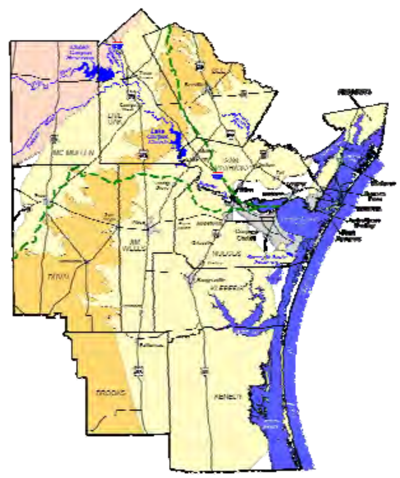
Coastal Bend Regional Water Planning Area Region N

Regional Water Plan Volume I Executive Summary and Regional Water Plan



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Coastal Bend Regional Water Planning Area

2011 Regional Water Plan

Acknowledgements

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Coastal Bend Regional Water Planning Area

Regional Water Plan

> This Regional Water Plan is released for planning purposes on September 1, 2010 by HDR Engineering, Inc., 8404 Indian Hills Dr., Omaha, NE 68114, Registration No. F-754 and the following individuals presented below.

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List of Acronyms

acft	acre-feet
acft/yr	acre-feet per year
ASR	Aquifer Storage and Recovery
BEG	Bureau of Economic Geology
BMPs	Best Management Practices
CA	Certificate of Adjudication
CaCO3	Calcium Carbonate
CBBEP	Coastal Bend Bays and Estuaries Program
CBRWP	Coastal Bend Regional Water Plan
CBRWPG	Coastal Bend Regional Water Planning Group
CCR/LCC	Choke Canyon Reservoir/Lake Corpus Christi
cfs	cubic feet per second
CGCGAM	Central Gulf Coast Groundwater Availability Model
DFCs	Desired Future Conditions
EPA	U.S. Environmental Protection Agency
IPP	Initially Prepared Plan
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GLO	General Land Office
GMA	Groundwater Management Area
gpcd	gallons per capita per day
GPM or gpm	gallons per minute
kW-hr	kilowatts hours
LCC	Lake Corpus Christi
LEPA	Low Energy Precision Application
LESA	Low Elevation Spray Application
LNRA	Lavaca-Navidad River Authority
LOUWCD	Live Oak Underground Water Conservation District
MAG	Managed Available Groundwater
MGD or mgd	million gallons per day
mg/L	milligrams per liter
MSA	Metropolitan Statistical Area
msl	mean sea level
MUD	Municipal Utility District
N/A	not available or not applicable
NEAC	Nueces Estuary Advisory Council
NPDES	National Pollutant Discharge Elimination System
NRA	Nueces River Authority
NTU	Nephelometric Turbidity Units
NUBAY	Lower Nueces River Basin and Estuary Model
NWF	National Wildlife Federation
O&M	Operation and Maintenance
PPD	Pounds per day
psi	pounds per square inch

List of Acronyms (Concluded)

REIS	Regional Economic Information System
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
SB1	Senate Bill 1
SPMWD	San Patricio Municipal Water District
STWA	South Texas Water Authority
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TOES	Texas Organization for Endangered Species
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
UWCD	Underground Water Conservation District
WAM	Water Availability Model
WCID	Water Control and Improvement District
WMS	Water Management Strategies
WRAC	Water Resources Advisory Committee
WRAP	Water Rights Analysis Package
WSC	Water Supply Corporation
WTP	Water Treatment Plant
WUG	Water User Group
WWP	Wholesale Water Provider
WWTP	Wastewater Treatment Plant

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Section 1
Planning Area Description
[31 TAC §357.7 (a)(1)]

1.1 Water Use Background

The area represented by the Coastal Bend Regional Water Planning Group ("Region N" or "Coastal Bend Region") includes the following counties: Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio (Figure 1-1). The Coastal Bend Region has four regional wholesale water providers: the City of Corpus Christi, San Patricio Municipal Water District (SPMWD), South Texas Water Authority (STWA), and Nueces County Water Control and Improvement District #3 (Nueces County WCID #3). The City of Corpus Christi, the largest of the four, sells water to two of the other regional water providers—SPMWD and STWA. The City of Corpus Christi and the SPMWD distribute water to cities, water districts, and water supply corporations which in turn provide water to residential, commercial, and industrial customers. SPMWD also sells water directly to large industrial facilities located on the La Quinta Ship Channel. STWA provides water to cities and water supply corporations that supply both residential and commercial customers within the western portion of Nueces County as well as Kleberg County. The smallest regional wholesale water provider, Nueces County WCID #3, provides water to the City of Robstown and other municipal entities within the western portion of Nueces County.

Municipal and industrial water use accounts for the greatest amount of water demand in the Coastal Bend Region, totaling 85 percent of the region's total water use in 2000 (Figure 1-2). The major water demand areas are primarily municipal systems in the greater Corpus Christi area, as well as large industrial (manufacturing, steam-electric, and mining) users located along the Corpus Christi and La Quinta Ship Channels. Agriculture (irrigation and livestock) is the third largest category of water use in the region (Figure 1-2). Based on recent water use records, the City of Corpus Christi provides supplies for about 67 percent of the municipal and industrial water demand in the region (not including supplies to SPMWD or STWA).

1.2 Water Resources and Quality

1.2.1 Surface Water Sources

The Coastal Bend Region depends mostly on surface water sources for municipal and industrial water supply use. The two major surface water resources include the Choke Canyon

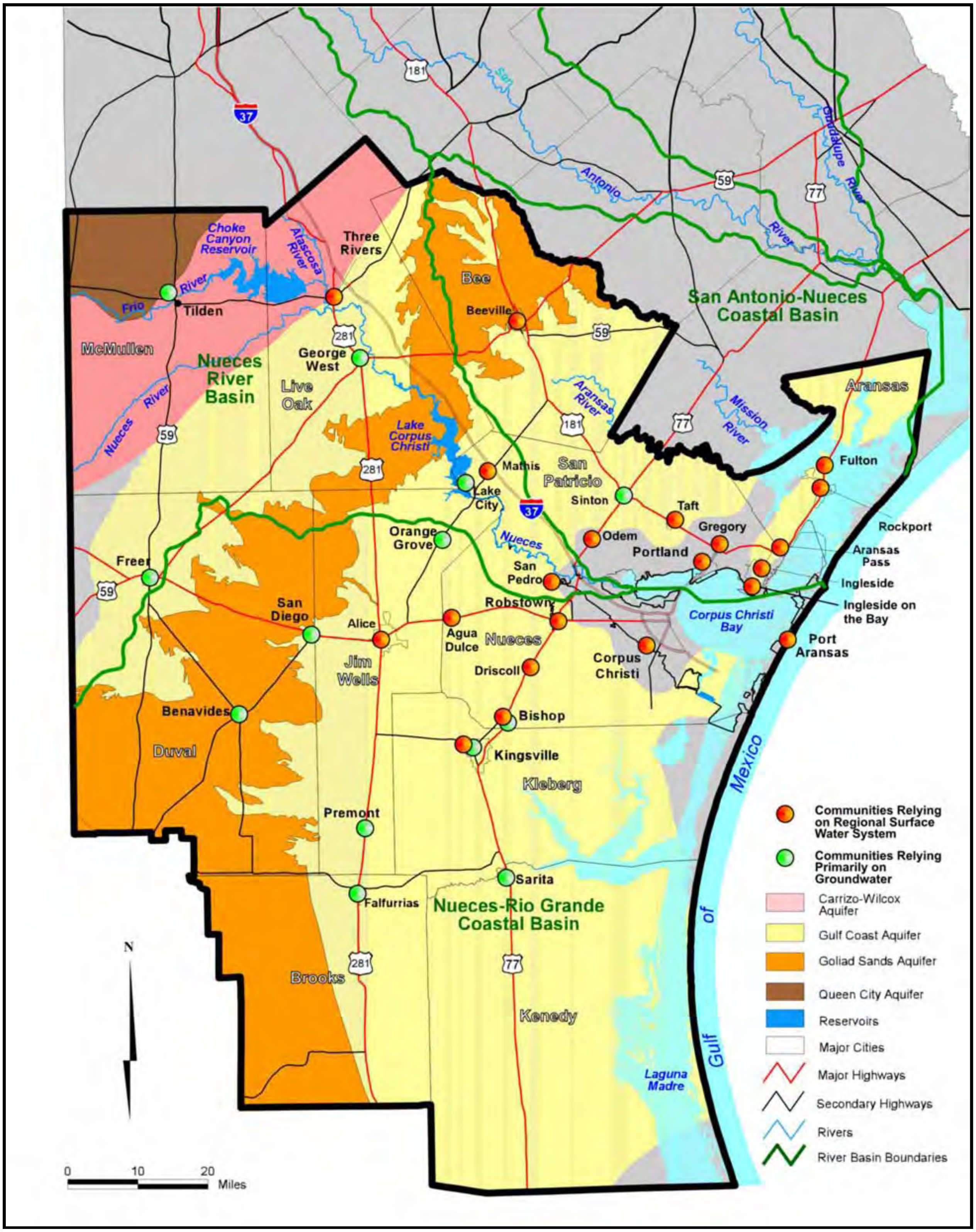

Figure 1-1. Water Providers in the Planning Region

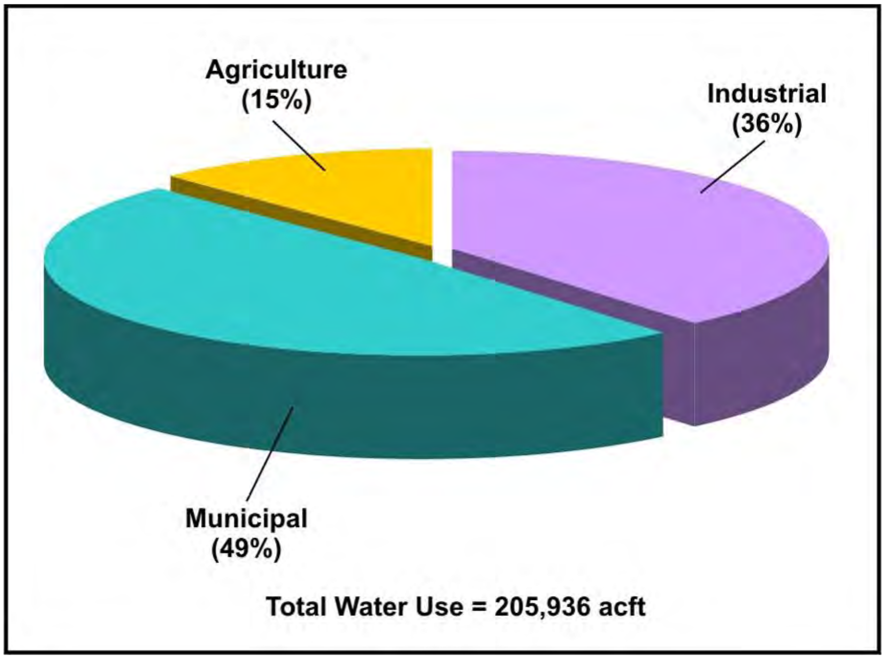

Figure 1-2. 2000 Water Use in the Coastal Bend Regional Water Planning Area

Reservoir/Lake Corpus Christi System (CCR/LCC System) in the Nueces River Basin and Lake Texana on the Navidad River in Jackson County. Water supply from Lake Texana is transported to the Coastal Bend Region via the Mary Rhodes Pipeline and provides the Coastal Bend Region with 41,840 acre-feet per year (acft/yr) and 12,000 acft/yr on an interruptible basis, according to the contract between the City of Corpus Christi and the Lavaca-Navidad River Authority (LNRA). Based on 2010 sediment conditions and Phase IV operating policy, including the 2001 Agreed Order governing freshwater pass-throughs to Nueces Estuary, the CCR/LCC System with supplies from Lake Texana has a safe annual yield of 205,000 acft/yr in 2010. The safe annual yield is based on keeping 75,000 acft in system storage (i.e., storage reserve of 7 percent CCR/LCC System) during the critical month of the drought of record. The Coastal Bend Regional Water Planning Group adopted use of safe yield supply for the 2011 Plan, which provides approximately 22,000 acft less than firm yield supply in 2010 (227,000 acft).

The Nueces River Authority's 2008 Basin Summary Report[1] compiled information on 13 water quality parameters for 44 segments in the San Antonio-Nueces Coastal Basin, the Nueces River Basin, the Nueces-Rio Grande Coastal Basin, and the adjacent bays and estuaries. The

[1] Nueces River Authority, "2008 Basin Summary Report for San Antonio-Nueces Coastal Basin, Nueces River Basin, and Nueces-Rio Grande Coastal Basin," August 2008.

report compiled results from 303 (d) List of Impaired Waters and 305 (b) Water Quality Inventory for a 7-year period from December 1, 1999 through November 30, 2006 and found that the water quality is generally good. However, there are some areas of concern. A few stream segments within the region, as well as local bays and estuaries, had elevated levels of dissolved solids, nutrients, bacteria, and low dissolved oxygen levels (Table 1-1).

The water quality of the water from Lake Texana has been reported as good. In fact, it exceeds the general quality of the water supply from the Nueces River Basin and has less Total Dissolved Solids (TDS) than the Nueces River water. However, because Lake Texana water is blended with Nueces River water prior to treatment, the higher Total Suspended Solids (TSS) levels in the Lake Texana water and the pH difference between the two different sources requires precise controls during the treatment process.

1.2.2 Groundwater Sources

Some areas in the region are dependent on groundwater. There are two major aquifers that lie beneath the region—the Carrizo-Wilcox and Gulf Coast Aquifers (Figure 1-1). (Note: For in-depth descriptions of these aquifer systems, the reader is referred to the extensive list of references in Appendix A.) The Carrizo-Wilcox Aquifer contains moderate to large amounts of either fresh or slightly saline water. Slightly saline water is defined as water that contains 1,000 to 3,000 milligrams per liter (mg/L) of dissolved solids. Although this aquifer reaches from the Rio Grande River north into Arkansas, it only underlies parts of McMullen and Live Oak Counties within the Coastal Bend Region. In this downdip portion of the Carrizo-Wilcox Aquifer, the water is softer, hotter (140 degrees Fahrenheit), and contains more dissolved solids.

The Gulf Coast Aquifer underlies all counties within the Coastal Bend Region and yields moderate to large amounts of both fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five aquifer formations: Catahoula, Jasper, Burkeville, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water formations within the Gulf Coast Aquifer System and, consequently, are the formations utilized most commonly. The Evangeline portion of the Gulf Coast Aquifer features the highly transmissive Goliad Sands. The Chicot portion of the Gulf Coast Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Chicot Aquifer within the Coastal Bend area. The Burkeville Aquifer is

Table 1-1.
Water Quality Concerns

Surface Water Resource (Stream Segment Number)	***Water Quality Concerns***	***Water Quality Impairments***
Aransas River Tidal (*2003*)	Orthophosphorus (OP)	Enterococcus
Aransas River Above Tidal (*2004*)	Low DO, Nitrite + Nitrate (N+N), OP, and Total Phosphorus	
Nueces River Below Corpus Christi (*2102*)	Chlorophyll-a, TDS*, Chloride*, and Sulfate*	
Lake Corpus Christi (*2103*)	Chlorophyll-a, OP, Total Phosphorus, TDS*, Chloride*, and Sulfate*	
Nueces above Frio River (*2104*)		Low Dissolved Oxygen (DO), Fish Community Habitat, and Macrobenthos Community
Nueces River / Lower Frio River (*2106*)	Chloride	TDS
Atascosa River (*2107*)	OP, Chlorophyll-a, Chloride, and Sulfate	E. coli, Low DO, and Habitat
San Miguel Creek (*2108*)	Chlorophyll-a	E. coli
Choke Canyon Reservoir (*2116*)	Low DO	Low DO
Frio Above Choke Canyon Reservoir (*2117*)	N+N	E. coli
Petronila Creek Tidal (2203)	Chlorophyll-a	
Petronila Creek above Tidal (*2204*)	Chlorophyll-a	TDS, Chloride, and Sulfate
San Antonio Bay / Hynes Bay / Guadalupe Bay (*2462*)	N+N, Total Phosphorus*, Chlorophyll-a*	
Mesquite Bay / Carlos Bay / Ayres Bay (*2463*)		
Aransas Bay (*2471*)	Chlorophyll-a*	
Copano Bay (*2472*)	Total Phosphorus*	Fecal Coliform
St. Charles Bay (*2473*)	Low DO, Enterococcus*	
Corpus Christi Bay (*2481*)		Enterococcus
Nueces Bay (*2482*)	Total Phosphorus*	
Redfish Bay (*2483*)		Bacteria for Oyster Waters
Corpus Christi Inner Harbor (*2484*)	Ammonia, N+N, and Chlorophyll-a	
Oso Bay (*2485*)	Chlorophyll-a, Total Phosphorus, and Ammonia	Low DO, Enterococcus, Bacteria for Oyster Waters
Laguna Madre (*2491*)	Chlorophyll-a, N+N, Ammonia*, Total Phosphorus*	Low DO and Bacteria for Oyster Waters
Baffin Bay / Alazan Bay / Cayodel Grullo / Laguna Salada (*2492*)	Chlorophyll-a, Ammonia*, Total Phosphorus*	

Source: Nueces River Authority 2008 Basin Summary Report - San Antonio-Nueces Coastal Basin, Nueces River Basin, and Nueces-Rio Grande Coastal Basin, August 2008.
Note: The 2008 Assessment included data from December 1, 1999 through November 30, 2006.
* Indicates possible concerns or increasing trends.

predominantly clay, and therefore provides limited water supplies. The Texas Water Development Board (TWDB) developed a Central Gulf Coast Groundwater Availability Model (CGCGAM) used by the Coastal Bend Region to determine groundwater availability. The TWDB CGCGAM includes four aquifer layers: Jasper, Burkeville, Evangeline, and Chicot.

Within Texas, the Houston area is the largest user of the Gulf Coast Aquifer. Due to growing population and water demand in that area, over-pumping of the aquifer has resulted in subsidence of up to 9 feet being recorded in Harris County. While not as severe as in the Houston area, subsidence has been reported within the Gulf Coast Aquifer in the Coastal Bend Region. In 1979, the Texas Department of Water Resources developed a Gulf Coast Aquifer Model to evaluate pumpage, water level drawdowns, and subsidence for the 10-year period of 1960 through 1969 for Houston, Jackson-Wharton Counties, and Kingsville areas. The objective of the study was to compare modeled results to historical water level declines and subsidence.[2] Areas in Kleberg County have recorded a 0.5-foot drop in elevation due to pumping of the Gulf Coast Aquifer. However, due to the increase in surface water use within Kleberg County, water levels of the aquifer are rising and the rate of subsidence has diminished. Water quality in the shallower parts of the aquifer is generally good; however, there is saltwater intrusion occurring in the southeast portion of the aquifer along the coastline. It should also be noted that the water quality deteriorates moving southwestward towards the Texas-Mexico border.

The Yegua-Jackson is an official minor aquifer and covers parts of McMullen, Live Oak, and Bee counties within the Coastal Bend Region.

1.2.3 Major Springs

Due to most areas having an underlying impervious clay layer, there has not been much opportunity for springs to form in the Coastal Bend Region. According to *Springs of Texas-Volume I* by Gunnar Brune, there are 18 small springs in the Coastal Bend Region with flows between 0.28 and 2.8 cfs and a number of these springs produce saline, hard, alkaline spring water. These are the largest documented springs in the Coastal Bend Region. There are no major springs in the Coastal Bend Region.

[2] "Groundwater Availability in Texas," Texas Department of Water Resources, Report 238, September 1979.

1.3 Economic Aspects

In 2000, the population of the Coastal Bend Region was 541,184 with a regional average per capita income of $19,833, ranging from $14,876 in Brooks County to $26,458 in McMullen County.[3] By 2007, the estimated population for the Coastal Bend Region was 549,686 with a regional average per capita income of $27,518, ranging from $20,887 in Bee County to $33,970 in Nueces County.[4] The Corpus Christi Metropolitan Statistical Area (MSA), consisting of Aransas, Nueces, and San Patricio Counties, accounts for 75 percent of the Coastal Bend Region's population and 79 percent of the total personal income. In 2007, the total personal income in the Coastal Bend Region was nearly $17.3 billion, including net earnings, dividends, and personal transfer receipts[5,6] (Figure 1-3).

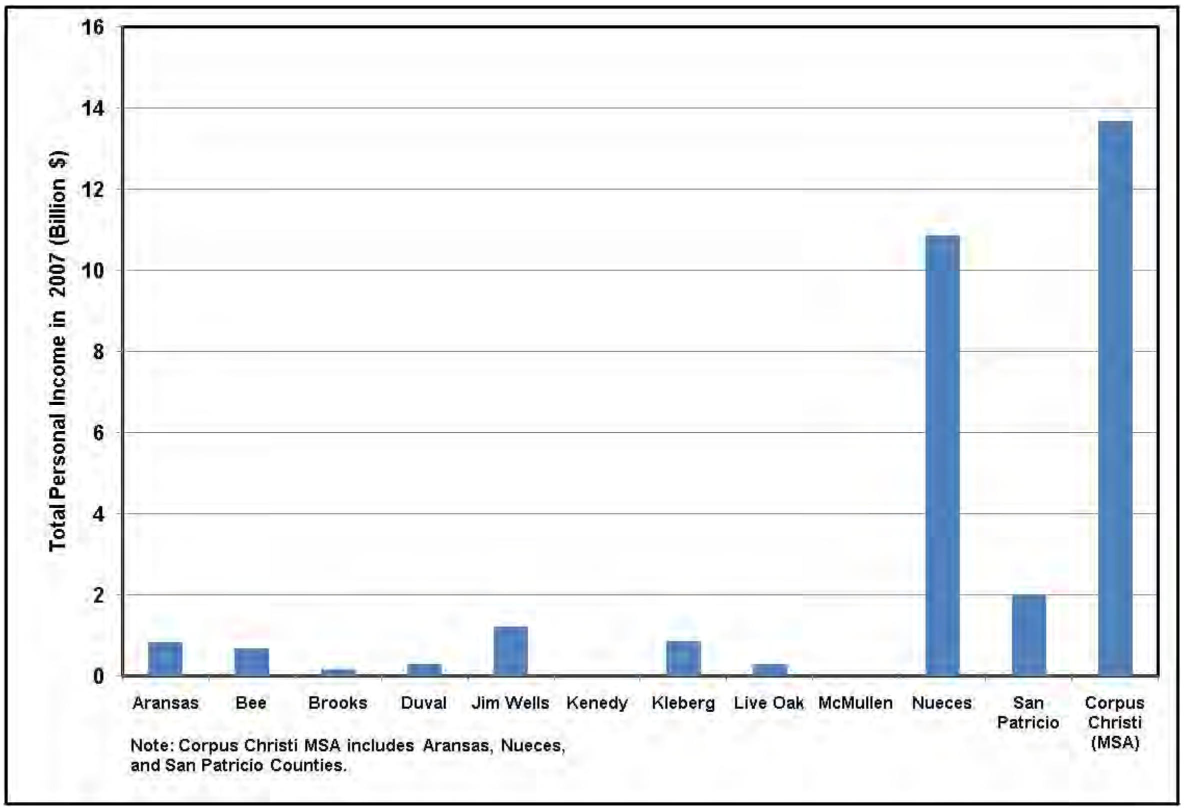

Figure 1-3. Total Personal Income (Earnings) by County

[3] U.S. Department of Commerce Bureau of Economic Analysis, Regional Economic Information System (REIS) Database, 2007.
[4] Ibid
[5] Ibid.
[6] Personal transfer receipts are government payments to individuals, including retirement and disability insurance and medical services.

The primary economic activities within the Coastal Bend Region include oil/gas production and refining, petrochemical manufacturing, military installations, retail and wholesale trade, agriculture, and service industries including health services, tourism/recreation industries, and governmental agencies. In 2007, these industries employed nearly 311,000 people in the Coastal Bend Region with annual compensation to employees of over $11.1 billion (Figures 1-4 and 1-5).[7] The service industries sector had the biggest economic impact in 2007, with a total compensation to employees of economic contribution of $3.8 billion, while employing 48% of the total workforce within the Region (Figures 1-4 and 1-5). The service industries sector includes information, finance and insurance, real estate, educational, and health care and social assistance businesses. Health services, the largest economic service industry contributor, generated nearly $1.2 billion in compensation to employees in 2007 for the Coastal Bend Region.

The retail/wholesale trade sector is also a large contributor to the local economy. In 2007, 14% of the local workforce was employed by this sector, receiving total compensation of $1.2 billion (Figures 1-4 and 1-5).

Government agencies accounted for more than 52,000 jobs (18 percent of total employment) in the Coastal Bend Region. In 2007, these government agencies—consisting of federal, military, state and local government—had total compensation to employees of over $2.9 billion.

The petrochemical and refining industries had total compensation to employees of almost $600 million in 2007.

Agriculture accounts for a major portion of the land use within the Coastal Bend Region. Of the cultivated land in 2007, over 97 percent was dryland farmed and approximately 34,666 acres of cultivated land was irrigated (Table 1-2). The dominant crops of the region are corn, wheat, sorghum, cotton, and hay. Livestock is a major agricultural product of the Coastal Bend Region. In 2007, livestock products made up 38.5 percent of the total market value of agriculture products.[8]

Fishing is another industry that adds to the economic value of the Coastal Bend Region. In 2007, reported bay and gulf commercial fishing generated over $44 million in sales and value

[7] U.S. Department of Commerce Bureau of Economic Analysis, REIS Database, 2007.
[8] 2007 Census of Agriculture.

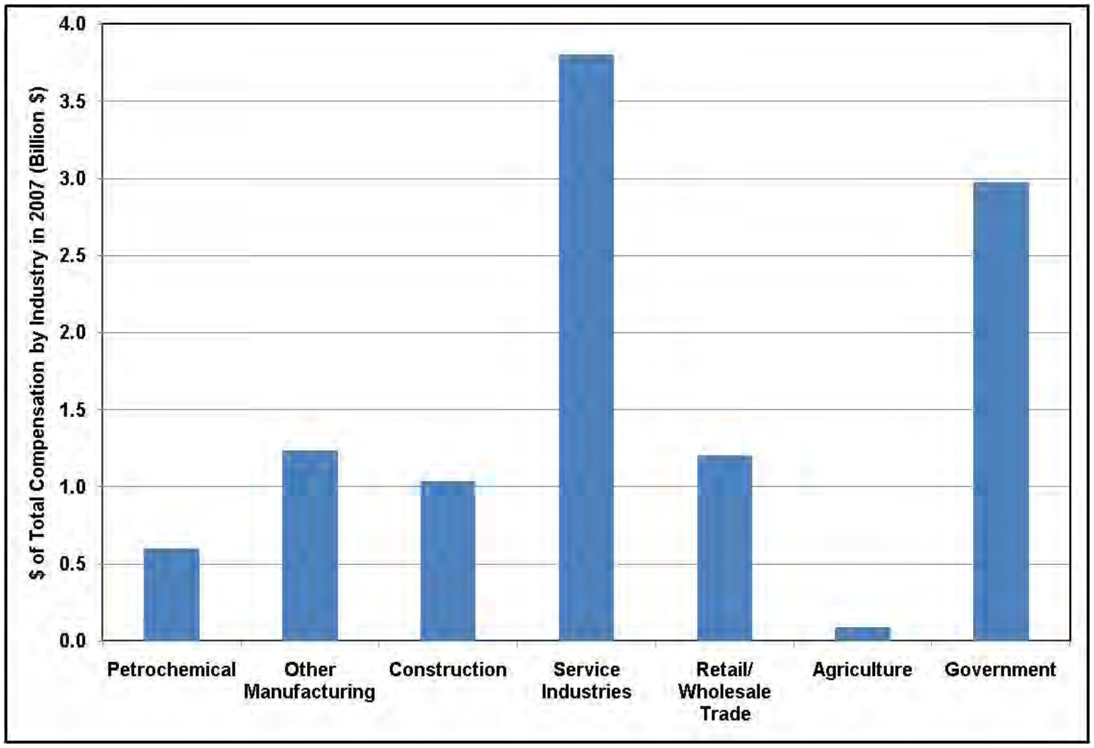

Figure 1-4. Total Compensation to Coastal Bend Region by Sector

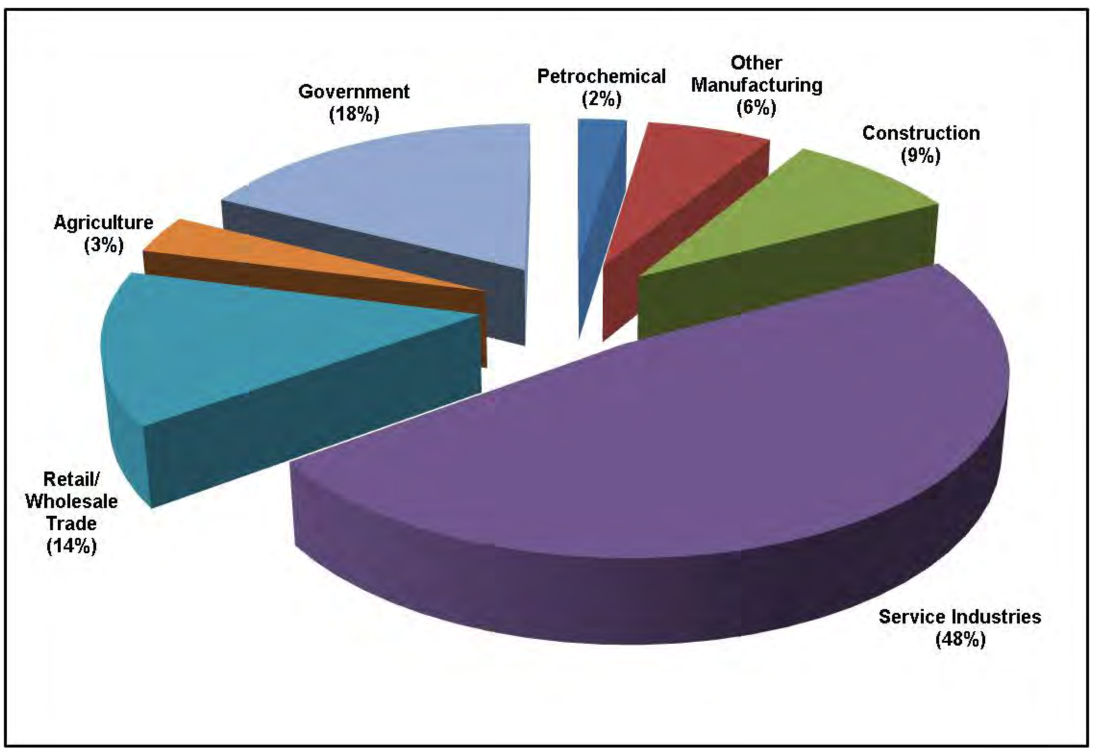

Figure 1-5. 2007 Percentages of Major Employment by Sector in the Coastal Bend Region — Total Number Employed – 310,898

Table 1-2.
Coastal Bend Regional Water Planning Area Agriculture Statistics — 2007

Counties	Region	Aransas	Bee[1]	Brooks	Duval	Jim Wells	Kenedy	Kleberg	Live Oak	McMullen	Nueces	San Patricio
Total Cropland (acres)	1,277,255	N/A	104,923	58,384	120,349	150,931	2,797	82,645	90,632	38,464	369,433	258,697
Irrigated Cropland (acres)	34,666	14	5,738	1,523	4,596	1,757	407	13	2,063	N/A	4,322	14,233
Irrigated Cropland/Total Cropland	2.7%	N/A	5.5%	2.6%	3.8%	1.2%	14.6%	0.0%	2.3%	N/A	1.2%	5.5%
Total Market Value of Agr icultural Product ($1,000)	450,631	1,669	39,203	19,111	14,771	61,034	N/A	64,991	20,968	8,778	110,905	109,201
Market Value of Crop Products Sold ($1,000)	277,253	45	19,075	911	3,946	24,862	N/A	25,073	5,356	295	108,055	89,635
Market Value of Livestock Products Sold ($1,000)	173,378	1,624	20,128	18,200	10,825	36,172	N/A	39,919	15,612	8,483	2,850	19,565
Crop Products/Total Agricultural Products	61.5%	2.7%	48.7%	4.8%	26.7%	40.7%	N/A	38.6%	25.5%	3.4%	97.4%	82.1%
Livestock Products/Total Agricultural Products	38.5%	97.3%	51.3%	95.2%	73.3%	59.3%	N/A	61.4%	74.5%	96.6%	2.6%	17.9%

N/A = Not Available

[1] Bee GCD indicated that about 7,600 acres were irrigated in Bee County in 2009.

to the Region.[9] Overall impact to the State's economy of commercial fishing, sport fishing and other recreational activities has been estimated by the TWDB to be $814 million per year for the 352,000-acre Nueces Estuary System.

