,761	357,074	377,835
Chambers	23,005	145,255	168,260	8,085	135,990	144,075
Fort Bend	122,416	70,494	192,910	76,107	76,953	153,060
Galveston	5,001	91,875	96,876	5,880	85,553	91,433
Harris	336,044	637,022	973,066	358,684	673,520	1,032,204
Leon	6,398	0	6,398	4,385	2,443	6,828
Liberty	40,199	61,761	101,960	13,786	69,480	83,266
Madison	2,725	0	2,725	2,611	705	3,316
Montgomery	55,701	576	56,277	54,865	952	55,817
Polk ¹	2,906	1,741	4,647	4,969	2,315	7,284
San Jacinto	3,057	667	3,724	1,955	1,379	3,334
Trinity ¹	1,601	316	1,917	1,000	1,348	2,348
Walker	16,259	1,655	17,914	4,157	10,459	14,616
Waller	28,353	322	28,675	29,551	1,009	30,560
Total	709,990	1,377,524	2,087,514	597,952	1,420,672	2,018,624

Source: TWDB Annual Survey of Ground and Surface Water Use

¹ Includes portion of the county in the Region H area

Table 1-10
Projected 2060 Supplies Available for Use in Region H

Groundwater	Projected Yield (acre-feet/year)
Gulf Coast Aquifer	616,648
Carrizo-Wilcox Aquifer	9,610
Queen City Aquifer	7,906
Sparta Aquifer	17,414
Brazos River Alluvium	41,539
Yegua-Jackson Aquifer	6,400
Undifferentiated Aquifer	1,117
Subtotal	700,634
Basin/Reservoir/Run-of-River	
Neches Basin	
Sam Rayburn Contract ¹	64,177
Neches-Trinity Coastal Basin	
Run-of-River	21,753
Trinity Basin	
Lake Livingston/Wallisville	1,344,000
Run-of-River, Lower Basin	224,530
Trinity-San Jacinto Coastal Basin	
Run-of-River	34,313
San Jacinto Basin	
Lake Houston	168,000
Lake Conroe	74,300
Run-of-River	69,944
San Jacinto-Brazos Coastal Basin	
Run-of-River	35,097
Brazos Basin	
Brazos River Authority System ²	155,030
Run-of-River, Lower Basin	449,773
Brazos-Colorado Coastal Basin	
Run-of-River	12,019
Local Supplies (i.e., stock ponds) all basins	31,895
Subtotal	2,529,801
Total	3,230,435

¹ Values based on long-term contracts from LNVA to Region H customers

² Values based on long-term contracts from BRA to Region H customers

1.4.8 Major Water Providers

A major water provider is an entity that delivers and sells a significant amount of raw or treated water for municipal and/or manufacturing use on a wholesale and/or retail basis. Generally major providers serve as a primary water source for a significant portion of the region's municipal or industrial water users and are those entities likely to develop future major water supply projects. As in the rest of the state, Region H has relatively few entities that hold the rights to significant amounts of water, particularly surface water, and provide retail or wholesale water supplies to a significant number of area users.

Five entities in Region H own over 100,000 acre-feet per year of municipal and/or industrial water rights. Their total holdings represent approximately 62 percent of the region's municipal and industrial water rights. The Chambers-Liberty Counties Navigation District has rights of over 100,000 acre-feet per year, but their supplies are currently used primarily for irrigation. Additionally, portions of these

supplies are not 100 percent reliable. Reliability is based on modeling diversions under drought of record conditions. Irrigation rights can be issued for supplies that are available on an interruptible basis, i.e. 75-percent of the time. These entities are listed in Table 1-11 along with other substantial water rights holders.

Table 1-11
Major Region H Water Rights

Provider	Permitted Amount (acre-feet per year)
City of Houston	1,234,567
Gulf Coast Water Authority ¹	449,432
Trinity River Authority ²	403,200
San Jacinto River Authority	203,377
Brazos River Authority ²	155,030
Brazosport Water Authority	45,000
Chamber-Liberty County Navigation Dist.	112,947

¹ Includes Water Right permits purchased from the Chocolate Bayou Water Co.

² Portion available within Region H only

Source: TNRCC Master Water Rights Database

One other group of water rights holders should be noted, industrial entities that hold large manufacturing use water rights to provide for plant operations. These entities, listed in Table 1-12, generally do not act as providers to other industrial customers. Dow Chemical, however, provides municipal water supply to the Brazosport Water Authority.

Table 1-12
Large Industrial Water Rights Holders

Industrial Water Rights Holder	Fresh Water Permits (acre-feet/year)
Dow Chemical Company	280,000
Reliant Energy / Texas Genco	166,238
Occidental Chemical Corporation	140,000
Phillips Petroleum Company	39,880

Over 2,300 public water suppliers deliver water to communities and businesses in Region H. A review of these suppliers indicates that 70 percent serve fewer than 500 customers. Of the over 700 municipal providers serving 500 or more customers, over 250 are addressed in this plan as part of collective reporting units. The North Harris County Regional Water Authority accounts for 152 Utility Districts (the two cities in the Authority, Tomball and Jersey Village, and listed separately in the plan). The West Harris County Regional Water Authority accounts for 107 Utility Districts, with its member city (Katy) similarly listed separately. The Central Harris County Regional Water Authority accounts for 11 Municipal Utility Districts. The North Fort Bend Water Authority including the City of Fulshear, which is listed separately in the plan. A final collective unit in the plan is The Woodlands, a planned community in Montgomery County served by a series of related utility districts.

1.5 Water Quality and Natural Resources

1.5.1 Water Quality

The Texas Natural Resource Conservation Commission (TNRCC) published The 15th State of Texas Water Quality Inventory (2000) addressing water quality in light of recent Federal Clean Water Act amendments. Also that year, participating water authorities compiled and published their Regional Water Quality Assessments as part of the Texas Clean Rivers Program. These reports established the condition of each river and stream segment and identified those segments with water quality concerns for a number of parameters. In Region H, the Brazos, San Jacinto and Trinity River Authorities participate in the Texas Clean Rivers Program and have each published reports on the water quality conditions within their respective basins.

Groundwater within the region is generally of good quality, with total dissolved solids below 1,000 mg/l. Iron is a concern in some portions of the Carrizo-Wilcox Aquifer, and calcium, magnesium and sulfate cause high total hardness in portions of the Brazos River Alluvium. There are many naturally occurring constituents in ground water with arsenic and radon being two of them. The current maximum contaminant level (MCL) for arsenic in water used for public supply is 0.01 mg/l set by the Environmental Protection Agency (EPA) in January of 2006. Currently ground water produced within Region H has an arsenic content below the existing MCL. There is a limited area within the northwest part of Harris County where the concentration of arsenic in some sands of the Gulf Coast aquifer exceeds 0.01 mg/l. Wells are now constructed to not screen these sands and in some instances consideration is being given to treating the water from older wells to lower the arsenic content below 0.01 mg/l.

Radon is not a regulated constituent as an MCL has not been established for it. There are some areas in the west part of Harris County where isolated sands can contain water with higher concentrations of radon. Through geophysical logging to identify these depth intervals and by the use of well construction techniques that isolate the sands from providing water to a well, production wells are constructed that produce water with low levels of radon.

Surface water throughout Region H is treated for municipal use using conventional measures. Contact recreation use is limited in the Lower Trinity River due to fecal coliform bacteria levels. Growth in the San Jacinto River Basin has increased nutrient loading and fecal coliform levels in many streams, particularly Buffalo Bayou. Likewise, nutrients, dissolved minerals and elevated fecal coliform levels have been identified in the Lower Brazos River. Also of concern in the Lower Brazos River are seasonal low flows, which allow the tidal salt-wedge to reach municipal and industrial freshwater intakes in Freeport.

1.5.2 Topography

Region H is located in the Gulf Coastal Plains of Texas. It is primarily made up of two vegetational areas, the Gulf Prairies and Marshes and the Piney Woods.

The Gulf Prairies make up the majority of the region. They hold marsh and saltwater grasses in tidal areas, and bluestems and tall grasses inland. Oaks, elms and other hardwoods grow in limited amounts. The natural grasses make the region ideal for cattle grazing, and the fertile soils support rice, cotton, wheat and hay farming as well. Wildlife in the area includes alligator, river otter, Attwater's prairie chicken, eastern brown pelican, Eskimo curlew, piping plover and whooping crane. Counties in the Gulf Prairie include Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris and Waller.

The Piney Woods encompass the northeastern portion of Region H, consisting of pine forests interspersed with native and improved grasslands. Longleaf, shortleaf and loblolly pine are the dominant native species harvested, but slash pine and various hardwood species are cultivated as

well. Timber production and cattle are the principal agricultural products in that portion of the region. Wildlife in the area includes bobcat, ringtail, river otter, red-cockaded woodpecker and bald eagle. Counties in the Piney Woods include Leon, Liberty, Madison, Montgomery, Polk, San Jacinto, Trinity and Walker.

1.5.3 Public Lands

The Region contains 325,394 acres of state and national forests, supporting hiking, camping, picnicking and horseback riding. It also contains 107,138 acres of coastal wildlife refuges for migratory waterfowl, as well as native waterfowl and plant species. It contains a portion of the Big Thicket National Preserve, designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as part of the International Biosphere Reserve. Finally, the region holds 12,170 acres of Texas Wildlife Management Areas, preserved for bird watching in coastal areas and seasonal hunting inland. The area names and locations are presented in Table 1-13, and a location map is provided at Figure 1-6.

Table 1-13
Public Lands

Resource Area	Acreage	County
State and National Forests		
W. Goodrich Jones State Forest	1,725	Montgomery
Davey Crockett National Forest	162,012	Total
	67,329	Trinity
Sam Houston National Forest	161,657	Total
	47,777	Montgomery
	60,247	San Jacinto
	53,633	Walker
Big Thicket National Preserve	86,000	Total
National Wildlife Refuges		
Anahuac NWR	30,000	Chambers
Brazoria NWR	42,338	Brazoria
San Bernard NWR	28,000	Brazoria
Trinity River NWR	6,800	Liberty
Texas Wildlife Management Areas		
Candy Cain Abshier WMA	207	Chambers
Atkinson Island WMA	151	Harris
Keechi Creek	1,500	Leon
Peach Point	10,312	Brazoria

Source: *Texas Almanac, Texas Parks & Wildlife Department*

1.5.4 Navigation

Navigation within Region H rivers is generally limited to the lower reaches of the main stems of the Brazos, San Jacinto, and Trinity Rivers including the Houston Ship Channel and Turning Basin. In addition the Gulf Intracoastal Waterway, an inland canal system that connects ports in the Gulf of Mexico, traverses the Region H coastline through the ports of Galveston and Freeport. There is significant use of rivers, streams and reservoirs throughout the region by recreational boaters and fishermen. There are no navigation water permits in the Region H area.

1.5.5 Threats to Agricultural and Natural Resources

The Regional Water Planning Guidelines (31 TAC 357) require planning groups to “identify threats to agricultural and natural resources of the state due to water quantity problems or water quality problems related to water supply.”

There are no water quantity problems for agriculture in Region H. However, it is common practice in the region for irrigation supply to be purchased on a year-to-year basis. The absence of long-term contracts prevents the full representation of irrigation supply as “allocated” in the regional plan. As a result, irrigation is represented as having a shortage met through water management strategies. The current plan meets all projected irrigation demands. Increased water costs, coupled with decreasing prices for rice and other irrigated crops, may cause agricultural water demand to decline in the future. No water quality concerns for agriculture have been identified.

Galveston Bay estuary is the most significant natural resource in Region H. The estuary is dependent upon freshwater inflows to maintain seasonal salinity ranges for wildlife habitat and fisheries productivity. The estuary is capable of withstanding to natural flood and drought cycles, but the amplified affects of water diversions during a drought may pose a threat to this resource. Target inflow amounts and frequencies for Galveston Bay are discussed in Chapter 3, and inflows with and without water management strategies are analyzed in Chapter 4.

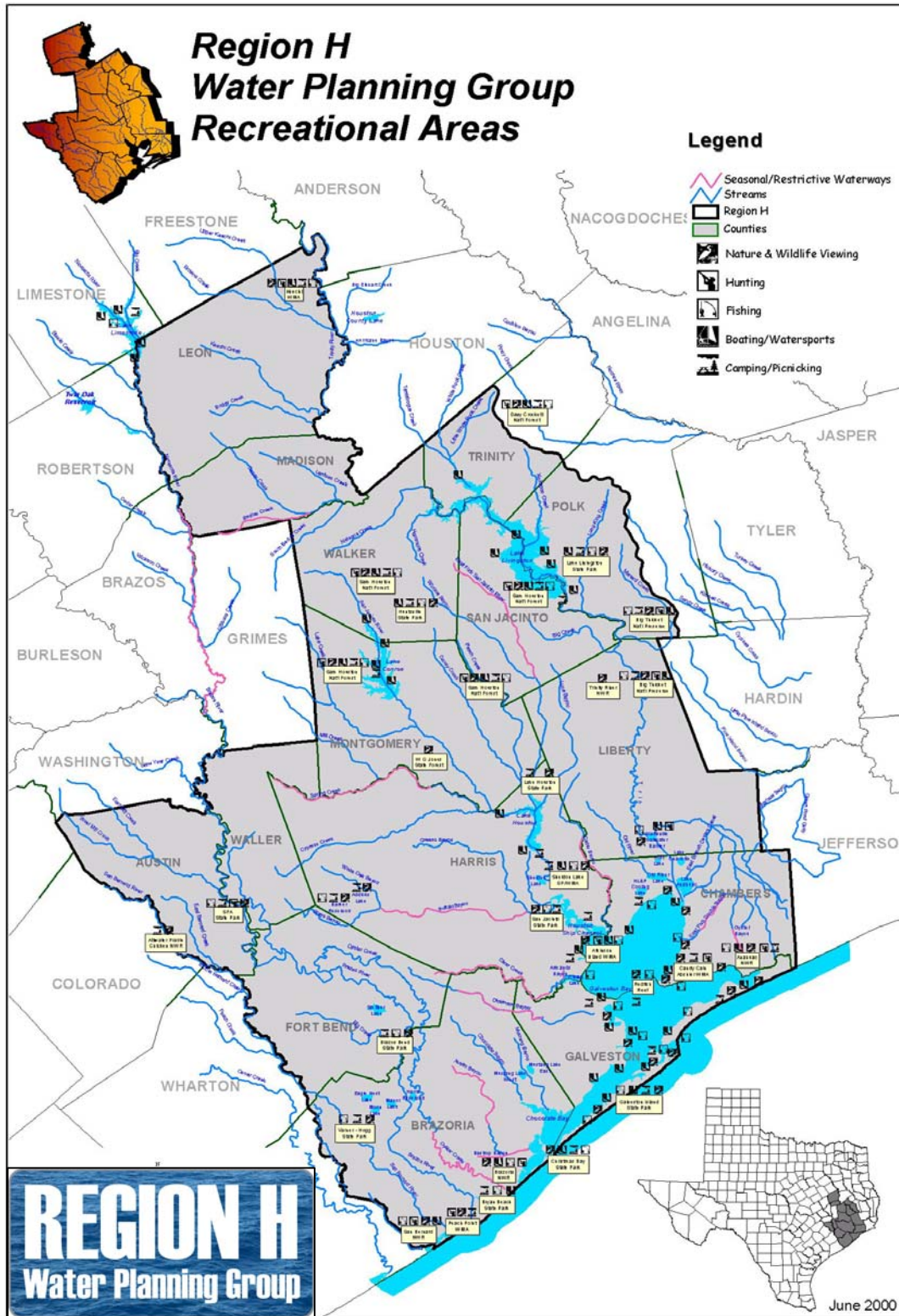
Other natural resources within the region also enjoy in-stream flows. As with Galveston Bay, peak diversions during drought periods may reduce flows to the point that detrimental affects are felt by the environment. Texas is currently developing policies and procedures to determine and protect the required minimum flows in the streams and estuaries of the State.