Unemployment rates in the Region in 1990 were between 6 and 7 percent, whereas in 1996 the unemployment rate ranged between 8 and 9 percent. In 2008, the unemployment rate for the Coastal Bend Region was 4.9 percent.[10]

1.4 Identified Threats to Agricultural and Natural Resources

The Coastal Bend Region's agricultural business relies on groundwater for irrigation and water for livestock. During previous planning efforts, in developing the 2001 and 2006 Plans, the Coastal Bend Regional Water Planning Group identified continuing groundwater depletion as a threat to agricultural and natural resources. The Coastal Bend Region also recognizes the following additional potential threats to agricultural and natural resources:

- Shortage of freshwater and economically accessible groundwater attributable to increased irrigation demands.
- Shortage of freshwater and economically accessible groundwater attributable to development of natural gas from the shale in the Eagleford Group and water demands associated with hydraulic fracturing of wells.
- Deterioration of surface water quality associated with sand and gravel operations and other activities.
- Deterioration of groundwater quality and increasing concerns of possible arsenic and uranium contamination attributable to uranium mining activities.
- Impacts of potential off-channel reservoir on terrestrial wildlife habitats.
- Potential impacts to threatened, endangered, and other species of concern.
- Potential impacts of brush control and other land management practices as currently considered in Federal studies.
- Abandoned wells (oil, gas, and water).

These threats are considered for each water management strategy, and when applicable, are specifically addressed in Section 4C.

1.5 Resource Aspects and Threatened, Endangered, and Rare Species of the Coastal Bend Region

While the Coastal Bend Region is known for its valuable mineral resources, especially oil and gas, this area also contains a rich diversity of living natural resources. The Coastal Bend

[9] U.S. Department of Commerce Bureau of Economic Analysis, REIS Database, 2007.
[10] Texas Workforce Commission, 2008.

Region contains three distinct natural regions; the South Texas Brush Country which characterizes the inland portion of the region, the Coastal Sand Plains along the southern coastline, and the Gulf Coast Prairies and Marshes along the northern coastline (Figure 1-6).

Regional water plan guidelines require the additional reporting of environmental factors for water management strategies. These factors include any possible effects to wildlife habitat, cultural resources, environmental water needs, and inflows to bays and estuaries. Each water management strategy summary (Section 4C) includes a discussion of these environmental considerations and potential impacts associated with project implementation.

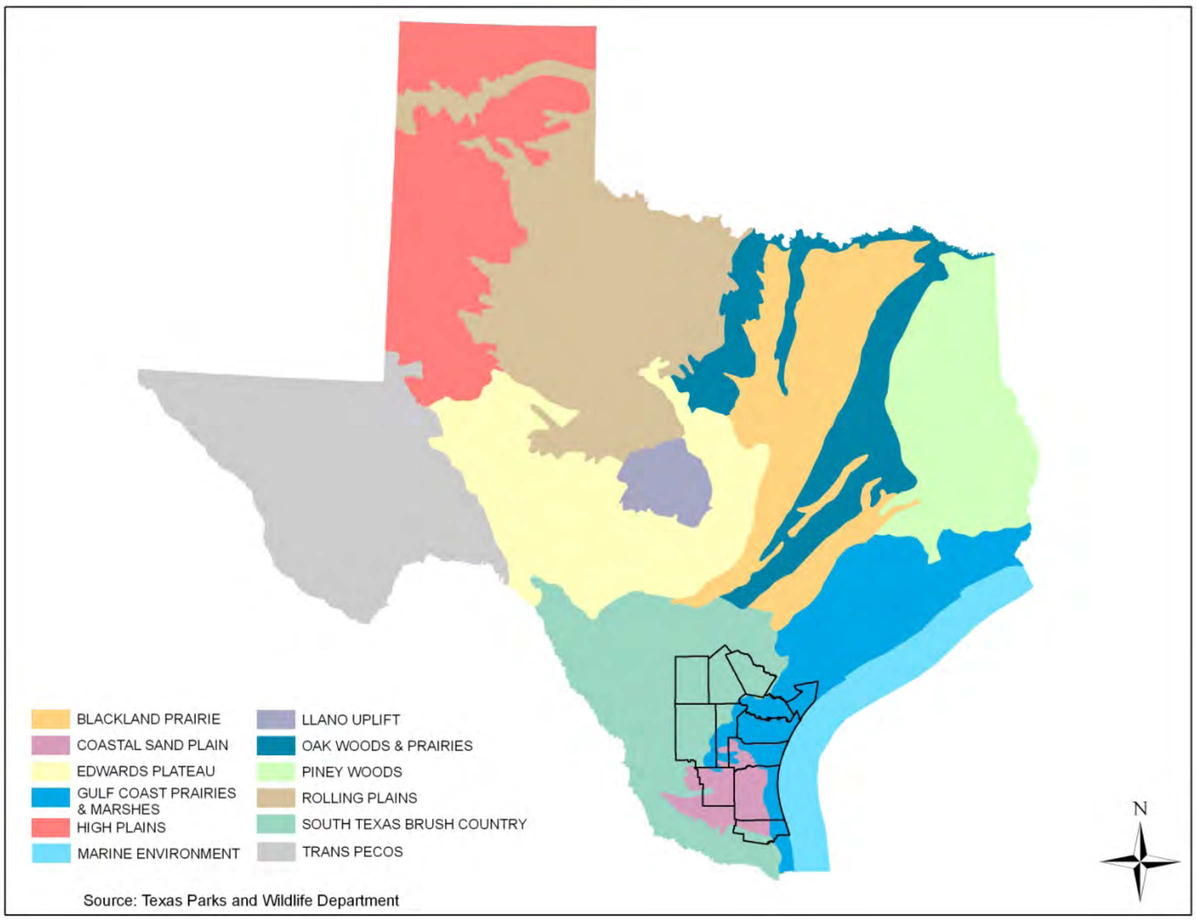

Figure 1-6. Natural Regions of Texas

Because the Coastal Bend Region is located along many migratory flyways, birds comprise a major portion of the wildlife population found within the area. The area provides many birds unique nesting and forage resources within its coastal prairies, wetlands, and riverine ecosystems. The endangered brown pelican utilizes the Coastal Bend's natural resources year-round while the endangered whooping crane is only found seasonally.

The Coastal Bend Region provides habitat for numerous state- and federally-listed endangered and threatened species. These listed species include birds, amphibians, reptiles, fish, mammals, and vascular plants (Table 1-3). Texas Parks and Wildlife and U.S. Fish and Wildlife Service- Southwest Region Ecological Service maintain maps identifying potential habitats (by county) of each endangered or threatened species. These potential habitats are considered for each water management strategy and when possibly impacted, are noted in the appropriate water management strategy summary (Section 4C).

Bay and estuary systems depend on freshwater inflows for maintaining habitats and productivity. Freshwater inflows provide a mixing gradient that establishes a range of salinity, as well as nutrients that are important to the productivity of estuarine systems. In addition, freshwater inflows deposit sediments, which help maintain the deltas and barrier islands that protect the bays and marshes. Without freshwater inflows, many plant and animal species could not survive. In accordance with an order issued by the Texas Commission on Environmental Quality (TCEQ) in 1995, and the subsequent 2001 Agreed Order amendment, Choke Canyon Reservoir and Lake Corpus Christi are operated in such a way as to "pass through" a certain target amount of water each month to the Nueces Bay and Estuary. This water provides the important freshwater inflows needed by the Nueces Estuary based on maximum harvest studies and inflow recommendations.

According to the TPWD,[11] the maximum harvest flow to the Nueces Bay and Estuary produced slightly higher harvests of red drum, black drum, spotted sea trout, and brown shrimp but slightly decreased amounts of blue crab.

The presence of widespread underlying impervious clay layers has resulted in the limited formation of springs within the Coastal Bend Region. According to *Springs of Texas- Volume I* by Gunnar Brune, there are only 18 small springs documented within the Coastal Bend Region, a number of which produce saline, hard, alkaline spring water. These springs have recorded flows

[11] Texas Parks and Wildlife Department, "Freshwater Inflow Recommendation for the Nueces Estuary," September 2002.

Table 1-3.
Endangered and Threatened Species of the Coastal Bend Region

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
Black bear	*Ursus americanus*	Historic in Aransas, Duval, and McMullen	Threatened	Threatened
Black Lace Cactus	*Echinocereus reichenbachii var. albertii*	Jim Wells, Kleberg	Endangered	Endangered
Black-spotted newt	*Notophthalmus meridionalis*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened
Black-striped snake	*Coniophanes imperialis*	Kenedy	___	Threatened
Brown Pelican	*Pelecanus occidentalis*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Cactus Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*	Brooks, Kenedy	___	Threatened
Coues' rice rat	*Oryzomys couesi*	Kenedy	___	Threatened
Eskimo Curlew	*Numenius borealis*	Historic in Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Green Sea Turtle	*Chelonia mydas*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Indigo snake	*Drymarchon corais*	Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak , McMullen, Nueces, San Patricio	___	Threatened
Interior Least Tern	*Sterna antillarum athalassos*	Live Oak, McMullen	Endangered	Endangered
Jaguar	*Panthera onca*	Brooks, Kenedy, Kleberg	Endangered	Endangered
Gulf coast Jaguarundi	*Herpailurus (=Felis) yaguarondi cacomitli*	Aransas, Brooks, Kleberg, Live Oak, San Patricio	Endangered	Endangered
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Leatherback Sea Turtle	*Dermochelys coriacea*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Loggerhead Sea Turtle	*Caretta caretta*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
Louisiana black bear	*Ursus americanus luteolus*	Historic in Aransas	Threatened	Threatened
Mexican treefrog	*Smilisca baudinii*	Kenedy	___	Threatened
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Migrant in Aransas, Brooks, Jim Wells, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Northern Beardless-Tyrannulet	*Camptostoma imberbe*	Brooks, Kenedy, Kleberg	___	Threatened
Northern cat-eyed snake	*Leptodeira septentrionalis*	Brooks, Kenedy, Kleberg	___	Threatened
Ocelot	*Leopardus (=Felis) pardalis*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	Endangered	Endangered

Table 1-3 (Continued)

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
Opossum pipefish	*Microphis brachyurus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	___	Threatened
Peregrine falcon	*Falco peregrinus anatum* (American)	Nesting/Migrant in Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened
	Falco peregrinus	Nesting/migrant in Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened
Piping Plover	*Charadrius melodus*	Migrant in Aransas, Kenedy, Kleberg, Nueces, San Patricio	Threatened	Threatened
Red wolf	*Canis rufus*	Historic in Aransas, Bee, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	Endangered	Endangered
Reddish Egret	*Egretta rufescens*	Aransas, Kleberg, Nueces, San Patricio	___	Threatened
Reticulate collared lizard	*Crotaphytus reticulates*	Duval, Jim Wells, Live Oak, McMullen Counties	___	Threatened
Rose-throated Becard	*Pachyramphus aglaiae*	Kenedy	___	Threatened
Sheep frog	*Hypopachus variolosus*	Aransas, Bee, Brooks, Duval, Jim Wells, Kleberg, Live Oak, San Patricio	___	Threatened
Slender Rush Pea	*Hoffmannseggia tenella*	Kleberg, Nueces	Endangered	Endangered
Smalltooth sawfish	*Pristis pectinata*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
Sooty Tern	*Sterna fuscata*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	___	Threatened
South Texas Ambrosia	*Ambrosia cheiranthifolia*	Jim Wells, Kleberg, Nueces	Endangered	Endangered
South Texas Siren	*Siren sp.1*	Jim Wells, Kenedy, Kleberg, San Patricio	___	Threatened
Southern yellow bat	*Lasiurus ega*	Brooks, Kenedy, Kleberg, Nueces, San Patricio	___	Threatened
Texas Botteri's Sparrow	*Aimophila botterii texana*	Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces	___	Threatened
Texas horned lizard	*Phrynosoma cornutum*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened
Texas scarlet snake	*Cemophora coccinea lineri*	Aransas, Brooks, Jim Wells, Kenedy, Kleberg, Nueces, San Patricio	___	Threatened
Texas tortoise	*Gopherus berlandieri*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened

Table 1-3 (Concluded)

Common Name	Scientific Name	County for which Species is Listed	Federal Status	State Status
Timber/canebrake rattlesnake	*Crotalus horridus*	Aransas, San Patricio	___	Threatened
Tropical Parula	*Parula pitiayumi*	Kenedy	___	Threatened
Walkers's manioc	*Manihot walkerae*	Duval	Endangered	Endangered
West Indian manatee	*Trichechus manatus*	Aransas, Kenedy, Kleberg, Nueces, San Patricio	Endangered	Endangered
White-faced Ibis	*Plegadis chihi*	Aransas, Bee, Duval, Jim Wells, Kleberg, Live Oak, Nueces, San Patricio	___	Threatened
White-nosed coati	*Nasua narica*	Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Nueces, San Patricio	___	Threatened
White-tailed hawk	*Buteo albicaudatus*	Nesting/migrant in Aransas, Bee, Brooks, Jim Wells, Kenedy, Kleberg, Live Oak , Nueces, San Patricio	___	Threatened
Whooping Crane	*Grus americana*	Resident in Aransas, Migrant in Bee, Jim Wells, Live Oak, McMullen, Nueces, San Patricio	Endangered	Endangered
Wood Stork	*Mycteria Americana*	Migrant in Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, San Patricio	___	Threatened
Zone-tailed Hawk	*Buteo albonotatus*	Kenedy	___	Threatened

Source: TPWD, Annotated County List of Rare Species, Aransas, Bee, Brooks, Duval, Jim Wells, Kleberg, Kenedy, Live Oak, McMullen, Nueces, and San Patricio Counties (updated May 2009).
--- Not Federally Listed as Endangered or Threatened

which range from 0.28 to 2.8 cfs. Before 1965, the Coast Bend Region relied heavily on groundwater for irrigation, an action which resulted in decreased groundwater levels and springflows. Since that time, irrigation water demands have been substantially reduced due to a decrease in the amount of irrigated acreage and more efficient irrigation practices. These actions could presumably result in a lessening of adverse impacts to existing local springs.

1.6 Water Quality Initiatives

The Clean Water Act of 1972 established a Federal program for restoring, maintaining, and protecting the nation's water resources. The Clean Water Act remains focused on eliminating discharge of pollutants into water resources and making rivers and streams fishable and swimmable. Water quality standards are to be met by industries, states, and communities under the Clean Water Act. Since the enactment of the Clean Water Act, more than two-thirds of the nation's waters have become fishable and swimmable, as well as a noticeable decrease of wetland and soil loss. One aspect of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES). This program regulates and monitors pollutant discharges into water resources. Whereas in the past the Environmental Protection Agency and the State of Texas each required separate permits to discharge (one under NPDES and one under state law), recently, the State of Texas has received delegation to administer a joint "TPDES" program.

In 1998, the Clean Water Action Plan (Plan) was initiated to meet the original goals of the Clean Water Act. The main priority of this Plan is to identify watersheds and their level of possible concern. The identification of these concerns has been defined within the Texas Unified Watershed Assessment (Assessment). Each watershed was then placed into one of four defined categories—Category I: Watersheds in need of restoration, Category II: Watersheds in need of preventive action to sustain water quality, Category III: Pristine Watersheds, and Category IV: Watersheds with insufficient data. Within the Nueces River Basin some areas of concern have been placed on the Clean Water Act 303(d) medium priority list; consequently both TCEQ and the Environmental Protection Agency are targeting these areas as a Category I.

The State of Texas has initiated other water quality programs. The Texas Clean Rivers Act of 1991 created the Clean Rivers Program within TCEQ. The purpose of this program is to maintain and improve the water quality of the State of Texas's river basins with aid from river authorities and municipalities. The Clean Rivers Program encourages public education, watershed planning, and water conservation, as well as provides technical assistance to identify pollutants and improve water quality in contaminated areas.

In the Coastal Bend Region, the Nueces River Authority (NRA) and TCEQ share the responsibility for surface water monitoring under the Clean Rivers Program. Surface water monitoring within the Coastal Bend Region focuses on freshwater stream segments within the Nueces River Basin, as well as local coastal waters. Each year, NRA and TCEQ coordinate sampling stations and divide stream segment stations between each other in order to eliminate sampling duplication. TCEQ and NRA work together to create the 305(b) Water Quality Inventory Report, which provides an overview of the status of surface waters in the Nueces River Basin and Nueces Coastal Basins. The TCEQ is responsible for administering the Total Maximum Daily Load Program, which addresses the water quality concerns of highest priority as identified in the 305(b) list. Under both the Clean Water Act and the Clean Rivers Program, surface waters must be sampled and monitored for identification of pollutants and possible areas of concern. Currently, certain water segments within the Nueces River Basin are posing some concerns (Table 1-1).

1.7 2006 Coastal Bend Regional Water Plan

Senate Bill 1 was enacted by the 75th Session of the Texas Legislature in 1997. It specified that water plans be developed for regions of Texas and provided that future regulatory and financing decisions of the TCEQ and the TWDB be consistent with approved regional water plans. Furthermore, Senate Bill 1 specified that regional water planning groups submit a regional water plan by January 2001, and at least as frequently as every 5 years thereafter, for TWDB approval and inclusion in the state water plan. In January 2001, the Coastal Bend Region submitted a plan for a 50-year planning period from 2000 to 2050.

In direct response to directives of Senate Bill 2 (77^{th} Texas Legislature, 2001), the CBRWPG revised the January 3, 2001, Coastal Bend Regional Water Plan completed under Senate Bill 1. In January 2006, the Coastal Bend Region submitted a plan for a 55-year planning period from 2000 to 2060 (2006 Coastal Bend Regional Water Plan), which consisted of water supply planning information, projected needs in the Region, and the Region's proposed water plans to meet needs. The total population of the Coastal Bend Region was projected to increase from 541,184 in 2000 to 885,665 by 2060. Similarly, the total water demand was projected to increase from 205,936 acft to 308,577 acft by 2060. There were 14 individual cities and water user groups (i.e., non-municipal water users, such as industrial and agricultural users) that showed projected needs during the 55-year planning horizon. Water management strategies were identified by the Coastal Bend Region to potentially meet water supply shortages. The TWDB evaluated social and economic impacts of not meeting projected water needs, which was included in the 2006 Coastal Bend Regional Water Plan.

1.8 2007 State Water Plan

In Water for Texas 2007 (State Plan), the TWDB utilized information and recommendations from the 16 individual 2006 Regional Water Plans developed by the Regional Water Planning Groups established under Senate Bill 1. In the State Plan, TWDB acknowledges that each Regional Water Planning Group identified many of the same basic recommendations to meet future water demands. These recommendations include: continue regional planning funding, support for groundwater conservation districts, brush control, water reuse, continued support of groundwater availability modeling, conservation education, ongoing funding for groundwater supply projects, and support of alternative water management strategies.

Also, within the State Plan, the TWDB submitted the twelve strategies that were recommended by the Coastal Bend Region in their 2006 Coastal Bend Regional Water Plan. These included:

- Municipal water conservation;
- Irrigation water conservation;
- Manufacturing water conservation;
- Mining water conservation;
- Seawater desalination;
- Additional supply from the Gulf Coast Aquifer;
- Reclaimed wastewater supplies;
- Nueces off-channel reservoir;
- Nueces feasibility projects (LCC/CC Pipeline);
- Palmetto Bend Stage II;
- Voluntary Redistribution of Existing Supplies; and
- Garwood Pipeline.

The State Plan also includes the Coastal Bend Region's policy recommendations to support managing all water resources on a conjunctive use basis, repeal junior rights provision regarding interbasin transfers, development of common set of standards for disposal of "reject" water for industrial and municipal desalination facilities and oil/gas industry, and encourage regional groundwater management where feasible.

In addition to summarizing each Regional Water Planning Group's recommendations, the TWDB defined its own policy recommendations. These included:

- Financing water management strategies;
- Reservoir site designation and acquisition;
- Interbasin transfers of surface water;
- Environmental water needs;
- Water conservation;
- Expedited amendment process; and
- Indirect reuse.

1.9 Local and Previous Regional Water Plans

There has been a number of regional water planning studies done for the Coastal Bend Region, focusing mainly on municipal and industrial water supply issues (refer to Appendix A for list of references). The following is a summary of the major planning efforts in the last 15 years.

In 1989, the Coastal Bend Alliance of Mayors created a Regional Water Task Force. The Regional Water Task Force Final Report,[12] issued in June of 1990, examined the historical and current regional water supply situation and made recommendations for water supply development in the area.

Throughout 1990 and 1991, the TWDB, NRA, the City of Corpus Christi, Edwards Underground Water District, and the STWA sponsored a study[13] that focused on the development of additional water supplies within the Nueces River Basin. The objectives of the study centered upon determining the feasibility of constructing additional recharge structures for the Edwards Aquifer within the basin. The study was also concerned with the effects of the proposed recharge structures on the firm yield of the CCR/LCC System and the required inflows to the Nueces Estuary. The recommendations that emerged from this study determined that additional recharge structures would increase the recharge of the Edwards Aquifer. The study also recommended that additional evaluations consider water supply alternatives for the CCR/LCC System service area as well as a benefit/cost analysis of each additional recharge project. Finally, one of the most useful products to emerge from this study is the Lower Nueces River Basin and Estuary Model, which is still used for evaluating reservoir-operating alternatives.

In 1991, a joint investigation sponsored by the LNRA, the Alamo Conservation and Reuse District, and the City of Corpus Christi, studied additional water supplies for the cities of San Antonio and Corpus Christi. The study[14] addressed the feasibility of transferring water from Lake Texana (Palmetto Bend Project), developing Stage II of the Palmetto Bend Project (Palmetto Bend Stage II), and acquiring water from the Colorado River. The cost and efficiency

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[12] Rauschuber, et al., "Regional Water Task Force: Final Report," Regional Water Conference, Coastal Bend Alliance of Mayors, Corpus Christi Area Economic Development Corporation, Port of Corpus Christi-Board of Trade, Dr. Manuel L. Ibanez, President, Texas A&I University, June 30, 1990.
[13] HDR Engineering, Inc. (HDR), et al., "Nueces River Basin Regional Water Supply Planning Study – Phase I," Vols. 1, 2, and 3, Nueces River Authority (NRA), et al., May 1991.
[14] HDR, "Regional Water Planning Study, Cost Update for Palmetto Bend Stage 2 and Yield Enhancement Alternative for Lake Texana and Palmetto Bend Stage 2," Lavaca-Navidad River Authority, et. al., May 1991.

of the diversion projects that would deliver the water to both cities was examined as well. The final recommendation of this study was to purchase the water from Lake Texana and the Garwood Irrigation Company water rights in the Colorado River and construct diversion structures to both San Antonio and Corpus Christi.

In 1992, the TWDB and the cities of Houston, Corpus Christi, and San Antonio initiated the *Trans-Texas Water Program* to address the water supply needs for each of these cities. The Corpus Christi service area was comprised of virtually the same region as the Coastal Bend Region with the exceptions that Refugio and Atascosa Counties were included in the study and Kenedy County was excluded from the study. The City of Corpus Christi, the Port of Corpus Christi Authority, the Corpus Christi Board of Trade, the TWDB, and the LNRA sponsored the *Trans-Texas Water Program* study[15] for the Corpus Christi Service Area. In 1993, an interim report (Phase I) was issued to give an overview of the objectives of the Program for the Corpus Christi Service Area.

Objectives of the *Trans-Texas Water Program* for the Corpus Christi Service Area:

- Determine water demands for a 50-year period (2000 through 2050);
- Identify possible water supply options that will meet the projected water demands; and
- Provide a general assessment of each water supply alternative as well as their cost and environmental impacts.

In Phase II, twenty-two different water supply alternatives were evaluated. Combinations of these alternatives would be necessary to meet the projected water demands. The 1995 report[16] on Phase II of the *Trans-Texas Water Program* study for the Corpus Christi Service Area recommended two integrated water supply plans (Plan A and Plan B). Both Plan A and Plan B recommended such water supply alternatives as the incorporation of changes in the CCR/LCC System operating policies and the 1995 Agreed Order for freshwater inflows to the Nueces Estuary. Other alternatives included additional water conservation practices within the service area and construction of pipelines from Lake Texana and the Colorado River. However, Plan A recommended the construction of an additional pipeline from Choke Canyon Reservoir to Lake Corpus Christi, whereas Plan B recommended obtaining additional water from the Colorado River as well as modifying the target operating elevation of Lake Corpus Christi. Each

[15] HDR, et al., "Trans-Texas Water Program – Corpus Christi Study Area – Phase II Report," City of Corpus Christi, et. al., September 1995.
[16] Ibid.

recommended plan from the *Trans-Texas Water Program* potentially provided the additional 100,000 acft that were projected as being needed in the study area by the year 2050.

In 1995, SPMWD sponsored a system evaluation study.[17] This study was developed in an effort to establish future water demands, evaluate SPMWD's current facilities and supplies, and recommend possible water supply alternatives for SPMWD's service area. The 1995 plan defined four water supply alternatives that would allow SPMWD to meet projected demands. These alternatives included: the purchasing of additional, or all, treated water from the City of Corpus Christi; expansion of SPMWD's existing facilities; or constructing a new water treatment facility near Odem or Portland. Phase I also recommended that a Phase II study be conducted for the preferred alternative to better identify the cost of the selected project, the time schedule commitment, any environmental issues, and the financial impact the alternative might have on the SPMWD. Based on the Phase II study, SPMWD began to upgrade their existing systems in 1997, including pipe refurbishment and construction of a microfiltration plant. In late 2000, SPMWD finished building the microfiltration plant and pipeline that connects their facilities with the Mary Rhodes Pipeline, which can divert an average of 7.5 million gallons per day of Lake Texana water into a new 193 million-gallon aboveground reservoir, where it is blended with incoming Nueces River water.

TWDB and NRA sponsored a regional water planning study to examine possible water supply alternatives for Duval and Jim Wells Counties. The regional water supply study[18] recommended that Freer, San Diego, and Benavides initiate surface water projects to replace existing groundwater sources. The study also determined that it would be best for Premont and Orange Grove to remain on groundwater supplies.

The Coastal Bend Bays and Estuaries Program (CBBEP) has developed the Coastal Bend Bays Plan[19] (Bays Plan) for the Coastal Bend Region. This plan is a long-term, comprehensive management plan designed to restore, maintain, and protect the Coastal Bend Region's bay and estuary ecosystems. Included within the Bays Plan is the allowance for coordination with the Regional Water Planning Group. The CBBEP does not possess taxing, federal, state, or local authority. Rather the CBBEP coordinates the implementation of the Bays Plan by providing

[17] Naismith Engineering, Inc. (NEI), et al., "Study of System Capacity, Evaluation of System Condition, and Projections of Future Water Demands – Phase 1," San Patricio Municipal Water District, September 1995.
[18] NEI, et al., "Regional Water Supply Study, Duval and Jim Wells Counties, Texas," NRA, et al., October 1996.
[19] "Coastal Bend Bays Plan," Coastal Bend Bays and Estuaries Program, August 1998.

limited amounts of technical and financial assistance towards meeting operating goals. CBBEP operating goals include:

- Understand the interdependence of the bays and estuaries with human uses;
- Maintain clean water quality for native living resources as well as providing clean waters for recreation;
- Maintain freshwater inflows;
- Preserve open spaces to meet growing populations; and
- Manage the region's bays and estuaries so they may survive catastrophic events and adapt to condition changes.

In 1998, the Texas Agricultural Extension Service published the *Wetland and Coastal Resources Information Manual for Texas*, 2nd Edition, which includes the Texas Wetland Plan. Initiated in April of 1994, the Texas Wetland Plan employs a non-regulatory, voluntary approach to conserving Texas' wetlands. The plan describes how wetlands have economic and ecological benefits, such as flood control, improved water quality, harvestable products, and habitat for fish, shellfish, and wildlife resources. It also identifies each type of wetland resource throughout the State of Texas and then makes recommendations for conservation actions. The focus of the plan includes enhancing the landowner's ability to use existing incentive programs and other land use options through outreach and technical assistance, developing and encouraging land management options that provide an economic incentive for conserving existing wetlands or restoring former ones, and coordinating regional wetlands conservation efforts. The plan addresses each of these goals by utilizing such tools as education, economic incentives, statewide and regional conservation, assessment and evaluation, and coordination and funding activities.

In 1997, the 75th Session of the Texas Legislature passed Senate Bill 1, specifying that water plans be developed for regions of Texas as well as providing the future regulatory and financing decisions of the TCEQ and the TWDB be consistent with the approved regional water plans. In January 2001, the Coastal Bend Region submitted a plan for a 50-year planning period from 2000 to 2050, which consisted of water supply planning information, projected needs in the Region, and the Region's proposed water plans to meet needs. The total population of the Coastal Bend Region was projected to increase from 569,292 in 2000 to 943,912 by 2050. Similarly, the total water demand was projected to increase from 223,797 acft to 309,754 acft by 2050. There were 20 individual cities and water user groups (i.e., non-municipal water users, such as industrial and agricultural users) that showed projected needs during the 50-year planning horizon. Water management strategies were identified by the Coastal Bend Region to potentially meet water supply shortages. The TWDB evaluated social and economic impacts of not meeting projected water needs, which was included in the 2001 Coastal Bend Regional Water Plan.

In Water for Texas 2002 (State Plan), the TWDB utilized information and recommendations from the 16 individual Regional Water Plans developed by the Regional Water Planning Groups established under Senate Bill 1. Within the State Plan, the TWDB submitted the 12 water management strategies that were recommended by the Coastal Bend Region in their 2001 Coastal Bend Regional Water Plan.

The State Plan also included the Coastal Bend Region's recommendations to further investigate large-scale desalination, interregional cooperation on interbasin transfers and the exchange of surface water rights, and consideration for setting groundwater pumping level cutoffs.

1.10 Groundwater Conservation Districts

The Texas Legislature authorized in 1947 the creation of groundwater conservation districts to conserve and protect groundwater and later recognized them, in 1997, as the "preferred method of determining, controlling, and managing groundwater resources." According to Texas Water Code statue, the purpose of groundwater districts is to provide for the conservation, preservation, protection, and recharge of underground water and prevent waste and control subsidence caused by pumping water.[20] There are ten counties in the 11-county Coastal Bend Region that contain groundwater conservation districts: Bee, Brooks, Duval, Jim Wells, Kleberg, Live Oak, McMullen, Nueces, Kenedy, and San Patricio (Figure 1-7). Information regarding groundwater conservation districts, including contact list, can be found on the TWDB website (http://www.twdb.state.tx.us/GwRD/GCD/gcdhome.htm).

1.10.1 Bee Groundwater Conservation District

The Bee Groundwater Conservation District was created and adopted Management Rules in September 2002 and amended those rules in December 2005. The Rules require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre owned or operated at a maximum annual production of 1 acft per acre.

[20] Texas Water Code б 36.0015.

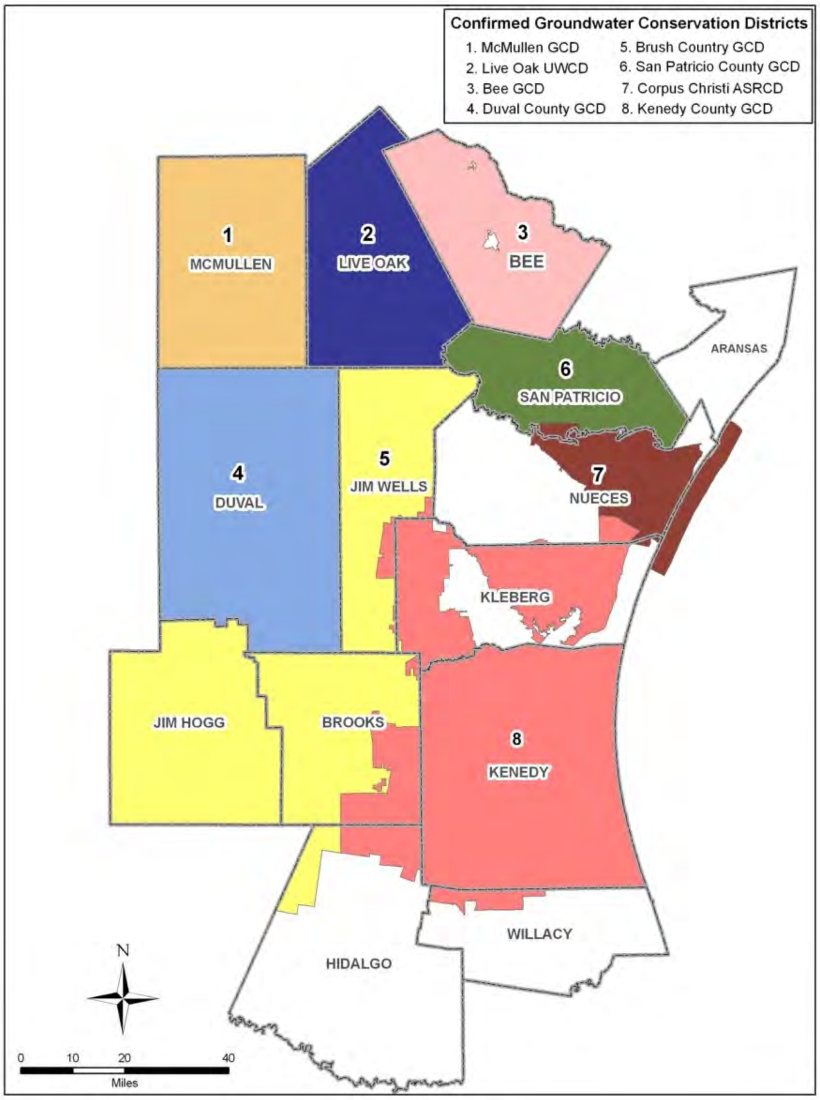

Figure 1-7. Groundwater Conservation Districts in Region N

1.10.2 Brush Country Groundwater Conservation District

Brush Country Groundwater Conservation District was created by the 81st Texas Legislature in 2009 and includes Brooks and Jim Wells Counties within the Coastal Bend Region as well as Jim Hogg County and a portion of Hidalgo County in Region M. District rules have not been established.

1.10.3 Corpus Christi Aquifer Storage and Recovery Conservation District

The Corpus Christi Aquifer Storage and Recovery Conservation District was created in 2005 by the 79th Texas Legislature. The District is located in Aransas, Kleberg, Nueces, and San

Patricio Counties. As with other GCDs, the major purposes of the District are to: (1) provide for conservation, preservation, protection, and recharge, (2) prevent waste, and (3) control land surface subsidence. The primary objective of the District is to facilitate the operation of aquifer storage and recovery operations by the City of Corpus Christi. The District adopted a Management Plan in June 2008 and is in the process of developing a proposed 5-year plan.

1.10.4 Duval County Groundwater Conservation District

The Duval County GCD was created in 2005 by the 79^{th} Texas Legislature. The District was approved by voters in 2009. The District currently does not have a Groundwater Management Plan.

1.10.5 Live Oak Underground Water Conservation District

The Live Oak Underground Water Conservation District (LOUWCD) was created June 14, 1989 and confirmed November 7, 1989. The District adopted Management Rules in June 1998 and amended the Rules in July 2000. The Rules require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre at a maximum annual production of 8 acft per acre. The District does not allow operation of Aquifer Storage and Recovery projects.

The Live Oak Underground Water Conservation District Management Plan was amended and adopted, by unanimous vote of all directors, on July 26, 2005.

1.10.6 McMullen Groundwater Conservation District

The McMullen Groundwater Conservation District was created and published District Rules in November 1999. The Rules, amended in August 2003 and again in November 2008, require registration for all existing and future wells in the District. The District imposes spacing and production limitations on new users and limits pumping to 10 gallons/minute per acre owned or operated at a maximum annual production of 1 acft per acre. The District does not allow operation of Aquifer Storage and Recovery projects.

1.10.7 Kenedy County Groundwater Conservation District

Kenedy County Groundwater Conservation District was created in 2003 and includes all of Kenedy County and parts of Brooks, Jim Wells, Kleberg, and Nueces Counties. The Rules, amended in January 2009, require registration for all existing and future wells in the District. The

District imposes spacing and production limitations on new users and limits annual production to 0.75 acre-inch/acre/year. New production limits will be determined once the Managed Available Groundwater is determined for the District.

1.10.8 San Patricio County Groundwater Conservation District

The San Patricio County GCD was created by the 79th Texas Legislature in 2005. The San Patricio County GCD is currently in the process of developing a Groundwater Management Plan.

1.11 Groundwater Management Areas

Groundwater Management Areas were created "in order to provide for the conservation, preservation, protection, recharging and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions…"[21] In December 2002, the TWDB designated 16 Groundwater Management Areas (GMAs) covering the entire state. There are three GMAs within the Coastal Bend Planning Area: 1) GMA 13 (McMullen County); 2) GMA 15 (Bee County); and 3) GMA 16 (all 11 Coastal Bend Planning Area Counties).

Originally, the areas were designated for determining which districts needed to coordinate joint planning by sharing their management plans. In 2005, the Legislature revised the direction of groundwater management. The new requirements, codified in Texas Water Code Chapter 36.108, required joint planning in management areas among groundwater conservation districts. The new requirement indicated that, "Not later than September 1, 2010, and every five years thereafter, the districts shall consider groundwater availability models and other data or information for the management area and shall establish desired future conditions for the relevant aquifers within the management area."

This means that, rather than individual districts determining how much groundwater was available, the districts would meet together, at least annually, to review groundwater management plans and accomplishments in the groundwater management area. Pursuant to House Bill 1763, districts are required to work together within a groundwater management area to develop desired future conditions (DFCs). The DFCs are a description of aquifers condition and production at some time in the future. This description is a precursor to developing

[21] Section 35.001, Chapter 35, Title 2, Texas Water Code.

groundwater availability, also called managed available groundwater (MAG). Both the TWDB and the TCEQ have processes developed and codified in their rules for the purpose of appealing either the DFCs or the joint planning process.

The TWDB is responsible for providing each groundwater conservation district and regional water planning group, located wholly or partly in the management area, with the MAG associated with the DFCs adopted by the districts. Groundwater availability models and other data or information may help in establishing managed available groundwater for the relevant aquifers within the management area. Once the MAG is determined, the districts begin issuing groundwater withdrawal permits to support the desired future condition of the aquifer up to the total amount of managed available groundwater. These permits express desired future conditions by only allowing withdrawals that will support the conditions established by the GMA. As of January 2010, none of the GMA's located in the Coastal Bend Region had established desired future conditions.

1.12 Current Status of Water Resources Planning and Management

Currently, the Coastal Bend Region is planning to meet future water demands in a number of ways. The City of Corpus Christi contracted with LNRA to receive 41,840 acft/yr from Lake Texana, which is delivered to the Region via the Mary Rhodes Pipeline. In 2002, LNRA submitted an application to TCEQ for an amendment to their water right, which would allow LNRA to divert an additional 7,500 acft of interruptible water to the Region. In July 2003, the LNRA entered into an agreement with the City of Corpus Christi to provide the Region an additional 4,500 acft water on an interruptible basis. This resulted in a total interruptible supply of 12,000 acft/yr provided to the Region from Lake Texana. In addition, the City of Corpus Christi has purchased 35,000 acft of water rights from the Garwood Irrigation Company to be transported to the Coastal Bend Region via an extension of the Mary Rhodes Pipeline.

For rural municipal communities and non-municipal water users that have historically used groundwater supplies, new groundwater availability studies (using the TWDB CGCGAM) indicate that in most cases, groundwater is available to meet local demands in the future.

A Water Resources Advisory Committee (WRAC) consists of nine members who represent various community interests. The advisory committee is appointed by the Mayor with approval of City of Corpus Christi City Council. With an understanding of regional water issues, the WRAC is tasked to monitor the effectiveness of the City's water related activities including advising the Mayor and City Council on the appropriateness of the City's current ordinances, suggested changes to ordinances, and response to activities to operate the water system efficiently in compliance with regulatory requirements.[22]

1.13 Assessment of Water Conservation and Drought Preparation

Besides extensive studies of the Coastal Bend Region's water needs and future resources, much of the Region has implemented the City of Corpus Christi's Water Conservation and Drought Contingency Plan. The City of Corpus Christi's Water Conservation Plan,[23] updated in April 2009, focuses on two goals: (1) to reduce summertime peak pumping, and (2) to reduce overall per capita consumption by 1 percent per year from the City's consumption of 233 gallons per capita per day (gpcd) in 2008 to 212 gpcd by 2018. The plan provides everyday water conservation tips, including plumbing codes and retrofit programs, and educational demonstrations and programs for the public. The City of Corpus Christi's Water Conservation Plan outlines a Drought Contingency Plan, which is implemented when current water supplies are threatened. In 2001, the City of Corpus Christi amended their Drought Contingency Plan to reflect changes to the operation of the CCR/LCC System. These amendments removed the "Conditions" hierarchical stages in their Drought Contingency Plan, which were previously used to implement the different water conservation measures as the threat of water shortage increased. The Drought Contingency Plan, updated in April 2009, is initiated as the percentage of combined storage of the CCR/LCC System decreases and includes water reduction targets based on storage levels (Table 1-4).

In addition, during severe drought conditions, both municipal and wholesale customers are subject to water allocation from the City of Corpus Christi. In turn, wholesale customers are responsible to impose similar allocations on their customers. The City's Water Conservation Plan includes water conservation targets and goals for their wholesale customers (Table 1-4).

The City of Corpus Christi's Water Conservation Plan recognizes its long-held conservation-based water rate structure, universal metering and a meter repair/replacement program, and leak detection program. Other programs outlined within the water conservation plan are such practices as reuse and recycling of wastewater and greywater, the establishment of landscape ordinances, and an outlined procedure to determine and control unaccounted-for water

[22] City of Corpus Christi website, December 2009.
[23] City of Corpus Christi Water Conservation and Drought Contingency Plan, Amended April 28, 2009.

loss. The City of Corpus Christi's Water Conservation Plan not only recognizes the ongoing water conservation practices within the City of Corpus Christi service area but it also defined water conservation goals. City of Corpus Christi water conservation goals include:

- Reduce the City's per capita water use by 1% per year;
- Limit unaccounted-for water from the City's system to no more than 10 percent (based on a moving 5-year average); and
- Assist City customers in continuing efforts toward water conservation.

Table 1-4.
City of Corpus Christi Drought Contingency Plan

Combined Storage below 50%	• City Manager issues a public notice requesting voluntary conservation measures • Target water demand reduction of 1 percent, including wholesale water contracts
Combined Storage below 40%	• City Manager issues a public notice implementing required water conservation measures • Outdoor watering restricted; no outdoor watering allowed between 10:00 a.m. and 6:00 p.m. • No runoff from yards or plants into gutters or streets allowed • All defective plumbing in a home or business must be addressed • No water shall be allowed to flow constantly through a tap, hydrant, valve, or otherwise by any user • Target Inflows to Nueces Bay are reduced to 1,200 acft per month • Target water demand reduction of 5 percent, including wholesale water contracts
Combined Storage below 30%	• City Manager publishes a lawn-watering schedule • Target Inflows to Nueces Bay are reduced to 0 acft per month • Target water demand reduction of 10 percent, including wholesale water contracts
Combined Storage below 20%	• Target water demand reduction of 15 percent, including wholesale water contracts

The TCEQ provides guidance for Water Conservation and Drought Contingency Plans in 30 TAC Chapter 288, which requires "specific, quantified 5- and 10-year targets for water savings to be included in all water conservation plans to be submitted to the TCEQ no later than

May 1, 2005." In addition to the City of Corpus Christi plan outline above, the following entities have provided a TCEQ approved water conservation plan and/or drought contingency plan to the Coastal Bend RWPG:

- Aransas County MUD #1;
- City of Alice;
- City of Aransas Pass;
- City of Beeville;
- City of Ingleside;
- City of Kingsville;
- City of Portland;
- City of Rockport;
- Nueces WSC;
- Ricardo WSC;
- Rincon WSC; and
- South Texas Water Authority.

1.14 TWDB Water Loss Audit Data

In December 2004 in response to House Bill 3338, the TWDB adopted rules to require retail public utilities, as defined by Texas Water Code §13.002, to perform a water loss audit and submit water loss audit forms to the TWDB every five years.[24] Pursuant to TWDB Rules[25] for regional water planning, regional water planning groups are required to include information compiled by the TWDB from water loss audits performed by retail public utilities and shall consider strategies to address any issues identified in the water loss audit information compiled by the TWDB.

In January 2007, the TWDB issued a report titled "An Analysis of Water Loss as Reported by Public Water Suppliers in Texas (Final Report)," which includes water loss data by region for regional water planning groups to consider while developing the 2011 Regional Water Plans. The report included data acquired as part of the 2005 Water Loss Audit, which is the first time that this water loss audit methodology has been used by many retail public utilities. The

[24] In accordance with Texas Administrative Code §358.6.
[25] In accordance with Texas Administrative Code §357.7(a)(1)(M) and Texas Administrative Code §357.7(a)(7)(a)(iv).

report indicates that “some of the self-reported data may be suspect and in need of further refinement.” Furthermore, a “balancing adjustment” was used by the TWDB when compiling data from the 2005 Water Loss Audit to represent amounts of water left over after all known and unknown uses of consumption and losses were accounted for and subtracted from the input volume. Since it is difficult to determine if these unaccounted for supplies are attributed to actual losses, unbilled water supplies, fire fighting, or other uses, it is challenging to differentiate “water losses” from beneficial unaccounted for supplied. It is anticipated that efforts to assess water losses will improve with future water audits filed on a five year basis, as retail public utilities become more familiar with reporting methodologies and the TWDB provides additional guidance and support.

According to the TWDB[26], the 2005 Water Loss Audit was primarily intended to gather information about water losses from retail public utilities and identify any significant reporting issues. On December 16, 2009, the TWDB provided “one methodology for how TWDB calculates percentage water loss for water systems.” Using the methodology provided by the TWDB, of the 31 retail public utilities in the Coastal Bend Region who reported water loss data, 13 of those reported total water losses of less than 10%. Of those 13 utilities, six reported water loss of less than 5% which appears suspect. Four of the utilities reported zero (or negative) water loss. The remaining 18 utilities, reported losses greater than 10%.

The TWDB rules require that regional water planning groups consider water management strategies to address issues identified in the water loss audits, which were provided by the TWDB on August 3, 2009. The Coastal Bend Regional Water Planning Group acknowledges the water loss data provided by the TWDB; however, because much of the self-reported data from the water loss audits is highly suspect and is unreliable, the RWPG cannot make recommendations concerning specific water management strategies for specific water user groups. It is hoped that future water loss audit information will improve in accuracy and be useful in the future as a basis for making specific water management strategy recommendations for water user groups.

[26] Based on phone conversation with John Sutton on August 11, 2009.

Section 2
Population and Water Demand Projections
[31 TAC §.57.7 (a)(2)]

2.1 Introduction

For the 2011 Coastal Bend Regional Water Plan (Plan), the TWDB did not issue new population or water demand projections due to the lack of new Census data. The Coastal Bend RWPG did request a water demand revision for irrigation in Bee and San Patricio Counties. This is discussed further in the Irrigation Water Demand Section. In all other cases, the population and water demand projections remained identical to the 2006 Plan. Population projections were developed for cities with a population greater than 500, water supply corporations and special utility districts using volumes of 280 acft or more in 2000, and 'county-other' to capture those people living outside the cities or water utility service areas for each county. Water demand projections were developed by type of use: municipal for cities and water supply corporations/special utility districts (along with a 'county-other' for each county), and countywide for manufacturing, steam-electric, mining, irrigation, and livestock. This section presents these figures for the 11-county Coastal Bend Regional Water Planning Area. These counties are located within three river basins: the Nueces River Basin, the San Antonio-Nueces Coastal Basin, and the Nueces-Rio Grande Coastal Basin (Figure 2-1). The population projections are a consensus-based "most-likely" scenario of growth, based on recent and prospective growth trends as determined by the opinions of a Technical Advisory Committee consisting of state agencies, key interest groups, and the general public. The demand projections for each type of water use were made under various assumptions that will be addressed in each water-use section below.

Appendix C contains population, per capita water use, and water demand projections for each city and county-other and manufacturing (including steam-electric, if applicable), mining, and irrigation and livestock water demand projections by county and river basin.

2.2 Population Projections

From 1980 to 2000, the population in the 11-county region grew by 72,927 (from 468,257 to 541,184), an increase of 15.6 percent (0.73 percent compound annual growth), as shown in Table 2-1. This compares with a statewide increase in population of 46.5 percent

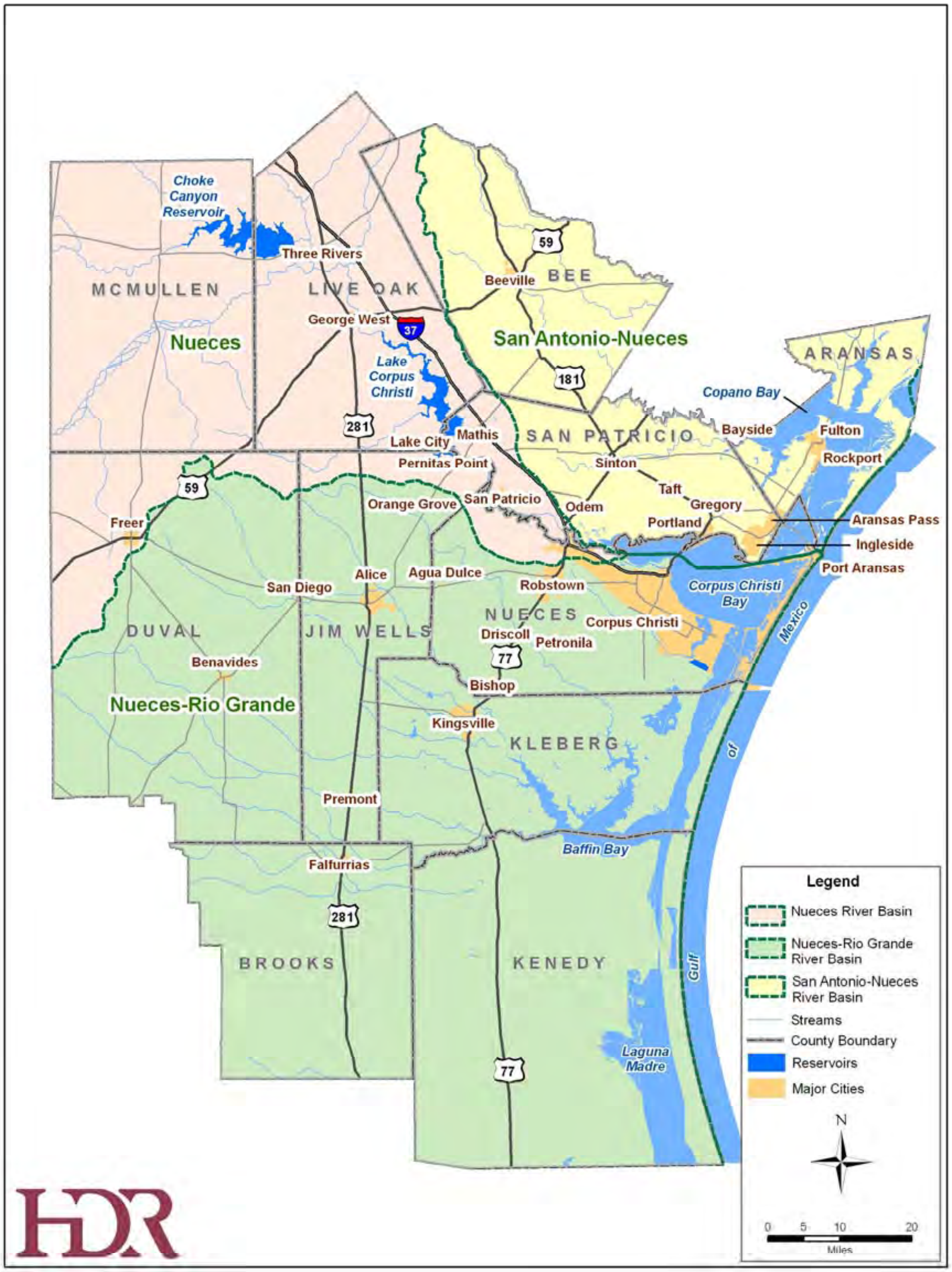

Figure 2-1. Coastal Bend Region River Basin Boundaries

Table 2-1.
Coastal Bend Regional Population
(by County and River Basin)

	Historical			Projections[1]						Percent Growth[2]	Percent Growth[2]
	1980	1990	2000	2010	2020	2030	2040	2050	2060	(1980-00)	(2000-60)
County											
Aransas	14,260	17,892	22,497	26,863	30,604	32,560	32,201	30,422	28,791	2.31%	0.41%
Bee	26,030	25,135	32,359	34,298	36,099	37,198	37,591	37,598	36,686	1.09%	0.21%
Brooks	8,428	8,204	7,976	8,607	9,303	9,909	10,288	10,399	10,349	-0.28%	0.44%
Duval	12,517	12,918	13,120	13,881	14,528	14,882	14,976	14,567	13,819	0.24%	0.09%
Jim Wells	36,498	37,679	39,326	42,434	45,303	47,149	47,955	47,615	46,596	0.37%	0.28%
Kenedy	543	460	414	467	495	523	527	529	537	-1.35%	0.43%
Kleberg	33,358	30,274	31,549	36,959	40,849	43,370	44,989	47,118	47,212	-0.28%	0.67%
Live Oak	9,606	9,556	12,309	13,735	14,929	15,386	15,018	13,808	12,424	1.25%	0.02%
McMullen	789	817	851	920	957	918	866	837	793	0.38%	-0.12%
Nueces	268,215	291,145	313,645	358,278	405,492	447,014	483,692	516,265	542,327	0.79%	0.92%
San Patricio	58,013	58,749	67,138	80,701	95,381	109,518	122,547	134,806	146,131	0.73%	1.30%
Total for Region	468,257	492,829	541,184	617,143	693,940	758,427	810,650	853,964	885,665	0.73%	0.82%
River Basin											
Nueces	38,122	40,062	56,482	62,655	68,897	73,705	77,095	79,088	80,134	1.99%	0.58%
Nueces-Rio Grande	341,308	360,810	372,608	422,954	473,751	516,683	552,859	584,074	606,293	0.44%	0.81%
San Antonio-Nueces	88,827	91,957	112,094	131,534	151,292	168,039	180,696	190,802	199,238	1.17%	0.96%
Total for Region	**468,257**	**492,829**	**541,184**	**617,143**	**693,940**	**758,427**	**810,650**	**853,964**	**885,665**	**0.73%**	**0.82%**
Total for Texas	**14,229,191**	**16,986,510**	**20,851,790**	**24,909,072**	**29,108,012**	**33,040,035**	**36,877,046**	**41,054,973**	**45,533,734**	**1.93%**	**1.31%**

[1]Projections from Texas Water Development Board.
[2]Compound annual growth rate.

(1.93 percent annually). The majority of the growth occurred in Nueces and San Patricio Counties, the two largest counties in the region by population. Combined, they accounted for 75 percent of the total increase, and in 2000 their populations totaled 70 percent of the region. In 2000, 58.0 percent of the region's total population lived in Nueces County, 12.4 percent in San Patricio County, 7.3 percent in Jim Wells County, 6.0 percent in Bee County, 5.8 percent in Kleberg County, and less than 5.0 percent in each of the remaining six counties.

The population in the 11-county region is projected to increase by 344,481 from 2000 to 2060, an increase of 63.7 percent (0.82 percent annually), as shown in Table 2-1. This compares to a statewide projected population growth in the same period of 118 percent (1.31 percent annually). The total population for the region in 2000 was 2.6 percent of the 20.85 million population statewide. It declines slightly by 2060, to 1.9 percent of the projected 45.5 million statewide totals. In 2060, it is projected that 61.2 percent of the region's population will live in Nueces County, 16.5 percent in San Patricio County, 5.3 percent in Kleberg County, 5.3 percent in Jim Wells County, and less than 5.0 percent in each of the remaining seven counties. Figure 2-2 shows the trend in population for the region from 1990 to 2060.

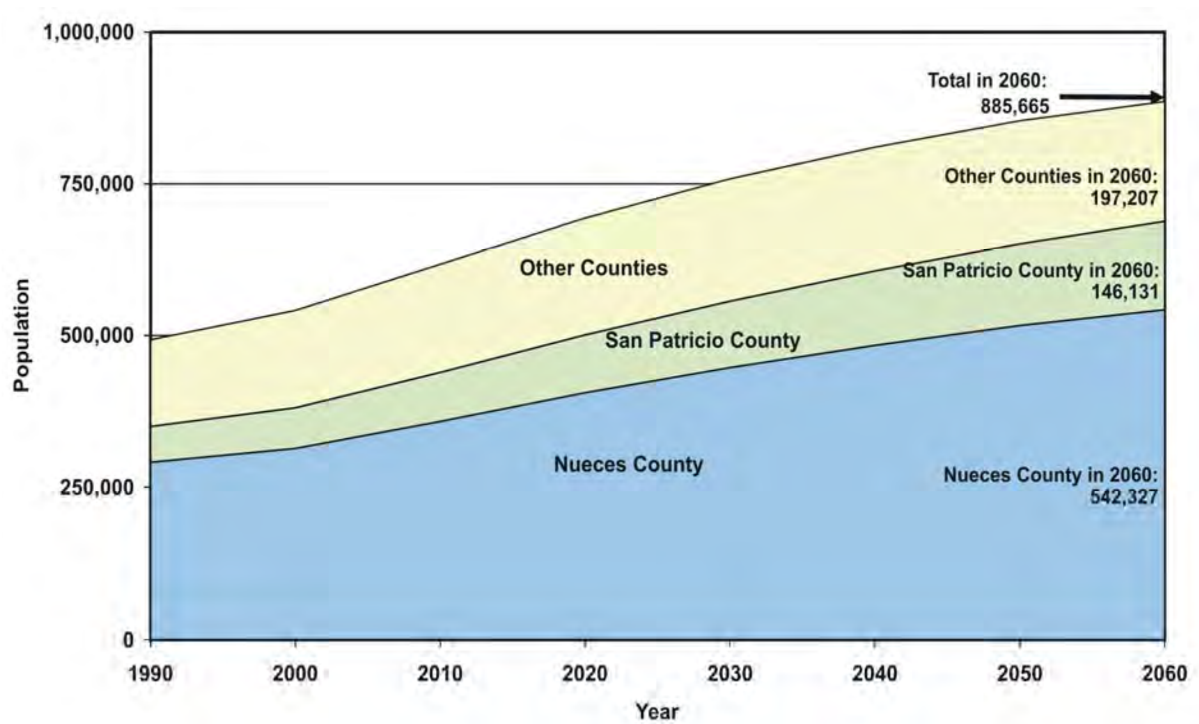

Figure 2-2. Coastal Bend Region Population

San Patricio and Nueces Counties are the fastest growing counties in the region, with future projections growing at an annual rate higher than the regional average of 0.82 percent (Figure 2-3). The population growth in those counties accounts for 89.3 percent of the total increase over the next 60 years. Aransas, Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg and Live Oak Counties all have positive annual growth rates, but less than the regional average. The growth rate in McMullen County, the second smallest county in the region, is negative, as their population is anticipated to decline over the 60-year period, from 851 to 793.

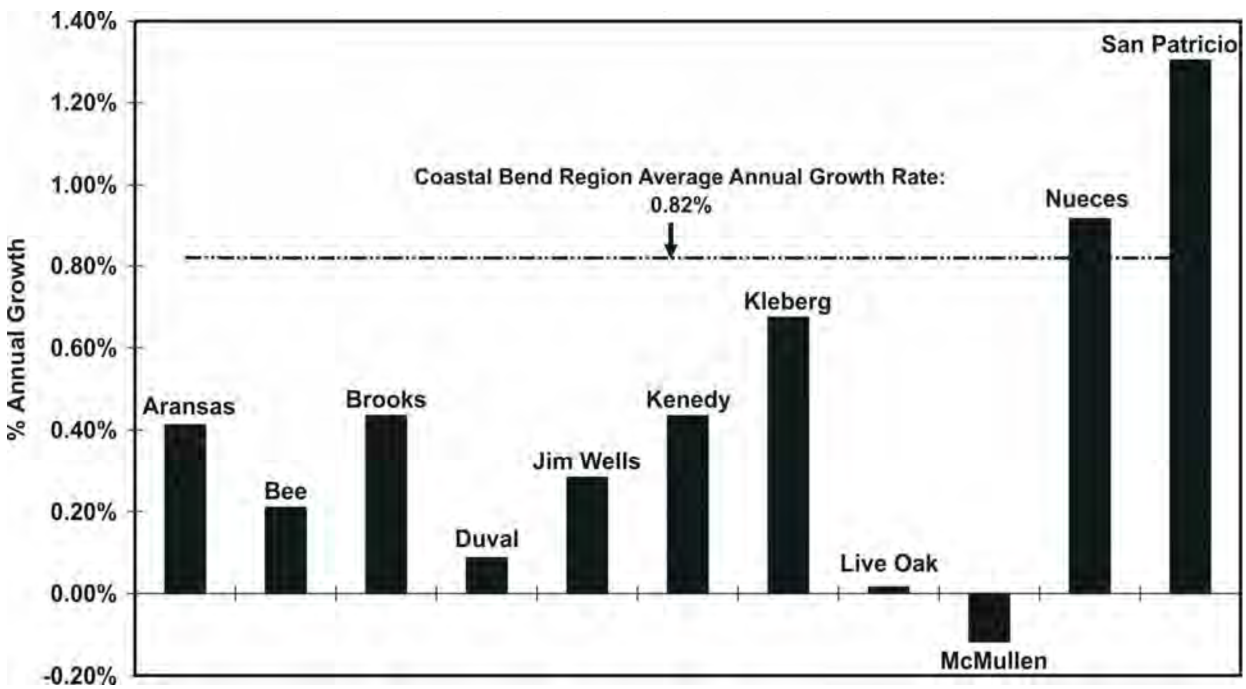

Figure 2-3. Percent Annual Population Growth Rate for 2000 through 2060 by County

Corpus Christi and Kingsville are the two largest cities in the region, accounting for 56.0 percent of the total population in 2000, increasing to 56.4 percent of the total in 2060. Population projections for the 46 cities, water supply corporations, and 'county-other' users in the region are shown in Table 2-2. County-Other category includes persons residing outside of cities and also outside water utility boundaries. Population for water user groups by county and river basin is included in Appendix C.