The number of additional threatened and endangered species added to each county by the Texas Department of Parks and Wildlife since the adoption of the 2006 Region H Water Plan is presented in Table 1-14. Threatened and endangered species are further discussed in Chapter 7.

Table 1-14
Threatened and Endangered Species

County	Species (2006 Plan)	New Species	Current County Total
Austin County	4	4	8
Brazoria County	3	13	16
Chambers County	3	13	16
Fort Bend County	3	2	5
Galveston County	4	11	15
Harris County	4	11	15
Leon County	4	4	8
Liberty County	7	5	12
Madison County	3	3	6
Montgomery County	6	4	10
Polk County	6	4	10
San Jacinto County	6	4	10
Trinity County	0	7	7
Walker County	5	4	9
Waller County	5	5	10

Figure 1-6
Public Lands within Region H



1.6 Existing Water Planning

1.6.1 Existing Regional and Local Water Management Plans

The first Region H Water Plan was published in 2001. It was incorporated into the State Water Plan in 2002. The Region H Water Plan recommended several water management strategies to ensure that all water demands in the Region were met. First, advanced water conservation was recommended for all municipalities with projected shortages. Next, supplies that were identified as surplus in one area were recommended for contract or sale to water users in other areas. These transfers included moving TRA water supply from Lake Livingston to Harris County, moving surplus water from Houston into Galveston County, and reducing BRA contract commitments in the upper Brazos basin to supply the lower basin. Three new reservoirs were recommended: Allens Creek Reservoir in Austin County to capture peak flows in the Brazos River, Bedias Reservoir in Madison County to create additional supply for the northern third of the region, and Little River Reservoir in Milam County to supply Region H and the Brazos G Region. In areas with limited groundwater, irrigation conservation was recommended as a means of increasing groundwater for municipal supply.

Before this, the Region H area was part of The Trans-Texas Water Program (TTWP): Southeast Area, a comprehensive water resource planning program created to evaluate a full range of water management strategies for a 32 county area of East Texas. This area encompassed all of Region H, plus the lower Sabine River Basin and portions of the middle Brazos River Basin. *The Phase II Report* (1998) identified a regional long-term shortage by the year 2035. To meet that need, the following management techniques were studied further: water conservation, wastewater reclamation, use of existing reservoir surplus supply, coordinated reservoir system operation, interbasin transfers and contractual transfers.

Technical studies of these management techniques were completed in Phase II of the TTWP. The *Phase II Report* (1998) determined that the Southeast Area could develop adequate supplies to meet expected regional demands, and export water to Central Texas (Regional Planning Regions L and N). Various management strategies would need to be implemented to accommodate growth in the different geographic areas across the fifty-year planning period. Water conservation, wastewater reclamation and coordinated systems operations strategies would extend the period of adequate supply, allowing additional time to plan and develop new water sources. The Allen's Creek Reservoir in the Brazos River Basin, with a yield of approximately 70,000 acre-feet per year, was reported as a potentially feasible project. Contractual transfers were identified that would align surface water rights with the owner's service areas, shortening conveyance systems. Finally, sustained interbasin transfers from the Toledo Bend Reservoir in the Sabine River Basin to the Trinity and San Jacinto River Basins were also reported as feasible strategies to meet the growing needs of the region and areas of central Texas.

Other previously completed regional water supply plans include the City of Houston Master Plan, Brazos Valley Long-Range Resource Plan, the San Jacinto River Authority Water Resources Development Plan, and the Trinity River Basin Master Plan. Within Region H, the BRA plan also recommends development of the Allen's Creek Reservoir. The SJRA plan recommended development of two reservoirs, Lake Creek and Spring Creek. These projects were tabled when the SJRA purchased part of the Devers Canal Systems water rights, which allowed the transfer of approximately 50,000 acre-feet per year from the Trinity River Basin. The TRA recommends development of thirteen potential reservoirs, six of which are located in Region H. The largest, Bedias Creek, could potentially provide 109,000 acre-feet per year, and is located to allow use in the Trinity, San Jacinto or Brazos River Basins.

The Harris-Galveston Coastal Subsidence District and Fort Bend Subsidence District developed Groundwater Management Plans to address subsidence through reduced groundwater extraction within their respective regulatory areas. These districts adopted regulatory plans in 1999 and 2003,

respectively, setting limits on groundwater use as a percentage of total water demand. Three of the four new groundwater conservation districts in the region, Bluebonnet, Lone Star and Mid-East Texas, have published groundwater management plans and started the collection of well data needed to consider if a regulatory plan is needed.

Additional plans are noted in the Region H Bibliography, included as Appendix 1A.

1.6.2 Current Preparations for Drought

The 1997 State Legislature mandated water conservation and drought contingency planning for all holders of municipal, industrial and non-irrigation water rights of 1,000 acre-feet or more and irrigation rights holders of 10,000 or more acre-feet. Previously, all water rights permit applications required a water conservation and drought contingency plan but existing rights holders were not required to prepare or implement plans. New regulations also distinguish between water conservation and drought contingency plans and extend the requirement to prepare and implement drought contingency plans to all holders of water rights as noted above and to public water systems with over 3,300 connections.

In the completed drought plans, the predominant response activities are first a public information effort to alert the public to drought conditions and encourage water conservation. If drought conditions persist, many plans impose mandatory water conservation measures, including restrictions on landscape watering and car washing. Water Conservation and Drought Response are discussed in Chapter 6 of this report.

1.6.3 Region H Drought Management Study

The Region H Water Planning Group (RHWP) requested and received funding from the Texas Water Development Board (TWDB) to conduct three studies in advance of the 2011 update of the Region H Water Plan. One study focused on evaluating the impacts of future water management strategies on freshwater inflows to Galveston Bay and on evaluating the impacts of instream flow requirements for future water management strategies. A second study focused on evaluating the feasibility of using available “interruptible” surface water supplies as a substitute for existing firm water supplies for certain uses, notably irrigated agriculture. The third study focused on evaluating the efficacy and impact of drought contingency (a.k.a. drought response) measures as a potential water management strategy in Region H. The key question addressed by this study was:

Can implementation of drought contingency measures within Region H during critical drought periods be used in lieu of other water management strategies to meet projected water demands?

The scope of work for the Region H Drought Management Study was divided into two primary tasks. The first task focused on evaluating the efficacy or effectiveness of drought contingency plans adopted and implemented by municipal water suppliers within Region H, elsewhere in Texas, and nationally. The second task consisted of a quantitative evaluation of the potential impact of drought response measures on major water supply reservoirs in Region H, namely Lake Conroe, Lake Houston, Lake Livingston and the proposed Allens Creek Reservoir. Specifically, Texas Commission on Environmental Quality (TCEQ) water availability models were used to analyze reservoir conditions (i.e., levels and storage volumes) during critical drought periods both with and without implementation of drought response measures.

The study found that most drought contingency plans place a heavy emphasis on “demand management measures” that are designed to reduce water demands by means of curtailment of certain uses. It’s important to note that demand management in this context is distinctly different from water conservation, although the terms are often used interchangeably. The objective of water conservation is to achieve lasting, long-term reductions in water use through improved water use efficiency, reduced waste, and through reuse and recycling. By contrast, demand curtailment is

focused on temporary reductions in water use in response to temporary and potentially recurring water supply shortages or other water supply emergencies (e.g., equipment failures caused by excessively high peak water demands). Common approaches to water demand curtailment, applied individually or in combination, include:

- Prescriptive restrictions or bans on non-essential water uses and waste. In a municipal setting, such restrictions commonly target landscape irrigation, car washing, ornamental fountains, etc.
- Use of water pricing strategies, such as excess use surcharges, to encourage compliance with water use restrictions or to penalize excessive water use.
- Water rationing, where water is allocated to users on some proportionate or pro rata basis.

A significant number of public water systems in Region were found on the TCEQ drought impact list and implemented drought measures during the years 1998 (62 systems), 2000 (35 systems) and 2005 (39 systems). The counties that recorded the most public water systems on the list are Harris and Montgomery counties. Together, Harris and Montgomery Counties accounted for approximately 55 percent of the systems on the drought impact list. Approximately 90 percent of the water systems on the drought impact list serve populations less than or equal to 10,000 people and have 5,000 connections or fewer. TCEQ records also indicate that the list is comprised mostly of public water systems that are supplied by groundwater.

Surveys of Major Public Water Systems indicated that none of the Region H public water systems that were on the TCEQ drought impact list over the period from 1996 to 2008 experienced actual water shortage conditions. Rather, it appears that these water systems were placed on the list because of high seasonal peak water demands and attendant problems or concerns with water production infrastructure. The majority of Region H public water systems on the TCEQ drought impact list are municipal utility districts (MUDs), water supply corporations (WSCs), subdivisions and rural municipalities that rely on groundwater from local wells. Sustained high peak water demands during the summer months often create a strain on groundwater supplies, not so much in terms of the availability of supply but rather in terms of groundwater production capacity, indicating a need perhaps for additional wells to increase delivery capacity or deeper wells to compensate for greater than normal draw down. Public water systems that rely on surface water often experience similar problems in terms of limited capacity to treat raw water and/or distribution system capacity limitations.

The study found that there is very little “good” empirical research to quantify the effectiveness of drought response measures. Most water suppliers that have implemented DCPs have not thoroughly evaluated the effects. “Post-event” analyses was found to typically only report “gross” changes in water demand, most commonly expressed as a percentage reduction. It was also found that most DCPs in Texas are focused on seasonal peaking problems rather than actual water shortage and are always addressed at peak shaving.

The Drought Management Study concluded that, while drought contingency planning is a critical component of water supply management and may provide short-term benefits during severe drought conditions; drought management alone will not replace any recommended long-term water management strategies. The results of the Drought Management Study are discussed in further detail in Chapter 6 of this report.

1.6.4 Water Loss Audits

An important part of a municipal conservation plan is minimizing the amount of water loss in their distribution system. The 78th Texas Legislature passed House Bill 3338 to provide the TWDB with a water loss audit. The first water loss audit deadline for submission to the TWDB was by March 31,

2006. Public utilities will be required to perform water loss audit at least once every five years and provide the data to the TWDB.

The water loss reporting followed a methodology recommended by the International Water Association (IWA) and the American Water Works Association (AWWA) Water Loss Control Committee. The methodology relies on defined water use categories as shown below:

Water Losses:

- Apparent Losses represent water that was used but not paid for, resulting in lost revenue. Apparent Losses include:
 - Unauthorized Consumption
 - Customer Meter Under-registering
 - Billing Adjustment and Waivers
- Real Losses represent water that is physically lost from the water system prior to use, resulting in lost revenue. Real Losses include:
 - Main Breaks and Leaks
 - Storage Overflows
 - Customer Service Line Breaks and Leaks

The study results found a high level of inaccuracy, particularly in Regions B, H and M suggesting that utilities in the regions should refine their water accounting procedures. Within Region H, the study utilized information provided by 638 utilities. The utilities ranged in type and were categorized as City, MUDs, SUDs, WCIDs, WSCs or Other. The number of utilities in each category along with the estimated total Apparent Loss, Real Loss, and Total Losses are presented in Table 1-15. The Total Annual Value of the reported water loss in Region H ranged from a lower bound value of approximately \$33,800,000 to an upper bound value of \$128,200,000. The large discrepancy between lower and upper bound estimates is the result of inaccuracies in the water loss estimates.

Table 1-15
Water Loss by Type

Utility Type	Number	Total Apparent Loss (acre-ft/year)	Total Real Loss (acre-ft/year)	Total Loss (acre-ft/year)
City	49	13,201	5,974	19,174
MUD	281	5,120	2,778	7,899
SUD	36	79	350	429
WCID	24	675	333	1,008
WSC	147	474	666	1,140
Other	101	1,967	1,169	3,136
Total	638	21,516	11,270	32,786

The study made the following recommendations for utilities and the Regional Water Planning Process:

- Utilities should implement annual or biennial programs to gradually reduce the uncertainty in their water audits. The programs should target water audit categories with the most uncertain water volume estimates.
- Regional Water Planning Groups should use the research results to estimate the potential water savings from water system audits and loss prevention strategies and should update the regional water plans accordingly.
- The TWDB should work to align the regional water planning cycle and the water audit reporting cycle so that up-to-date water loss data is used in developing the regional water plans.

1.7 Recommendations Made in the 2006 Region H Water Plan

In the 2006 Region H Water Plan, the RHWPG recommended twenty-two water management strategies to meet projected water demands through the year 2060. The planning group recommended eight stream segments and four reservoir sites as unique, and also recommended regulatory, administrative and legislative changes to the Legislature. Those recommendations are listed below. Recommendations which have been acted upon are noted in italics.

1.7.1 Water Management Strategies Recommended in the 2006 Regional Plan

The RHWPG considered a variety of strategies for meeting the projected shortages and solicited input from the public before adopting a management plan. A detailed analysis process was developed to define potential water management strategies. The process addressed the specific shortages of 193 WUGs and then developed associated specific strategies assuming the MWPs would be the vehicle to solve WUG shortages. The process generally consisted of the following:

Municipal Conservation – For WUGs with projected shortages, an appropriate level of water conservation would be implemented, as discussed below.

Contract Extension and Increase – For all WUGs currently served by a WWP, it was assumed that current contracts would be renewed throughout the planning period. Additionally, it was assumed that WUGs would increase their contracts with their current WWPs to meet projected growth, until current WWP supplies were fully allocated. This could not be applied to collective WUGs, such as Manufacturing.

This met the supply needs for 15 of the 193 WUGs with shortages. The remainder of the WUGs with shortages were grouped and addressed by county. Potential water management strategies were screened and considered to meet the needs of each county. The strategies considered included those in the 2001 Regional Water Plan, new water rights applications, wastewater reuse and seawater desalination. Significantly, the consideration of new supply sources allowed the RHWPG to replace two reservoir projects recommended in the 2001 Plan. Management strategies that involved adjoining regions were coordinated with the appropriate water planning group.