Table 2-2.
Coastal Bend Region Population
(by City/County)

City/County	Historical			Projections						Percent Growth[2]	Percent Growth[2]
	1980	1990	2000	2010	2020	2030	2040	2050	2060	1980-00	2000-60
ARANSAS PASS (P)	860	912	867	1,035	1,179	1,255	1,241	1,172	1,110	0.04%	0.41%
FULTON		763	1,553	1,854	2,113	2,248	2,223	2,100	1,987	N/A	0.41%
ROCKPORT	3,686	5,355	7,385	8,818	10,046	10,688	10,570	9,987	9,451	3.54%	0.41%
COUNTY-OTHER	9,714	10,862	12,692	15,156	17,266	18,369	18,167	17,163	16,243	1.35%	0.41%
Aransas County	*14,260*	*17,892*	*22,497*	*26,863*	*30,604*	*32,560*	*32,201*	*30,422*	*28,791*	*2.31%*	*0.41%*
BEEVILLE	14,574	13,547	13,129	13,916	14,646	15,092	15,252	15,255	14,885	-0.52%	0.21%
EL OSO WSC (P)		271	320	339	357	368	372	372	363	N/A	0.21%
COUNTY-OTHER	11,456	11,317	18,910	20,043	21,096	21,738	21,967	21,971	21,438	2.54%	0.21%
Bee County	*26,030*	*25,135*	*32,359*	*34,298*	*36,099*	*37,198*	*37,591*	*37,598*	*36,686*	*1.09%*	*0.21%*
FALFURRIAS	6,103	5,788	5,297	6,981	8,316	9,310	9,924	10,178	10,215	-0.71%	1.10%
COUNTY-OTHER	2,325	2,416	2,679	1,626	987	599	364	221	134	0.71%	-4.87%
Brooks County	*8,428*	*8,204*	*7,976*	*8,607*	*9,303*	*9,909*	*10,288*	*10,399*	*10,349*	*-0.28%*	*0.44%*
BENAVIDES	1,978	1,788	1,686	1,784	1,867	1,912	1,925	1,872	1,776	-0.80%	0.09%
FREER	3,213	3,271	3,241	3,429	3,589	3,676	3,699	3,598	3,414	0.04%	0.09%
SAN DIEGO (P)	4,331	4,109	3,928	4,156	4,350	4,456	4,484	4,361	4,137	-0.49%	0.09%
COUNTY-OTHER	2,995	3,750	4,265	4,512	4,722	4,838	4,868	4,736	4,492	1.78%	0.09%
Duval County	*12,517*	*12,918*	*13,120*	*13,881*	*14,528*	*14,882*	*14,976*	*14,567*	*13,819*	*0.24%*	*0.09%*
ALICE	20,961	19,788	19,010	20,512	21,899	22,792	23,181	23,017	22,524	-0.49%	0.28%
ORANGE GROVE	1,212	1,175	1,288	1,390	1,484	1,544	1,571	1,559	1,526	0.30%	0.28%
PREMONT	2,984	2,914	2,772	2,991	3,193	3,323	3,380	3,356	3,284	-0.37%	0.28%
SAN DIEGO (P)	894	874	825	890	950	989	1,006	999	978	-0.40%	0.28%
COUNTY-OTHER	10,447	12,928	15,431	16,651	17,777	18,501	18,817	18,684	18,284	1.97%	0.28%
Jim Wells County	*36,498*	*37,679*	*39,326*	*42,434*	*45,303*	*47,149*	*47,955*	*47,615*	*46,596*	*0.37%*	*0.28%*
COUNTY-OTHER	543	460	414	467	495	523	527	529	537	-1.35%	0.43%
Kenedy County	*543*	*460*	*414*	*467*	*495*	*523*	*527*	*529*	*537*	*-1.35%*	*0.43%*
KINGSVILLE	28,808	25,276	25,575	26,844	27,756	28,347	28,727	29,226	29,248	-0.59%	0.22%
RICARDO WSC		1,503	2,301	5,687	8,122	9,700	10,713	12,046	12,105	N/A	2.81%
COUNTY-OTHER	4,550	3,495	3,673	4,428	4,971	5,323	5,549	5,846	5,859	-1.06%	0.78%
Kleberg County	*33,358*	*30,274*	*31,549*	*36,959*	*40,849*	*43,370*	*44,989*	*47,118*	*47,212*	*-0.28%*	*0.67%*
CHOKE CANYON WS (P)		539	2,250	2,511	2,729	2,812	2,745	2,524	2,271	N/A	0.02%
EL OSO (P)		*812*	1,000	1,116	1,213	1,250	1,220	1,122	1,009	N/A	0.01%
GEORGE WEST	2,627	2,586	2,524	2,816	3,061	3,155	3,079	2,831	2,548	-0.20%	0.02%
MCCOY WSC (P)		185	443	494	537	554	540	497	447	N/A	0.01%
THREE RIVERS	2,133	1,889	1,878	2,096	2,278	2,347	2,291	2,107	1,896	-0.63%	0.02%
COUNTY-OTHER	4,846	3,545	4,214	4,702	5,111	5,268	5,143	4,727	4,253	-0.70%	0.02%
Live Oak County	*9,606*	*9,556*	*12,309*	*13,735*	*14,929*	*15,386*	*15,018*	*13,808*	*12,424*	*1.25%*	*0.02%*

Table 2-2.
Coastal Bend Region Population
(by City/County) (Concluded)

City/County	Historical			Projections						Percent Growth²	Percent Growth²
	1980	*1990*	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*	*1980-00*	*2000-60*
CHOKE CANYON WS (P)		60	250	270	281	270	254	246	233	N/A	-0.12%
COUNTY-OTHER	789	757	601	650	676	648	612	591	560	-1.35%	-0.12%
McMullen County	*789*	*817*	*851*	*920*	*957*	*918*	*866*	*837*	*793*	*0.38%*	*-0.12%*
AGUA DULCE		794	737	737	737	737	737	737	737	N/A	0.00%
ARANSAS PASS (P)	5	22	70	163	259	343	417	482	534	14.11%	3.44%
BISHOP	3,706	3,337	3,305	3,305	3,305	3,305	3,305	3,305	3,305	-0.57%	0.00%
CORPUS CHRISTI	231,999	257,453	277,450	316,058	356,123	391,077	421,761	448,879	470,523	0.90%	0.88%
DRISCOLL		688	825	1,090	1,364	1,603	1,813	1,999	2,147	N/A	1.61%
NUECES COUNTY WCID #4		2,192	4,663	9,434	14,385	18,704	22,496	25,847	28,521	N/A	3.06%
PORT ARANSAS	1,968	2,233	3,370	5,565	7,843	9,830	11,575	13,117	14,348	2.73%	2.44%
RIVER ACRES WSC		2,130	2,750	3,947	5,189	6,273	7,224	8,065	8,736	N/A	1.95%
ROBSTOWN	12,100	12,849	12,727	12,727	12,727	12,727	12,727	12,727	12,727	0.25%	0.00%
COUNTY-OTHER	18,437	9,447	7,748	5,252	3,560	2,415	1,637	1,107	749	-4.24%	-3.82%
Nueces County	*268,215*	*291,145*	*313,645*	*358,278*	*405,492*	*447,014*	*483,692*	*516,265*	*542,327*	*0.79%*	*0.92%*
ARANSAS PASS (P)	6,308	6,246	7,201	8,653	10,225	11,739	13,134	14,447	15,660	0.66%	1.30%
GREGORY	2,739	2,458	2,318	2,318	2,318	2,318	2,318	2,318	2,318	-0.83%	0.00%
INGLESIDE	5,436	5,696	9,388	15,003	21,080	26,933	32,327	37,402	42,090	2.77%	2.53%
INGLESIDE ON THE BAY		529	659	857	1,071	1,277	1,467	1,646	1,811	N/A	1.70%
LAKE CITY		465	526	619	719	816	905	989	1,066	N/A	1.18%
MATHIS	5,667	5,423	5,034	5,034	5,034	5,034	5,034	5,034	5,034	-0.59%	0.00%
ODEM	2,363	2,366	2,499	2,701	2,920	3,131	3,325	3,508	3,677	0.28%	0.65%
PORTLAND	12,023	12,224	14,827	18,786	23,071	27,197	31,000	34,578	37,884	1.05%	1.58%
SINTON	6,044	5,549	5,676	5,869	6,078	6,279	6,465	6,640	6,801	-0.31%	0.30%
TAFT	3,686	3,222	3,396	3,661	3,947	4,223	4,477	4,716	4,937	-0.41%	0.63%
COUNTY-OTHER	13,747	14,571	15,614	17,200	18,918	20,571	22,095	23,528	24,853	0.64%	0.78%
San Patricio County	*58,013*	*58,749*	*67,138*	*80,701*	*95,381*	*109,518*	*122,547*	*134,806*	*146,131*	*0.73%*	*1.30%*
Total For Region	**468,257**	**492,829**	**541,184**	**617,143**	**693,940**	**758,427**	**810,650**	**853,964**	**885,665**	**0.73%**	**0.82%**

Notes:
[1] Projections from Texas Water Development Board
[2] Compound annual growth rate
(P) Partial

2.3 Water Demand Projections

The TWDB water demand projections have been compiled for each type of consumptive water use: municipal, manufacturing, steam-electric power, mining, irrigation, and livestock. In these consumptive types of water use there is a “loss” in water. In non-consumptive water use, such as navigation, hydroelectric generating, or recreation, there is little or no water loss. As shown in Table 2-3, total water use for the region is projected to increase by 119,002 acft/yr between 2000 and 2060, from 205,936 acft/yr to 324,938 acft/yr, a 57.8 percent rise. Municipal, manufacturing, steam-electric, irrigation, and mining water use are all projected to increase, while livestock use is unchanged. The trend in total water use for 2000 to 2060 is shown in Figure 2-4. In 2000, 48.5 percent of the total water use was for municipal purposes, 26.4 percent for manufacturing, 4.3 percent for steam-electric water, 5.8 percent for mining, 10.7 percent for irrigation, and 4.3 percent for livestock. In 2060, municipal use as a percentage of the total is projected to decrease to 46.6 percent, manufacturing use to increase to 27.1 percent, steam-electric water use to increase to 8.5 percent, mining use to increase to 5.9 percent, irrigation water use to decrease to 9.1 percent, and livestock use to decrease to 2.8 percent. These components of total water use for 2000 and 2060 are shown in Figure 2-5.

Table 2-3.
Coastal Bend Region Total Water Demand by Type of Use and River Basin (acft/yr)

	Historical		*Projections*[1]					
	1990	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Water Use								
Municipal	108,620	99,950	111,495	122,861	132,063	139,425	146,036	151,474
Manufacturing	43,611	54,481	63,820	69,255	73,861	78,371	82,283	88,122
Steam-Electric	2,404	8,799	7,316	14,312	16,733	19,683	23,280	27,664
Mining	7,563	11,897	15,150	16,524	16,640	17,490	18,347	19,114
Irrigation	14,237	21,971	25,884	26,152	26,671	27,433	28,450	29,726
Livestock	9,624	8,838	8,838	8,838	8,838	8,838	8,838	8,838
Total for Region	**186,059**	**205,936**	**232,503**	**257,942**	**274,806**	**291,240**	**307,234**	**324,938**
River Basin								
Nueces	23,734	38,217	41,060	51,000	54,365	57,964	61,846	66,587
Nueces-Rio Grande	135,782	137,622	153,474	165,077	175,110	184,817	193,843	203,406
San Antonio-Nueces	26,543	30,097	37,969	41,865	45,331	48,459	51,545	54,945
Total for Region	**186,059**	**205,936**	**232,503**	**257,942**	**274,806**	**291,240**	**307,234**	**324,938**

[1] Projections from Texas Water Development Board

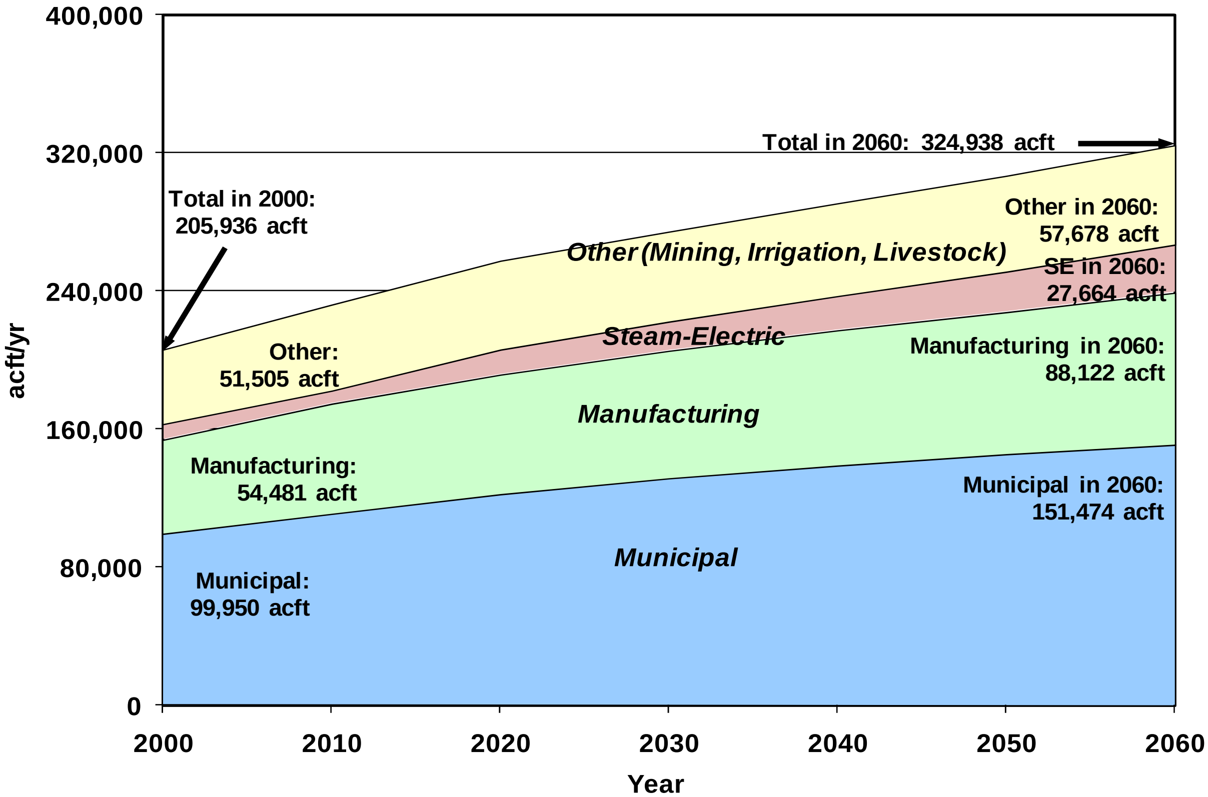

Figure 2-4. Coastal Bend Region Water Demand

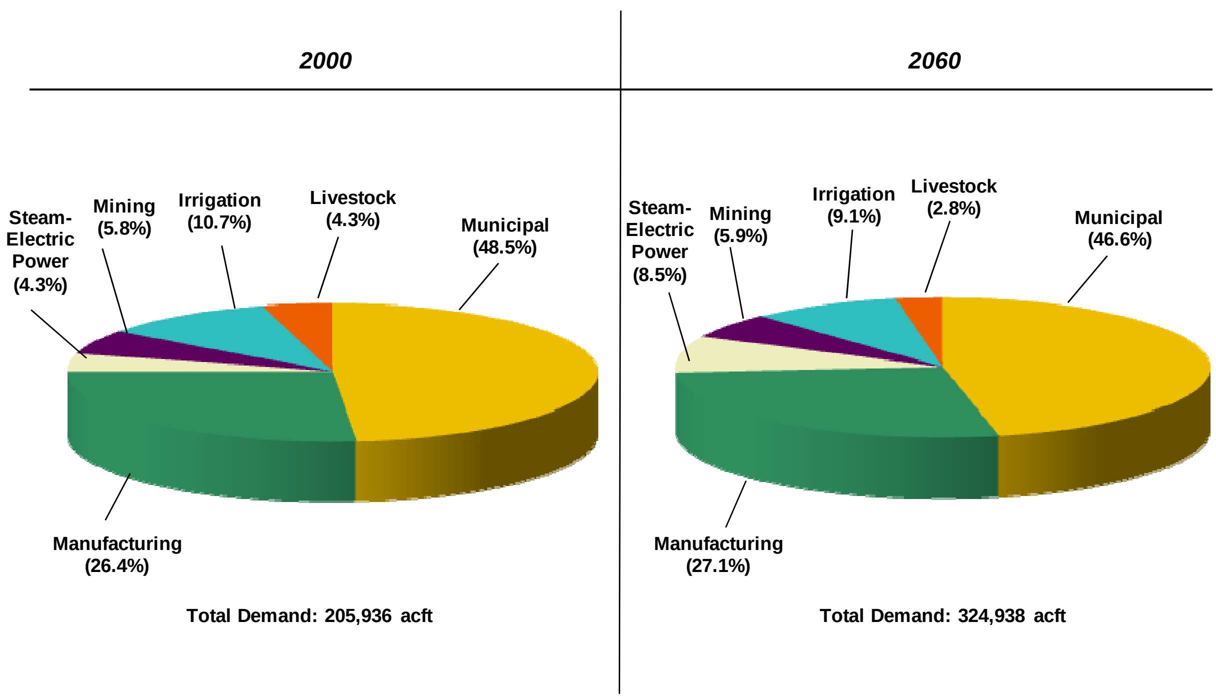

Figure 2-5. Total Water Demand by Type of Use

The Coastal Bend Region is located within three river basins: the Nueces River Basin, the San Antonio-Nueces Coastal Basin, and the Nueces-Rio Grande Coastal Basin. Total water demand in each basin is shown in Table 2-3. Water demands for water user groups by county and river basin are included in Appendix C.

2.3.1 Municipal Water Demand

Water that is used by households (e.g., drinking, bathing, food preparation, dishwashing, laundry, flushing toilets, lawn watering and landscaping, swimming pools and hot tubs) commercial establishments (e.g., restaurants, car washes, hotels, laundromats, and office buildings) and for fire protection, public recreation and sanitation are all referred to as municipal water. This type of water must meet safe drinking water standards as specified by Federal and State laws and regulations.

The TWDB computes the municipal water demand projections by multiplying the projected population of an entity by the entity's projected per capita water use, adjusted for conservation savings. Again, projected population is the "most-likely" scenario. The projected per capita water use takes into account current plumbing fixtures as well as anticipated effects of the 1991 State Water-Efficient Plumbing Act and is estimated based on year 2000 water use, which represents below-normal rainfall in most of the state. The projected per capita water use is an "expected" scenario of water conservation including installation of water-efficient plumbing fixtures as defined by the 1991 State Water-Efficient Plumbing Act. In all cases, applying this conservation scenario to the per capita use results in a declining per capita water use over time.

In 2000 total municipal use in the Coastal Bend Region was 99,950 acft/yr. Nueces and San Patricio Counties accounted for 71.6 percent of the total. Municipal use is projected to increase 51.5 percent to 151,474 acft by year 2060 (Table 2-4). Brooks, Nueces, and San Patricio Counties will experience the largest increases, 54.6 percent, 64.3 percent, and 82.5 percent, respectively. By 2060, Nueces and San Patricio Counties will account for 78.7 percent of the total municipal water use in the region (Figure 2-6).

The increase in municipal water demand correlates to an increase in the region's population. This is illustrated in the entities of the City of Corpus Christi and Ricardo Water Supply Corporation (WSC). Both are projected to experience large increases in population, and as a result, in water use as well. Corpus Christi's water use is projected to increase 56.3 percent over the next 60 years while Ricardo WSC's increase is projected to increase 372.0 percent.

Table 2-4.
Coastal Bend Region Municipal Water Demand by County and River Basin (acft/yr)

County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas	2,614	3,314	3,831	4,263	4,444	4,326	4,053	3,835
Bee	3,569	4,220	4,342	4,456	4,492	4,439	4,397	4,291
Brooks	1,150	1,970	2,315	2,621	2,857	2,994	3,043	3,045
Duval	2,090	2,323	2,400	2,453	2,463	2,428	2,345	2,223
Jim Wells	6,535	8,562	9,068	9,526	9,756	9,761	9,640	9,433
Kenedy	44	46	50	52	53	53	52	53
Kleberg	6,261	5,415	6,051	6,436	6,664	6,762	7,008	7,020
Live Oak	1,796	2,350	2,573	2,750	2,796	2,693	2,459	2,213
McMullen	109	175	186	190	180	168	160	152
Nueces	76,521	62,702	70,609	78,691	85,697	91,988	97,882	103,018
San Patricio	7,931	8,873	10,070	11,423	12,661	13,813	14,997	16,191
Total for Region	**108,620**	**99,950**	**111,495**	**122,861**	**132,063**	**139,425**	**146,036**	**151,474**
River Basin								
Nueces	10,862	10,017	10,832	11,628	12,184	12,521	12,698	12,821
Nueces-Rio Grande	84,992	74,787	83,683	92,369	99,570	105,617	111,198	115,677
San Antonio-Nueces	12,766	15,146	16,980	18,864	20,309	21,287	22,140	22,976
Total for Region	**108,620**	**99,950**	**111,495**	**122,861**	**132,063**	**139,425**	**146,036**	**151,474**

[1] Projections from Texas Water Development Board

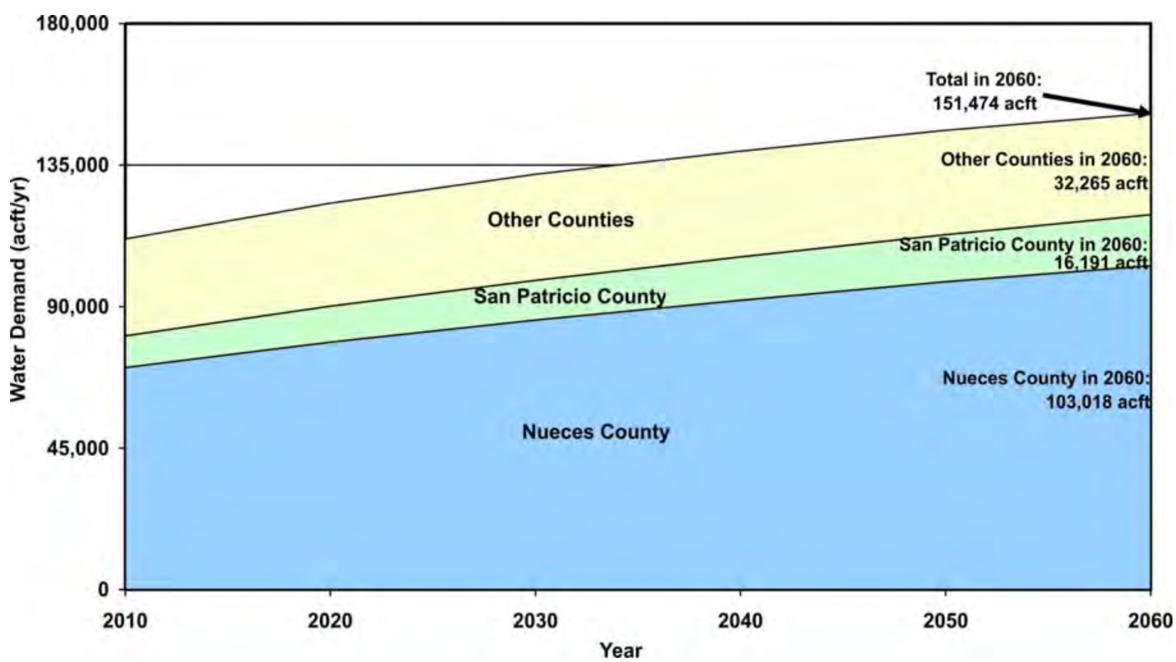

Figure 2-6. Coastal Bend Region Municipal Water Demand

However, the increase in water use for each of these entities is less than their respective increases in population (i.e., low flow plumbing fixtures). This is attributable to a declining per capita water use, which includes conservation built-in the TWDB demand projections. Per capita water use in Corpus Christi is projected to decline 7.8 percent, from 179 gallons per capita daily (gpcd) in 2000 to 165 gpcd in 2060. Per capita water use for Ricardo WSC was estimated to be 115 gpcd in 2000, declining 10.4 percent to 103 gpcd in 2060. Municipal water use projections for the 46 entities in the region are presented in Table 2-5.

2.3.2 Manufacturing Water Demand

Manufacturing is an integral part of the Texas economy, and for many industries, water plays a key role in the manufacturing process. Some of these processes require direct consumption of water as part of the products; others consume very little water but use a large quantity for cleaning and cooling. Whether the water is a product component or used to transport waste heat and materials, it is considered manufacturing water use. The water-using manufacturers in the 11-county Coastal Bend Region are food processing, chemicals, petroleum refining, stone and concrete, fabricated metal, and electronic and electrical equipment. Of these industries present in the region, chemicals and petroleum refining are the largest and biggest water users.

The TWDB projects manufacturing water demand by taking industry-specific water demand coefficients, adjusted for water-use efficiencies (recycling/reuse), and applying them to growth trends for each industry. These growth trends assume expansion of existing capacity and building of new facilities; continuation of historical trends of interaction between oil price changes and industrial activity; and that the makeup of each county’s manufacturing base remains constant throughout the 60-year planning period.

In 2000, total manufacturing water use for Coastal Bend Region was 54,481 acft. Nueces and San Patricio Counties accounted for 96.3 percent of this total (Table 2-6). Manufacturing use is projected to be 73,861 acft in 2030 and 88,122 acft in 2060, a 61.7 percent increase. In 2060, Nueces and San Patricio Counties are projected to account for 97.1 percent of the total manufacturing water use in the region (Figure 2-7). This projected increase can be attributed to continued growth in the petroleum refining industry in Nueces and San Patricio Counties.

The TWDB water demand projections show minimal water use for manufacturing activities in Bee and McMullen County. According to the local groundwater conservation districts, water is being used for manufacturing activities in Bee and McMullen Counties. Due to time constraints and TWDB guidance, these manufacturing demands were not evaluated in detail for the 2011 Plan but should be considered in future planning efforts.

Table 2-5.
Coastal Bend Region Municipal Water Demand by City/County
(acft/yr)

City/County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas Pass (P)	116	146	168	186	195	190	179	169
Fulton	128	261	307	346	365	359	336	318
Rockport	1,001	1,357	1,590	1,778	1,868	1,823	1,712	1,620
County-Other	1,369	1,550	1,766	1,953	2,016	1,954	1,826	1,728
Aransas County	*2,614*	*3,314*	*3,831*	*4,263*	*4,444*	*4,326*	*4,053*	*3,835*
Beeville	1,929	2,529	2,619	2,690	2,722	2,699	2,683	2,618
El Oso (P)		60	62	65	66	66	65	64
County-Other	1,640	1,631	1,661	1,701	1,704	1,674	1,649	1,609
Bee County	*3,569*	*4,220*	*4,342*	*4,456*	*4,492*	*4,439*	*4,397*	*4,291*
Falfurrias	819	1,661	2,135	2,515	2,795	2,957	3,021	3,032
County-Other	331	309	180	106	62	37	22	13
Brooks County	*1,150*	*1,970*	*2,315*	*2,621*	*2,857*	*2,994*	*3,043*	*3,045*
Benavides	456	315	326	333	334	330	319	302
Freer	521	624	645	659	663	655	633	600
San Diego (P)	660	471	479	482	479	467	449	426
County-Other	453	913	950	979	987	976	944	895
Duval County	*2,090*	*2,323*	*2,400*	*2,453*	*2,463*	*2,428*	*2,345*	*2,223*
Alice	3,581	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Orange Grove	212	353	374	394	405	406	402	393
Premont	970	807	858	905	931	935	925	905
San Diego (P)	140	99	103	105	106	105	103	101
County-Other	1,632	2,022	2,127	2,210	2,238	2,213	2,177	2,130
Jim Wells County	*6,535*	*8,562*	*9,068*	*9,526*	*9,756*	*9,761*	*9,640*	*9,433*
County-Other	44	46	50	52	53	53	52	53
Kenedy County	*44*	*46*	*50*	*52*	*53*	*53*	*52*	*53*
Kingsville	4,776	4,440	4,570	4,601	4,604	4,569	4,616	4,619
Ricardo WSC		296	682	955	1,130	1,236	1,390	1,397
County-Other	1,485	679	799	880	930	957	1,002	1,004
Kleberg County	*6,261*	*5,415*	*6,051*	*6,436*	*6,664*	*6,762*	*7,008*	*7,020*

Table 2-5 (Concluded)

City/County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Choke Canyon WS (P)		360	397	425	435	421	384	346
El Oso WSC (P)		189	206	220	223	215	196	176
George West	530	642	703	754	767	738	675	608
McCoy WSC		50	54	57	58	56	51	46
Three Rivers	379	425	465	498	505	485	444	399
County-Other	887	684	748	796	808	778	709	638
Live Oak County	*1,796*	*2,350*	*2,573*	*2,750*	*2,796*	*2,693*	*2,459*	*2,213*
Choke Canyon WS (P)		40	43	44	42	39	37	35
County-Other	109	135	143	146	138	129	123	117
McMullen County	*109*	*175*	*186*	*190*	*180*	*168*	*160*	*152*
Agua Dulce	99	115	112	110	107	105	103	103
Aransas Pass (P)	3	12	26	41	53	64	73	81
Bishop	465	459	444	433	422	411	404	404
Corpus Christi	66,966	55,629	61,953	68,212	73,592	78,422	82,961	86,962
Driscoll	88	97	122	148	171	191	208	224
Nueces County WCID #4		977	1,913	2,884	3,729	4,460	5,124	5,655
Port Aransas	1,308	1,601	2,606	3,655	4,558	5,355	6,068	6,637
River Acres WSC		314	429	546	646	736	813	881
Robstown	2,429	2,153	2,110	2,067	2,024	1,982	1,953	1,953
County-Other	5,163	1,345	894	595	395	262	175	118
Nueces County	*76,521*	*62,702*	*70,609*	*78,691*	*85,697*	*91,988*	*97,882*	*103,018*
Aransas Pass (P)	792	1,210	1,405	1,615	1,828	2,015	2,201	2,386
Gregory	239	249	239	231	223	216	210	210
Ingleside	613	873	1,294	1,771	2,202	2,607	3,016	3,394
Ingleside On The Bay		74	92	112	130	148	164	181
Lake City		70	79	89	99	107	116	125
Mathis	770	671	648	632	615	598	586	586
Odem	260	319	330	347	361	372	389	408
Portland	1,794	1,976	2,399	2,868	3,290	3,715	4,106	4,498
Sinton	789	1,036	1,052	1,062	1,076	1,086	1,108	1,135
Taft	432	559	586	619	648	672	703	735
County-Other	2,242	1,836	1,946	2,077	2,189	2,277	2,398	2,533
San Patricio County	*7,931*	*8,873*	*10,070*	*11,423*	*12,661*	*13,813*	*14,997*	*16,191*
Total for Region	**108,620**	**99,950**	**111,495**	**122,861**	**132,063**	**139,425**	**146,036**	**151,474**

[1] Projections from Texas Water Development Board
(P) Partial

Table 2-6.
Coastal Bend Region Manufacturing Water Demand by County and River Basin
(acft/yr)

County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas	283	235	267	281	292	302	311	331
Bee	1	1	1	1	1	1	1	1
Brooks	0	0	0	0	0	0	0	0
Duval	0	0	0	0	0	0	0	0
Jim Wells	0	0	0	0	0	0	0	0
Kenedy	0	0	0	0	0	0	0	0
Kleberg	0	0	0	0	0	0	0	0
Live Oak	943	1,767	1,946	1,998	2,032	2,063	2,088	2,194
McMullen	0	0	0	0	0	0	0	0
Nueces	34,949	39,763	46,510	50,276	53,425	56,500	59,150	63,313
San Patricio	7,435	12,715	15,096	16,699	18,111	19,505	20,733	22,283
Total for Region	**43,611**	**54,481**	**63,820**	**69,255**	**73,861**	**78,371**	**82,283**	**88,122**
River Basin								
Nueces	2,154	10,196	11,931	13,006	13,935	14,849	15,650	16,761
Nueces-Rio Grande	33,865	38,486	45,016	48,661	51,709	54,685	57,250	61,280
San Antonio-Nueces	7,592	5,799	6,873	7,588	8,217	8,837	9,383	10,081
Total for Region	**43,611**	**54,481**	**63,820**	**69,255**	**73,861**	**78,371**	**82,283**	**88,122**

[1] Projections from Texas Water Development Board

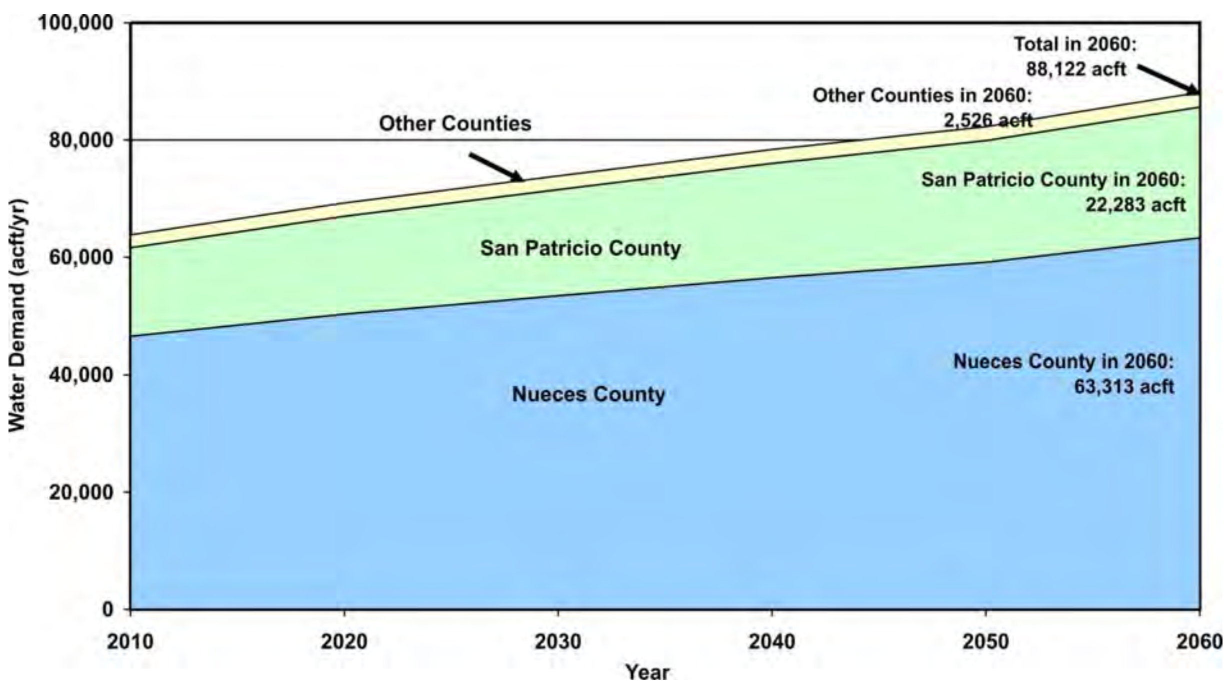

Figure 2-7. Coastal Bend Region Manufacturing Water Demand

As noted previously, petroleum refining is one of the largest industries in the region, accounting for about 60 percent of all manufacturing water use. Corpus Christi, in Nueces County, is home to nearly 13 percent of Texas' petroleum refining capacity. The refineries in the Corpus Christi area have implemented significant water conservation and water use efficiency improvement programs. These refineries use between 35 and 46 gallons of water per barrel of crude petroleum refined, compared to the State average of 100 gallons per barrel refined.[1]

2.3.3 Steam-Electric Water Demand

The TWDB and Bureau of Economic Geology (BEG) released a report entitled "Water Demand Projections for Power Generation in Texas" on August 31, 2008. This report contained updated demand projections for steam-electric power. The TWDB allowed planning groups to select their preferred set of steam-electric water demand projections from either the 2006 Plan or the BEG study. The Coastal Bend RWPG adopted the 2006 Plan steam-electric water demands for use in the 2011 Plan.

Projections for steam-electric power water demand are based on power generation projections—determined by population and manufacturing growth—and on generating capacity and water use for that projected capacity. The steam-electric generation process uses water in boilers and for cooling the generating equipment. The usual practice is to use freshwater with a very low concentration of dissolved solids for boiler feed water and to use either freshwater or saline water for power plant cooling purposes. At two of the three plants located in Corpus Christi in Nueces County, freshwater is used for the boiler feed and seawater is used for cooling. The Nueces Bay Power Station is not currently operating. The use of saltwater for cooling at Topaz (formerly AEP-CPL's) Barney Davis Power Station saves approximately 6,300 acft/yr in freshwater (1999 figures). At the third plant, Lon C. Hill, fresh water is used for the boiler feed and cooling. Table 2-7 shows that in 2000, 8,799 acft/yr of water was used. According to AEP,[2] approximately two-thirds of water used in Year 2000 was forced evaporation of saltwater. In 2060, steam-electric demands for freshwater are projected to be 27,664 acft/yr (Figure 2-8). The large increase between 2010 and 2020 is attributable to a proposed, new 1,200 MW plant in

[1] "Report of Water Use for Refineries and Selected Cities in Texas, 1976-1987," South Texas Water Authority, Kingsville, Texas, 1990.
[2] Correspondence with Greg Carter, AEP-CPL.