The water management strategies selected in the 2006 Region H Water Plan to meet the projected growth were as follows:

Municipal Conservation—The conservation strategy is applied at the WUG level, reducing demands from 5.5% to 7.0%, depending on the size of the WUG. Projected water savings total 71,109 ac-ft/yr in year 2030 and 101,200 ac-ft/yr in year 2060.

Industrial Conservation—Industries with projected shortages will seek out ways to reduce their water demand as a means of managing their operating costs. The wide range of industries within Region H, and their varying progress in this area, prevented the estimation of projected savings for this strategy.

Irrigation Conservation—Reduction of on-farm demands through land leveling, canal lining and other system improvements. Projected water savings are 18,792 ac-ft/yr in Brazoria County, 24,018 ac-ft/yr in Chamber County, 5,198 ac-ft/yr in Fort Bend County, 2,392 ac-ft/yr in Galveston County, 20,877 ac-ft/yr in San Jacinto County and 6,606 ac-ft/yr in Waller County.

Expanded Use of Groundwater—Only a portion of the groundwater available to Region H is developed supply (i.e., existing wells). An additional 91,500 ac-ft/yr of new well capacity is needed to fully utilize this resource.

New Contracts for Existing Supply—WWPs with unallocated existing supplies were identified, and new contracts were recommended within existing service areas.

Luce Bayou Transfer—This conveyance project enables the City of Houston to transfer water it owns in the Trinity basin to Lake Houston to meet projected growth in north and northwest Harris County.

Brazos River Authority System Operations—The Brazos River Authority has applied for a water right that permits existing additional yield within their reservoirs, and new yield that can be achieved through operation of their reservoirs as a basin-wide system. Approximately 120,000 ac-ft/yr of this water will be available for customers in Region H.

Allen's Creek Reservoir—This proposed reservoir creates 99,650 ac-ft/yr of supplies for the City of Houston and the Brazos River Authority.

Little River Off-Channel Reservoir—This proposed reservoir creates 32,100 ac-ft/yr for the Brazos River Authority.

Non-Municipal Contractual Transfer—This strategy involves the transfer of 21,000 ac-ft/yr of manufacturing, mining and irrigation supplies from WUGs with surpluses to WUGs with needs in Brazoria and Galveston Counties.

Wastewater Reclamation for Industry—This strategy proposes that 67,200 ac-ft/yr of Houston's municipal wastewater be treated and directly reused by industries along the Houston Ship Channel.

Houston/Trinity River Authority Contract—Under this strategy, the City of Houston will purchase up to 150,000 ac-ft/yr of uncommitted supplies from the Trinity River Authority.

SJRA/Trinity River Authority Contract—Under this strategy, the SJRA will purchase up to 50,000 ac-ft/yr of uncommitted supplies from the Trinity River Authority to serve Montgomery County.

Houston to Gulf Coast Water Authority Transfer—Water wheeling strategy, in which Houston provides 28,000 ac-ft/yr to the GCWA in Galveston County, beginning in 2050. The GCWA then reallocates their existing Brazos River supply to meet demands in Fort Bend County. Included is a pumping station and pipeline to convey the water to the GCWA's Texas City reservoir.

Houston Indirect Wastewater Reuse—The City of Houston has applied for a water right permit to indirectly reuse up to 580,900 ac-ft/yr of wastewater discharges. A portion of that is recommended for direct reuse to industry. An additional 98,000 ac-ft/yr is recommended for use beginning in 2050.

NHCRWA Indirect Wastewater Reuse—The North Harris County Regional Water Authority has the potential to indirectly reuse up to 157,000 ac-ft/yr of wastewater discharges. 31,400 ac-ft/yr is recommended for use beginning in 2060.

Lake Houston Additional Yield—Volumetric surveys and WAM analysis show that Lake Houston can yield an additional 32,500 ac-ft/yr of supply (declining over time due to storage losses to sedimentation).

Freeport Seawater Desalination—A pilot plant is being considered under the Governors Desalination Initiative, with an initial capacity of 11,200 ac-ft/yr and a recommended increase to 33,600 ac-ft/yr.

Brazos Saltwater Barrier—A proposed gated structure on the lower Brazos above Freeport to protect lower basin intakes from the seasonal saltwater influence, which is expected to worsen as the basin is fully utilized.

Redesignation of Existing Water Rights—WWPs who identify local changes in water usage types due to development are recommended to add appropriate usage types to their water rights permits.

New San Jacinto River Water Rights—The SJRA and City of Houston have jointly applied for an interruptible supply permit on the San Jacinto River. The conjunctive use of this supply with existing supplies owned in the Trinity River Basin will reduce interbasin transfers in non-drought years.

New Harris County Bayous Water Rights—The City of Houston has applied for an interruptible supply permit in the lower San Jacinto basin. The conjunctive use of this supply with existing supplies owned in the Trinity River Basin will reduce interbasin transfers in non-drought years.

The 2006 Region H Water Plan met all projected water demands, at an estimated capital cost of \$5.5 billion for the recommended water management strategies.

1.7.2 Unique Streams Segments Recommended in the 2006 Regional Plan

The Texas Water Code offers the opportunity to identify river and stream segments of unique ecological value. The selection criteria established within the Texas Water Code are as follows:

- Biological Function
- Hydrologic Function
- Riparian Conservation Area
- High Water Quality/Exceptional Aquatic Life/High Aesthetic Value
- Threatened or Endangered Species/Unique Natural Communities

Stream Segments designated by the legislature as having unique ecological value can not be developed as reservoir sites by the State or any political subdivision of the State. After consideration of the above factors, the Region H 2006 Water Plan recommended the following eight streams for designation as Streams of Unique Ecological Value in Region H:

Table 1-16
Recommended Unique Stream Segments

Stream Segments (not in priority order)	County
Armand Bayou	Harris
Austin Bayou	Brazoria
Bastrop Bayou	Brazoria
Big Creek	Fort Bend
Big Creek	San Jacinto
Cedar Lake Creek	Brazoria
Menard Creek	Liberty, Hardin*, Polk
Oyster Bayou	Chambers

*(Hardin County is in Region I)

The entire stream segment length was recommended for Armand Bayou and Menard Creek (segment within Region H). For the remaining four streams, only those portions adjacent to or within riparian conservation areas were recommended as unique streams. The Legislature has not yet designated any unique streams.

1.7.3 Unique Reservoir Sites Recommended in the 2006 Regional Plan

The Texas Water Code offers an opportunity to designate sites of unique value for use as surface water supply reservoirs. Through use of a decision-based water management strategy analysis and selection process, the RHWPG selected two surface water reservoir projects, Allens Creek and Little River Off-Channel, for inclusion in the 2006 Regional Water Plan. Two additional reservoir projects, Bedias Creek and Little River were recommended in the 2001 Plan but were replaced in the 2006 Plan by different water management strategies. The RHWPG has decided to recommend the locations of each of these projects as unique sites. To date, the Legislature has only designated Allens Creek Reservoir as unique.

The four sites are:

Table 1-17
Recommended Unique Reservoir Sites

Name	County	General Location
Allen's Creek	Austin	1 Mile N. of the City of Wallis
Little River, Off-Channel	Milam	Beaver Creek, approx. 5 Miles NE of City of Milano
Bedias	Madison (Principally)	Bedias Creek, 3.5 Miles W. of State Hwy 75
Little River	Milam	Main Stem of Little River, Immediately Upstream of its Confluence with the Brazos River

1.8 Regulatory, Administrative and Legislative Recommendations

Section 357.7(a)(10) of the Texas Water Development Board regional water planning guidelines requires that a regional water plan include recommendations for regulatory, administrative, and legislative changes. These recommendations are addressed to each governmental agency that has the appropriate jurisdiction over each subject. It is generally assumed that regulatory recommendations are directed towards the Texas Commission on Environmental Quality (TCEQ), that administrative recommendations are directed towards the Texas Water Development Board

(TWDB), and that legislative recommendations are directed towards the State of Texas Legislature. The Region H Water Planning Group has currently adopted the following regulatory, administrative, and legislative recommendations:

1.8.1 Regulatory and Administrative Recommendations from the 2006 Plan

Clarify the agency rules to address consistency with the regional water plans.

Water rights applications must be consistent with the Regional Water Plans in order to be approved. The TCEQ has interpreted this to mean that the requested water right must be directly linked to a recommended water management strategy, otherwise the applicant has had to petition the RWPG for a plan amendment to add their permit application. RWPGs should not be required to formally adopt or amend the regional plan to include a proposed management strategy for water supply in order for new water rights applications to be evaluated by the TCEQ. This creates a situation that can deter the study of viable alternatives by agencies outside the RWPG and may ultimately block their ability to obtain permits for new supplies that the agencies need to meet their future needs. These alternatives may be preferable to existing management strategies (such as building reservoirs) that were previously recommended by the RWPG. A water right application that is not in conflict with the regional water plan (i.e., does not compete for supply allocated in the plan) should be considered consistent with the plan by the TWDB and TCEQ. If the strategy would benefit the region, it could then be added to the plan as a formal management strategy in the next five-year update, undergoing the full analysis, consideration and Public Hearing process.

The Region H Water Planning Group recommends that the Agency rules be amended to clarify the consistency requirement. Only those water rights applications in conflict with the current regional water plan should be referred to the RWPG for amendment.

Allow more flexibility in the allocation of alternate or multiple water management strategies to meet defined water shortages.

Section 357.7(a)(9) of the TWDB Regional Water Planning guidelines requires “specific recommendations of water management strategies to meet the needs...” The TWDB interpretation of these requirements suggests a direct relationship between a defined water shortage with one specific water management strategy. In reality, the WUG may have two or three possible suppliers that they could negotiate and choose between. Also, WUGs may form sub-regional groups to pursue more cost effective strategies than are achievable separately. While this single-supplier option is a necessary assumption for the planning effort (so that we do not recommend more strategies than the region requires), it is unrealistic for the TWDB to hold the WUG to our recommended supplier. This by-passes the market and hinders competition. Correcting these WUG-Supplier associations in the plan (to allow TWDB funding assistance) requires a formal amendment and incurs costs related to that process. The RWPGs should not be placed in that position and the public should not bear that cost.

Additionally, WUGs and wholesale water providers may have several viable strategies to choose between. The RWPGs are limited to recommending the best or most feasible strategies, based upon the regional planning rules and assumptions. The individual WUG or WWP may opt to implement a different viable strategy, based on their own analysis and differing assumptions and criteria. Currently, reflecting this change between viable alternatives requires amending the regional water plan. If alternative strategies could be fully analyzed and recognized in the plan when it is adopted, they could be exchanged with recommended strategies without requiring a full amendment.

The Region H Water Planning Group recommends that the TWDB and the TCEQ interpret existing legislation to give the maximum possible flexibility to water user groups and suppliers. Legislative and regulatory changes should be made to remove this requirement for specificity from the regional water planning guidelines and allow plans to present multiple sources of supply where appropriate.

Alternative strategies should be designated in the plan, where appropriate, to remove the single-strategy restriction placed on water users groups.

Modify the notification procedures for amendments to regional water plans that only affect a portion of the region.

The same notification requirements associated with adoption of a regional water plan should not be used upon amendment of a specific component of the plan. Based on the number of WUGs within the region, the RHWPG anticipates a number of plan amendments will be requested during every planning cycle. The majority of these plan amendments will only affect certain aspects of the plan and certain communities and water suppliers. The current notification requirements for the entire plan are expensive.

The Region H Water Planning Group recommends adoption of a revised set of notification procedures for those regional water plan amendments that only affect a limited portion of the region.

Clarify agency rules on quantitative environmental analysis.

The Regional Water Planning Guidelines require that the evaluation of potentially feasible water management strategies include a quantitative analysis of environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico (31TAC357.7.(a)(8)(A)). The TWDB has provided detailed guidance on specific study methods to be used in determining population, water demand, socioeconomic impacts and yield from current and proposed supply sources, but has not provided similar guidance in the area of environmental impacts. This lack of specificity is resulting in different methods being used in different regions. Additionally, it places the planning groups at risk of needing to conduct additional analysis after state agencies review the Initially Prepared Plans, and add those results to the report after the public review period has closed.

The Region H Water Planning Group recommends that the TWDB determine, in conjunction with the TCEQ and TPWD, which specific environmental studies and analysis is required for each category of management strategy (i.e., new water right, new reservoir, etc.), and that guidance be added to the Planning Guidelines, so that RWPGs can reflect these requirements in their budgets and scopes of work, and so that plans are consistent across the State.

TDDES Permitting of Wastewater Reclamation Facilities.

Existing Texas Pollutant Discharge Elimination System (TPDES) permit requirements do not encourage, and in fact discourage, wastewater reuse and reclamation.

In terms of wastewater reuse (e.g., without further treatment), a violation of an end-user's discharge permit could be caused by using effluent to replace or supplement another water source. An example would be an industry, whose discharge is close to its permitted limit for a given constituent, exceeding that limit by virtue of its use of effluent from a separate wastewater treatment plant.

In terms of wastewater reclamation (e.g., with further treatment), permitting the discharge from a wastewater reclamation facility could be difficult and unnecessarily expensive. Wastewater reclamation often entails advanced treatment of wastewater discharged from one or more treatment facilities for industrial use. If this advanced treatment facility is separate, it requires a separate TPDES permit. Under current TCEQ rules, discharges from a new facility are considered as occurring *in addition to* all currently permitted discharges, for the purpose of assessing the collective effect on the receiving stream. While this is the correct procedure for evaluating a discharge from a new waste source, it effectively double-counts the waste load from a reclamation facility (once at the original plant, and again at the additional treatment facility). Designing a reclamation facility to sufficiently mitigate this double-counting is unneeded and may be cost-prohibitive. In actuality, the

waste load should be divided between the applicable facilities, depending upon the reuse and reclamation demands.

Therefore, the permitting process should be modified to address both reuse and reclamation projects that draw effluent from existing wastewater plants, so that daily loads may be accurately assessed on a combined maximum daily load and maximum daily concentration basis, and permitted accordingly.

The Region H Water Planning Group recommends that the TCEQ modify the rules for wastewater permitting, so that the environmental impacts of reuse and reclamation facility discharges are assessed in conjunction with appurtenant reductions in discharges for their source water facilities.

1.8.2 Legislative Recommendations from the 2006 Regional Plan

Remove barriers to interbasin transfers of water within Region H.

Senate Bill One states that water rights developed as a result of an interbasin transfer become junior to other water rights granted before the interbasin transfer permit. The effect of this change is to make obtaining a permit for interbasin transfer significantly more problematic than it was under prior law and thus discourages the use of interbasin transfers for water supply. This is undesirable for several reasons:

- Current supplies greatly exceed projected demands in some basins, and the supplies already developed in those basins can only be used via interbasin transfers (Trinity Basin within Region H.)
- Interbasin transfers have been used extensively in Texas and are an important part of the state's current water supply. For example, three of the five Region H Major Water Providers (City of Houston, Trinity River Authority and San Jacinto River Authority) maintain current permits for interbasin transfers collectively of over 1,000,000 acre-feet per year. Virtually all future water demands within the San Jacinto basin (Harris County in particular) of Region H must rely on interbasin transfers.
- Emerging regional water supply plans for major metropolitan areas in Texas (Dallas-Fort Worth and San Antonio) rely on interbasin transfers as a key component of their plans. It is difficult to envision developing a water supply for these areas without significant new interbasin transfers.

The Region H Water Planning Group recommends that the legislature revise the current law on interbasin transfers and remove the unnecessary and counterproductive barriers to such transfers that now exist.

Adopt the recommended stakeholder process for determining bay and basin environmental flow requirements, and include Region H and the Galveston Bay Freshwater Inflows Group (GBFIG) in the Galveston Bay stakeholder group.

Region H contains many water-dependant natural resources, most significantly Galveston Bay, which provide ecological habitat for native and migratory species. Under current water law, waters of the state belong to the environment until appropriated for another beneficial use. As basins become fully allocated, a method of establishing a minimum environmental flow for each stream or estuary must be established, both to protect the environment and to facilitate water planning.

The Study Commission on Water for Environmental Flows delivered an interim report to the 79th Legislature. In that report, the study commission recommended, among other things, that the study commission be reauthorized, and that the commission appoint a Bay/Basin Area Stakeholder group for each bay/basin ecological area of the state. Such group would then take prescribed actions

leading to the establishment of environmental flow “set-asides” for its bay/basin ecological area. These values would be reviewed on a ten-year basis. The commission recommended that Galveston Bay be included on the first round bay/basins list.

The Region H Water Planning Group endorses the stakeholder process and requests that Region H and the Galveston Bay Freshwater Inflows Group (GBFIG) be represented on the Galveston Bay BBAS.

Increase funding for the Bays and Estuaries programs of state resource agencies and for additional monitoring and research to scientifically determine freshwater inflow needs.

The RHWPG has adopted specific language associated with establishment of freshwater inflows to maintain the health and productivity of the bay. Galveston Bay is an important economic and recreational resource for our region. Current levels of funding within the State of Texas Bay & Estuary program are insufficient to continue the needed monitoring, study and development of management strategies for the bay.

The Region H Water Planning Group recommends establishment of additional funding to pursue necessary future efforts of the Galveston Bay & Estuary program.

Maintain the current rule of capture basis of groundwater law within Texas in all areas not subject to defined subsidence or groundwater conservation districts.

Groundwater is a vital resource within Region H. This is especially true within the rural counties of the region that are predominantly dependent on groundwater. Current groundwater law based on the Rule-of-Capture has facilitated orderly development of groundwater systems throughout the State of Texas and, barring the intrusion of private interests, could continue to serve the water usage interests throughout the state. It appears that the Rule-of-Capture could continue per the status quo to serve the groundwater interests within the region.

The Region H Water Planning Group supports continued usage of the Rule-of-Capture as the basis of groundwater law throughout the State of Texas except as modified through creation of certified groundwater conservation districts.

Support development of Groundwater Conservation Districts to protect current groundwater users, and encourage these districts to study and manage aquifer storage and recovery.

Region H communities, particularly those within the rural areas of the region, are dependent on groundwater supplies. Groundwater is a very valuable resource to this region. Region H contains counties, specifically Austin, Leon and Madison where some municipalities, water supply corporations and property owners believe Groundwater Conservation Districts (GCD) are needed to retain long-term groundwater supplies within their respective counties. Region H also has several counties, including Brazoria, Waller and Montgomery, where groundwater supplies will, in theory, reach their maximum sustainable yield due solely to projected in-county water usage rates. A GCD is a potential vehicle for these counties to manage and protect groundwater supplies from over-development within each respective county. The potential of losing these supplies to outside interests before the county of origin can maximize the use of these supplies would create a burden on local water users.

The Region H Water Planning Group supports creation of GCDs, as necessary, by local subarea water interests. The RHWPG supports development of truly regional GCDs as opposed to single county districts to recognize the regional expansiveness of underground aquifers and to provide the greatest degree of regional water supply protections.

Senate Bill 2 of the 77th Legislature authorized the formation of four new GCDs in Region H (Bluebonnet, Brazoria County, Lone Star and Mid-East Texas).

Establish financing mechanisms for development of new water supply projects identified within the adopted regional water plans.

The Region H Regional Water Plan includes development of several surface water reservoirs and other supply projects. The capital cost to develop these projects is significantly higher than the historic cost of water supply projects. The projected costs are such as to dissuade local communities from making a financial commitment to support future projects. These financing issues will delay the implementation of needed projects.

To address this situation, the Region H Water Planning Group supports establishment of financing methods by the State of Texas to capitalize a fund to support development of water supply projects recommended within adopted regional water management plans.

Following completion of the 2001 Regional Plans, the Regions conducted an Infrastructure Financing Survey among their WUGs with projected infrastructure needs, and reported those results to the Legislature. This is now a required task within the cyclic regional water planning process.

Act on the RHWPG recommendations of unique stream segments and unique reservoir sites.

While the RHWPG adopted both unique stream segment and reservoirs, there appears to be some confusion on the definition and legislative intent of the designations for each of these elements. It is clear that conflicts may be created for stream segments that might be used for both water supply conveyance and recreational purposes. To assist in the adoption of future unique stream segments and/or unique reservoir sites the RHWPG requests additional legislative clarification.

The Region H Water Planning Group supports clarification and definition of the legislative intent of the unique stream segments and of the unique reservoir sites.

Senate Bill 2 of the 77th Legislature amended the Water Code to restrict political subdivisions from taking certain actions within unique stream segments and unique reservoir sites.

Continue funding of the State of Texas Groundwater Availability Modeling effort.

Many areas of Region H are totally dependent on groundwater to support the long-term viability of these areas. The current Groundwater Availability Modeling effort is supported since it is the most comprehensive groundwater assessment and analysis effort of the previous 20 years. The current GAMs effort, however, is omitting minor aquifers and other groundwater considerations that are vital for certain local communities.

The Region H Water Planning Group supports continued funding for the GAMs effort, and recommends comprehensive analysis of all groundwater resources within the state.

The TWDB, in conjunction with the USGS, is continuing the GAM process.

Establish funding for agricultural research into the area of efficient irrigation practices.

The Region H water management plan includes a number of irrigation conservation based water management strategies. It is apparent that adoption of irrigation conservation practices may benefit the irrigation and agricultural industry in addition to local communities that may take advantage of water supply savings resulting from irrigation conservation. Additionally, the RHWPG supports further research and development of water-efficient and drought-resistant crop and species.

The Region H Water Planning Group supports funding of research and development studies associated with the efficient usage of irrigation technologies and practices.

Implement the programs recommended by the Water Conservation Implementation Task Force.

The RHWPG strongly supports water conservation at all levels, and has incorporated it in the regional water plan as a management strategy. However, realizing advanced conservation savings in municipal county-other areas may be difficult, as these practices require some management, funding and oversight. While the RHWPG does not advocate a one-size-fits-all conservation program for the State of Texas, they recommend that the legislature address water conservation and provide some guidance and ability for county and local governments to implement these programs.

The Region H Water Planning Group supports water conservation and recommends that the legislature address and improve water conservation activities in the state.

78th Legislature appointed a Water Conservation Task Force to study water conservation policies and best management practices, and to report their results to the 79th Legislature in 2005.

Establish funding for research in advanced conservation technologies.

The Water Conservation Implementation Task Force identified numerous best management practices in TWDB Report 362 – Water Conservation Best Management Practices Guide. The Best Management Practices outlined that report were developed using information compiled from past research and studies along with information provided by the task force members. Additional water-saving technologies may still be developed in the future.

The Region H Water Planning Group recommends that the State fund research into advanced conservation technologies.

Resolve the issues related to water rights permitting for indirect reuse, and advocate water reuse statewide.

The TCEQ water rights permitting process for wastewater reuse need to be clarified. Conflicts exist between Texas Water Code Sections 11.042 and 11.046 regarding the permitting of indirect reuse water. Section 11.042(c) states that return flows, once introduced to the stream, are property of the State of Texas and are therefore subject to appropriation by others. However, Section 11.046(b) and (c) allow the owner of return flows to obtain a bed-and-banks permit to transport this water to a place of reuse. This leads to potential conflicts between downstream appropriators and those who wish to indirectly reuse effluent.

Furthermore, the TCEQ has issued some water rights permits based on the existence of return flows in the river, and in the adjudication process some claims were established based on return flows. Additionally, some bed and banks permits were issued with priority dates, while others were issued without priority dates. Because of these issues and the conflicts discussed above, it is difficult to analyze indirect reuse as a water management strategy. Due to these significant unknowns and outstanding questions, the benefits and yields from reuse projects cannot be accurately estimated under the current regulatory environment. Specific regulatory issues that need to be resolved or clarified are outlined below:

- A policy for establishing a priority date, if any, for an indirect reuse authorization (i.e., bed-and-banks authorization) should be developed.
- Conflicts between Texas Water Codes 11.042 and 11.046 relating to the ownership of return flows (water right holders, groundwater users, and the State) need to be resolved.
- A policy for establishing the method and technical approach for evaluating indirect reuse permits (i.e., “no injury” analysis, WAM Run 3, WAM Run 8, etc.) needs to be developed.

- Clarification regarding the ownership of return flows and the right to permit return flows for indirect reuse needs to be provided. The issue of third-party permitting of return flows needs additional clarification.
- Additional clarification regarding the notification requirements for reuse permits, addressing both new discharges and historically discharged effluent, should be developed to ensure the protection of existing water rights.

These above issues directly impact water management strategies recommended in the Region H Water Plan, and therefore regulatory clarification is required.

The RHWPG recommends that TCEQ resolve the issues related to the permitting of indirect reuse water rights. In addition, the RHWPG supports wastewater reuse as a management strategy, and recommended it be advocated statewide through targeted State funding or other incentives to promote reuse projects.

Establish flood damage liability limits for water supply reservoirs.

Flood control reservoirs are generally drawn down at the beginning of the annual wet season so that when large rain events occur, the runoff may be captured and later released more slowly into the receiving stream. These reservoirs therefore reduce downstream flood levels and prevent inundation in low areas. In contrast, water supply reservoirs are operated to capture and retain as much streamflow as allowable under their permits, in order to have supply available during periods of high demand. This practice results in less available storage volume to capture runoff during major storms. When a major storm event occurs upstream or above a water supply reservoir, the reservoir operator must sometimes release flood flows during and after the event to prevent flooding upstream of the reservoir or to prevent damage to the dam and other facilities associated with the reservoir. This flood flow can contribute to downstream flooding, but with most reservoirs, actually reduces the amount of flooding which would have occurred had the reservoir not been constructed.

In recent years, plaintiffs with property in the downstream floodplains have brought multiple lawsuits against major water supply reservoir operators. Some recent court decisions have held the operators liable for damages to the downstream properties. If this trend is allowed to continue, this will force insurance rates for these entities to rise and operational changes to occur that may result in less available water storage for periods of need. The net affect to water users will be an increase in the cost of surface water throughout the state.

Consider State legislation clarifying the liability exposure of reservoir operators for passing storm flows through water supply reservoirs.

Continue funding of the Regional Water Planning process.

It is apparent that the RWPGs will have to meet periodically to address changed conditions related to the adopted regional water management plans. Ongoing activities will include, but not be limited to:

- Consideration of additions and modifications to the adopted plans
- Serving as communications liaisons with the water user communities within each region
- Assisting in the reconciliation of inter-regional water issues

It will be necessary to consider additional funding to support maintenance of the RWPGs. Also, the administrative provisions of Senate Bill One and the subsequent policies that have been enacted should be reviewed to determine if the appropriate organizational structure exists to accomplish the

work of the RWPGs. Additional funding should be developed to support technical studies necessary to support the needs of the RWPGs.

The Region H RWPG recommends that the TWDB request additional funding and adoption of the appropriate administrative procedures from the legislature to facilitate ongoing activities of the RWPGs.

The current round of Regional Water Planning is funded by the TWDB, with no requirement for local funding participation.

1.8.3 Infrastructure Financing Recommendations

Increase the funding of the State Participation Program as needed to allow development of water supply projects sized to meet projected long-term demands.

This program enables the Water Development Board to assume a temporary ownership interest in a regional project when the local sponsors are unable to assume debt for an optimally sized facility. Payments on the funds provided by the State are deferred until a customer base grows into the capacity it funded. The deferred interest payments do not accrue additional interest. By funding up to 50% of a project, the program helps the local sponsors optimize facility sizes and avoid later expansions and replacements.

This program will be extremely important for the development of the recommended water management strategies, as well as for water treatment and distribution systems. Large projects, particularly reservoirs, must be developed in anticipation of future demands due to the long periods of time required for planning, permitting, property acquisition and construction. For example, Bedias Reservoir, which will require a transmission system as well as the reservoir itself, is estimated to cost \$194.3 million. The current customer base cannot support this high cost. The Bureau of Reclamation no longer funds the development of new water supply reservoirs and this project would not qualify for other federal funding. Therefore, the State Participation program is one of the few programs available to assist local sponsors with this water management strategy. Other reservoir projects within Region H could also experience similar financing issues.

The State Participation Program will also be important during the expansion of surface water service into areas affected by subsidence. As areas develop and implement Groundwater Reduction Plans, it is expected that communities will develop plans for regional treatment and distribution systems to reduce costs. State participation in these facilities will allow them to be optimally sized at their inception. The State Participation Program offers the important advantage of reducing the unit costs for water service for both existing and future water users of the optimally sized facility.

The Region H RWPG recommends increased funding of the State Participation Program as needed to allow development of these water supply projects.

Increase the funding of the State Revolving Fund Programs in future decades, and expand the program to include coverage for system capacity increases to meet projected growth for communities.

These programs provide loans at subsidized interest rates for the construction of water treatment and distribution systems and for source water protection (DWSRF) and for wastewater collection and treatment systems (CWSRF). As the loans are paid off, the TWDB uses the funds to make new loans (thus the name Revolving Fund). State funds for the program receive a federal match through the Environmental Protection Agency. These loans are intended for projects to bring existing systems into compliance with rules and regulations, and are available to political subdivisions, water supply corporations and privately-owned water systems. Applications are collected at the beginning of each

year, given a priority ranking, and funded to the extent possible. Projects not funded in a given year may carry forward into the next year's ranking.

These programs are important in that they assist sub-standard water systems in attaining the minimum water quality mandated by Federal and State regulations, but they are not intended to fund system expansions due to projected growth. However, these programs may apply to individual systems in the Region experiencing water quality declines, or to those systems affected by the changed standard for Arsenic. The SRF Fund may also provide assistance to water providers with aging treatment systems and transmission lines.

The Region H RWPG recommends increasing the funding of this program in future decades, and expand the program to include coverage for system capacity increases to meet projected growth for communities.

Increase funding of the State Loan Program to allow financing of near-term infrastructure cost projections.