Nueces County. For projected water demands from 2020 to 2060, the projected fresh water use is estimated to be over three-quarters of the total projected steam- electric water demand.[3]

2.3.4 Mining Water Demand

Projections for mining water demand are based on projected production of mineral commodities, and historic rates of water use, moderated by water requirements of technological processes used in mining.

The development of natural gas from the shale in the Eagleford Group has begun in several counties in the Coastal Bend Region. Water demands associated with these mining activities are not included in Table 2-8, but may impact local groundwater use, especially in the Carrizo Aquifer. It is anticipated that in the near future about 200 acft/yr of water use will be used for hydraulic fracturing of wells in each of these three counties: McMullen, Bee, and Live

Table 2-7.
Coastal Bend Region Steam-Electric Water Demand by County and River Basin (acft/yr)

County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas	0	0	0	0	0	0	0	0
Bee	0	0	0	0	0	0	0	0
Brooks	0	0	0	0	0	0	0	0
Duval	0	0	0	0	0	0	0	0
Jim Wells	0	0	0	0	0	0	0	0
Kenedy	0	0	0	0	0	0	0	0
Kleberg	0	0	0	0	0	0	0	0
Live Oak	0	0	0	0	0	0	0	0
McMullen	0	0	0	0	0	0	0	0
Nueces	2,404	8,799	7,316	14,312	16,733	19,683	23,280	27,664
San Patricio	0	0	0	0	0	0	0	0
Total for Region	**2,404**	**8,799**	**7,316**	**14,312**	**16,733**	**19,683**	**23,280**	**27,664**
River Basin								
Nueces	2,347	3,768	3,133	10,977	12,834	15,097	17,855	21,218
Nueces-Rio Grande	57	5,031	4,183	3,335	3,899	4,586	5,425	6,446
San Antonio-Nueces	0	0	0	0	0	0	0	0
Total for Region	**2,404**	**8,799**	**7,316**	**14,312**	**16,733**	**19,683**	**23,280**	**27,664**

[1] Projections from Texas Water Development Board

[3] TWDB, "Power Generation Water Use in Texas for the Years 2000 Through 2060", January 2003.

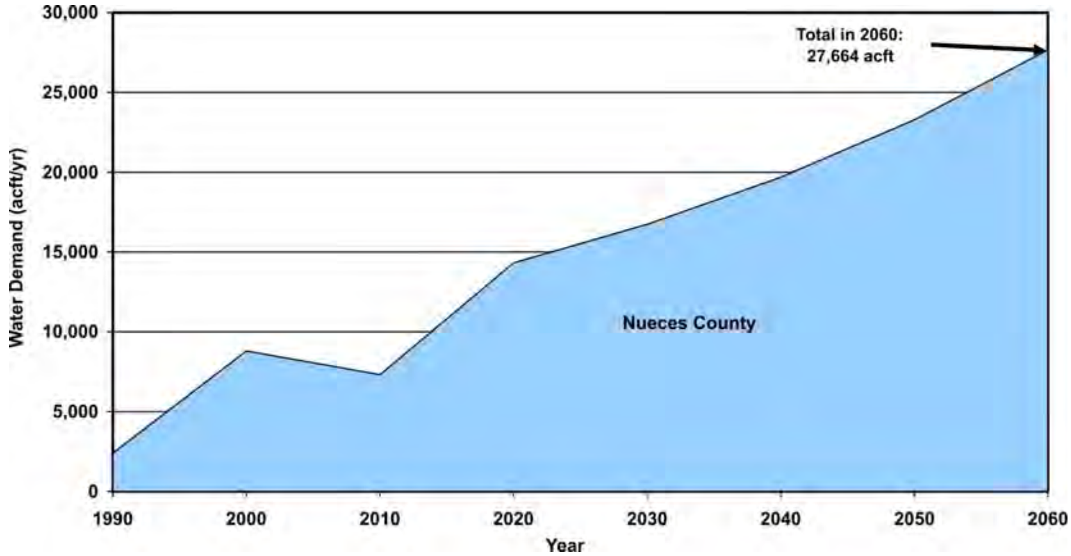

Figure 2-8. Coastal Bend Region Steam-Electric Water Demand

Oak.[4] Furthermore, uranium mining is in the initial phases of exploration in Live Oak County and is anticipated to use additional groundwater supplies. The impacts of developing gas wells in the Eagleford shale and uranium mining activities on groundwater supplies in the Coastal Bend Region should be considered in future planning efforts.

In 2000 for the 11 counties of the Coastal Bend Planning Area, 11,897 acft was used in the mining of sand, gravel, and in the production of crude oil. Water is required in the mining of these minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation. Duval, Kleberg and Live Oak Counties accounted for 82.2 percent of the 2000 total use (Table 2-8). Mining water use in 2030 is expected to be 16,640 acft and is projected to increase to 19,114 acft in 2060, a 60.7 percent from 2000 to 2060. Duval, Kleberg, and Live Oak Counties, which will increase at 88.2 percent, 4.9 percent, and 72.0 percent, respectively, will account for 84.4 percent of the 2060 total use (Figure 2-9).

2.3.5 Irrigation Water Demand

Irrigated crop production in Coastal Bend Region is practiced in 9 of the 11 counties. Irrigation surveys[5] by the Natural Resource Conservation Service reported 23,975 acres of irrigated farmland in 2000, with over 97 percent irrigated with groundwater. In 2007, of the

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[4] Correspondence from Bee GCD, McMullen GCD, and Live Oak GCD in November 2009.
[5] Surveys of Irrigation in Texas, TWDB Report 347, August 2001.

Table 2-8. Coastal Bend Region Mining Water Demand by County and River Basin (acft/yr)

County	*Historical*		*Projections*[1]					
	1990	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Aransas	0	81	103	115	123	131	139	146
Bee	20	29	36	40	42	44	46	48
Brooks	145	127	150	161	167	173	179	184
Duval	3,049	4,544	5,860	6,630	7,119	7,610	8,108	8,553
Jim Wells	393	347	423	461	484	507	530	550
Kenedy	4	1	1	1	1	1	1	1
Kleberg	1,221	2,127	2,917	2,934	2,207	2,216	2,225	2,232
Live Oak	2,385	3,105	3,894	4,319	4,583	4,845	5,108	5,341
McMullen	239	176	195	203	207	211	215	218
Nueces	50	1,275	1,472	1,555	1,599	1,641	1,682	1,724
San Patricio	57	85	99	105	108	111	114	117
Total for Region	**7,563**	**11,897**	**15,150**	**16,524**	**16,640**	**17,490**	**18,347**	**19,114**
River Basin								
Nueces	3,787	5,046	6,350	7,068	7,515	7,963	8,414	8,814
Nueces-Rio Grande	3,719	5,876	7,662	8,246	7,875	8,239	8,609	8,938
San Antonio-Nueces	57	975	1,138	1,210	1,250	1,288	1,324	1,362
Total for Region	**7,563**	**11,897**	**15,150**	**16,524**	**16,640**	**17,490**	**18,347**	**19,114**

[1] Projections from Texas Water Development Board

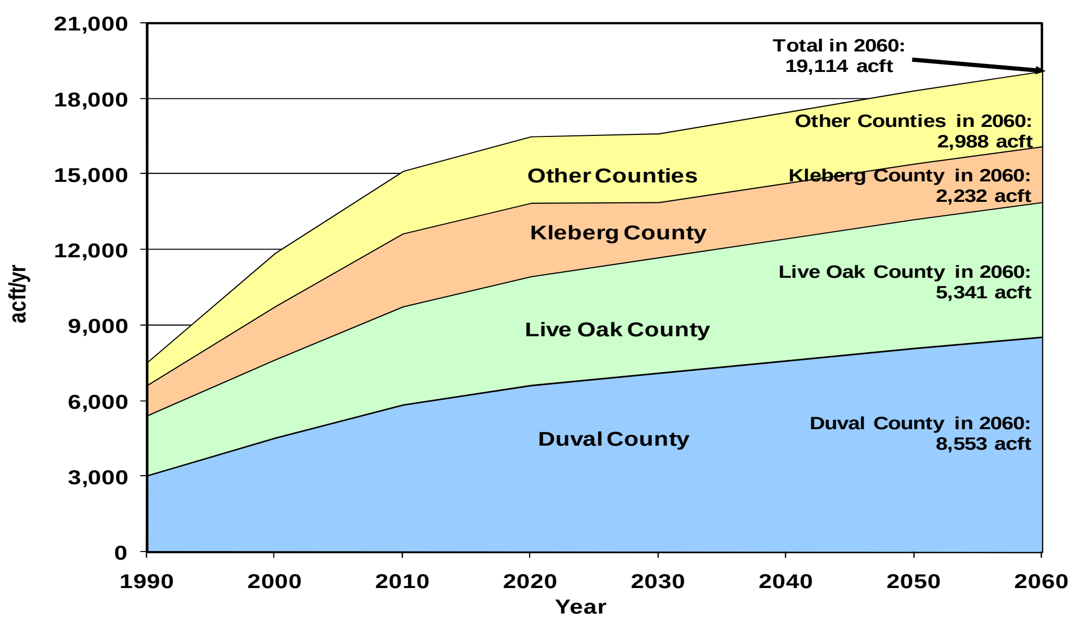


Figure 2-9. Coastal Bend Region Mining Water Demand

7,015 farms in the region, 238 had 34,666 acres of irrigated farmland.[6] The region receives on average about 29.2 inches of rainfall per year, which is generally adequate for dry-land crops. Irrigated cropland only accounts for 2.7 percent of all harvested cropland.[7] Major crops include corn, cotton, sorghum, hay and wheat.

The irrigation water demand projections are based on specific assumptions regarding crop prices, crop yields, agricultural policy, and technological advances in irrigation systems. The TWDB estimated 2000 total irrigated water use in the Coastal Bend Region at 21,971 acft based on irrigation water use surveys (Table 2-9). Duval and San Patricio Counties accounted for 41.4 percent of that total. Irrigated water use is projected to increase by 35.3 percent from 2000 to 2060, 21,971 acft to 29,726 acft (Figure 2-10). This increase is attributable to a projected increase is the number of acres being irrigated within the region. It should be noted that in Bee and Live Oak Counties, most irrigation occurs in the southern portion of those counties in the more productive Evangeline layers of the Gulf Coast Aquifer.

On June 26, 2009, the Coastal Bend RWPG requested the TWDB to modify the irrigation water demand projections for Bee and San Patricio Counties based on recent, historical irrigation water use trends for these counties and comparing these to the 2006 Regional Water Plan irrigation water demand projections. After considering the requested change, the TWDB approved the change in irrigation water demand for Bee and San Patricio Counties. This change resulted in an increased irrigation demand of 9,594 acft/yr in 2030 and 16,361 acft/yr in 2060 as compared to the 2006 Plan.

2.3.6 Livestock Water Demand

In the 11-county Coastal Bend Region, the principal livestock type is beef cattle, with some dairy herds. Livestock drinking water is obtained from wells, stock watering tanks that are dug/constructed on the ranches, and streams that flow through the ranches.

The livestock water demand projections are based upon estimates of the maximum carrying capacity of the rangeland of the area and the estimated number of gallons of water per head of livestock per day. In 2000, livestock water use for the Coastal Bend region was 8,838 acft: 21.5 percent in Kleberg County, 12.0 percent in Jim Wells County, 11.3 percent in Bee County, 10.2 percent in Kenedy County, and 45.0 percent in the remaining counties.

[6] U.S Department of Agriculture, 2007 Census of Agriculture.
[7] Ibid.

Table 2-9.
Coastal Bend Region Irrigation Water Demand by County and River Basin (acft/yr)

County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas	0	0	0	0	0	0	0	0
Bee	3,474	2,798	3,796	4,193	4,632	5,116	5,652	6,243
Brooks	350	25	24	24	23	22	21	21
Duval	2,586	4,524	4,444	4,365	4,289	4,212	4,138	4,064
Jim Wells	1,189	3,731	3,278	2,878	2,528	2,221	1,953	1,717
Kenedy	0	107	107	107	107	107	107	107
Kleberg	461	1,002	866	745	644	555	477	410
Live Oak	3,333	3,539	3,289	3,056	2,840	2,639	2,451	2,277
McMullen	0	0	0	0	0	0	0	0
Nueces	1,734	1,680	1,449	1,250	1,077	928	801	692
San Patricio	1,110	4,565	8,631	9,534	10,531	11,633	12,850	14,195
Total for Region	**14,237**	**21,971**	**25,884**	**26,152**	**26,671**	**27,433**	**28,450**	**29,726**
River Basin								
Nueces	5,483	6,971	6,597	6,103	5,679	5,316	5,008	4,754
Nueces-Rio Grande	4,214	8,100	7,585	7,123	6,715	6,347	6,019	5,723
San Antonio-Nueces	4,540	6,900	11,702	12,926	14,277	15,770	17,423	19,249
Total for Region	**14,237**	**21,971**	**25,884**	**26,152**	**26,671**	**27,433**	**28,450**	**29,726**

[1] Projections from Texas Water Development Board

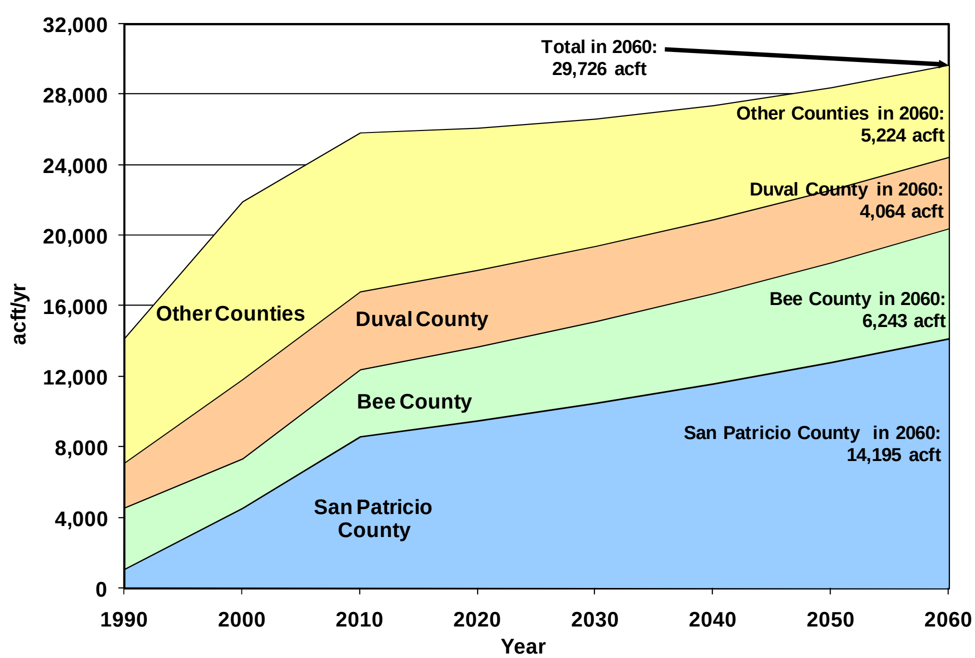


Figure 2-10. Coastal Bend Region Irrigation Water Demand

Table 2-10.
Coastal Bend Region Livestock Water Demand by County and River Basin (acft/yr)

County	Historical		Projections[1]					
	1990	2000	2010	2020	2030	2040	2050	2060
Aransas	52	23	23	23	23	23	23	23
Bee	1,088	995	995	995	995	995	995	995
Brooks	816	747	747	747	747	747	747	747
Duval	1,177	873	873	873	873	873	873	873
Jim Wells	907	1,064	1,064	1,064	1,064	1,064	1,064	1,064
Kenedy	1,065	901	901	901	901	901	901	901
Kleberg	1,745	1,900	1,900	1,900	1,900	1,900	1,900	1,900
Live Oak	1,170	833	833	833	833	833	833	833
McMullen	484	659	659	659	659	659	659	659
Nueces	373	379	279	279	279	279	279	279
San Patricio	747	564	564	564	564	564	564	564
Total for Region	**9,624**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**
River Basin								
Nueces	2,500	2,219	2,219	2,219	2,219	2,219	2,219	2,219
Nueces-Rio Grande	5,613	5,342	5,342	5,342	5,342	5,342	5,342	5,342
San Antonio-Nueces	1,511	1,277	1,277	1,277	1,277	1,277	1,277	1,277
Total for Region	**9,624**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**	**8,838**

[1] Projections from Texas Water Development Board

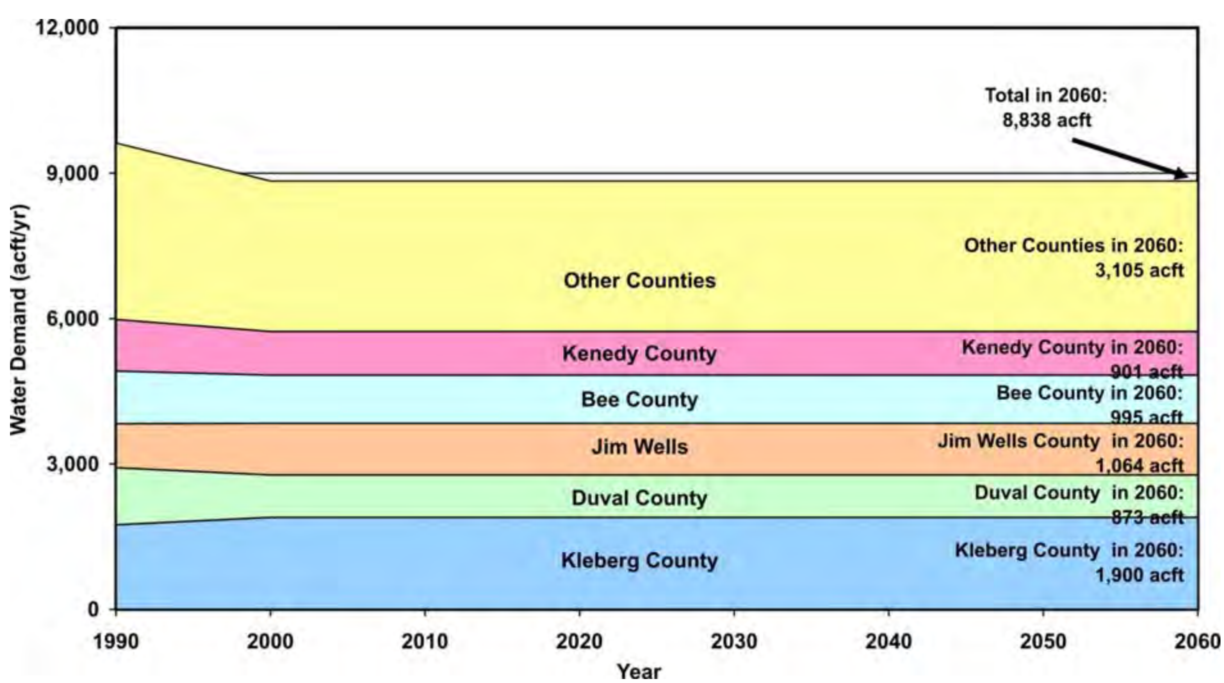


Figure 2-11. Coastal Bend Region Livestock Water Demand

From 2000 to 2060, water use for livestock use is projected by the TWDB to remain constant at 8,838 acft (Figure 2-11 and Table 2-10).

2.4 Water Demand Projections for Wholesale Water Providers

There are four regional wholesale water providers in the Coastal Bend Region: the City of Corpus Christi, SPMWD, STWA, and Nueces WCID #3. The City of Corpus Christi provides water to SPMWD and STWA, as shown in Table 2-11. The City of Corpus Christi is contracted to provide 40,000 act/yr to SPMWD (up to 30,000 acft/yr of raw water and 10,000 acft/yr of treated water supplies) and meet demands of STWA and their customers. For the 2011 Plan, water supply constraints are considered based on system yield (raw water) or water treatment plant capacity (treated water). Accordingly, the water demands for each wholesale water provider and their customers are shown in Table 2-11 and are categorized according to raw or treated water demands for ease of comparison to supplies discussed in Sections 3 and 4A. The City of Corpus Christi and SPMWD provide both raw and treated water supplies to their customers. STWA solely provides treated water supplies to its customers. Nueces County WCID # 3 provides a majority of treated water supplies to its customers and also provides a small amount of raw water for local irrigation uses. Water use for wholesale water providers by county and river basin are included in Appendix C.

Table 2-11.
Coastal Bend Region Water Demand Projections for Wholesale Water Providers

Wholesale Water Provider (Water User/County)	*2000 (acft/yr)*	*2010 (acft/yr)*	*2020 (acft/yr)*	*2030 (acft/yr)*	*2040 (acft/yr)*	*2050 (acft/yr)*	*2060 (acft/yr)*
CITY OF CORPUS CHRISTI							
Raw Water Demand							
Municipal							
Jim Wells County							
City of Alice	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Bee County							
City of Beeville	2,529	2,619	2,691	2,722	2,699	2,683	2,618
San Patricio County							
City of Mathis	671	648	632	615	598	586	586
San Patricio MWD *(based on water supply contract)*	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Live Oak County							
City of Three Rivers	3,363	3,363	3,363	3,363	3,363	3,363	3,363
Non-Municipal							
Manufacturing (Nueces County)[1]	9,698	11,343	12,262	13,030	13,780	14,426	15,441
Mining (Nueces County)	1,189	1,375	1,453	1,494	1,534	1,572	1,612
Total Raw Water Demand	**52,731**	**54,954**	**56,313**	**57,300**	**58,076**	**58,663**	**59,524**
Treated Water Demand							
Municipal							
San Patricio County							
San Patricio MWD *(based on water supply contract)*	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Nueces County							
Nueces County WCID #4 (Port Aransas)[2]	977	1,913	2,884	3,729	4,460	5,124	5,655
City of Corpus Christi	55,629	61,953	68,212	73,592	78,422	82,961	86,962
County-Other[3,4]	116	116	116	116	116	116	116
Kleberg County							
South Texas Water Authority *(based on water supply contract)*	2,284	2,619	2,867	3,011	3,065	3,236	3,260
Non-Municipal							
Manufacturing (Nueces County)[5]	29,093	34,030	36,785	39,089	41,339	43,278	46,324
Steam-Electric (Nueces County)[6]	8,799	7,316	14,312	16,733	19,683	23,280	27,664
Total Treated Water Demand	**106,898**	**117,947**	**135,176**	**146,270**	**157,085**	**167,995**	**179,981**
Total Water Demand	**159,629**	**172,901**	**191,489**	**203,570**	**215,161**	**226,658**	**239,505**
River Basin							
Nueces	13,606	13,683	22,144	24,525	27,266	30,468	34,292
Nueces- Rio Grande	102,735	115,724	125,730	135,372	144,219	152,507	161,569
San Antonio- Nueces	43,288	43,494	43,615	43,673	43,676	43,683	43,644
Total Water Demand	**159,629**	**172,901**	**191,489**	**203,570**	**215,161**	**226,658**	**239,505**
SAN PATRICIO MUNICIPAL WATER DISTRICT							
Raw Water Demand							
Non-Municipal							
Manufacturing (San Patricio County)[7]	7,841	7,841	7,841	7,841	7,841	7,841	7,841
Total Raw Water Demand	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**
Treated Water Demand							

Table 2-11 (Continued)

Wholesale Water Provider (Water User/County)	***2000 (acft/yr)***	***2010 (acft/yr)***	***2020 (acft/yr)***	***2030 (acft/yr)***	***2040 (acft/yr)***	***2050 (acft/yr)***	***2060 (acft/yr)***
SAN PATRICIO MUNICIPAL WATER DISTRICT (cont.)							
Municipal							
Nueces County							
City of Aransas Pass	12	26	41	53	64	73	81
Nueces County WCID #4 (Port Aransas)	1,601	2,606	3,655	4,558	5,355	6,068	6,637
San Patricio County							
City of Aransas Pass	1,210	1,405	1,615	1,828	2,016	2,201	2,386
City of Gregory	249	239	231	223	216	210	210
City of Ingleside	873	1,294	1,771	2,202	2,607	3,016	3,395
City of Ingleside on the Bay	74	92	112	130	148	164	181
City of Portland	1,976	2,399	2,869	3,290	3,716	4,106	4,498
City of Odem	319	330	347	361	372	389	408
City of Taft	559	586	619	648	672	703	736
County-Other	975	1,033	1,103	1,163	1,209	1,274	1,345
Aransas County							
City of Aransas Pass	146	168	186	195	190	179	169
City of Fulton	261	307	346	365	359	336	318
City of Rockport	1,357	1,590	1,778	1,868	1,823	1,712	1,620
County-Other[2]	1,338	1,524	1,686	1,740	1,687	1,575	1,491
Non-Municipal							
Manufacturing (San Patricio County)[8]	4,865	7,244	8,846	10,257	11,650	12,877	14,426
Total Treated Water Demand	**15,815**	**20,839**	**25,205**	**28,881**	**32,084**	**34,883**	**37,901**
Total Water Demand	**23,656**	**28,684**	**33,046**	**36,722**	**39,925**	**42,724**	**45,742**
River Basin							
Nueces	7,152	8,491	9,393	10,187	10,971	11,662	12,534
Nueces- Rio Grande	1,601	2,606	3,655	4,558	5,355	6,068	6,637
San Antonio- Nueces	14,903	17,587	19,998	21,977	23,599	24,994	26,571
Total Water Demand	**23,656**	**28,684**	**33,046**	**36,722**	**39,925**	**42,724**	**45,742**
SOUTH TEXAS WATER AUTHORITY							
Municipal							
Nueces County							
City of Agua Dulce	115	112	110	107	105	103	103
City of Driscoll	97	122	148	171	191	208	224
City of Bishop	420	317	309	301	294	289	289
County-Other	213	213	213	213	213	213	213
Kleberg County							
City of Kingsville	1,221	1,352	1,382	1,385	1,350	1,397	1,400
Ricardo WSC	218	503	705	834	912	1,026	1,031
Total Water Demand (All Treated)	**2,284**	**2,619**	**2,867**	**3,011**	**3,065**	**3,236**	**3,260**
River Basin							
Nueces	0	0	0	0	0	0	0
Nueces- Rio Grande	2,284	2,619	2,867	3,011	3,065	3,236	3,260
San Antonio- Nueces	0	0	0	0	0	0	0
Total Water Demand	**2,284**	**2,619**	**2,867**	**3,011**	**3,065**	**3,236**	**3,260**

Table 2-11 (Concluded)

Wholesale Water Provider (Water User/County)	*2000 (acft/yr)*	*2010 (acft/yr)*	*2020 (acft/yr)*	*2030 (acft/yr)*	*2040 (acft/yr)*	*2050 (acft/yr)*	*2060 (acft/yr)*
NUECES COUNTY WCID #3							
Nueces County							
County-Other	155	155	155	155	155	155	155
City of Robstown	2,153	2,110	2,067	2,024	1,982	1,953	1,953
River Acres WSC	291	291	291	291	291	291	291
Total Water Demand (All Treated)	**2,599**	**2,556**	**2,513**	**2,470**	**2,428**	**2,399**	**2,399**
River Basin							
Nueces	291	291	291	291	291	291	291
Nueces- Rio Grande	2,308	2,265	2,222	2,179	2,137	2,108	2,108
San Antonio- Nueces	0	0	0	0	0	0	0
Total Water Demand	**2,599**	**2,556**	**2,513**	**2,470**	**2,428**	**2,399**	**2,399**

Notes:

1. Calculated based on 25% of the Nueces County Manufacturing demand being for raw water. This is based upon City billing records for 2001 through 2005.
2. The TWDB provides separate decadal water demands for Nueces County WCID #4 and the City of Port Aransas. Based on conversations with the City of Corpus Christi and San Patricio Municipal Water District (SPMWD) in February 2005, the City is shown to provide water supplies to Nueces County WCID #4 and SPMWD is shown to provide water supplies to Port Aransas to meet demands. Of the total water demand for both entities in Year 2060, the TWDB projections show Nueces County WCID #4 having 46% of the demand and 54% for the City of Port Aransas.
3. Includes Violet WSC.
4. The City of Corpus Christi does not meet full demand (i.e. additional supply from groundwater).
5. Calculated based on 75% of the Nueces County Manufacturing Demand being for treated water. This is based upon City billing records for 2001 through 2005, the most recent data which was readily available.
6. Steam-Electric water demands include Lon Hill and potential, future steam-electric power plants accounted by TWDB studies. As a conservative estimate, future steam-electric water demands are assumed to be provided treated water.
7. Based on total raw water contracts of 7MGD.
8. Remaining Manufacturing demand (San Patricio County) after accounting for raw water sales.

Section 3
Evaluation of Current Water Supplies in the Region
[31 TAC §357.7 (a)(3)]

3.1 Surface Water Supplies

The Coastal Bend Region is located within three river basins: the Nueces River Basin, the San Antonio-Nueces Coastal Basin, and the Nueces-Rio Grande Coastal Basin (Figure 3-1). Streamflows in the two coastal basins are highly variable and intermittent and do not supply large quantities of water. However, streamflow in the Nueces River and its tributaries, along with municipal and industrial water rights in the Nueces River Basin, comprise a significant supply of water used in the Coastal Bend Region, as this basin drains about 17,000 square miles. These water rights provide authorization for an owner to divert, store and use the water; however, it does not guarantee that a dependable supply will be available from their source. The availability of water to a water right is dependent on several factors including hydrologic conditions (i.e., rainfall, runoff, springflows), priority date of the water right, quantity of authorized storage, and any special conditions associated with the water right (e.g., instream flow conditions, maximum diversion rate). Because the Nueces River Basin is subject to periods of significant drought and low flows, storage is very important to help "firm up" water rights.

3.1.1 Texas Water Right System

The State of Texas owns the surface water within the state watercourses and is responsible for the appropriation of these waters. Surface water is currently allocated by the TCEQ, formerly Texas Natural Resource Conservation Commission, for the use and benefit of all people of the state. Texas water law is based on the riparian and prior appropriation doctrines. The riparian doctrine extends from the Spanish and Mexican governments that ruled Texas prior to 1836. After 1840, the riparian doctrine provided landowners the rights to make reasonable use of water for irrigation or for other consumptive uses. In 1889, the prior appropriation doctrine was first adopted by Texas, which is based on the concept of "first in time is first in right." Over the years, the riparian and prior appropriation doctrines resulted in a system that was very difficult to manage. Various types of water rights existed simultaneously and many rights were unrecorded. In 1967, the Texas Legislature passed the Water Rights Adjudication Act that

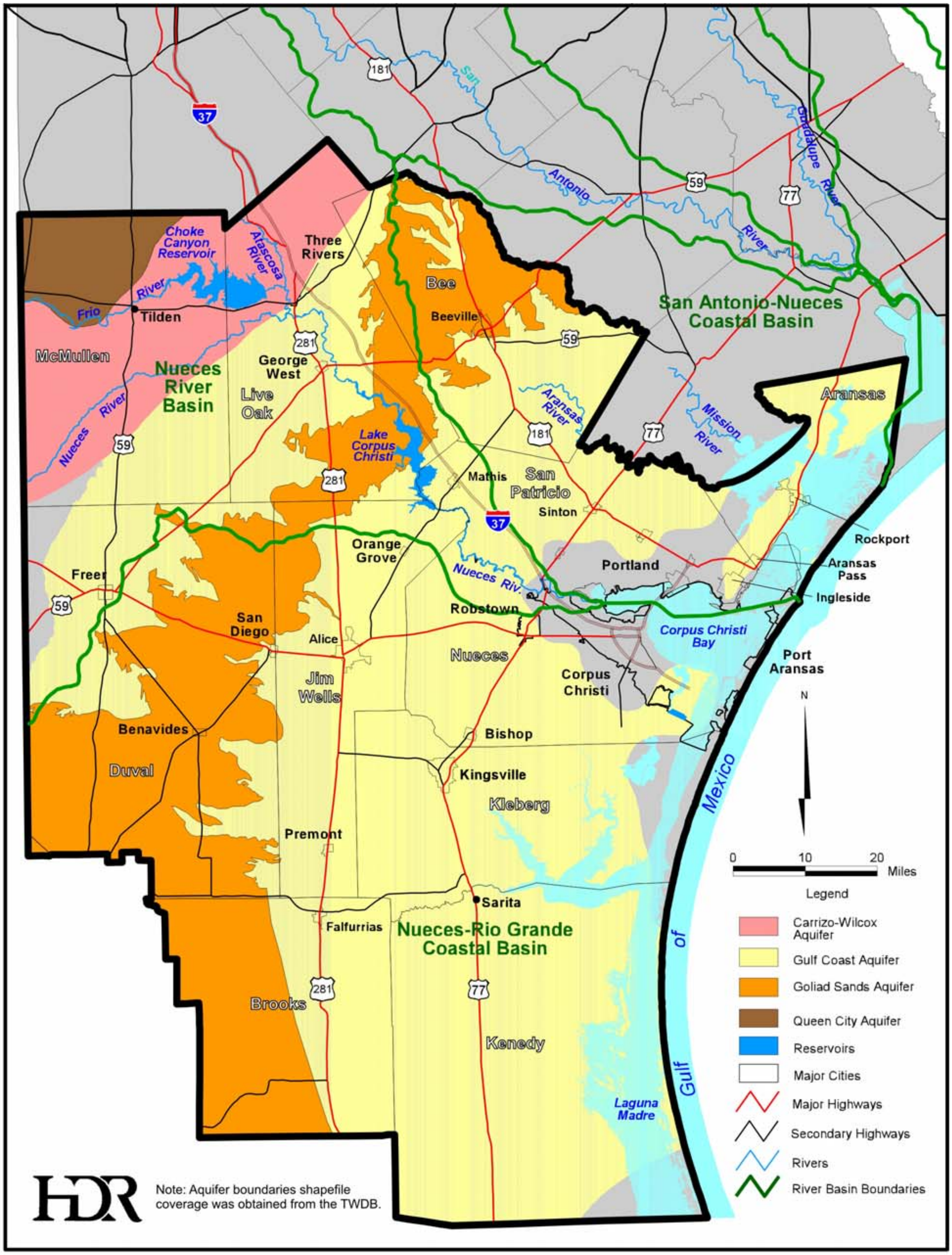


Figure 3-1. Watershed Boundaries and Aquifer Location Map

merged the riparian water rights into the prior appropriation system, creating a unified water permit system.