The State Loan Program provides loans to Political Subdivisions and Water Supply Corporations for water, wastewater, flood control and municipal solid waste projects. Payments are not deferred in this program as they are under the State Participation Program, and the interest rates are not subsidized as they are in the Revolving Fund Programs. These loans are available for both local projects and for the local sponsors of regional projects. Acquisition and construction of water treatment and distribution systems are eligible for funding. Loans are made on a first come, first served basis.

This program will be heavily utilized in groundwater-served areas introducing surface water to meet current and projected demands. The ready availability of groundwater across the region has allowed development to occur outside existing surface water service areas. As the limits of available groundwater are reached (sustainable yields and/or regulatory limits), surface water treatment and transmission systems must be constructed to meet future demands. The costs are significant in that they are required in a short time span, instead of initiated and expanded over time as they are in areas originally served by surface water. Where local rate payers cannot afford to directly pay for transition costs, State loans offer a significant cost advantage over most commercial and many public funding options, using the State's high bond rating rather than the rating of the local sponsor.

The Region H RWPG recommends increasing the funding of this program to meet near-term infrastructure cost projections.

Increase funding of the Agricultural Water Conservation loan program, leverage Federal grant programs by providing the local matching share, and consider adding a one-time grant or subsidy program to stimulate early adoption of conservation practices by individual irrigators.

The Region H water management plan includes a number of irrigation conservation based water management strategies. It is apparent that adoption of irrigation conservation practices may benefit the irrigation and agricultural industry in addition to local communities that may take advantage of water supply savings resulting from irrigation conservation. Additionally, the RHWPG supports further research and development of water-efficient and drought-resistant crop and species.

The Region H Water Planning Group supports funding of research and development studies associated with the efficient usage of irrigation technologies and practices. Provide a mechanism to leverage Federal grant programs by providing the local matching share. Increase funding of this loan program and consider adding a one-time grant or subsidy component to stimulate early adoption of conservation practices by individual irrigators.

Continue State and Federal support of the Texas Community Development program, and increase the allocation of funds for the Small Town Environment Program.

The federal Community Development Block Grant program provides grants and loans to low-income communities for certain projects, including water and wastewater infrastructure. It is administered in Texas under the Office of Rural Community Affairs as the Texas Community Development Program. The Small Town Environment Program (STEP) under the TCDP provides water and sewer system grants to cities and counties not eligible for funding under the Colonias or Economically Disadvantaged Areas Programs (EDAP). Within Region H, there are no Colonias or EDAP-eligible communities, but STEP grants may be obtained.

The Region H Water Planning Group recommends continued State and Federal support of the Texas Community Development Program, and increase the allocation of funds for the Small Town Environment Program.

Increase funding of the Regional Water Supply and Wastewater Facilities Planning Program in anticipation of upcoming development throughout the state, and expand the program to include the costs for preliminary engineering design and development of detailed engineering cost estimates of recommended facilities.

This program provides planning grants to Political Subdivisions for studies and analyses to determine feasible alternatives for regional water supply and wastewater facility needs. The planning must include more than one service area or political subdivision to be considered regional. Grants are generally limited to 50% of the total cost, and cannot be applied to the preparation of state and federal permits, administrative or legal proceedings of regulatory agencies, or the preparation of engineering plans and specifications.

This grant program can assist in planning for local areas, particularly the unincorporated areas of each county. Local sponsors investigating the best means to serve their populations may join with neighboring communities and water providers and request a planning grant, thus reducing their individual planning costs. Determination of the optimal institutional arrangement between political subdivisions is one of the eligible study areas under this program. Should a regional facility prove to be the best solution for the group, they may elect to pursue additional support from the State Loan and Participation programs.

One limitation of the program is that it cannot be applied to the detailed facility planning or preliminary engineering design of the proposed facility. These early engineering phase costs can represent as much as 30% of the cost of the facility, and generally must be completed before accurate financial requirements can be defined. Inclusion of these costs in either the planning grant or pre-project loan programs would better help these small communities develop the projects they need.

The Region H Water Planning Group recommends increasing funding of this program in anticipation of upcoming development throughout the state, and expand the program to include the preliminary engineering design costs for recommended facilities.

Support continued and increased funding of the USDA Rural Utilities Service programs at the Federal level, and fund the State Rural Water Assistance Fund.

This Federal program provides loans and grants in rural areas and communities of up to 10,000 people for water, wastewater, storm water and municipal solid waste projects. The program is intended for communities that cannot obtain commercial loans at reasonable rates. Loans are made at or below market rates, depending upon the eligibility of the recipient. Grants can cover up to 75% of project costs when required to reduce user costs to a reasonable level. A separate program of Emergency Community Water Assistance Grants (up to \$500,000 per project) is also available to communities experiencing rapid declines in water quality or quantity.

This program is similar to the state loan and revolving fund programs. It offers another option to small communities and rural areas unable to finance required infrastructure without assistance. However, this is a nationwide program, and the competition for available funds is correspondingly greater. Colonias and border areas are specifically identified as target areas for the grant portion of this program, and it is therefore in the State's interest to support its continued funding.

The TWDB was recently authorized by the 77th Texas legislature to establish a similar program at the state level. The Rural Water Assistance Fund will provide low-interest loans to municipalities, water districts and non-profit water supply corporations. The program is still under development and has not yet been funded.

The Region H Water Planning Group recommends continued support and increased funding of this program at the Federal level, and fund the State Rural Water Assistance Fund.

Provide research grants for the study of current and upcoming desalination technologies available to wholesale and retail water suppliers. Continue to fund appropriate demonstration facilities to develop a customer base, and pursue Federal funding for desalination programs.

The RHWPG considered desalination of brackish groundwater as a potential water source, but did not include it in the final plan because this strategy was more costly than other strategies. However, the RHWPG recognizes that the cost of desalination technology is decreasing, and that this strategy may merit consideration in future plans. It would be helpful and appropriate for the state to establish a program promoting desalination research and development. Such a program might offer financial assistance or incentives for project implementation.

The Region H Water Planning Group recommends that a research and development program for desalination be established in Texas, and that it include financial assistance and/or incentives for desalination project implementation.

Governor Perry is currently sponsoring a seawater desalination initiative, to study seawater desalination along the Texas Coast as a future source of supply.

Provide increased research grants to study and better develop drought-resistant crop species and efficient irrigation practices.

The Texas Water Development Board offers research grants to individuals or political subdivisions for water research on topics published in the Board's Request for Proposals. Eligible topics include product and process development.

In the Region H Water Plan, one recommendation to the legislature is to establish funding for agricultural research in the areas of efficient irrigation practices and the development of water-efficient and drought-resistant crop and species. Irrigators cannot generally afford the increased cost of water when new supplies are developed in today's market. By reducing demand in a cost-efficient manner, small irrigators may be able to continue farming. This is another potential topic for the Water Research Program.

The Region H Water Planning Group recommends increased research grants to study and better develop drought-resistant crop species and efficient irrigation practices.

Support regulatory changes that will allow USACE to increase water supply storage in new reservoirs that they construct and manage, and investigate other alternatives for increased involvement of USACE in funding water supply projects.

The U.S. Army Corps of Engineers (USACE) builds and operates dams and reservoirs for flood control purposes under its Civil Works program. Congress authorizes funding on a project by project

basis. Under current regulations, storage in these reservoirs may be used for present and future municipal and industrial water supply, but that portion of the project must be funded by a non-Federal agency. Also, only 30% of the M&I water storage may be allocated to future needs. The balance must supply existing water users, as the repayment schedule for non-Federal costs is capped at 30 years. USACE is also authorized to fund projects for navigation, water quality improvement and ecosystem restoration.

As a result of the first round of Regional Water Planning, the Texas Congressional Delegation requested a study on the potential for federal assistance with water supply in Texas. The Fort Worth District recently published the Texas Water Allocation Assessment Report, which identifies those projects that USACE might participate in. Within Region H, only Bedias Reservoir might receive USACE funding if the scope of the project were modified to include flood control. Also discussed were potential modifications to existing reservoirs to increase water supply yields (these modifications are generally limited to a 15% increase in storage). A saltwater barrier to improve water quality in the Brazos River was also identified as a potential project. USACE also has the ability to provide planning assistance to states for regional water supply studies, particularly studies crossing state and international boundaries.

Limitations for USACE assistance with water supply projects are (1) current policy preventing the USACE from participating in single-purpose water supply projects, (2) USACE inability to share the cost of water supply projects, and (3) the time required to move appropriations actions through the federal government. The Texas Congressional Delegation could pursue changes to the governing regulations to allow participation in water supply projects, or to increase the percentage of water supply storage for future use allowed in USACE projects. However, USACE civil works projects are authorized individually by Congress. If the project sponsor desires USACE assistance, an exception permitting that assistance might be authorized in the same appropriation bill. The latter option requires the sponsor to have a project champion in Congress.

The Region H Water Planning Group recommends supporting regulatory changes that will allow USACE to increase water supply storage in new reservoirs which they construct and manage, and investigate other alternatives for increased involvement by USACE in funding water supply projects.

Region H supports the forming of regional facilities and encourages the State to remove any impediments to these entities, including restrictions to the use of public/private partnerships. Additionally, the State Participation Program should be made available to these public/private partnerships and to private nonprofit water supply corporations.

As communities assess the growing costs of water infrastructure, economies of scale can be realized by combining the needs of water user groups into larger, more efficient water supply, treatment and distribution facilities. Regional facilities offer interconnections between existing systems, which can increase overall reliability. The individual system connections to these systems can be phased over time to meet regional demands with less impact on individual systems than each individually trying to expand. In areas where groundwater limits are being reached, regional groups can identify areas where surface water supply is most needed, and allow other areas to remain on groundwater systems. Sharing costs across a wide customer base keeps rates comparable between service areas.

A range of cooperative options exists, including formation of regional authorities, inter-local agreements, public-private partnerships, local government corporations and public contracting with a private regional supplier. The optimal arrangement between political subdivisions depends upon the specific project and the goals of the parties. Partnerships with private investors through public-private partnerships and direct contracting with privately-owned facilities offer an advantage of using private financing to meet part of the initial planning and construction costs. The regulations governing these partnerships must protect the public represented by the partnership, but if too restrictive, may prevent

the partnership from realizing potential cost savings through the use of private-sector procurement and construction practices.

Consideration should be given to reducing procurement restrictions for Local Government Corporations to encourage the pooling of resources for funding regional projects. Also, existing assistance programs should remain available when political subdivisions enter into public/public or public/private partnerships.

The Region H Water Planning Group supports the forming of regional partnerships and encourages the State to allow them the greatest possible latitude for financing in their governing regulations. Additionally, the State Participation Program should be made available to these public/private partnerships and to private nonprofit water supply corporations.

APPENDIX 1A

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1A.1 Water Planning Reports

1A.1.1 State Water Plan

Water for Texas, 2002. Texas Water Development Board

Water for Texas: A Consensus-Based Update to the State Plan, 1997. Texas Water Development Board

Region H Water Plan, 2001. Brown & Root/Turner Collie & Braden

Region C Water Plan, 2001, Freese and Nichols

Brazos G Regional Water Plan, 2001, HDR Engineering

East Texas Regional Water Plan, 2001, Schaumberg and Polk

Lower Colorado Regional Water Plan, 2001, HDR Engineering

1A.1.2 Trans-Texas Water Program Reports

Contractual Transfers in the Southeast Area, 1998. Brown and Root

Desalinization, 1998. Brown and Root

Engineering Analysis of Interbasin Transfer Strategy 1998. Freese and Nichols

Environmental Analysis of Potential Transfer Routes, 1998. Freese and Nichols

Galveston Bay Freshwater Inflows Study, 1998. Brown and Root

Operation Studies and Opinions of Cost for Allens Creek Reservoir; Volumes I and II and Status of Environmental Issues for Allens Creek Reservoir, 1997. Freese and Nichols

System Operation of Surface Water Supply Sources in the Houston Area, 1997. Freese and Nichols

System Operation Study for Livingston / Wallisville and San Jacinto Basin for the Trans-Texas, September 1997. Freese and Nichols

Trans-Texas Water Program Southeast Area Phase I Report, March 1994. Brown and Root and Freese and Nichols

Trans-Texas Water Program Report, Planning Information Update, April 1996. Brown and Root and Freese and Nichols

Trans-Texas Water Program Southeast Area Phase II Report, April 1998. Brown and Root and Freese and Nichols

Wastewater Reclamation, 1998. Brown and Root

Water Conservation, 1998. Brown and Root

Water for Texas - A Consensus-Based Update to the Texas Water Plan, Volume II, Technical Planning Appendix, 1997, Texas Water Development Board

Water for Texas - Today and Tomorrow: A 1996 Consensus-based Update to the Texas Water Plan, Volume III, Water Use Planning Data Appendix, 1996, Water Demand/Drought Management Technical Advisory Committee of the Consensus-Based State Water Plan

1A.1.3 City / Agency Water Plans

City of Houston Final Water Conservation Plan, March 1997. Montgomery Watson

Cinco MUD No. 1 Water Supply and Wastewater Master Plan Update, 1997 Turner Collie & Braden Inc

Cinco Ranch Reclaimed Water Reuse Study, 1992 Turner Collie & Braden Inc.

Fairfield Village Regional Facilities Master Plan, 1993 Turner Collie & Braden Inc.

Feasibility Investigation of Allens Creek Reservoir, 1997, Turner, Collie and Braden, Inc. for the Fort Bend County Surface Water Supply Corporation

Feasibility Study, Interbasin Transfer, Sabine to San Jacinto, October 1988. Wayne Smith and Associates

Harris County UD 5 - Water and Wastewater Master Plan Investigation, 1994 Turner Collie & Braden Inc.

Long Range Water Supply Plan 1990 - 2050 to the City of Dallas, Texas, December 1989. Turner Collie & Braden

Preliminary Engineering Report for Modifications and Improvements to the Livingston Regional Water Supply System, 1991 Turner Collie & Braden Inc.

Regional Water Supply Plan for the Tarrant County Water Control and Improvement District Number One and the Texas Water Development Board, October 1990. Freese and Nichols and Alan Plummer and Associates

Regional Water Supply Planning Study, Fort Bend County, Texas, 1992. Turner Collie & Braden Inc. for Fort Bend Surface Water Supply Corporation

Regional Water Planning Study for the Harris-Galveston Coastal Subsidence District, 1991, update 1996, Turner Collie & Braden Inc.

Reservoir System Operation Plan for the City of Houston, May 1996. Montgomery Watson / Georgia A. Wilson & Associates

Review of the Water System Master Plan for the Bartonville Water Supply Corporation for Highland Shores, Inc.", 1991 Turner Collie & Braden Inc.

San Jacinto River Authority Water Resources Development Plan, Water Supply Plan, 1988. Pate Engineers

Trinity River Basin Master Plan, February 1989. Trinity River Authority of Texas

Water Conservation and Drought Contingency Plan for the Woodlands Planning Area, 1989 Turner Collie & Braden Inc.

Water and Wastewater Master Plan for Wood Trace, Montgomery County, 1991 Turner Collie & Braden Inc.

1A.1.4 Groundwater Management Plans

Bluebonnet Groundwater Conservation District Groundwater Management Plan, 2004

Fort Bend Subsidence District Groundwater Management Plan, 1998

Fort Bend Subsidence District 2003 Regulatory Plan

Harris-Galveston Coastal Subsidence District Groundwater Management Plan, 1998

Harris-Galveston Coastal Subsidence District, District Regulatory Plan, 1999

Lone Star Groundwater Conservation District Groundwater Management Plan, 2003

Mid-East Texas Groundwater Conservation District Management Plan, 2004

1A.1.5 Other Studies

Feasibility of Water Reuse (prepared for City of Houston), May 1992 Espey, Huston & Associates

Preliminary Feasibility Study, Interbasin Water Transfer from the Sabine River to the San Jacinto River Authority Service Area, November 1989. Freese and Nichols

Water Availability Model Selection and Project Management, ongoing, Parsons ES (in association with Turner Collie & Braden Inc. and Sarma)

Yield Analysis and Cost Estimate for Allens Creek Reservoir, (prepared for BRA), 1989. Freese and Nichols

An Analysis of Water Loss as Reported by Public Water Suppliers in Texas, January 2007. Alan Plummer Associates, Inc

Surface Water Studies and Reports

1A.1.6 Water Availability Models

Neches River Basin, 2000, Brown & Root, Freese & Nichols, Espey Consulting and Crespo Consulting, 2000

Sabine River Basin, Brown & Root, Freese & Nichols, R.J. Brandes and Crespo Consulting, 2001

Trinity – San Jacinto River Basins, Espey Consulting, Brown & Root, Freese & Nichols, Crespo Consulting and GSG, Inc., 2001

Brazos River Basin, HDR Engineering, 2004

1A.1.7 US Geologic Survey Reports

Analysis of Minimum 7-Day Discharges and Estimation of Minimum 7-Day, 2-Year Discharges for Streamflow-Gaging Stations in the Brazos River Basin, Texas; T.H. Raines and W.H. Asquith, 1997

Documented and Potential Extreme Peak Discharges and Relation Between Potential Extreme Peak Discharges and Probable Maximum Flood Peak Discharges in Texas; By W.H. Asquith and R.M. Slade, Jr. , 1995

Floods in Central Texas, December 1991; By H.R. Hejl, Jr., R.M. Slade, Jr., and M.E. Jennings, 1995

Index of Stations-Surface-Water Data-Collection Network of Texas, September 1993; S.C. Gandara and R.E. Jones, 1995

Index of Stations-Surface-Water Data-Collection Network of Texas, September 1995; Compiled by S.C. Gandara and R.E. Jones, 1996

Peak Data for U.S. Geological Survey Gaging Stations, Texas Network; and Computer Program to Estimate Peak-Streamflow Frequency; By R.M. Slade, Jr., and W.H. Asquith, 1996

Regional Equations for Estimation of Peak-Streamflow Frequency for Natural Basins in Texas; By William H. Asquith and Raymond M. Slade, Jr, 1996.

Stratigraphic Nomenclature and Geologic Sections of the Gulf Coastal Plain of Texas; E.T. Baker, Jr., 1994

Streamflow to the Gulf of Mexico; By L.J. Judd, 1995

Streamflow Analysis of the Apalachicola, Pearl, Trinity, and Nueces River Basins, Southeastern United States; By K.E. Greene and R.M. Slade, Jr. , 1995

Summary of Surface-Water Hydrologic Data for the Houston Metropolitan Area, Texas, Water Years 1964-89; Fred Liscum, D.W. Brown and Mark C. Kasmarek, 1996

Techniques to Estimate Generalized Skew Coefficients of Annual Peak Streamflow for Natural Basins in Texas; By L.J. Judd, W.H. Asquith, and R.M. Slade, Jr. , 1996

Topographic Data Sets for Texas by River Basin; L.L. Tan, 1997

Water-Quality Assessment of the Trinity River Basin, Texas-Pesticides in a Coastal Prairie Agricultural Area, 1994-95; By M.F. Brown, 1996

1A.1.8 Other Studies

Bon Weir Project, 1990 Bureau of Reclamation

Lake Livingston Project, Lake Livingston, Texas Area and Capacity Tables, December 1991. Bureau of Reclamation

Proposed Allens Creek Reservoir Feasibility Study, 1998 Turner Collie & Braden Inc.

Reconnaissance report: Local flood protection: Little Fossil Creek- Haltom City, Texas, 1972, U.S. Army Engineer District, Fort Worth.

Trinity River & Tributaries -Wallisville Lake Non-Overflow Dam, 1985. U. S. Army Corps of Engineers

Trinity River Yield Study, Phase I, II, & III, 1983. Espey, Huston & Associates

1A.2 Groundwater Studies and Reports

1A.2.1 US Geological Survey Reports

- Approximate Land-Surface Subsidence in Fort Bend County, Texas, 1943-87 and 1973-87; By R.K. Gabrysch and L.S. Coplin, 1998
- Estimated Depth to the Water Table and Estimated Rate of Recharge in Outcrops of the Chicot and Evangeline Aquifers near Houston, Texas; By J.E. Noble, P.W. Bush, M.C. Kasmarek, and D.L. Barbie, 1996
- Ground-Water Resources of the Houston District, Texas, 1944; By W.N. White, N.A. Rose, and W.F. Guyton
- Water-Level Altitudes 1998, Water-Level Changes 1977-98 and 1997-98, and Compaction 1973-97 in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas; By L.S. Coplin, 1998
- Water-Level Altitudes 1998 and Water-Level Changes 1990-98 and 1997-98 in the Chicot and Evangeline Aquifers, Fort Bend County and Adjacent Areas, Texas; By L.S. Coplin and Horacio X. Santos, 1998
- Water-Level Altitudes in Wells Completed in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas, January-February 1992, 1993, and 1994; by M.C. Kasmarek, 1997
- Water-Level Altitudes in Wells Completed in the Chicot and Evangeline Aquifers, Fort Bend County and Adjacent Areas, Texas, January-February 1992, 1993, and 1994; by M.C. Kasmarek, 1997
- Water-Level Altitudes in Wells Completed in the Chicot and Evangeline Aquifers, Fort Bend County and Adjacent Areas, Texas, January-February 1990; by M.C. Kasmarek, 1997
- Report 82-431 Ground-Water Withdrawals and Changes in Water Levels in the Houston District, Texas 1975-1979, August 1982; By R. K. Gabrysch
- Report 82-571 Ground-Water Withdrawals and Land-Surface Subsidence in the Houston-Galveston Region, Texas 1906-1980, 1982; By R. K. Gabrysch
- Report 86-57 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Chambers, Liberty, and Montgomery Counties, Texas, 1980-1984, 1986; By James F. Williams III, L.S. Coplin, C.E. Ranzau, Jr. and W.B. Lind
- Report 88-4154 Flow Pattern in Regional Aquifers and Flow Relations Between the Lower Colorado River Valley and Regional Aquifers in Six Counties in Southeastern Texas, 1989; By Dennis G. Woodward
- Report 90-4012 Ground-Water Withdrawals, Water-Level Changes, Land-Surface Subsidence, and Ground-Water Quality in Fort Bend County, Texas 1969-1987, 1990; By Glenn L. Locke
- Report 90-588 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Brazoria, Fort Bend, and Waller Counties, Texas, 1985-1989, 1991; By Glenn L. Locke
- Report 90-594 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Chambers, Liberty, and Montgomery Counties, Texas, 1985-1989, 1991; By Glenn L. Locke
- Report 90-598 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Harris and Galveston Counties, Texas, 1984-1989, 1991; By L.S. Coplin and Al Campodonico
- Report 92-4180 Ground-Water Withdrawals, Water Levels, and Ground-Water Quality in the Houston District, Texas, With Emphasis on 1985-1989, 1993; By Dana L. Barbie and Glenn L. Locke

Report 96-4018 Estimated Depth to the Water Table and Estimated Rate of Recharge in Outcrops of the Chicot and Evangeline Aquifers Near Houston, Texas, 1996; By J. E. Noble, P.W. Bush, M. C. Kasmarek. and D.L. Barbie

1A.2.2 Texas Water Development Board Reports

- Report 41 Ground Water in the Flood-Plain Alluvium of the Brazos River, Whitney Dam to Vicinity of Richmond, Texas, March 1967; By James G. Cronin and Clyde A. Wilson
- Report 68 Ground-Water Resources of Austin and Waller Counties, Texas, December 1967; By Clyde A. Wilson
- Report 72 Ground-Water Resources of Liberty County, Texas, April 1968; By R.B. Anders, G.D. McAdoo, and W.H. Alexander, Jr.
- Report 80 Ground-Water Resources of San Jacinto County, Texas, August 1968; By W.M. Sandeen
- Report 123 Records of Water-Level Measurements in Wells in Galveston County, Texas, December 1970; By R.K. Gabrysch, Gene D. McAdoo, and C.W. Bonnett
- Report 133 Ground-Water Resources of Chambers and Jefferson Counties, Texas August 1971; By Saul Aronow
- Report 136 Ground-Water Resources of Montgomery County, Texas, November 1971; By Barney P. Popkin
- Report 139 Records of Wells, Drillers' Logs, and Chemical Analyses of Ground Water in Galveston County, Texas, December 1971; By R.K. Gabrysch, Gene D. McAdoo and W. L. Naftel
- Report 152 Development of Ground Water in the Houston District, Texas, 1966-1969, June 1972; By R.K. Gabrysch
- Report 155 Ground-Water Resources in Fort Bend County, Texas, August 1972; By J. B. Wesselman
- Report 163 Ground-Water Resources of Brazoria County, Texas, February 1973; By William M. Sandeen and John B. Wesselman
- Report 178 Ground-Water Data for Harris County, Texas Volume II, Records of Wells 1892-1972, January 1974; By R.K. Gabrysch, W. L. Naftel, Gene D. McAdoo and C.W. Bonnett
- Report 201 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Brazoria, Fort Bend, and Waller Counties, Texas, 1966-1974, March 1976; By W. L. Naftel, Kenneth Vaught, and Bobbie Fleming
- Report 202 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Chambers, Liberty, and Montgomery Counties, Texas, 1966-1974, March 1976; By W. L. Naftel, Bobbie Fleming, and Kenneth Vaught
- Report 238 Groundwater Availability in Texas, Estimates and Projections through 2030, September 1979
- LP-103 A Digital Model for Simulation of Ground-Water Hydrology in the Houston Area, Texas , 1979; By Walter R. Meyer and Jerry E. Carr
- Report 241 Development of Ground Water in the Houston District, Texas 1970-1974, January 1980; By R. K. Gabrysch
- Report 277 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Brazoria, Fort Bend, and Waller Counties, Texas, 1975-1979, July 1983; By Karl W. Ratzlaff, C.E. Ranzau, and W.B. Lind

- Report 280 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Chambers, Liberty, and Montgomery Counties, Texas, 1975-1979, September 1983; By Karl W. Ratzlaff, C.E. Ranzau, and W.B. Lind
- Report 285 Records of Wells, Drillers' Logs, Water-Level Measurements, and Chemical Analyses of Ground Water in Harris and Galveston Counties, Texas, 1975-1979, March 1984; By Karl W. Ratzlaff, C.W. Bonnet, and L.S. Coplin
- Report 289 Digital Models for Simulation of Ground-Water Hydrology of the Chicot and Evangeline Aquifers along the Gulf Coast of Texas, May 1985; By Jerry E. Carr, Walter R. Meyer, William M. Sandeen, and Ivy R. McLane
- Report 295 Hydrology of the Jasper Aquifer in the Southeast Texas Coastal Plain, October 1986; By E. T. Baker, Jr.
- Report 309 Ground-Water Conditions in Texas, 1980-1985, October 1988; Compiled By Ground Water Unit
- Report 332 Ground-Water Resources of the Carrizo-Wilcox Aquifer in the Central Texas Region, September 1991; By David Thorkildsen and Robert D. Price

1A.2.3 Texas Groundwater Protection Committee Publications

- Joint Groundwater Monitoring and Contamination Report - 1996; TNRCC Publication Number SFR-56, June 1997.
- Activities of the Texas Groundwater Protection Committee, Report to the 75th Legislature; TNRCC Publication Number SFR-47, December 1996.
- Texas Groundwater Program Directory; TNRCC Publication Number GI-226, October 1996.
- Texas Ground-Water Data Dictionary; TNRCC Publication Number AS-109, August, 1996.
- Joint Groundwater Monitoring and Contamination Report - 1995; TNRCC Publication Number SFR-36, April 1996.
- Texas State Management Plan for the Prevention of Pesticide Contamination of Groundwater; Draft TNRCC Publication, March 1996.
- Texas State Management Plan for the Prevention of Pesticide Contamination of Groundwater (Educational Brochure); TNRCC Publication Number GI-141, June 1995.
- Joint Groundwater Monitoring and Contamination Report - 1994; TNRCC Publication Number SFR-20, April 1995.
- Activities of the Texas Groundwater Protection Committee, Report to the 74th Legislature; TNRCC Publication Number SFR-14, December 1994.
- Texas Groundwater Protection (Educational Brochure); Texas Natural Resource Conservation Commission (TNRCC) Publication Number GI-88, November 1994.
- Joint Groundwater Monitoring and Contamination Report - 1993; Texas Natural Resource Conservation Commission Report SFR-6, May 1994.
- Joint Groundwater Monitoring and Contamination Report - 1992; Texas Natural Resource Conservation Commission Report SFR-1, November 1993.
- Activities of the Texas Groundwater Protection Committee, Report to the 73rd Legislature; Texas Water Commission Report R 93-01, January 1993.
- Joint Groundwater Monitoring and Contamination Report - 1991; Texas Water Commission Report R 92-02, May 1992.
- Texas Ground Water Protection Profiles; unpublished Texas Water Commission Report, June 1991.

Texas State Management Plan for Agricultural Chemicals in Ground Water; Agricultural Chemicals Subcommittee, June 1991.

Joint Groundwater Monitoring and Contamination Report - 1990; Texas Water Commission Report Z-104, April 1991.

Activities of the Texas Groundwater Protection Committee, Report to the 72nd Legislature; Texas Water Commission Report Z-96, January 1991.

Joint Groundwater Monitoring and Contamination Report; Texas Water Commission Report Z-94, April 1990.

Groundwater Protection Committee (GPC), Texas Groundwater Protection Strategy; TWC Report Z-80, January 1988.

Texas Ground Water Protection Activities - 1986; Texas Water Commission (TWC) Report Z-79, October 1986.

1A.2.4 Texas Board of Water Engineers

Ground-Water Resources of Brazoria County, Texas, November 1947; By C.R. Follett

Ground-Water Resources of Liberty County, Texas, 1950; By W. H. Alexander, Jr.