The adjudication process took many years, stretching into the late 1980s before it was finally completed. In the end, Certificates of Adjudication were issued for entities recognized as having legitimate water rights. Today, individuals or groups seeking a new water right must submit an application to the TCEQ. The TCEQ determines if the water right will be issued and under what conditions. The water rights grant a certain quantity of water to be diverted and/or stored, a priority date, location of diversion, and other restrictions. The priority date of a water right is essential to the operation of the water rights system. Each right is issued a priority date based on the date each right was filed at the TCEQ. When diverting or storing water for use, all water right holders must adhere to the priority system. A right holder must allow water to be passed to downstream senior water rights when conditions are such that the senior water rights would not be otherwise satisfied. Other restrictions may include a maximum diversion rate and instream flow restrictions to protect existing water rights and provide environmental flows for instream needs and needs of estuary systems, although most water rights issued prior to 1985 do not include such conditions. An important exception to the rule is Certificate of Adjudication Number (CA#) 21-3214 for Choke Canyon Reservoir, which represents approximately 75% of the Nueces River Basin water rights and requires instream flows and freshwater flows for the Nueces Estuary. Operations of the CCR/LCC System are governed, in part, by CA #21-3214, within which Special Conditions B and E state:

B. (Part)

> "Owners shall provide not less than 151,000 acft of water per annum for the estuaries by a combination of releases and spills from the reservoir system at Lake Corpus Christi Dam and return flows to the Nueces and Corpus Christi Bays and other receiving estuaries."

E.

> "Owners shall continuously maintain a minimum flow of 33 cubic feet per second below the dam at Choke Canyon Reservoir."

Special Condition B of CA #21-3214 further states:

> "Water provided to the estuaries from the reservoir system under this paragraph shall be released in such quantities and in accordance with such operational procedures as may be ordered by the Commission."

Hence, the certificate provided for a means to further establish specific rules governing operations of the CCR/LCC System with respect to maintaining freshwater inflows to the Nueces Estuary.

To address concerns about the health of the Nueces Estuary, a Technical Advisory Committee (TAC) chaired by the TCEQ was formed in 1990 to establish operational guidelines for the CCR/LCC System and desired monthly freshwater inflows to the Nueces Estuary. These operational guidelines were summarized in the 1992 Interim Order.[1]

The 1992 Interim Order established a monthly schedule of desired freshwater inflows to Nueces Bay to be satisfied by spills, return flows, runoff below Lake Corpus Christi, and/or dedicated releases from the CCR/LCC System. Mechanisms for relief from reservoir releases under the Interim Order were based on inflow banking, monthly salinity variation in upper Nueces Bay, and implementation of drought contingency measures tied to CCR/LCC System Storage.

The Nueces Estuary Advisory Council (NEAC) was formed under the 1992 Interim Order and charged with continued study of the interdependent relationship between the firm yield of the CCR/LCC System and the health of the Nueces Estuary. One of NEAC's primary goals was to evaluate the 1992 Interim Order and other alternative release policies and recommend a more permanent reservoir operations plan for providing freshwater inflows to the Nueces Estuary. This goal was to be achieved within 5 years of NEAC's formation.

The goal of recommending a more permanent reservoir operations plan was fulfilled on April 28, 1995, when the TCEQ issued an order regarding reservoir operations for freshwater inflows to the Nueces Estuary, known as the 1995 Agreed Order.[2] This Agreed Order is very similar to the Interim Order, with one major exception—monthly releases (pass-throughs) to the estuary were limited to CCR/LCC System inflows and stored water is not required to meet estuary freshwater flow needs.

On April 17, 2001, the TCEQ issued an amendment to the 1995 Agreed Order to revise operational procedures in accordance with revisions requested by the City of Corpus Christi.

[1] Texas Water Commission, Interim Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, held by the City of Corpus Christi, et al., March 9, 1992.

[2] Texas Commission on Environmental Quality (TCEQ), Agreed Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, held by City of Corpus Christi, et al., April 28, 1995.

Changes included: (1) passage of inflows to Nueces Bay and Estuary at 40 percent and 30 percent reservoir system capacity upon institution of mandatory outdoor watering restrictions; (2) calculating reservoir system storage capacity based on most recently completed bathymetric surveys; and (3) provisions for operating Rincon Bayou diversions and conveyance facility from Calallen Pool to enhance the amount of freshwater to the Nueces Bay and Delta. All CCR/LCC System yield analyses presented as part of this study were performed using the 2001 Agreed Order.

3.1.2 Types of Water Rights

There are various types of water rights. Water rights are characterized as Certificates of Adjudication, permits, short-term permits, or temporary permits. Certificates of Adjudication were issued in perpetuity for approved claims during the adjudication process. This type of water right was generally issued based on historical use rather than water availability. As a consequence, the amount of water to which rights on paper are entitled to generally exceeds the amount of water available during a drought. The TCEQ issues new permits generally when normal flows are sufficient to meet 75 percent of the requested amount 75 percent of the time. Permits, like Certificates of Adjudication, are issued in perpetuity and may be bought and sold like other property interests. Short-term permits may be issued by the TCEQ in areas where waters are fully appropriated, but not yet being fully used. Term permits are usually issued for 10 years and may be renewed if, after 10 years, water in the basin is still not being fully used by other water right holders. Temporary permits are issued for up to 3 years. Temporary permits are issued mainly for roadway and other construction projects, where water is used to suppress dust, to compact soils, and to start the growth of new vegetation.

Water rights can include the right to divert and/or store the appropriated water. A run-of-river water right provides for the diversion of streamflows and generally does not include a significant storage volume for use during dry periods. A run-of-river right may be limited by streamflow, pumping rate, or diversion location.

Water rights that include provisions for storage of water allow a water right holder to impound streamflows for use at a later time. The storage provides water for use during dry periods, when water may not be available due to hydrologic conditions or because flows are required to be passed to downstream senior water rights.

Water rights are generally diverted and used within the river basin of origin. An interbasin transfer permit is required of all water that is diverted from one river basin and used in another basin. For diversion of water from a river basin for use in an adjoining coastal basin, such as from the Nueces River Basin to either the San Antonio-Nueces or the Nueces-Rio Grande Coastal Basins, the procedure is simplified and does not require an extensive process.

The annual availability of a water right is typically considered in terms of firm yield or safe yield supply. According to the TCEQ, the firm yield is defined as "that amount of water, based upon a simulation utilizing historic streamflows, that the reservoir could have produced annually if it had been in place during the worst drought of record."[3] The water rights of Nueces County WCID #3 and small run-of river rights on the Nueces Basin (less than 2000 acft/yr) are based on firm yield analyses.

Safe yield supply represents a more conservative approach to determining minimum annual availability in areas where the severity of droughts is uncertain. Safe yield supply is the amount of water that can be withdrawn from a reservoir such that a given volume remains in reservoir storage during the critical month of the drought of record. The surface water availabilities for the largest water rights in the Nueces Basin (i.e., City of Corpus Christi and their customers) are based on safe yield analyses and assume a reserve of 75,000 acft (i.e., 7 percent LCC/CCR System storage) for future drought conditions.[4]

3.1.3 Water Rights in the Nueces River Basin

A total of 256 water rights exist in the Nueces River Basin with a total authorized diversion and consumptive use of 539,691 acft/yr.[5] It is important to note that a small percentage of the water rights make up a large percentage of the authorized diversion volume. In the Nueces River Basin, four water rights (1.5 percent) make up 483,444 acft/yr (89.5 percent) of the authorized diversion volume as shown in Figure 3-2. Of these, three water rights are in the Coastal Bend Region and account for 455,444 acft/yr of the 483,444 acft/yr total. The remaining 252 water rights primarily consist of small municipal, industrial, irrigation and recharge rights distributed throughout the river basin. Municipal and industrial diversion rights represent

[3] TCEQ, "A Regulatory Guidance Document for Applications to Divert, Store, or Use State Water," RG-141, June 1995.
[4] Safe yield analysis for the City of Corpus Christi and their customers (i.e. LCC/CCR/Lake Texana System) approved by the TWDB in their letter provided to the CBRWPG on April 30, 2009 for planning purposes in the 2010 Plan.
[5] The number of water rights and corresponding authorized diversion amounts are based on the Texas Commission on Environmental Quality's Water Rights Database dated November, 2003.

Major Water Rights*					
Water Right #	Owner	Diversion Rights (acft/yr)	Consumptive Rights (acft/yr)	Storage Rights	Notes
2464	City of Corpus Christi	304,898	304,898	300,000 1,175	Lake Corpus Christi Calallen Reservoir
3214	City of Corpus Christi, Nueces River Authority	139,000	139,000	700,000	Choke Canyon Reservoir
3082	Zavala-Dimmit Co. WCID #1	28,000	28,000	5,633	
2466	Nueces County WCID #3	11,546	11,546	0	

*Authorized Annual Diversions > 10,000 acft. Major water rights information obtained from the TCEQ.

Figure 3-2. Location of Major Water Rights in the Nueces River Basin

76 percent of all authorized diversion rights in the Nueces River Basin. Based in large part on water stored in the CCR/LCC System, which is subsequently delivered via the Nueces River to Calallen Dam at Corpus Christi for diversion, the City of Corpus Christi and the NRA hold 98 percent of these municipal and industrial rights in the *basin*.[6] With the inclusion of the municipal water rights held by the Nueces County WCID #3, diverted from the Nueces River upstream of the Calallen Dam, the Coastal Bend Region includes over 99 percent of the Nueces River Basin municipal and industrial surface water rights permits. Table 3-1 summarizes the surface water rights in the Nueces River Basin included in the Coastal Bend Planning Region.

Table 3-1.
Nueces River Basin Water Rights in the Coastal Bend Region

Water Right No.	Name	Annual Diversion Volume (acft/yr)	Reservoir Storage Capacity (acft)	Priority Date	Type of Use	Facility	County
2464	City of Corpus Christi	304,898	301,175	12/1913[1]	Municipal (51%) Industrial (49%) Irrigation (minimal) Mining (minimal)	Lake Corpus Christi (300,000 acft) and Calallen Dam (1,175 acft)	Nueces
2465A	Realty Traders & Exchange, Inc.	20	580	10/1952	Irrigation		San Patricio
2465B	Wayne Shambo	140	580	10/1952	Irrigation		San Patricio
2466	Nueces Co. WCID #3	11,546	0	2/1909[1]	Municipal (37%) Irrigation (63%)		Nueces
2467	Garnett T. & Patsy A. Brooks	221	0	2/1964	Irrigation		San Patricio
2468	CE Coleman Estate	27	0	2/1964	Irrigation		Nueces
2469	Ila M. Noakes Lindgreen	101	0	2/1964	Irrigation		Nueces
3141	Randy J. Corporron et. al.	8	0	12/1965	Irrigation		McMullen
3142	WL Flowers Machine & Welding Co.	132	100	12/1958	Irrigation		McMullen
3143	Ted W. True et. al.	220	40	12/1958	Irrigation		McMullen
3144	Harold W. Nix Et Ux	0	285	2/1969	Recreation		McMullen
3204	Richard P. Horton	233	0	12/1963	Irrigation		McMullen
3205	Richard P. Horton	103	122	12/1963	Irrigation		McMullen
3206	James L. House Trust	123	0	12/1966	Irrigation		McMullen
3214	Nueces River Authority and City of Corpus Christi	139,000	700,000	7/1976	Municipal (43%) Industrial (57%) Irrigation (minimal)	Choke Canyon Reservoir	Nueces/ Live Oak
3215	City of Three Rivers	1,500	2,500	9/1914	Municipal (47%) Irrigation (53%)		Live Oak
4402	City of Taft	600	0	9/1983	Irrigation		San Patricio
5065	Diamond Shamrock Refining[2]	0	0	6/1986	Irrigation		Live Oak
5145	San Miguel Electric Co-Op, Inc.	300	335	12/1990	Industrial		McMullen
	TOTAL	**459,172**					

[1] Water right with multiple priority dates. Earliest date shown in table.
[2] Diamond Shamrock irrigation right is used for irrigation from onsite process water return flows. In effect, this permit is for a reuse project.

[6] The Nueces River Authority's water right is for 20% of Choke Canyon Reservoir.

3.1.4 Coastal Basins

In addition to the Nueces River Basin, the Coastal Bend Regional Planning Area includes portions of two coastal river basins in Texas: the San Antonio-Nueces Coastal Basin and the Nueces-Rio Grande Coastal Basin. The San Antonio-Nueces Coastal Basin is located on the Texas Coast between the Nueces and Guadalupe-San Antonio River Basin. The drainage area of the basin is approximately 2,652 square miles, and it drains surface water runoff into Copano and Aransas Bays. The Nueces-Rio Grande Coastal Basin is located on the southern side of the Coastal Bend Region between the Nueces and Rio Grande Coastal Basins. This basin drains approximately 10,442 square miles into the Laguna Madre Estuary system. Combined, there are approximately 99 water rights in these two coastal basins authorizing diversions of about 1,838,600 acft/yr.[7] Approximately 1,738,000 acft (94 percent) of the combined authorized diversions are from within the Coastal Bend Region Planning Area, and of these rights, 1,699,000 acft (98 percent) are industrial diversions for steam-electric and manufacturing processes from the bays and saline water bodies along the coast. Most of this water is used for cooling purposes and is returned to the source. Based on the size and locations of the remaining freshwater rights in these coastal basins and on the lack of a major river or reservoir in these basins, there are few of these freshwater rights that are sustainable throughout an extended drought. In the San Antonio-Nueces Coastal Basin, firm yield supplies for irrigation users in Bee and San Patricio Counties total less than 200 acft/yr. The Nueces-Rio Grande Basin has firm yield supplies of 569 acft/yr for irrigation users in Nueces County. These water rights were considered as firm yield supplies for the irrigation users.

3.1.5 Interbasin Transfer Permits

A number of interbasin transfer permits exist in the Coastal Bend Regional Planning Area. These permits include authorizations for diversions from river basins north of the planning region into the Nueces River Basin. Both major interbasin transfer permits provide water to the City of Corpus Christi and include supplies from the Lavaca-Navidad and Colorado River Basins. The City of Corpus Christi benefits from an interbasin transfer permit[8] and a contract with the LNRA to divert 41,840 acft/yr on a firm basis and up to 12,000 acft/yr on an

[7] The number of water rights and corresponding authorized diversion amounts are based on the Texas Commission on Environmental Quality's Water Rights Database dated November 2003.
[8] TCEQ, Certificate of Adjudication No. 16-2095C, held by Lavaca-Navidad River Authority and Texas Water Development Board (TWDB), October 21, 1996.

interruptible basis from Lake Texana in the Lavaca-Navidad River Basin to the City's O.N. Stevens Water Treatment Plant. This water is delivered to the City via the Mary Rhodes Pipeline, which became operational in 1998. In addition, the pipeline was designed to convey a second interbasin transfer permit owned by the City of Corpus Christi. The second permit[9] allows the diversion of up to 35,000 acft/yr of run-of-river water on the Colorado River. Analyses of this water right, one of the most senior in the Colorado River Basin, indicate that nearly the full 35,000 acft/yr is available from this run-of-river right without off-channel storage.[10] Table 3-2 summarizes the major interbasin transfer permits in the Coastal Bend Region.

Table 3-2. Summary of Major Interbasin Transfer Permits in the Coastal Bend Region

River Basin of Origin	Name of Interbasin Transfer Permit Holder	Description	Authorized Diversion (acft/yr)	Priority Date
Lavaca-Navidad	LNRA	Transfer from Lake Texana to adjacent river basins including the Nueces River Basin.	53,840[1]	5/1972
Colorado	City of Corpus Christi	Transfer from Garwood Irrigation Co. water right to the City of Corpus Christi.	35,000	11/1900

[1] City of Corpus Christi currently holds a contract with the Lavaca-Navidad River Authority to provide 41,840 acft/yr and a maximum of 12,000 acft/yr on an interruptible basis from Lake Texana to the City.

3.1.6 Water Supply Contracts

Many entities within the Coastal Bend Region obtain surface water through water supply contracts. These supplies are usually obtained from entities that have surface water rights to provide a specified or unspecified quantity of water each year to a buyer for an established unit price. The City of Corpus Christi is the largest provider of water supply contracts in the Coastal Bend Region. The City of Corpus Christi supplies water from the CCR/LCC System, including water from Lake Texana via the Mary Rhodes Pipeline, to two major wholesale customers: SPMWD and STWA. Each of these major wholesale customers in turn sells water to other entities within their service area. In addition to the two major wholesale customers, the City of Corpus Christi also provides wholesale raw surface water to a number of smaller customers.

[9] TCEQ, Certificate of Adjudication No. 14-5434B, held by the City of Corpus Christi (via the Garwood Irrigation Company), October 13, 1998.
[10] HDR Engineering, Inc. (HDR), "Dependability and Impact Analyses of Corpus Christi's Purchase of the Garwood Irrigation Company Water Right," Draft Report for the City of Corpus Christi, September 1998.

The City of Corpus Christi has contractual obligations to provide consumptive water use plus up to 10% growth each year to City of Alice, City of Beeville, City of Mathis, Nueces County WCID #4 (Port Aransas), Violet WSC, and South Texas Water Authority. The City of Corpus Christi is contracted to provide up to 3,363 acft/yr to City of Three Rivers and up to 40,000 acft/yr to San Patricio Municipal Water District (up to 30,000 acft/yr of raw water and 10,000 acft/yr of treated water supplied). Furthermore, the City of Corpus Christi provides raw and treated water supply to meet needs of Manufacturing, Mining, and Steam and Electric water users in Nueces County. SPMWD and STWA meet water needs of their customers (Figure 3-3). Within the Coastal Bend Region, the Nueces County WCID #3 also provides wholesale water supplies through contracts with a number of small municipalities, water supply corporations, and irrigators. Nueces County WCID #3 meets water needs of City of Robstown and City of North San Pedro and has contractual obligations to provide up to 291 acft/yr to River Acres WSC.

Figure 3-3 summarizes the major contract relationships in the Coastal Bend Region and Figure 3-4 presents water supply systems in the Coastal Bend Region. These relationships will be revisited in Section 4 when comparisons of supplies and demands in the region are presented.

3.1.7 Wholesale Water Providers

The Coastal Bend Region has four Wholesale Water Providers. The TCEQ defines Wholesale Water Providers as “any entity that has contracts to sell more than 1,000 acft of water wholesale in a given year.” These include the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID #3. Based on recent water use records, the City of Corpus Christi supplies about 67 percent of the municipal and industrial water demand in the region (not including supplies to SPMWD or STWA). SPMWD and STWA purchase 100 percent of their water from the City of Corpus Christi. The SPMWD subsequently treats and distributes water to numerous entities and supplies about 14 percent of the municipal and industrial water demand in the region. Both STWA and Nueces County WCID #3 provide less than 5 percent of the municipal and industrial water demand in the region. As for water supply planning, each Water User Group in the region was analyzed to the same level of detail to ensure that the needs of the entire region are met. If in the future the CBRWPG deems it necessary, the CBRWPG reserves the right to revisit wholesale water provider designations during subsequent planning efforts. Surface and groundwater availability is delineated by counties and river basins in Appendix C.

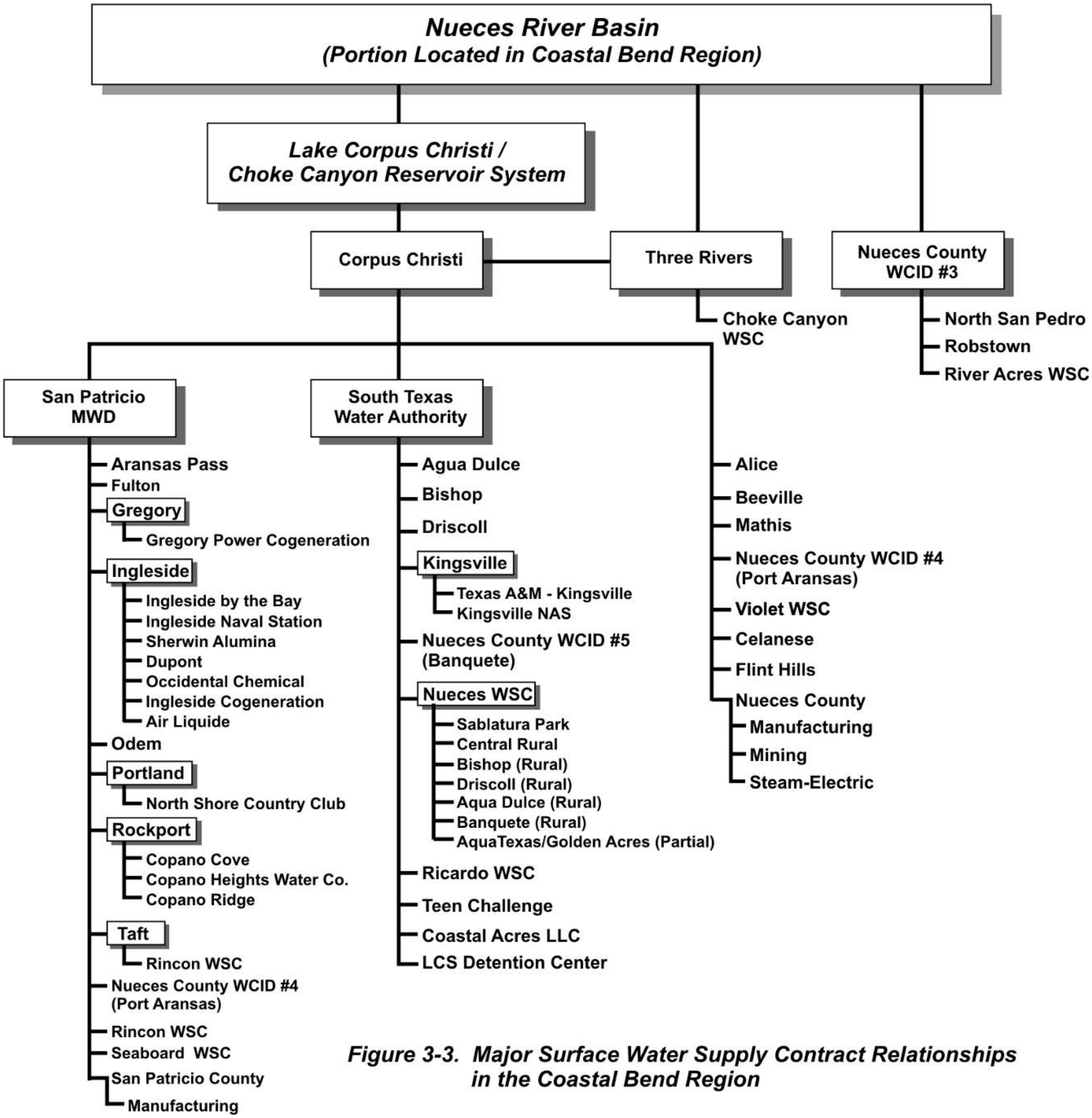
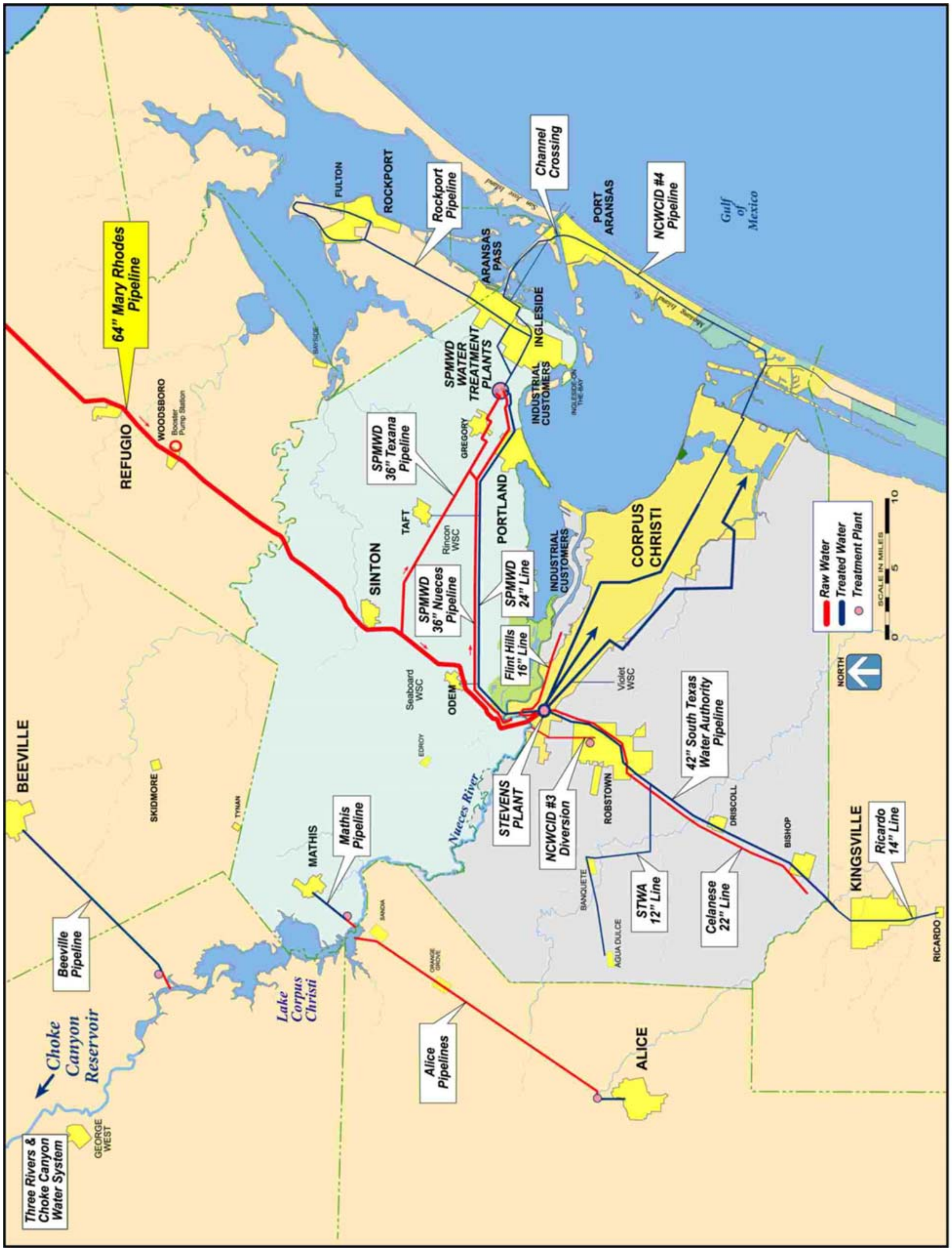


Figure 3-3. Major Surface Water Supply Contract Relationships in the Coastal Bend Region



Source: The Rodman Company

Figure 3-4. Coastal Bend Water Supply System

3.2 Reliability of Surface Water Supply

Hydrologic conditions are a primary factor that affects the reliability of a water right. Severe drought periods have been experienced in all areas of the Coastal Bend Region. Recurring droughts are common in the region with significant drought periods occurring in the 1950s, 1960s, 1980s, and 1990s. As shown in Figure 3-5, recent studies indicate that the 1990s drought appears to be the most severe on record for the CCR/LCC System,[11] decreasing average annual flows by 67,000 acft/yr (36 percent) when compare to flows in the 1950s.

Municipal and industrial water suppliers typically require a very high degree of reliability for their water sources. In most cases, interruptions to water supply are not acceptable, requiring the reliability of the supply to be 100 percent of the time. Municipal and industrial supplies are commonly based on firm yield; however, safe yield analyses are becoming commonly used in anticipation of future droughts greater in severity than the worst drought of record. Since each drought in the Nueces River Basin is more severe than previous droughts (Figure 3-5), the Coastal Bend Region has adopted use of safe yield analyses for supply from the CCR/LCC/Lake Texana System.

For reservoirs, the safe yield may decrease over time as a result of sedimentation. When a reservoir is constructed on a stream channel, the sediment carried by the stream accumulates on the bottom of the reservoir. This accumulation reduces the volume of water that can be stored in the reservoir, which in turn reduces the firm yield available for diversion. Sedimentation rates for the CCR/LCC System have been measured over a period of time and estimated sedimentation rates are well documented.[12] It is estimated that the CCR/LCC System capacity will be reduced by 47,850 acft due to sediment accumulations between 2010 and 2060.[13] For the 50-year planning period, the reduction in safe yield for future sedimentation was considered. Safe yield for the CCR/LCC System is presented for both the year 2010 and for the year 2060.

For Nueces County WCID #3 and smaller run-of-river water rights in the Nueces River Basin, firm yield supplies was based on the minimum annual supply that could be diverted over a historical period of record.

[11] HDR, "Water Supply Update for City of Corpus Christi Service Area," City of Corpus Christi, January 1999.

[12] Ibid.

[13] Calculation based on annual sedimentation rate of 717 acft/yr for LCC and 240 acft/yr for CCR.

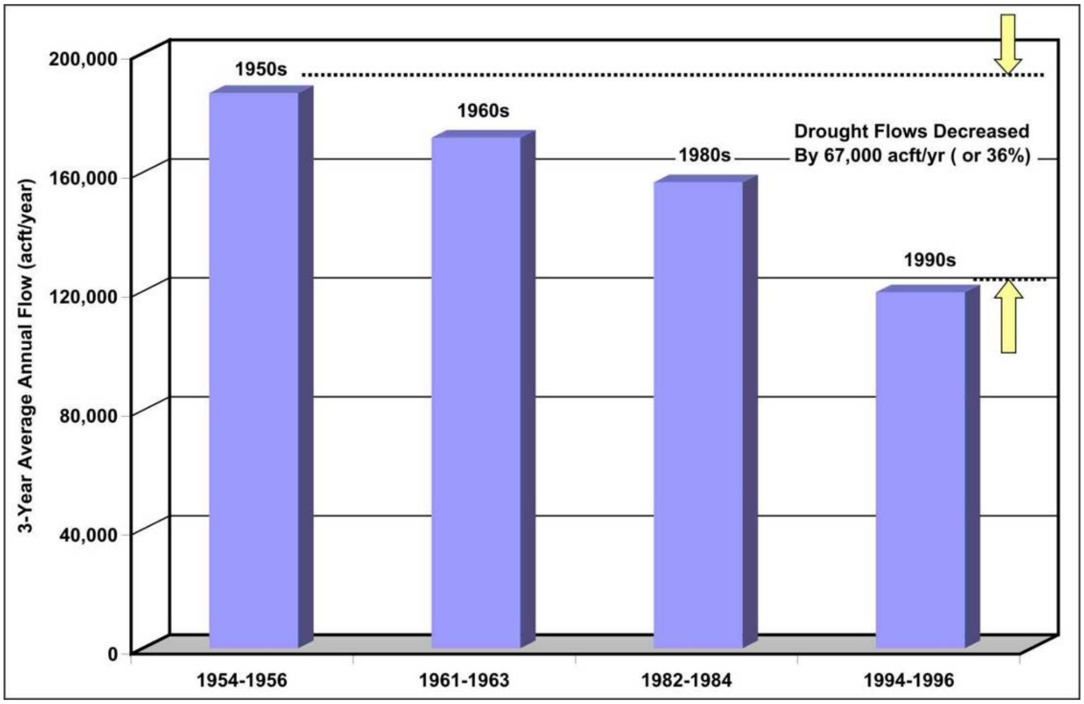


Figure 3-5.
3-Year Reservoir Inflows

3.3 Surface Water Availability

Two computer models were used to evaluate the water rights in the Nueces River Basin and within the Coastal Bend Region. The first model was a version of the Water Rights Analysis Package (WRAP) computer model developed by HDR Engineering, Inc. (HDR) for the TCEQ as part of its Water Availability Modeling (WAM) Program.[14] The WRAP model is designed for use as a water resources management tool. The model can be used to evaluate the reliability of existing water rights and to determine unappropriated streamflow potentially available for a new water right permit. WRAP simulates the management and use of streamflow and reservoirs over a historical period of record, adhering to the water right priority system. The second model used in determining surface water rights availability in the Nueces River Basin was the City of Corpus Christi Water Supply Model (formerly known as the Lower Nueces River Basin and Estuary Model (NUBAY)) developed under previous studies.[15] The City of Corpus Christi Water Supply Model focuses on the operations of the CCR/LCC/Lake Texana System and is capable of simulating this system subject to the City of Corpus Christi's Phased Operations Plan and the 2001 Agreed Order governing freshwater inflow passage to the Nueces Estuary. On April 30,

[14] HDR, "Water Availability in the Nueces River Basin," TCEQ, October 1999.
[15] HDR, Op. Cit., January 1999.

2009, the TWDB approved continued use of safe yield for development of the 2011 Plan for surface water supplies from the CCR/LCC/Lake Texana System. The City of Corpus Christi Water Supply Model was used to estimate the safe yield of the CCR/LCC/Lake Texana System and the TCEQ WAM WRAP Model was used to determine the firm yield availability of water to all other rights on the Nueces River and its tributaries within the Coastal Bend Region. A summary of the water rights and yield availability is presented in Table 3-3. These surface water supplies served as a basis for the supply and demand comparisons in Section 4.

3.4 Groundwater Availability

The Coastal Bend Region includes parts of four aquifers—two major (Gulf Coast and Carrizo-Wilcox Aquifers) and three minor (Yegua-Jackson, Queen City and Sparta Aquifers). Figure 3-1 shows the locations of the major aquifers. Table 3-4 summarizes estimates of groundwater availability on a sustained yield basis and projected groundwater use on a sustained yield basis, by aquifer, in the planning region. Groundwater availability estimates are based on either: (1) the amount of groundwater available based on 2001 Plan Coastal Bend Regional Water Planning Group (CBRWPG) groundwater analyses, or (2) Central Gulf Coast Groundwater Availability (CGCGAM) analyses from the 2006 Plan, as noted. Groundwater use is based on projected groundwater demands and is the same as used for CGCGAM analyses as presented in Section 4.

Of the four aquifers, the Gulf Coast Aquifer underlies each of the 11 counties in the planning region, is the primary groundwater resource in the Coastal Bend Region, and is capable of providing more than 80 percent of the region's groundwater supply.

3.4.1 Gulf Coast Aquifer

The Gulf Coast Aquifer underlies all counties within the Coastal Bend Region and yields moderate to large amounts of fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five water-bearing formations: Catahoula, Jasper, Burkeville Confining System, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water-bearing formations, are the most productive and, consequently, are the formations utilized most commonly. The Evangeline Aquifer of the Gulf Coast Aquifer

Table 3-3. Surface Water Rights Availability Nueces River Basin Water Rights in the Coastal Bend Region

Water Right Owner	Annual Permitted Diversion Volume (acft/yr)	Yield[1] (acft)	Type Of Use	Priority Date	County
City of Corpus Christi and Nueces River Authority	497,738[2]	200,000[3]	Municipal & Industrial	12/1913[4]	Nueces
		14	Irrigation	12/1913	Nueces
		12	Mining	12/1913	Nueces
		200	Irrigation	12/1913	Live Oak
Reality Traders & Exchange, Inc.	20	0	Irrigation	10/1952	San Patricio
Wayne Shambo	140	0	Irrigation	10/1952	San Patricio
Nueces Co. WCID #3	4,246 7,300 11,546	3,665 3,438 7,103	Municipal Irrigation	2/1909[4]	Nueces
Garnett T. & Patsy A. Brooks	221	0	Irrigation	2/1964	San Patricio
CE Coleman Estate	27	0	Irrigation	2/1964	Nueces
Ila M. Noakes Lindgreen	101	0	Irrigation	2/1964	Nueces
Randy J. Corporron et. al.	8	0	Irrigation	12/1965	McMullen
WL Flowers Machine & Welding Co.	132	6	Irrigation	12/1958	McMullen
Ted W. True et. al.	220	0	Irrigation	12/1958	McMullen
Harold W Nix Et Ux	0	0	Recreation	2/1969	McMullen
Richard P. Horton	336	0	Irrigation	12/1963	McMullen
James L. House Trust	123	0	Irrigation	12/1966	McMullen
City of Three Rivers	700 800 1,500	700 800 1,500	Municipal Industrial	9/1914	Live Oak
City of Taft	600	0	Irrigation	9/1983	San Patricio
Diamond Shamrock Refining	0[5]	0	Irrigation	6/1986	Live Oak
San Miguel Electric Co-Op, Inc.	300	0	Industrial	12/1990	McMullen
Muriell E. McNeill	64	0	Irrigation	9/1989	Live Oak
City of Mathis	50	0	Irrigation	11/1996	San Patricio
TOTAL	513,126	208,835			

[1] Firm yield computed assuming 2060 sediment accumulation in all reservoirs.
[2] Corpus Christi annual permitted diversion includes CCR/LCC System (443,898 acft/yr) and LNRA contracts with Corpus Christi (41,840 acft/yr) and a maximum 12,000 acft/yr from Lake Texana on an interruptible basis.
[3] Corpus Christi minimum annual supply equals computed 2060 safe yield of the CCR/LCC System with Lake Texana water as per HDR, March 2005.
[4] Water right with multiple priority dates. Earliest date shown in table.
[5] Diamond Shamrock irrigation right is for irrigation from on-site process water return flows. In effect, this permit is for a reuse project.

Table 3-4.
Groundwater Availability and Use from Aquifers within the Coastal Bend Region

Aquifer	2060 Availability (acft/yr)	2060 Use[1] (acft/yr)
Gulf Coast	96,944[2]	80,913
Carrizo-Wilcox	10,702[3]	513
Queen City	1,105[3]	-
Sparta	600[3]	-
Total	109,351	81,426

[1] Source: CGCGAM analyses (see Appendix D).
[2] Source: Groundwater model analysis as part of 2006 Plan and CGCGAM analyses (2009).
[3] TWDB, "Water for Texas," August 1997. (Data supporting the 1997 Texas State Water Plan.) Groundwater availability estimates were based on TWDB Report 238: Groundwater Availability in Texas estimates for the Nueces Basin prorated to applicable counties within the Coastal Bend Region by aquifer.

System features the highly transmissive Goliad Sands. The Chicot Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Coastal Bend Area. The Burkeville Confining System is a limited water-bearing formation and characterized as containing substantial amounts of clay.

A CGCGAM was developed by the TWDB to simulate steady-state, predevelopment and developed flow in the Gulf Coast Aquifer along the south Texas Gulf Coast and to assist in the determination of groundwater availability for the region. Steady-state, predevelopment flow conditions represent the state of the aquifer prior to development as a water supply source. Under these conditions, inflow from recharge is assumed to be equal to outflow to adjacent aquifers or other discharge areas and no significant diversion (pumpage) from aquifer storage is occurring. Under developed flow conditions, existing well fields and measured drawdowns are used to calibrate the aquifer parameters. The model consists of four layers with 1-mile (5,280-foot) grid spacing and extends from the outcrop areas in the Jasper outcrop areas in the west to the Gulf of Mexico in the east, and from the groundwater divide to the north through Colorado, Fort Bend, and Brazoria Counties to the south approximately midway through Jim Hogg, Brooks, and Kenedy Counties, as shown in Figure 3-6. The four layers from top to bottom are: Chicot, Evangeline, Burkeville Confining System, and Jasper. The Catahoula Confining System provides

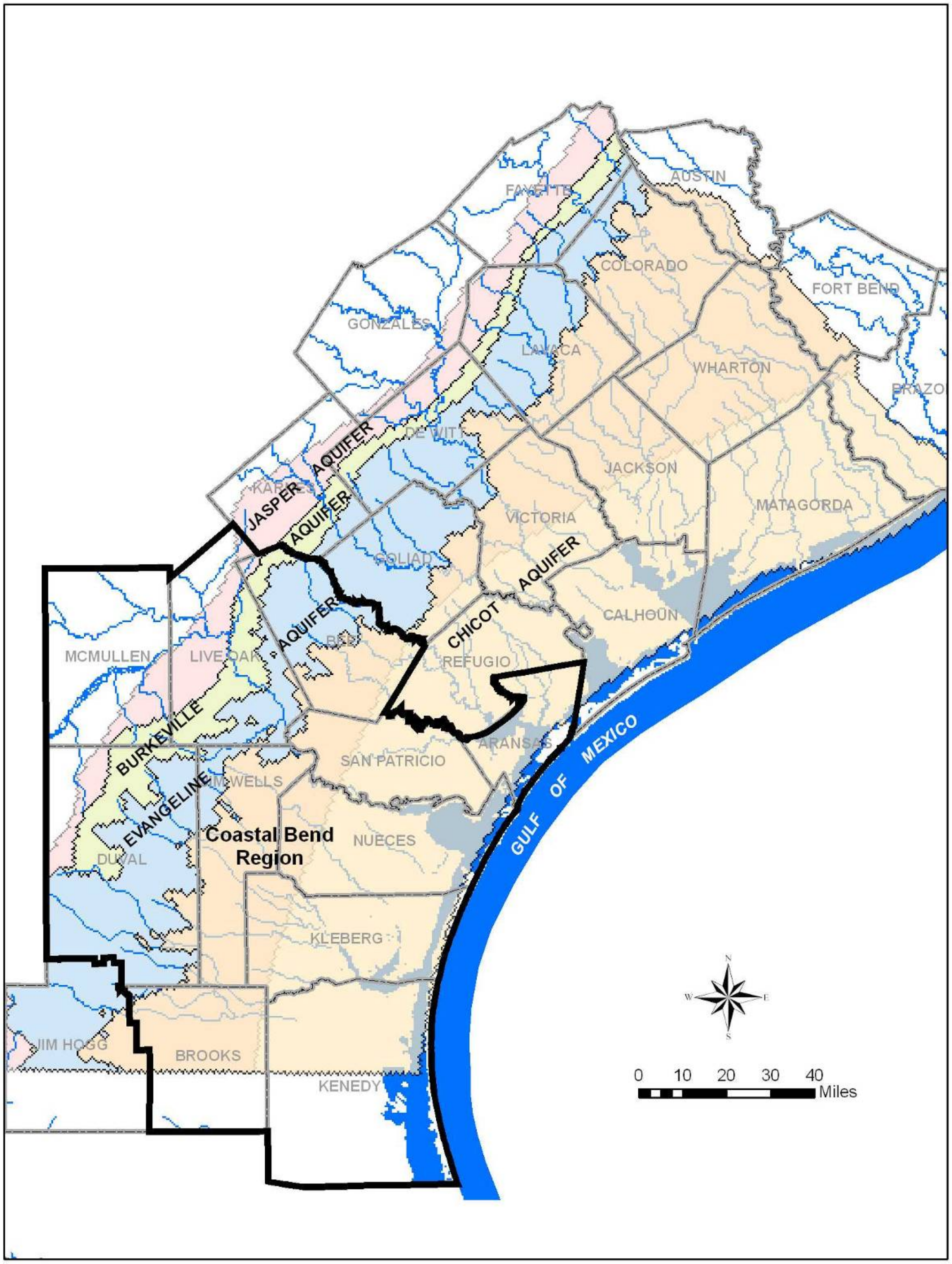


Figure 3-6. Location of Central Gulf Coast Groundwater Availability Model and Aquifer Layers

the base of the model and is not included as a model layer. The CGCGAM was use to calculate groundwater availability for Gulf Coast Aquifer groundwater supplies.

The model area includes all or parts of several Regional Water Planning Group areas including Region H, Lower Colorado (Region K), Lavaca/Navidad (Region P), South Central Texas (Region L), Coastal Bend (Region N), and Rio Grande (Region M). It also includes all or parts of 22 groundwater conservation districts (GCDs) including Live Oak Underground Water Conservation District (UWCD), McMullen GCD, Bee GCD, Kenedy County GCD, Duval County GCD, Brush Country GCD, San Patricio GCD, and the Corpus Christi Aquifer Storage and Recovery Conservation District for the Coastal Bend Region.

Predictive pumping estimates were developed using TWDB historical pumping amounts (Year 1999) prorated for anticipated groundwater use in 2000 to 2060 based on TWDB water demand projections using the following method:

- For entities solely using groundwater as their water supply, the projected groundwater pumpage was set equal to projected water demands.
- For entities using both groundwater and surface water, the future groundwater pumping was based on 2000 water use (i.e., if an entity satisfied their water demand using 20 percent groundwater in 2000, then the groundwater pumping in 2060 would be calculated at 20 percent their projected water demand in 2060).

The pumping amounts were distributed to individual cells for municipal, mining, steam-electric, and most manufacturing users. For irrigation, municipal county-other, and water supply corporations, pumping was distributed uniformly across the county to all active pumping cells included in the TWDB historical model. For more detail regarding the new Gulf Coast Aquifer model development and application, please refer to Appendix D.

The calibrated and verified groundwater flow model with projected pumping was used to run a number of groundwater availability simulations subject to acceptable drawdown and water quality constraints, as based on the following criteria adopted by the Coastal Bend Region, also used in the 2006 Plan:

1. Long-term (sustainable) pumping simulations (i.e., steady-state model simulation).
2. In the unconfined aquifer:
   a. Water level declines were limited to no more than 125 feet below predevelopment levels; and
   b. A minimum saturated thickness of 150 feet.
3. In the confined aquifer:
   a. Water level declines were limited to no more than 250 feet below predevelopment levels; and
   b. Water level declines were not to exceed 62.5 percent of the elevation difference between predevelopment flow heads and the top of the aquifer.

Based on these criteria, the available groundwater for the planning region was determined. The revised irrigation water demand increases for Bee and San Patricio Counties adopted by the CBRWPG were considered to be supplied by the Gulf Coast Aquifer. The increased water use did not exceed the groundwater drawdown constraints. There were three instances when the drawdown criteria were exceeded based on projected groundwater demands for Duval County-Mining, Live Oak County-Mining, and Live Oak County-Manufacturing users. In all cases, some of the pumping was distributed to nearby model cells. Based on the response of pumping that is distributed uniformly across the county, Live Oak and Duval Counties can likely sustain this pumping on a county basis without exceeding the drawdown criteria. However, the local groundwater supply, associated with assigned individual pumping cells, cannot fully support the groundwater demand; therefore, the groundwater supply for Live Oak Mining-Manufacturing and Duval-Mining in Section 4A has been prorated back so that drawdown does not exceed the adopted criteria.

The resulting groundwater available by county in the Coastal Bend Region is presented in Table 3-5. The issue of determining future acceptable drawdown (past Year 2060) should be considered in future planning cycles. It is important to note that these availabilities are long-term (sustainable) yields. In addition, should projects be proposed outside the Coastal Bend Region setting, the Coastal Bend Region requests that site-specific analyses be performed by the project participants to demonstrate to the Coastal Bend Region that no long-term detrimental impacts to the aquifer will result from said "over-pumpage."

The TWDB is currently working with the Groundwater Management Areas (GMAs) to determine desired future conditions for the aquifer. Once these have been determined, the GAMs will be used to model those conditions to determine aquifer availability for future planning cycles. These values may be different than what has been previously adopted by the CBRWPG.

3.4.2 Carrizo-Wilcox Aquifer

Three counties within the Coastal Bend Region have significant Carrizo-Wilcox Aquifer reserves available to them. The Carrizo-Wilcox Aquifer contains moderate to large amounts of either fresh or slightly saline water. Slightly saline water is defined as water that contains 1,000 to 3,000 mg/L of dissolved solids. Although this aquifer reaches from the Rio Grande River north into Arkansas, it only underlies parts of McMullen, Live Oak, and Bee Counties within the

Coastal Bend Region. In this downdip portion of the Carrizo-Wilcox Aquifer, the water is soft, hot (140 degrees Fahrenheit), and contains more dissolved solids than in updip parts of the aquifer. Long-term groundwater available from the Carrizo-Wilcox in the region is summarized in Table 3-6. Groundwater availabilities are based on TWDB analyses and are carried over from the 2006 Plan.[16] According to project groundwater use in 2060, less than 1% of the groundwater supplies in the Coastal Bend Region are estimated to be supplied by the Carrizo-Wilcox aquifer (or about 513 acft/yr total combined for McMullen and Live Oak Counties) as shown in Table 3-6.

Table 3-5.
Groundwater Availability and Use from the Gulf Coast Aquifer within the Coastal Bend Region

County	***2060 Availability (acft/yr)***	***2060 Use[1] (acft/yr)***
Aransas	715[2]	715
Bee	17,053[2]	17,053
Brooks	3,325[2]	3,325
Duval	10,122[,4]	10,122
Jim Wells	5,902[2]	5,902
Kenedy	12,700[3]	251
Kleberg	9,700[3]	7,421
Live Oak	8,295[2]	8,295
McMullen	1,200[3]	34
Nueces	2,100[3]	1,963
San Patricio	25,832[2]	25,832
Total	96,944	80,913

[1] Source: CGCGAM analyses (see Appendix D).

[2] Availability based on 2060 use from Central Gulf Coast Groundwater Availability Model analyses.

[3] Source: CBRWPG Groundwater Model analysis as part of 2001 Plan.

[4] 600 acft for the City of Freer is from the Catahoula Formation, which is located in the Gulf Coast Aquifer but not included in the CGCGAM.

[16] TWDB, "Water for Texas," August 1997. (Data supporting the 1997 Texas State Water Plan.)

Table 3-6.
Groundwater Availability and Use from the Carrizo-Wilcox Aquifer within the Coastal Bend Region

County	*2060 Availability[1] (acft/yr)*	*2060 Use[2] (acft/yr)*
Bee	394	—
Live Oak	2,399	60
McMullen	7,909	453
Total	**10,702**	**513**

[1] Source: CBRWPG Groundwater model analysis as part of 2001 Plan.
[2] Source: CGCGAM analyses (see Appendix D).

3.4.3 Queen City and Sparta Aquifers

The Queen City and Sparta Aquifers are classified by the TWDB as minor aquifers and underlie McMullen County. The Queen City is a thick sand and sandy clay aquifer and runs from its southern boundary in Frio and LaSalle Counties northeasterly towards Louisiana. The Queen City Aquifer supplies small to moderate amounts of either fresh or slightly saline water in the Coastal Bend Region. The Sparta Aquifer is composed of interbedded sands and clays that yield small to moderate quantities with fresh to slightly saline quality. Long-term groundwater available from these aquifers, as tabulated by the TWDB,[17] and are carried over from the 2006 Plan, in Table 3-7. According to projected groundwater use in 2060, no water use is estimated from Queen City or Sparta sources.

Table 3-7.
Groundwater Availability and Use from the Queen City and Sparta Aquifers within the Coastal Bend Region

County	*Aquifer*	*2060 Availability[1] (acft/yr)*	*2060 Use[2] (acft/yr)*
McMullen	Queen City	1,105	—
McMullen	Sparta	600	—
Total		**1,705**	**—**

[1] Source: CBRWPG Groundwater Model analysis as part of 2001 Plan.
[2] Source: Central Gulf Coast GAM analyses (see Appendix D).

[17] Ibid.

3.4.4 Summary of Groundwater Availability

Groundwater resources in the Coastal Bend Region are made up of supplies from the Gulf Coast, Carrizo-Wilcox, Queen City, and Sparta Aquifers. Long-term (sustainable) yield from the aquifers, based on recent CGCGAM modeling of the Gulf Coast Aquifer (Appendix D) and estimates from the TWDB,[18] are summarized in Table 3-8. These availabilities were used in supply and demand comparisons in Section 4.

3.5 Drought Response

Texas Water Code Sections 16.053(e)(3)(A) and 31 TAC 357.5(e)(7) require that, for each source of water supply in the regional water planning area designated in accordance with

Table 3-8.
Total Groundwater Available in the Coastal Bend Region by County

County	2060 Groundwater Availability (acft/yr)				
	Gulf Coast Aquifer	Carrizo-Wilcox Aquifer	Queen City Aquifer	Sparta Aquifer	Total
Aransas	715	0	0	0	715
Bee	17,053	394	0	0	17,447
Brooks	3,325	0	0	0	3,325
Duval	10,122	0	0	0	10,122
Jim Wells	5,902	0	0	0	5,902
Kenedy	12,700	0	0	0	12,700
Kleberg	9,700	0	0	0	9,700
Live Oak	8,295	2,399	0	0	10,694
McMullen	1,200	7,909	1,105	600	10,814
Nueces	2,100	0	0	0	2,100
San Patricio	25,832	0	0	0	25,832
Total	**96,944**	**10,702**	**1,105**	**600**	**109,351**

31 TAC 357.7(a)(1), the regional water plan shall identify: (A) factors specific to each source of water supply to be considered in determining whether to initiate a drought response; and (B) actions to be taken as part of the response. The Texas Commission on Environmental Quality has model municipal water conservation and drought management plans for entities to use for guidance (Appendix E.1 and E.2). The City of Corpus Christi and their customers receive

[18] Ibid.

surface water supplies from Lake Texana, through contract agreement with Lavaca Navidad River Authority as described earlier in Section 3.1.5. The Lavaca Navidad River Authority's Drought Contingency responses are summarized in Table 3-9. The LNRA drought contingency plan is included in Appendix E.3. Table 3-10 summarizes the drought contingency plan of the City of Corpus Christi (largest wholesale water provider in the Coastal Bend Region) and shows both trigger conditions and actions to be taken. Water Conservation and Drought Contingency Plans for the City of Corpus Christi, San Patricio Municipal Water District, and South Texas Water Authority are included in Appendices E.4 to E.6.

Through water purchase agreements, the customers of the City of Corpus Christi are required to implement similar water conservation measures when conditions warrant. Table 3-11 includes a summary of drought contingency plans for entities supplied by groundwater, within the Region.

Supplies from other surface water sources such as run-of-river water rights are determined on the basis of minimum year availability and firm yield, respectively. Hence, the current surface water supplies presented herein are, by TWDB definition, dependable during drought. Factors that are typically considered in initiating drought response for surface water sources are streamflow and reservoir storage as they may be conveniently measured and monitored. In contrast to groundwater sources, water right priority with respect to other rights and special permit conditions regarding minimum instream flows can also be important factors in determining whether to initiate drought responses for surface water sources. In the Nueces River Basin, coordination with the TCEQ Watermaster is an essential drought response for all entities dependent upon surface water supply sources.

Table 3-9.
Lavaca Navidad River Authority's Drought Contingency Response

Drought Condition	Reservoir System Storage	Actions
Condition I – Compromised Reservoir Condition One	Lake Texana Reservoir elevation is at or below elevation 43.00 msl	1. LRNA will notify TCEQ Watermaster of reservoir condition. 2. Inform public, giving notice of reservoir condition to the customers served by the LNRA system and upstream water rights permit holders. Include in information to the public a recommendation that water users look for ways to conserve water. 3. *Impacts permit holders upstream of Lake Texana who divert water for irrigation purposes.* Diversions must cease within 24 hours following the time when the reservoir level drops below elevation 43.00 msl.
Condition II – Compromised Reservoir Condition Two	Lake Texana Reservoir elevation is at or below elevation 40.15 msl	In addition to Actions 1–3 under Conditions I, take the following actions 4. *Impacts freshwater releases to bays and estuaries.* LNRA may reduce the volume of freshwater releases to bays and estuaries to 5 cubic feet per second, when Lake Texana reaches elevation 40.15 (or roughly 78% of the reservoir capacity).
Condition III – Severe Local Drought Condition	Equal to or less than 30%	In addition to Actions 1–4 under Conditions I and II, take the following actions: 5. The goal is a 7% reduction of the use that would have occurred in the absence of drought contingency measures. *The water sales contract between the LNRA and City of Corpus Christi allows for the return of 10,400 acre-feet for meeting the needs of Jackson County.* 6. The affected communicates should continue implementation of relevant Drought Contingency Plan and water conservation actions. 7. Upon authorization by the TCEQ Watermaster, the LNRA will enact contractual provisions and assist the affected community as appropriate. 8. Certain industrial and commercial water uses which are not essential to the health and safety of the community should be prohibited; and 9. Through the news media, the public should be advised daily of the trigger conditions.

Table 3-10.
City of Corpus Christi Surface Water Sources Drought Contingency Response

Drought Condition	Reservoir System Storage	Actions
Condition I – Water Shortage Possibility	Below 50%	• City Manager issues a public notice to inform water users of the Corpus Christi water supply region to begin voluntary conservation measures. • Target water demand reduction of 1 percent, including for wholesale water contracts.
Condition II – Water Shortage Watch	Between 40% and 30%	• City Manager issues a public notice implementing required water conservation measures. • City Manager issues a public notice in a daily newspaper restricting outdoor watering between 10:00 am and 6:00 pm. • No runoff from yards or plants into gutters or streets allowed. • Prohibits defective plumbing in home or business establishment. • No water shall be allowed to flow constantly through a tap, hydrant, or valves by any user of water connected to the City system. • Requires City's wholesale customers to issue public notice advising water customers of required drought management measures. • Target inflows to Nueces Bay are reduced to 1,200 acre-ft per month. • Target water demand reduction of 5 percent, including for wholesale water contracts.
Condition III – Water Shortage Warning	Equal to or less than 30%	• In addition to Actions 1–8 under Conditions I and II, take the following actions: • City Manager issues a public notice and lawn watering schedule. • Target Inflows to Nueces Bay are reduced to 0 acre-feet per month. • Target water demand reduction of 10 percent, including for wholesale water contracts.
	Equal to or less than 20%	• Target water demand reduction of 15 percent, including for wholesale water contracts

Table 3-11.
Water Supply Systems Using Groundwater Sources - Drought Contingency Response

Groundwater Systems	Stage I (Voluntary)	Stage II	Stage III	Stage IV (if applicable)	Stage V (if applicable)
Utility Development & Research, Inc. (Riviera, TX)	***Customer Awareness*** Public announcement designed to increase water conservation	***Voluntary Water Conservation*** Overnight recovery rate reaches 4 feet - or - Pump hours per day is 17 hours.	***Mandatory Water Use Restrictions*** Overnight recovery rate reaches 2 feet - or - Pump hours per day is 20 hours.	***Critical Water Use Restrictions*** Overnight recovery rate reaches 0 feet - or - Pump hours per day is 22 hours.	
Escondido Creek Estates, Inc. (Kingsville, TX)	***Customer Awareness*** Public announcement designed to increase water conservation	***Voluntary Water Conservation*** Pump discharge flow is less than 180 gpm - or - Total daily demand as 60% of pumping capacity	***Mandatory Water Use Restrictions*** Pump discharge flow is less than 170 gpm - or - Total daily demand as 70% of pumping capacity	***Critical Water Use Restrictions*** Pump discharge flow is less than 160 gpm - or - Total daily demand as 80% of pumping capacity	
McCoy Water Supply Corporation (Service area includes 608 square miles located in Atascosa, Wilson, and Live Oak Counties)	***Mild Water Shortage Conditions*** Well flow from any regularly used well is less than 90% of full capacity. A storage facility is not filled for 72 consecutive hours. An elevated storage tank is out of service due to repainting or other required maintenance.	***Moderate Water Shortage Conditions*** Well flow from any regularly used well is less than 80% of full capacity. A storage facility is not filled for 96 consecutive hours.	***Severe Water Shortage Conditions*** Well flow from any regularly used well is less than 70% of full capacity. A storage facility is not filled for 120 consecutive hours.	***Critical Water Shortage Conditions*** Well flow from any regularly used well is less than 60% of full capacity. A storage facility is not filled for 144 consecutive hours.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. Natural or man-made contamination of the water supply source(s).
El Oso Water Conservation District (Service area includes 500 square miles located in Karnes, Bee, Wilson, and Live Oak Counties)	***Mild Drought*** Average daily water usage reaches 85% of production capacity for three consecutive days. Consideration will be given to weather conditions, time of year and customer complaints of low water pressure. There is an extended period of low rainfall and daily use has risen 20% above the use for the same period during the previous year.	***Moderate Drought*** Average daily water use reaches 90% of production capacity for three consecutive days. Net water storage is continually decreasing on a daily basis, and falls below 80% storage for 48 hours. Water pressures fall to below 49 psi in the water distribution system, during non-peak water usage hours, as measured by the distribution line gages.	***Severe Drought*** The imminent or actual failure of a major component of the system that would interrupt water delivery for a prolonged period, or cause an immediate health or safety hazard. Water demand exceeds 97% of the production capacity for three consecutive days. Water demand exceeds 95% of production capacity for 30 days.		

Table 3-11.
Water Supply Systems Using Groundwater Sources - Drought Contingency Response (Continued)

Groundwater Systems	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
El Oso Water Conservation District (Continued)			Other unforeseen events which could pose imminent health or safety risks to the public.		
City of Falfurrias and Falfurrias Utility Board (Service area includes City of Falfurrias and Brooks County)	***Mild Water Shortages Conditions*** Initiated when one or more of the following exist: Static water level in the Falfurrias Utility Board's water well(s) is equal to or below mean sea level. Specific capacity of the Falfurrias Utility Board's water well(s) is equal to or less than 5% of the well's original specific capacity. Total daily water demand equals or exceeds 2.5 million gallons for 10 consecutive days or 5 million gallons on a single day (e.g., based on the "safe" operating capacity of water supply facilities). Continually falling treated water reservoir levels that do not refill above 80% overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).	***Moderate Water Shortage Conditions*** Initiated when two or more of the previous conditions exist.	***Severe Water Shortage Conditions*** Initiated when three or more of the previous conditions exist.	***Critical Water Shortage Conditions*** Initiated when four or more of the previous conditions exist.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; - or - Natural or man-made contamination of the water supply source(s).
Pettus Municipal Utility District (City of Pettus)	***Mild Water Shortage Conditions*** Total daily water demand equals or exceeds 85% of the system's safe operating capacity for three consecutive days or equals or exceeds 90% of system capacity on a single day.	***Moderate Water Shortage Conditions*** Total daily water demand equals or exceeds 90% of the system's safe operating capacity for three consecutive days or equals or exceeds 95% of system capacity on a single day.	***Severe Water Shortage Condition*** Total daily water demand equals or exceeds 95% of the system's safe operating capacity for three consecutive days, or equals or exceeds 100% of capacity on a single day.	***Critical Water Shortage Conditions*** Total daily water demand equals or exceeds 100% of the system's safe operating capacity for three consecutive days, or equals or exceeds 100% of capacity on a single day.	***Emergency Water Shortage Conditions*** System outage due to equipment failure.

Table 3-11.
Water Supply Systems Using Groundwater Sources - Drought Contingency Response (Continued)

Groundwater Systems	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
San Diego Municipal Water District No. 1 (City of San Diego)	***Mild Water Shortage Conditions*** Annually, beginning on May 1 through October 31 of every year. When the water supply available to the San Diego Municipal Utility District No. 1 is equal or less than 70% of storage capacity. When the static water level in the San Diego Municipal Water Utility District No. 1 well(s) is equal or less than 100 feet above water pump level. When the specific capacity of the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 70% of the well's original specific capacity. When total daily water demands equal or exceed one million gallons for three consecutive days.	***Moderate Water Shortage Conditions*** Water levels fall below 70% of storage capacity. Water demands exceed 70% of water well capacity. When the static water level in the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 100 feet above water pumps.	***Severe Water Shortage Conditions*** Water levels fall below 50% of storage capacity. Water demands exceed 90% of water well capacity. When the static water level in the San Diego Municipal Utility District No. 1 well(s) is equal to or less than 100 feet above water pumps. System outages due to equipment failure.	***Emergency Water Shortage Conditions*** Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service - or - Natural or man-made contamination of the water supply source(s).	
Freer WCID	***Mild Water Shortage Conditions (voluntary)*** Annually, beginning May 1 through September 1. When the static level in the Freer WCID is equal to or less than 10 feet above sea level. When the specific capacity of the Freer WCID wells are equal to or less than 70% of the well's original specific capacity. When total daily water demand equals or exceeds 700,000 gallons for 10 consecutive days or 700,000 gallons on a single	***Moderate Water Shortage Conditions*** When total daily water demand equals or exceeds 700,000 gallons for 10 consecutive days or 700,000 gallons on a single day.	***Severe Water Shortage Conditions*** When the specific capacity of the Freer WCID wells is equal to or less than 70% of the well's original specific capacity.	***Critical Water Shortage Conditions*** When the static water level in the Freer WCID wells is equal to or less than 10 feet above sea level.	