1A.2.5 Texas Water Commission

Availability and Quality of Ground Water in Leon County, Texas, May 1965; By Richard C. Peckham, Bulletin 6513

Ground Water Protection and Management Strategies for Fort Bend County, March 1990; By John Austin Williamson

1A.2.6 Other

Brackish Groundwater Manual for Texas Water Planning Groups, 2003. LBG-Guyton Associates

Managing Texas' Groundwater Resources Through Groundwater Conservation Districts, November, 1998, By Guy Fipps. Texas A&M System, Texas Agricultural Extension Service, B-1612/11-98.

1A.3 Agricultural Studies and Reports

Water Use and Management in the Texas Rice Belt Region, 1984, Ronal C. Griffin, Gregory M. Perry and Garry N. McCauley

Potential Rice Irrigation Water Conservation Measures, Water Planning Group - Region H, James A. Stansel, Texas A&M University System, July 2000

1A.4 Environmental and Water Quality Reports

1A.4.1 Texas Commission on Environmental Quality Reports

- 1996 Regional Assessment of Water Quality; Brazos River Basin including the Oyster Creek Watershed, 1996 Brazos River Authority
- 1996 Regional Assessment of Water Quality, 1996, Harris-Galveston Area Council of Governments
- 1996 Regional Assessment of Water Quality, 1996, Trinity River Authority of Texas
- Assessment of Water Quality and Fish Kills in Upper Oyster Creek Segment 1245 (SR 92-05), 1992, TNRCC
- State of Texas 1996 Water Quality Assessment, Texas Natural Resources Conservation Commission, 1997
- Texas Water Quality Inventory 2000, TCEQ, April 2002
- Waste Load Evaluation for Dissolved Oxygen in the Intracoastal Waterway in the Neches-Trinity Coastal Basin, Segment 0702. TNRCC, 1993.

1A.4.2 Texas Parks and Wildlife Department Reports

- Wildlife Habitat Appraisal for the Proposed Allens Creek Reservoir Site. Lovelace et al., 1995. University of Houston Clear Lake.
- A Fisheries Inventory and Assessment of Allens Creek and the Brazos River, Austin County, Texas. Linam et al., 1994. Resource Protection Division, Texas Parks & Wildlife Department, Final Report to TWDB, Research and Planning Fund Contract No. 93-483-364.
- Status of Environmental Issues for Allens Creek Reservoir. Paul Price & Associates, 1996. Trans-Texas Water Program, Southeast Area Memorandum Report to the TWDB.
- Macroinvertebrate Assessment of Allens Creek and the Brazos River, Austin County, Texas. Wood et al., Department of Biology-Aquatic Station, Southwest Texas State University, San Marcos, Texas, 1994. Final Report submitted to Texas Parks & Wildlife Department, for TWDB Research and Planning Fund Contract No. 93-483-364.
- Utilization of Marsh and Associated Habitats along a Salinity Gradient in the Galveston Bay. Zimmerman et al., National Marine Fisheries Service, U.S. Department of Commerce, 1990. Technical Memorandum NMFS-SEFC-250.
- Planning Report/Final Environmental Statement for the San Jacinto Project, Texas. U.S. Bureau of Reclamation, 1988.
- Ecologically Significant River and Stream Segments of Region H, Regional Water Planning Area, Chad W. Norris and Gordon W. Linam, TPWD, October 1999.

1A.4.3 US Geological Survey Reports

- Water Resources Data-Texas Volume 3, 1998-2003; US Geological Survey
- Nutrient Loading and Selected Water-Quality and Biological Characteristics of Dickinson Bayou Near Houston, Texas, 1995-97; J.W. East, E.M. Paul, and S.D. Porter, 1998
- Water-Quality Assessment of the Trinity River Basin, Texas-Nutrients and Pesticides in the Watersheds of Richland and Chambers Creeks, 1993-95; L.F. Land, 1997
- Light Attenuation in a Shallow, Turbid Reservoir, Lake Houston, Texas; By Roger W. Lee and Walter Rast, 1997
- Occurrence and Distribution of Organochlorine Compounds in Biological Tissue and Bed Sediment From Streams in the Trinity River Basin, Texas, 1992-93; J. Bruce Moring, 1997
- Water-Quality Assessment of the Trinity River Basin, Texas-Pesticides in Streams Draining an Urban and an Agricultural Area, 1993-95; L.F. Land and M.F. Brown, 1996
- Trends in Nutrient Inflows to the Gulf of Mexico from Streams Draining the Conterminous United States, 1972-93; By David D. Dunn, 1996
- Water-Quality Assessment of the Trinity River Basin, Texas-Nutrients in Streams Draining an Agricultural and an Urban Area, 1993-95; By L.F. Land and A.A. Shipp, 1996
- Summary Statistics and Graphical Comparisons of Specific Conductance, Temperature, and Dissolved Oxygen Data, Buffalo Bayou, Houston, Texas, April 1986-March 1991; By D.W. Brown and E.M. Paul, 1995

1A.4.4 Reports from Other Agencies

- 1998 Annual Water Quality Report, Brazos River Authority, 1998
- Certified Report of Water Quality Management Study for Lower Oyster Creek, 1983, Espey, Huston & Associates
- Characterization of non-point sources and loadings to Galveston Bay; Charles J. Newell, Hanadi S. Rifai, Philip B. Bedient. PUB/DATE: Galveston Bay National Estuary Program, 1992.
- Environmental impact statement: Limestone electric generating station and Jewett mine in Freestone, Limestone, and Leon counties, Texas; U.S. Environmental Protection Agency, Region 6 ; prepared in cooperation with U.S. Soil Conservation Service, Texas Railroad Commission, Texas Historical Commission, Texas Dept. of Water Resources, Texas Air Control Board, U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Army Corps of Engineers, and U.S. Dept. of Interior Office of Surface Mining. PUB/DATE Dallas, TX: The Agency, 1981.
- Freshwater Inflows to Texas Bays and Estuaries: Ecological Relationships and Methods for Determination of Needs. Longley (ed.), TWDB and TPWD, 1994.
- Freshwater Inflow Recommendation for the Trinity-San Jacinto Estuary. Texas Parks & Wildlife Department, Coastal Studies Program, Austin, Texas, 1998.
- Guidelines for Water Resources Permitting: Nutrient Requirements for Maintenance of Galveston Bay Productivity. Brock et al. Final TWDB Report to Near Coastal Waters Program, U.S. EPA, Region 6, 1996.
- Lake Livingston 1991 Sedimentation Survey, 1992, Bureau of Reclamation
- Potential Aquatic Ecological Impacts of Interbasin Water Transfers in the Southeast, West-Central, and South-Central Study Areas. Geo-Marine, Inc., Plano, Texas, 1995. Report Prepared for TWDB and U.S. Army Corps of Engineers, Fort Worth District, Contract No. DACA63-93-D-0014.

- Regulatory effectiveness study for the Armand Bayou Coastal Preserve; Gary Mitchell and Duane Windsor. PUB/DATE: Galveston Bay National Estuary Program, 1991.
- Regulatory effectiveness study for the Christmas Bay Coastal Preserve; Gary Mitchell. PUB/DATE: Galveston Bay National Estuary Program, 1991.
- Segmentation development for Galveston Bay; prepared by Jones and Neuse, Inc., Environmental and Engineering Services. Galveston Bay National Estuary Program, 1992.
- Toxic contaminant characterization of aquatic organisms in Galveston Bay: a pilot study; prepared by James M. Brooks, et al. PUB/DATE: Galveston Bay National Estuary Program, 1992.
- Trinity River Basin Regional Assessment of Water Quality, Trinity River Authority, 1996
- Trinity River & tributaries: regional environmental impact statement; US Army Corps of Engineers, Fort Worth District. PUB/DATE Fort Worth, TX: The District, 1987.
- Trinity-San Jacinto Estuary: A Study of the Influence of Freshwater Inflows. Texas Department of Water Resources (now TWDB), 1981. Report No. LP-113

1A.5 Recreational and Navigational Water Use Reports

1A.5.1 Stream Flow Information

McKinney, Larry, et al. "Freshwater Inflow Recommendation For the Trinity - San Jacinto Estuary of Texas." Coastal Studies Program, Resource Protection Division, Texas Parks & Wildlife Department; Austin, TX, March 1998.

Texas River Recreation Advisory, June 1999

<http://twister.sbs.ohio-state.edu/text/wxascii/rivercond/FGUS44.KFWD>

Brazos River Basin Water Supply Reservoir Data, Brazos River Authority, June 1999

<http://www.brazos.org/wrd/water%20supply%20data.htm>

Freshwater Inflows to Texas Bays and Estuaries-Ecological Relationships and Methods for Determination of Needs, Texas Parks & Wildlife Department, November 1998

<http://www.tpwd.state.tx.us/conservesb1/enviro/envwaterneeds/envwaterneeds.html>

Galveston Bay/Trinity and San Jacinto Estuary Draft Report, Texas Parks & Wildlife Department, October 1998

<http://www.tpwd.state.tx.us/conservesb1/enviro/galvestonbay-trinitysanjac/inlandflow.html>

Freshwater Inflows to Texas Bays and Estuaries-Ecological Relationships and Methods for Determination of Needs, Texas Parks & Wildlife Department, December 1998

www.tpwd.state.tx.us/conservesb1/enviro/freshwaterinflows/freshwaterinflows.html

Reservoir Conditions for selected River Basins in Texas, USGS, September 1999

tx.usgs.gov/nwis-bin/current?type=lake&group=basin&search=

Ft Worth District Reservoir Release Report, USACE, September 1999

www.swf-wc.usace.army.mil/reports/fish.htm

CanoeTX webpage, Texas River Recreation Association, flows compiled in 1972

<http://world.std.com/~reichert/canoeTX.htm>

Brown & Root, Inc. Trans-Texas Water Program: Southeast Area, Technical Memoranda CD, 1997

Brown & Root, Inc. Trans-Texas Water Program Reports CD, May 1998

1A.5.2 River/River Basin Information

Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory: Surface Water Quality Monitoring Program. TNRCC, Austin, TX; Volume 1-4, December 1996.

Texas Clean Rivers Program & TNRCC, Texas Water Quality: A Summary of River Basin Assessments. TNRCC, Austin, TX; December 1996.

Jack Bauer, et al, A Natural Resource Survey For Proposed Reservoir Sites And Selected Stream Segments In Texas. Texas Parks & Wildlife Department, Austin, TX; Contract Study: Number 1; Part 1, August 1991.

San Jacinto River Authority, June 1999 www.neosoft.com/~mtaylor/sjra.htm

Trinity River Authority of Texas, June 1999 trinityra.org/masterplan/masterplan.htm

Brazos River Authority Home Page, June 1999 www.brazos.org/home.htm

- East Texas Seasonal and Restrictive Waterways, page 1, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_08.htm
- East Texas Seasonal and Restrictive Waterways, page 2, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_09.htm#navasota-river
- Table of Contents: Analysis of Texas Waterways, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/waterways_toc.htm
- East Texas Waterways: Trinity River, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_06.htm
- East Texas Waterways: San Jacinto River-West Fork, Sulphur River, Trinity River-Elm Fork, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_05.htm
- East Texas Waterways: Pine Island Bayou, Red River, Sabine River, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_04.htm
- East Texas Waterways: Neches River, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_03.htm#neches
- East Texas Waterways: Brazos River, Texas Parks & Wildlife Department, February 1999 www.tpwd.state.tx.us/conserv/sb1/econom/waterways/e_tx_02.htm#brazos-river
- Table 6.1. Present Texas Natural Resource Conservation Commission Water Quality Segments, Designated Uses, and Standards in the Galveston Bay System, June 1995 <http://www.rice.edu/armadillo/Galveston/Chap6/table6a1.html>

1A.5.3 Navigation

- Trinity River Basin Navigation, January 1998 trinityra.org/masterplan/navigat.htm
- Navigation Information Connection, June 1999 www.mrr.usace.army.mil/hic.htm
- Tide Predictions for Galveston, Galveston Channel, TX, NOAA/National Ocean Service, October 1999 <http://www.opsd.nos.noaa.gov/tides/gulfGAL.html>
- Tidal Datums Procedure- Galveston Update, NOAA/National Ocean Service, July 1998 http://www.opsd.nos.noaa.gov/galv_dtm.html
- NOAA, Physical Oceanographic Real- Time Systems, March 1999 <http://www.opsd.nos.noaa.gov/hgports/hgports.html>
- The Gulf Intracoastal Waterway in Texas, Texas Department of Transportation, 2002
- The Texas Transportation Plan Update, Marine Transportation, Cambridge Systematics, October 2002
- The Handbook of Texas Online, Texas State Historical Association, DEC 2002, www.tsha.utexas.edu/handbook/online

1A.5.4 Recreational Areas/Activities

- Galveston Bay National Estuary Program, "Galveston Bay Recreational User's Handbook." Galveston Bay National Estuary Program; May 1992.
- Ramos, Mary G., 1998-1999 Texas Almanac and State Industrial Guide. The Dallas Morning News, Dallas, TX; 1997.
- The Roads of Texas. Shearer Publishing, Fredericksburg, Texas; 1988.

"The Great Texas Coastal Birding Trail: Upper Texas Coast." TPWD, Austin, TX; 1999. (Map)

Ducks Unlimited Texas, February 1998 www.ducks.org/7x/states/texas.htm

Search Fishbase, July 1999 www.ccgjar.org/ICLARM/fishbase/search.cfm

Brazoria County, July 1999 www.travelingtexas.com/brazoriaco.html

Southern Brazoria County Visitors and Convention Bureau, July 1999 www.tourist-ino.org/

Chambers County, Texas – Attractions, April 1998 co.chambers.tx.us/tourism/attracts.html#BirdWatching

Attractions –Lake Conroe, June 1999 www.chamber.montgomery.tx.us/lake_conroe/non-frames/attractions.htm

Fort Bend County community activities, 1998 www.fortbend.org/activities/index.htm

Wallisville Lake Project, June 1996 www.neosoft.com/~mtaylor/news/news6.htm#lake

Trinity River Basin Recreation, January 1998 trinityra.org/masterplan/saltintr.htm

Central Regional Wastewater System –Livingston Recreation Facilities, November 1998 www.trinityra.org/pubserve/livrec.htm

Recreation, Brazos River Authority Lakes, September 1999 www.brazos.org/r&p/recreation.htm

National Marine Fisheries Service –Estuary Selections, 1998 galveston.ssp.nmfs.gov/efh/estuaries.asp

South Central States Park Detail, June 1999 www.usace.army.mil/inet/functions/cw/cecwo/scdet.htm#Texas

USDA Forest Service, September 1999 www.fs.fed.us/

Galveston Bay Estuary Program –Recreational Uses, June 1999 riceinfo.rice.edu/armadillo/Galveston/Chap4/rec.html

Galveston Bay Estuary Program –Boating, June 1999 riceinfo.rice.edu/armadillo/Galveston/Chap4/boating.html

Galveston Bay Estuary Program –Sport Fishing, June 1999 riceinfo.rice.edu/armadillo/Galveston/Chap4/sport.html

Galveston Bay Estuary Program –Recreational Uses Map, June 1999 riceinfo.rice.edu/armadillo/Galveston/Chap4/fig4a12.html

Galveston Bay Estuary Program –Table 4.9. Licensed Fisherman by Fiscal Year, June 1999 riceinfo.rice.edu/armadillo/Galveston/Chap4/tab4a9.htm

Recreation.Gov –Addicks Dam, June 1999 www.recreation.gov/detail.cfm?ID=517

Recreation.Gov –Barker Dam, June 1999 www.recreation.gov/detail.cfm?ID=519

Recreation.Gov –Wallisville Reservoir, June 1999 www.recreation.gov/detail.cfm?ID=518

Recreation.Gov –Anahuac NWR, June 1999 www.recreation.gov/detail.cfm?ID=1262

Recreation.Gov –Attwater Prairie Chicken NWF, June 1999 www.recreation.gov/detail.cfm?ID=1281

Recreation.Gov –Brazoria NWR, June 1999 www.recreation.gov/detail.cfm?ID=1318

Recreation.Gov –San Bernard NWR, June 1999 www.recreation.gov/detail.cfm?ID=1593

Recreation.Gov –National Forests in Texas: Angelina-Davy Crockett -Sabine -Sam Houston National Forests, June 1999 www.recreation.gov/detail.cfm?ID=1049

U.S. Fish & Wildlife Service –Southwest Region –Texas Links, June 1999 southwest.fws.gov/statelinks/texaslinks.htm

- Anahuac NWR, U.S. Fish & Wildlife Service, September 1999
southwest.fws.gov/refuges/texas/anahuac.html
- Attwater Prairie Chicken NWR, September 1999 southwest.fws.gov/refuges/texas/apc.html
- Brazoria NWR, U.S. Fish & Wildlife Service, September 1999
southwest.fws.gov/refuges/texas/brazoria.html
- San Bernard NWR, U.S. Fish & Wildlife Service, September 1999
southwest.fws.gov/refuges/texas/sanber.html
- Trinity River NWR, U.S. Fish & Wildlife Service, September 1999
southwest.fws.gov/refuges/texas/trinity.html
- U.S. Fish & Wildlife Service –Texas Links, March 1998
sturgeon.irm1.r2.fws.gov:80/u2/refuges/texas/txlinks.html
- NPS units in TX, National Park Service, September 1999 www.nps.gov/parklists/tx.html
- National Parks Service –Visits by State 1997 N-Y, March 1999
www2.nature.nps.gov/stats/bystaten_y.html#TX
- Big Thicket National Preserve, National Park Service, June 1999 www.nps.gov/bith/
- Great Outdoor Recreation Pages Attractions, September 1999
www.gorp.com/gorp/resource/main.htm
- GORP –U.S. National Parks and Preserves, September 1999
www.gorp.com/gorp/resource/us_national_park/main.htm
- GORP –Big Thicket National Preserve, September 1999
www.gorp/resource/US_National_Park/tx_big_t.HTM
- GORP –Texas National Forests, September 1999
www.gorp.com/gorp/resource/us_national_forest/tx.htm
- GORP –Angelina, Davy Crockett, Sabine and Sam Houston National Forests, September 1999
www.gorp.com/gorp/resource/US_National_Forest/tx_texas.HTM
- GORP –Davy Crockett National Forest –Four C National Recreation Trail, September 1999
www.gorp.com/gorp/resource/us_trail/tx_crock.htm
- GORP –Texas National Wildlife Refuges/Marine Sanctuaries, September 1999
www.gorp.com/gorp/resource/us_nwr/tx.HTM
- GORP –Anahuac National Wildlife Refuge, September 1999
www.gorp.com/gorp/resource/us_nwr/tx_anahu.htm
- GORP –Attwater Prairie Chicken National Wildlife Refuge, September 1999
www.gorp.com/gorp/resource/us_mwr/tx_attwa.htm
- GORP –Brazoria National Wildlife Refuge, September 1999
www.gorp.com/gorp/resource/us_nwr/tx_brazo.htm
- GORP –San Bernard National Wildlife Refuge, September 1999
www.gorp.com/gorp/resource/us_nwr/tx_san_b.htm
- GORP –U.S. Army Corps of Engineers –Texas Projects, September 1999
www.gorp.com/gorp/resource/us_nra/ace/tx.htm
- GORP –Barker Dam –Texas Corps Projects, September 1999
www.gorp.com/gorp/resource/us_nra/ace/tx_bark.htm
- US Department of Agriculture, US Forest Service, Recreation Areas, June 1999
www.r8web.com/texas/recreati.htm

- 1999-2000 Wildlife and Recreation Information –Hunting, September 1999
www.r8web.com/texas/hunting_99_2000.htm
- Sam Houston National Forest Map, September 1999
www.r8web.com/texas/images/maps/samhouston.jpg
- Alphabetical Listing of State Parks, Texas Parks & Wildlife Department, August 1999
www.tpwd.state.tx.us/park/parklist.htm
- Brazos Bend State Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/brazos/brazos.htm#activities
- Galveston Island State Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/galvesto/galvesto.htm
- Huntsville State Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/huntsvil/huntsvil.htm
- Lake Houston State Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/lakehous/lakehous.htm
- Lake Livingston State Park, Texas Parks & Wildlife Department, March 1999
www.tpwd.state.tx.us/park/lakelivi/lakelivi.htm
- San Jacinto Battleground State Historical Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/battlesh/battlesh.htm
- Sheldon Lake State Park and Wildlife Management Area, Texas Parks & Wildlife Department, February 1998
www.tpwd.state.tx.us/park/sheldon/sheldon.htm
- Stephen F. Austin State Historical Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/sfa/sfa.htm
- Varner Hogg State Historical Park, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/park/varner/varner.htm
- Wildlife Management Areas, Texas Parks & Wildlife Department, October 1998
www.tpwd.state.tx.us/wma/index.htm
- Alphabetical Listing of Wildlife Management Areas, Texas Parks & Wildlife Department, August 1999
www.tpwd.state.tx.us/wma/wmalist.htm
- WMA Recreational Opportunities Form –Candy Abshier, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/wma/wmarea/abshier.htm#text
- WMA Recreational Opportunities Form –Atkinson Island, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/wma/wmarea/atkinson.htm#text
- WMA Recreational Opportunities Form –Sam Houston National Forest, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/wma/wmarea/samhouston.htm#text
- WMA Recreational Opportunities Form –Keechi Creek, Texas Parks & Wildlife Department, August 1999
www.tpwd.state.tx.us/wma/wmarea/keechi.htm#text
- WMA Recreational Opportunities Form –Peach Point, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/wma/wmarea/peachpnt.htm#recreation
- Texas Fishing –The Official Page, Texas Parks & Wildlife Department, June 1999
www.tpwd.state.tx.us/fish/fish.htm
- Freshwater Fish ID, Texas Parks & Wildlife Department, June 1999
www.tpwd.state.tx.us/fish/infish/species/fishgrup.htm
- Alphabetical Listing of Texas Lakes, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/listing.htm

- Lake Conroe –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/conroe/lake_id.htm
- Lake Conroe Point A –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/conroe/access/pointa.htm
- Lake Conroe Point B –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/conroe/access/pointb.htm
- Lake Conroe Point D –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/conroe/access/pointd.htm
- Lake Conroe Point G –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/conroe/access/pointg.htm
- Lake Houston –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/lake_id.htm
- Lake Houston Point A –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointa.htm
- Lake Houston Point B –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointb.htm
- Lake Houston Point C –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointc.htm
- Lake Houston Point D –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointd.htm
- Lake Houston Point E –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointe.htm
- Lake Houston Point F –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/houston/access/pointf.htm
- Lake Limestone –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/limeston/lake_id.htm
- Lake Limestone Point A –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/limeston/access/pointa.htm
- Lake Limestone Point B –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/limeston/access/pointb.htm
- Lake Limestone Point C –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/limeston/access/pointc.htm
- Lake Limestone Point D –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/limeston/access/pointd.htm
- Lake Livingston –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/aleks/living/lake_id.htm
- Lake Livingston Point B –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointb.htm
- Lake Livingston Point M –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointm.htm
- Lake Livingston Point V –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointv.htm
- Lake Livingston Point Y –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointy.htm

Lake Livingston Point aa –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointaa.htm

Lake Livingston Point gg –Fishing, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/fish/infish/lakes/living/access/pointgg.htm

Related Sites –TPW, Texas Parks & Wildlife Department, September 1999
www.tpwd.state.tx.us/admin/hot/hotlinks.htm

TX GEMS, Texas Parks & Wildlife Department, November 1998
www.tpwd.state.tx.us/conserve/txgems/mapimage/mapimage.htm

GEMS- Chrstimas Bay Coastal Preserve, Texas Parks & Wildlife Department, February 1999
www.tpwd.state.tx.us/conserve/txgems/christma/christma.htm

1A.5.5 Economics

Southwick Associates, "The Economic Contributions of Bird and Waterfowl Recreation in the United States During 1991." International Association of Fish and Wildlife Agencies and the USFWS North American Waterfowl and Wetlands Office, March 1995.

Boat and Motor Dealer, "NMMA's latest statistics show 1998 marine industry market at a glance." 1998 Retail Market Review, February 1999.

Allen, Michael. "Birding Trail Takes Aim At Affluent Eco-Tourists." The Wall Street Journal, Texas Journal, August 31, 1994.

Kerlinger, Ph.D., Paul. "The Economic Impact of Birding Ecotourism On Communities Surrounding Eight National Wildlife Refuges." 1993-1994.

"Nature Tourism in the Lone Star State: Economic Opportunities in Nature, A report from the State Task Force on Texas Nature Tourism." TPWD and Texas Department of Commerce.

"Factsheet: Birding as an Economic Asset." National Fish and Wildlife Foundation.

"Birds mean Business for America." Ducks Unlimited and International Association of Fish and Wildlife Agencies.

Tveten, John and Gloria. "Birding trail boosts Texas' ecotourism." Houston Chronicle. February 4, 1996.

The Economic Importance of Sport Fishing, Recreation & Economics, TPWD, October 1998

<http://www.tpwd.state.tx.us/conserce/sb1/econom/econsportfish/econsportfish.html>

Economics.html, Texas-Sea-Grant, Texas A&M University, June 1999

<http://texas-sea-grant.tamu.edu/economics.html>

1A.6 Ecologically Unique Stream Segments, Unique Reservoir Sites and Legislative References

Brazos G Water Planning Group, 2001 Brazos G Regional Water Plan.

Bureau of Reclamation, Great Plains Region, November 1988, *Planning Report / Final Environmental Statement, San Jacinto Project, Texas*

Espey, Huston & Associates, Inc., 1986, *Trinity River Yield Study Phase III: Yield Analysis*.

Freese and Nichols, Inc., 1996, *Memorandum Report: Updated Water Project Opinions of Cost*.

- Freese & Nichols, 1997, Trans-Texas Water Program Southeast Area, *Operation Studies and Opinions of Cost for Allens Creek Reservoir Volumes I and II*.
- Metcalf & Eddy, 1991, *Houston Water Master Plan, Appendix L*
- Norris, Chad W. and Gordon W. Linam, Texas Parks and Wildlife Department, October 1999, *Ecologically Significant River and Stream Segments of Region H, Regional Water Planning Area*.
- Pate Engineers, Inc, 1988, San Jacinto River Authority, *Water Resources Development Plan-Water Supply Plan*.
- Peterson, Dave, US Forest Service, 2003, *Boswell Creek Watershed, Healthy Forest Initiative, Specialist Report – Aquatics*.
- Quesada, Felix, US Forest Service, 2003, *Boswell Creek Watershed, Healthy Forest Initiative, Wildlife Report*.
- Texas Parks and Wildlife Dept. and U.S. Fish & Wildlife Service, 1990, *Texas Water and Wildlife: A Natural Resource Survey for Proposed Reservoir Sites and Selected Stream Segments in Texas*.
- Texas Parks and Wildlife Department, *Ecologically Significant River and Stream Segments Reports*, updated October 2003, accessed at <http://www.tpwd.state.tx.us/texaswater/sb1/rivers/unique/sigseg.phtml>
- Texas Parks and Wildlife Department, Texas Gulf Ecological Management Sites, Anahuac NWR data page, accessed at www.tpwd.state.tx.us/texaswater/txgems/anahuac/anahuac.phtml

1A.7 Water Infrastructure Financing References

1A.7.1 Self Financing Information

- A Handbook for Board Members of Water Districts in Texas, Fourth Edition, *Sections on Taxation and Bonds only*, TNRCC Regulatory Guidance RG-238, June 1996
- TNRCC Jurisdiction Over Utility Rates and Service Policies, TNRCC Regulatory Guidance RG-245, rev. July 2000
- Texas Small Towns Environment Program (STEP), Guidelines for Community Self-Help Projects, The Rensselaerville Institute, 2001
- Texas Small Towns Environment Program (STEP), Role of Government to Support Community Self-Help Projects, The Rensselaerville Institute, 2001
- Texas Small Towns Environment Program (STEP), Sparkplugs...Leading Resident Volunteers Through Community Self-Help, The Rensselaerville Institute, 2001

1A.7.2 Government Loan and Grant Programs

2003 Drinking Water State Revolving Fund (DWSRF) Funding Opportunities for Public Drinking Water Projects & Source Water Protection Projects, TWDB Letter, November 15, 2001, with attachments

Agricultural Water Conservation Loan Program, summary information from the TWDB website, www.twdb.state.tx.us

Agricultural Water Conservation Program, Texas Administrative Code, Title 31, Chapter 367

Civil Works Programs, US Army Corps of Engineers, 2001 Report, *Introduction and Water Supply sections only*.

Clean Water State Revolving Fund, Texas Administrative Code, Title 31, Chapter 375

Economically Distressed Areas Program (EDAP), summary information from the TWDB website, www.twdb.state.tx.us *Two eligible counties in Region H, Leon and Liberty*

EDAP Status Report, TWDB, December 31, 2001

Funding Sources for Utilities, TNRCC Regulatory Guidance RG-220, rev. May 2001

Financial Assistance Programs, Texas Administrative Code, Title 31, Chapter 363

Research and Planning Funding, Texas Administrative Code, Title 31, Chapter 355

Water and Waste Disposal Programs, Fiscal Year 2001, USDA Rural Utilities Service, July 1, 2001

1A.7.3 Additional Reports

Clean Safe Water for the 21st Century, Water Infrastructure Network, April 2000

Drinking Water Infrastructure Needs Survey, Second Report to Congress, *Executive Summary and Appendices B, C and E only*, US EPA Report 814-R-01-004, February 2001

Funding America's Drinking Water Infrastructure: From Public to Private, Christina Brow, Washington Internships for Students of Engineering, 2001

Texas Water Allocation Assessment Report, prepared for the Fort Worth District, USACE by Freese and Nichols, Inc., March 2002

Water Infrastructure Now, Water Infrastructure Network, February 2001

Water Conservation Plans, Drought Contingency Plans, Guidelines and Requirements, Texas Administrative Codes, Title 30, Chapter 288