Table 3-11.
Water Supply Systems Using Groundwater Sources - Drought Contingency Response (Concluded)

Groundwater Systems	Stage I (Voluntary)	Stage II	Stage III	Stage IV (If applicable)	Stage V
Aransas County Municipal Utility District No. 1	***Mild Drought Conditions (voluntary) — Target Reduction in Well Run Time = 5%*** *When demand on the District's water supply reaches or exceeds 70% of the production capacity of such facilities for 5 consecutive days.*	***Moderate Drought Conditions — Target Reduction in Well Run Time = 10%*** *When demand on the District's water supply reaches or exceeds 90% of the production capacity of such facilities for 3 consecutive days.*	***Severe Drought Conditions — Target Reduction in Well Run Time = 15%*** *When demand on the District's water supply reaches or exceeds 100% of the production capacity of such facilities for 24 hours.*		
Blueberry Hills Water Works, LLC	***Customer Awareness (voluntary)*** *Annually, beginning April 1 through September 30* *Water customers are requested to voluntarily limit the use of water fro nonessential purposes and to practice water conservation.*	***Voluntary Water Conservation (voluntary)*** *Overnight recovery fails to restore 90% of full storage capacity.* *Production or distribution limitations.*	***Mandatory Water Use Restrictions*** *Overnight recovery fails to restore 85% of full storage capacity.* *Production or distribution limitations.*	***Critical Water Use Restrictions*** *Overnight recovery fails to restore 80% of full storage capacity.* *Production or distribution limitations.*	
McMullen County WCID #2	***Mild Water Shortage Conditions (voluntary)*** *When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day.*	***Moderate Water Shortage Conditions*** *When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 90% overnight.*	***Severe Water Shortage Conditions*** *When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 80% overnight.*	***Critical Water Shortage Conditions*** *When total daily water demands equals or exceeds 2 million gallons on 3 consecutive days or 2.2 million gallons on a single day and/or continually falling treated water reservoir levels do not refill above 75% overnight.*	***Emergency Water Shortage Conditions*** Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Natural or man-made contamination of water supply source(s).
City of Orange Grove	***Mild Water Shortage Conditions (voluntary)*** *When the static water level in City Water Well No. 4 is equal or more than 140 feet below the top of the casing.* *When total daily water demands equals or exceeds 90% of system safe operating capacity which is 750,000 gallons per day, for 10 consecutive days.*	***Moderate Water Shortage Conditions*** *When the static water level in City Water Well No. 4 drops to 150 feet below the top of the casing.*	***Severe Water Shortage Conditions*** *When the static water level in City Water Well No. 4 reaches 160 feet below the top of the casing.*	***Critical Water Shortage Conditions*** *When the static water level in City Water Well No. 4 reaches 165 feet below the top of the casing.*	***Emergency Water Shortage Conditions*** Major line breaks, or pump or system failures occur, which cause unprecedented loss of capacity to provide water service. Natural or man-made contamination of water supply source(s).

3.6 Potential for Emergency Transfers of Surface Water

TWDB Rules, Section 357.5(i) direct that the RWPG include recommendations for the emergency transfer of surface water and further direct that a determination be made of the portion of each right for non-municipal use that may be transferred without causing unreasonable damage to the property of the non-municipal water right holder. Senate Bill 1, Section 3.03 amends Texas Water Code Section 11.139 and allows the Executive Director of TCEQ, after notice to the Governor, to issue emergency permits or temporarily suspend or amend permit conditions without notice or hearing to address emergency conditions for a limited period of not more than 120 days if an imminent threat to public health and safety exists. A person desiring to obtain an emergency authorization is required to justify the request to TCEQ. If TCEQ determines the request is justified, it may issue an emergency authorization without notice and hearing, or with notice and hearing, if practicable. Applicants for emergency authorizations are required to pay fair market value for the water they are allowed to divert, as well as any damages caused by the transfer. In transferring the quantity of water pursuant to an emergency authorization request, the Executive Director, or the TCEQ, shall allocate the requested quantity among two or more water rights held for purposes other than domestic or municipal purposes.

Surface water availability models have been developed for the streams of Coastal Bend Region (Region N) in which the locations, quantities, and yields of the surface water rights of the region have been determined (Table 3-3). The Regional Water Plan incorporates Table 3-3 as a primary source of information to water user groups and the TCEQ for use in cases of emergencies that result in a threat to public health and safety. Water user groups who are located in proximity to one or more existing surface water diversion permits for non-municipal use can readily estimate quantities of water that might be available for emergency use applications, and TCEQ may also consider Table 3-3 in its administration of this provision of Senate Bill 1.

Section 4A
Comparison of Water Demands with Water Supplies to Determine Needs [31 TAC §357.7(a)(5-7)]

4A.1 Introduction

In this section, the demand projections from Section 2 and the supply projections from Section 3 are brought together to estimate projected water needs in the Coastal Bend Region for the next 50 years. As a recap, Section 2 presented demand projections for six types of use: municipal, manufacturing, steam-electric, mining, irrigation, and livestock. Municipal water demand projections are shown for each city with a population of more than 500 and for County-Other users in each county. Section 3 presented surface water availability by water right and groundwater availability and projected use by aquifer.

For each of the 11 counties in the Coastal Bend Region there is a summary page that highlights specific supply and demand information in Section 4A.3, followed by two tables. The first table contains supply and demand comparisons for the six types of water use; the second table contains supply and demand comparisons for the municipal water user groups in the county.

Section 4A.6 summarizes the water supply and demand picture for the entire region, focusing on those cities and other users that have immediate and/or long-term needs.

4A.2 Allocation Methodology

Surface water and groundwater availability was allocated among the six user groups using the methods explained below.

4A.2.1 Surface Water Allocation

Surface water in the region that is available to meet projected demands consists of the yield of reservoirs, dependable supply of run-of-river water rights through drought of record conditions, and local on-farm sources. Surface water rights were allocated as supplies according to their stated type of use: municipal, industrial (manufacturing, steam-electric, and mining), and irrigation. Municipal supply was further allocated among cities and other municipal water supply entities. This was done by obtaining water seller information (i.e., which wholesale water providers resell water to other water supply entities) and water purchase contract limits between buyers and sellers, provided by the TWDB and Wholesale Water Providers. In most cases, for those cities purchasing water on a wholesale basis the contract amount remains constant through 2060. It was also assumed that water associated with a wholesaler that is not resold remains as an available supply to the wholesaler. In the case where a wholesaler's supply is deficient to meet its own demands and contract requirements, a shortage would be expected for their non-municipal customers. Also in the case of surface water, the available supplies were compared to the water treatment plant (WTP) capacities shown in Table 4A-1. If the total available surface water supplies were greater than treatment plant capacity, the supplies were constrained by the treatment plant capacity. A detailed explanation of water demand and supplies for Wholesale Water Providers is described in Section 4A.4. Figure 4A-1 presents major contract relationships in the Coastal Bend Region and Figure 4A-2 shows how the surface water in the Coastal Bend Region is distributed.

Two situations deserve special attention regarding raw water supplies for the region. The City of Corpus Christi (City) has 200,000 acft in available safe yield supply in 2060, through its own water right in the Nueces Basin from the CCR/LCC System and a contract with the Lavaca-Navidad River Authority for a base amount of 41,840 acft/yr and up to 12,000 acft on an interruptible basis from Lake Texana. These supplies are referred to collectively as supplies from the CCR/LCC/Lake Texana System. The City also has a permit to divert up to 35,000 acft/yr of run-of-river water under its interbasin transfer permit on the Colorado River (via the Garwood Irrigation Co.). While the City owns the water right on the Colorado River, it does not have the facilities to divert this water and convey it to the City. Therefore, under the rules governing the regional water planning process, this water is not a current water supply. The facilities to deliver Colorado River water to the region are analyzed as a water supply option in Section 4C.14 in Volume II.

From this availability—CCR/LCC/Lake Texana System—Corpus Christi supplies its municipal customers throughout the Coastal Bend Region and manufacturing, mining, and steam-electric customers in Nueces County (Figure 4A-1). San Patricio Municipal Water District (SPMWD) has a contract to buy 40,000 acft of raw and treated water from the City of Corpus Christi and provides water to municipal customers in Aransas, Nueces and San Patricio Counties, as well as manufacturing needs in San Patricio County. South Texas Water Authority (STWA) supplies municipal and rural customers in Nueces and Kleberg Counties. Nueces County WCID #3 supplies municipal customers in Nueces County.

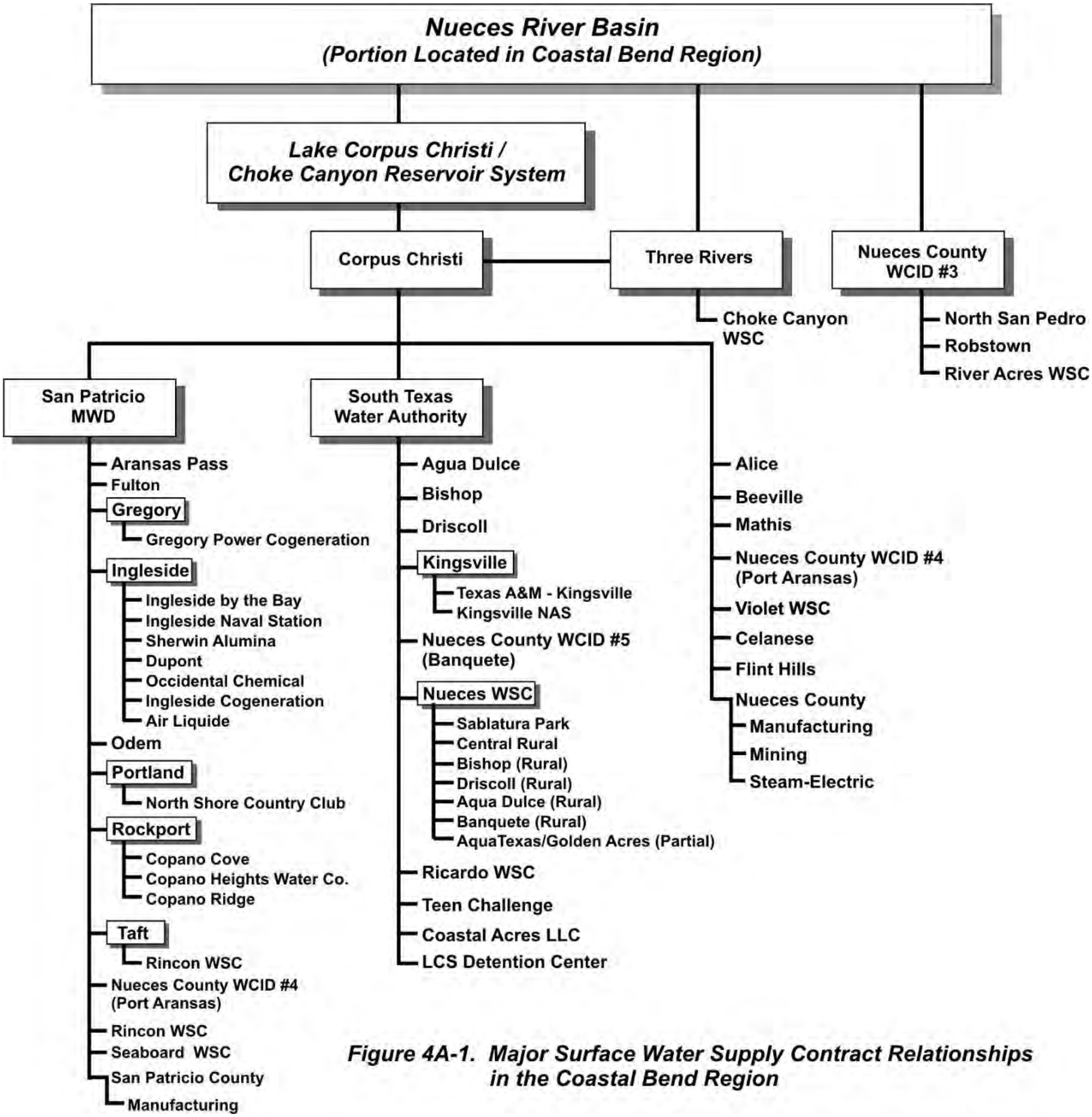


Figure 4A-1. Major Surface Water Supply Contract Relationships in the Coastal Bend Region

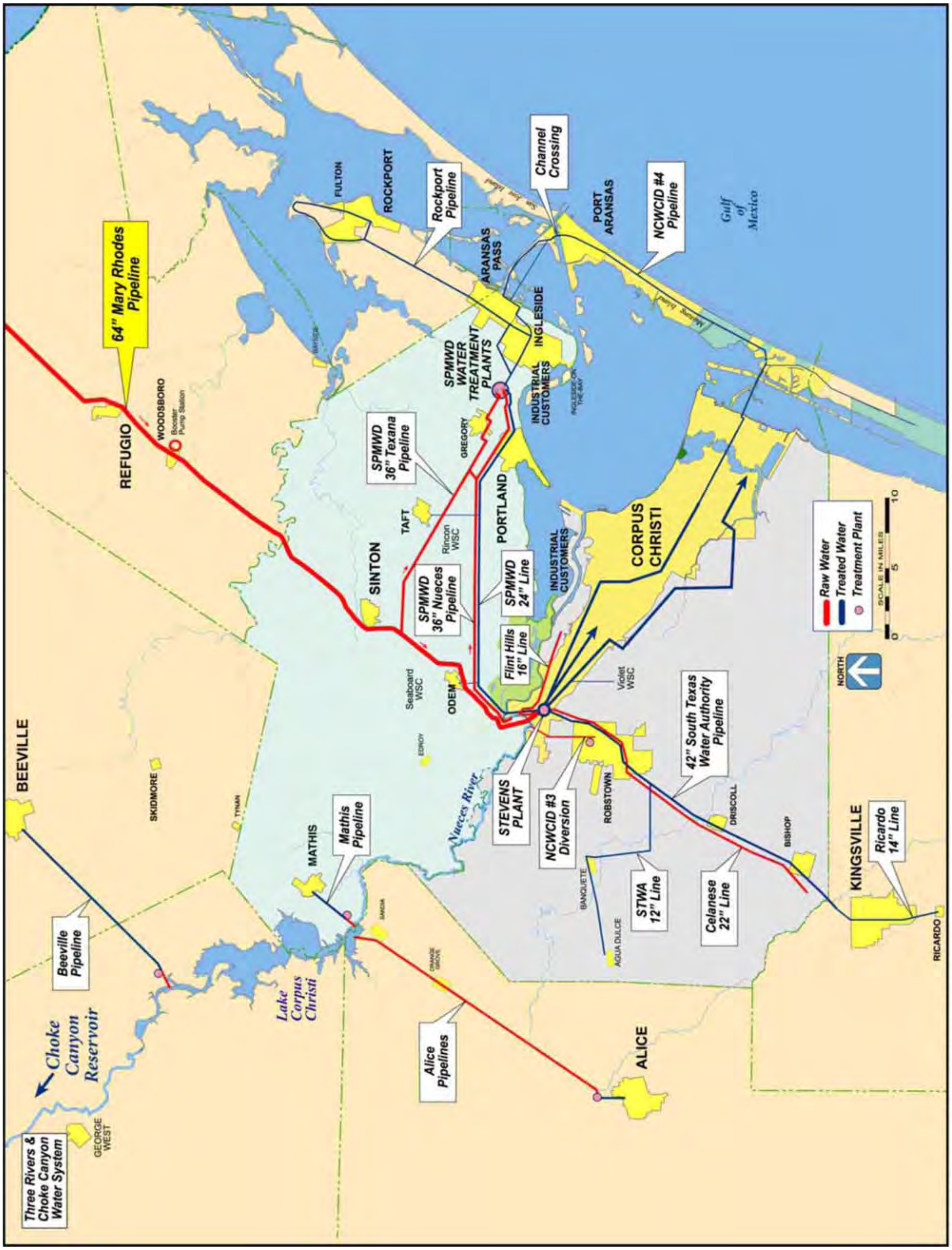


Figure 4A-2. Coastal Bend Water Supply System

Source: The Rodman Company

The final process in the allocation of surface water supplies was to examine the available WTP capacity for each entity with a WTP and compare that capacity to existing raw water supplies. The WTP capacity was calculated based on average day production using a peaking factor of 2:1 (i.e., the normal rated design flows shown in Table 4A-1 were divided by 2), except for the City, SPMWD, and the City of Alice where a 1.4:1 peaking factor was used based on historical data provided. If the WTP capacity was insufficient to treat the existing raw water supplies, then surface water supplies to that entity were limited to the current WTP treatment capacity. Current WTP capacities are shown in Table 4A-1.

Table 4A-1.
Water Treatment Plant Capacities for Region N Water User Groups

Entity	*Normal Rated Design Flow (MGD)*	*Average Day WTP Capacity (MGD)[1]*
City of Beeville	6.9	3.5
City of Alice	8.7	6.2[2]
City of Three Rivers	1.7	0.9
City of Mathis	2.0	1.0
City of Corpus Christi	159.0	113.6[2]
San Patricio MWD	25.0	17.9[2]
Nueces County WCID #3	6.6	3.3

1. Average day WTP capacities calculated as ½ of normal rated design flow.
2. Calculation based on 1.4:1 peaking factor.

Local surface water supply from stock ponds and streams is available to meet livestock needs when groundwater supplies are insufficient to meet those demands. Generally, these ponds are not large enough to require a water rights permit (>200 acft of storage).

4A.2.2 Groundwater Allocation

For the previous 2001 and 2006 Regional Water Plans, total groundwater availability in the region was determined based on the long-term sustainable pumpage of each of the aquifers in the region using an analytical groundwater model developed for the Coastal Bend Region and the Central Gulf Coast Groundwater Availability Model developed by the TWDB. This approach was carried over to the 2011 Plan for the Carrizo-Wilcox, Queen City, and Sparta Aquifers. For the Gulf Coast Aquifer, which provided over 90 percent of the groundwater supply in 2000, the TWDB's Central Gulf Coast

Groundwater Availability Model was used during development of the 2006 Plan to determine projected groundwater use from 2000 to 2060. Predictive pumping estimates were developed based on historic water use and projected water demands. The model was used to simulate the effects of future pumping on Gulf Coast Aquifer water levels, and to determine groundwater availability subject to acceptable drawdown constraints, as discussed in Section 3.4.1. There were only three instances when the drawdown criteria were exceeded based on projected groundwater demands through 2060. These included Duval County-Mining, Live Oak County-Mining, and Live Oak County-Manufacturing. In these instances, pumping was limited so that the drawdown in 2060 does not exceed the adopted drawdown criteria. For all other groundwater users, supply is limited to either well capacity or projected groundwater use, whichever is less. Well capacities were generally set at one-half the actual well capacity to accommodate for peak demands. For each county, groundwater is allocated among five of the six user groups—municipal, manufacturing, mining, irrigation, and livestock. Nueces County is the only county in the Coastal Bend Region with steam-electric demands, and these are met with surface water supplies. Groundwater supply was allocated in the following manner:

<u>Municipal Use</u>

- For cities, groundwater supply was based upon projected water use or well capacity reported to TCEQ, whichever is less.
- For rural areas, well capacities were estimated as 125 percent of the 2000 usage from the Gulf Coast Aquifer. Groundwater supply was based upon projected water use or well capacities, whichever is less.

<u>Irrigation Use</u>

- Irrigation supply was estimated as either the projected demand in each decade or well capacity, whichever is less. The well capacity was estimated as the amount of water used by irrigators in 2000. For Bee and San Patricio Counties, the well capacity was assumed to be equal to the maximum annual pumping during the 2000 to 2006 time period based on TWDB records. The well capacities for Bee and San Patricio Counties were set equal to 5,311 acft/yr and 9,698 acft/yr, respectively. Actual well capacity pumping constraints may be different than those estimated based on previous maximum annual irrigation water use. Most irrigation water in the Coastal Bend Region is applied during growing seasons, and therefore wells may be capable of providing additional supplies for peak use conditions. Surface water supplies for Bee, Live Oak, Nueces, and San Patricio Counties were also considered.

<u>Manufacturing Use</u>

- The manufacturing well capacity was generally estimated as 130 percent of the 2000 usage from the Gulf Coast Aquifer. Groundwater supply was based on projected water use or estimated well capacities, whichever is less. In cases when the projected water use on that portion (i.e., county and river basin) of the aquifer exceeded the adopted drawdown criteria, supply was prorated downwards.

Mining Use

- The mining supply was estimated as either the projected demand in each decade or well capacity, whichever is less. A portion of the projected water demand in Nueces County is met with surface water supplies. In cases when the projected water use on that portion (i.e., county and river basin) of the aquifer exceeded the adopted drawdown criteria, supply was prorated downwards.

Livestock Use

- The groundwater supply for livestock was calculated based on 1997 groundwater use reported by TWDB, represented as a percent of total groundwater used to meet demands. This percent of groundwater used is applied to each livestock demand by decade. The remaining demand is met with local surface water supplies.

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4A-3 County Summaries — Comparison of Demand to Supply

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4A.3.1 Comparison of Demand to Supply – Aransas County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-2 for all categories of water use. Table 4A-3 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 3,314 acft in 2000 to 4,444 acft in 2030 and to 3,835 acft in 2060.
- Manufacturing demand increases from 235 acft to 331 acft from 2000 to 2060.
- Mining demand increases from 81 to 146 acft from 2000 to 2060.
- There is no irrigation demand projected; livestock demand is constant at 23 acft/yr.

Supplies

- Surface water from the CCR/LCC/Lake Texana System is supplied to municipalities by the City of Corpus Christi via the SPMWD.
- Groundwater supplies are from the Gulf Coast Aquifer.
- Surface water for livestock needs is provided from on-farm and local sources.

Comparison of Demand to Supply

- There are municipal shortages from 2050 to 2060, with the greatest shortage attributable to County-Other users in 2050 (1,527 acft), due to insufficient surface water supply for SPMWD.
- There are immediate and long-term shortages through 2060 for manufacturing users. Groundwater supply to manufacturing users is limited by well capacity, which results in groundwater supplies to the county being 136 acft less than projected groundwater use for Aransas County in 2060 (Section 3.4).

Table 4A-2.
Aransas County
Population, Water Supply, and Water Demand Projections

	Population Projection	Year 2000	2010	2020	2030	2040	2050	2060
		22,497	26,863	30,604	32,560	32,201	30,422	28,791

	Supply and Demand by Type of Use	Year 2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand (See Table 4A-3)	3,314	3,831	4,263	4,444	4,326	4,053	3,835
	Municipal Existing Supply							
	Groundwater	212	242	267	276	267	250	236
	Surface water	3,102	3,589	3,996	4,168	4,059	2,276	2,156
	Total Existing Municipal Supply	3,314	3,831	4,263	4,444	4,326	2,526	2,392
	Municipal Balance	0	0	0	0	0	(1,527)	(1,443)
Industrial	Manufacturing Demand	235	267	281	292	302	311	331
	Manufacturing Existing Supply							
	Groundwater	195	195	195	195	195	195	195
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	195	195	195	195	195	195	195
	Manufacturing Balance	(40)	(72)	(86)	(97)	(107)	(116)	(136)
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	81	103	115	123	131	139	146
	Mining Existing Supply							
	Groundwater	81	103	115	123	131	139	146
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	81	103	115	123	131	139	146
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	0	0	0	0	0	0	0
	Irrigation Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	0	0	0	0	0	0	0
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	23	23	23	23	23	23	23
	Livestock Existing Supply							
	Groundwater	2	2	2	2	2	2	2
	Surface water	21	21	21	21	21	21	21
	Total Livestock Supply	23	23	23	23	23	23	23
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	3,630	4,201	4,659	4,859	4,759	4,503	4,312
	Existing Municipal and Industrial Supply							
	Groundwater	488	540	577	594	593	584	577
	Surface water	3,102	3,589	3,996	4,168	4,059	2,275	2,155
	Total Municipal and Industrial Supply	3,590	4,129	4,573	4,762	4,652	2,859	2,732
	Municipal and Industrial Balance	(40)	(72)	(86)	(97)	(107)	(1,644)	(1,580)
	Agriculture Demand	23	23	23	23	23	23	23
	Existing Agricultural Supply							
	Groundwater	2	2	2	2	2	2	2
	Surface water	21	21	21	21	21	21	21
	Total Agriculture Supply	23	23	23	23	23	23	23
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	3,653	4,224	4,682	4,882	4,782	4,526	4,335
	Total Supply							
	Groundwater	490	542	579	596	595	586	579
	Surface water	3,123	3,610	4,017	4,189	4,080	2,297	2,177
	Total Supply	3,613	4,152	4,596	4,785	4,675	2,883	2,756
	Total Balance	(40)	(72)	(86)	(97)	(107)	(1,644)	(1,580)

Table 4A-3.
Aransas County
Municipal Water Demand and Supply by City/County
(acft)

City/County	2000	2010	2020	2030	2040	2050	2060
Aransas Pass							
Demand	146	168	186	195	190	179	169
Supply	146	168	186	195	190	179	169
Groundwater	—	—	—	—	—	—	—
Surface Water	146	168	186	195	190	179	169
Balance	—	—	—	—	—	—	—
Fulton							
Demand	261	307	346	365	359	336	318
Supply	261	307	346	365	359	336	318
Groundwater	—	—	—	—	—	—	—
Surface Water	261	307	346	365	359	336	318
Balance	—	—	—	—	—	—	—
Rockport							
Demand	1,357	1,590	1,778	1,868	1,823	1,712	1,620
Supply	1,357	1,590	1,778	1,868	1,823	1,712	1,620
Groundwater	—	—	—	—	—	—	—
Surface Water	1,357	1,590	1,778	1,868	1,823	1,712	1,620
Balance	—	—	—	—	—	—	—
County-Other							
Demand	1,550	1,766	1,953	2,016	1,954	1,826	1,728
Supply	1,550	1,766	1,953	2,016	1,954	299	285
Groundwater	212	242	267	276	267	250	236
Surface Water	1,338	1,524	1,686	1,740	1,687	49	49
Balance	—	—	—	—	—	(1,527)	(1,443)
Total for Aransas County							
Demand	3,314	3,831	4,263	4,444	4,326	4,053	3,835
Supply	3,314	3,831	4,263	4,444	4,326	2,526	2,392
Groundwater	212	242	267	276	267	250	236
Surface Water	3,102	3,589	3,996	4,168	4,059	2,276	2,156
Balance	—	—	—	—	—	(1,527)	(1,443)

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4A.3.2 Comparison of Demand to Supply – Bee County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-4 for all categories of water use. Table 4A-5 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 4,220 acft in 2000 to 4,492 acft in 2030 and to 4,291 acft in 2060.
- Manufacturing demand is constant at 1 acft from 2000 to 2060.
- Mining demand increases from 29 acft in 2000 to 48 acft in 2060.
- For the period 2000 to 2060, irrigation demand increases from 2,798 acft to 6,243 acft; livestock demand is constant at 995 acft.

Supplies

- Surface water is provided to the City of Beeville from the CCR/LCC System by the City of Corpus Christi.
- Surface water for livestock needs is provided from on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.
- Groundwater supply for irrigation was set equal to the maximum pumping from 2000 to 2006 (i.e. estimated well capacity).

Comparison of Demand to Supply

- There are sufficient municipal, industrial, and livestock supplies through 2060.
- Supplies for irrigation are constrained by well capacity, resulting in an irrigation shortage of 299 acft/yr in 2050, increasing to 890 acft/yr in 2060.

Table 4A-4.
Bee County
Population, Water Supply, and Water Demand Projections

		Year						
Population Projection		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
		32,359	34,298	36,099	37,198	37,591	37,598	36,686
Supply and Demand by Type of Use		**2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-5)	4,220	4,342	4,456	4,492	4,439	4,397	4,291
	Municipal Existing Supply							
	Groundwater	1,691	1,723	1,766	1,770	1,740	1,714	1,673
	Surface water	2,529	2,619	2,691	2,722	2,699	2,683	2,618
	Total Existing Municipal Supply	4,220	4,342	4,457	4,493	4,439	4,397	4,291
	Municipal Balance	0	0	1	1	0	0	0
Industrial	Manufacturing Demand	1	1	1	1	1	1	1
	Manufacturing Existing Supply							
	Groundwater	1	1	1	1	1	1	1
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	1	1	1	1	1	1	1
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	29	36	40	42	44	46	48
	Mining Existing Supply							
	Groundwater	29	37	40	42	44	46	48
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	29	37	40	42	44	46	48
	Mining Balance	0	1	0	0	0	0	0
Agriculture	Irrigation Demand	2,798	3,796	4,193	4,632	5,116	5,652	6,243
	Irrigation Existing Supply							
	Groundwater	2,756	3,754	4,151	4,590	5,074	5,311	5,311
	Surface water[1]	42	42	42	42	42	42	42
	Total Irrigation Supply	2,798	3,796	4,193	4,632	5,116	5,353	5,353
	Irrigation Balance	0	0	0	0	0	(299)	(890)
	Livestock Demand	995	995	995	995	995	995	995
	Livestock Existing Supply							
	Groundwater	88	88	88	88	88	88	88
	Surface water	907	907	907	907	907	907	907
	Total Livestock Supply	995	995	995	995	995	995	995
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	4,250	4,379	4,497	4,535	4,484	4,444	4,340
	Existing Municipal and Industrial Supply							
	Groundwater	1,721	1,761	1,807	1,814	1,785	1,761	1,722
	Surface water	2,529	2,619	2,691	2,722	2,699	2,683	2,618
	Total Municipal and Industrial Supply	4,250	4,380	4,498	4,536	4,484	4,444	4,340
	Municipal and Industrial Balance	0	1	1	1	0	0	0
	Agriculture Demand	3,793	4,791	5,188	5,627	6,111	6,647	7,238
	Existing Agricultural Supply							
	Groundwater	2,844	3,842	4,239	4,678	5,162	5,399	5,399
	Surface water	949	949	949	949	949	949	949
	Total Agriculture Supply	3,793	4,791	5,188	5,627	6,111	6,348	6,348
	Agriculture Balance	0	0	0	0	0	(299)	(890)
	Total Demand	8,043	9,170	9,685	10,162	10,595	11,091	11,578
	Total Supply							
	Groundwater	4,565	5,603	6,046	6,492	6,947	7,160	7,121
	Surface water	3,478	3,568	3,640	3,671	3,648	3,632	3,567
	Total Supply	8,043	9,171	9,686	10,163	10,595	10,792	10,688
	Total Balance	0	1	1	1	0	(299)	(890)

[1] Surface water supplies from run-of-river water rights in the San Antonio-Nueces Coastal Basin.

Table 4A-5.
Bee County
Municipal Water Demand and Supply by City/County
(acft)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Beeville							
Demand	2,529	2,619	2,691	2,722	2,699	2,683	2,618
Supply[1]	2,529	2,619	2,691	2,722	2,699	2,683	2,618
Groundwater	—	—	—	—	—	—	—
Surface Water	2,529	2,619	2,691	2,722	2,699	2,683	2,618
Balance	—	—	—	—	—	—	—
El Oso WSC							
Demand	60	62	65	66	66	65	64
Supply	60	62	65	66	66	65	64
Groundwater	60	62	65	66	66	65	64
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
County-Other							
Demand	1,631	1,661	1,701	1,704	1,674	1,649	1,609
Supply	1,631	1,661	1,701	1,704	1,674	1,649	1,609
Groundwater	1,631	1,661	1,701	1,704	1,674	1,649	1,609
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Total for Bee County							
Demand	4,220	4,342	4,457	4,493	4,439	4,397	4,291
Supply	4,220	4,342	4,457	4,493	4,439	4,397	4,291
Groundwater	1,691	1,723	1,766	1,770	1,740	1,714	1,673
Surface Water	2,529	2,619	2,691	2,722	2,699	2,683	2,618
Balance	—	—	—	—	—	—	—

[1] According to the City of Beeville's contract with City of Corpus Christi, the City provides supply equal to the greater supply of previous years plus 10 percent. This amount was greater than demand; therefore supply was set equal to the demand. The City of Beeville's WTP capacity of 3.45 MGD (or 3,864 acft/yr) is not expected to limit surface water availability.

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4A.3.3 Comparison of Demand to Supply – Brooks County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-6 for all categories of water use. Table 4A-7 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 1,970 acft in 2000 to 2,857 acft in 2030 and to 3,045 acft in 2060.
- Mining demand increases from 127 acft to 184 acft from 2000 to 2060.
- For the period 2000 to 2060, irrigation demand decreases from 25 acft to 21 acft; livestock demand is constant at 747 acft.

Supplies

- Surface water for livestock needs is provided from on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- There are sufficient municipal, industrial, and agricultural supplies through 2060.

Table 4A-6.
Brooks County
Population, Water Supply, and Water Demand Projections

	Population Projection	2000	2010	2020	2030	2040	2050	2060
		7,976	8,607	9,303	9,909	10,288	10,399	10,349

	Supply and Demand by Type of Use	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand (See Table 4A-7)	1,970	2,315	2,621	2,857	2,994	3,043	3,045
	Municipal Existing Supply							
	Groundwater	1,970	2,315	2,621	2,857	2,994	3,043	3,045
	Surface water	0	0	0	0	0	0	0
	Total Existing Municipal Supply	1,970	2,315	2,621	2,857	2,994	3,043	3,045
	Municipal Balance	0	0	0	0	0	0	0
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
	Manufacturing Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	127	150	161	167	173	179	184
	Mining Existing Supply							
	Groundwater	127	150	161	167	173	179	184
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	127	150	161	167	173	179	184
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	25	24	24	23	22	21	21
	Irrigation Existing Supply							
	Groundwater	25	24	24	23	22	21	21
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	25	24	24	23	22	21	21
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	747	747	747	747	747	747	747
	Livestock Existing Supply							
	Groundwater	75	75	75	75	75	75	75
	Surface water	672	672	672	672	672	672	672
	Total Livestock Supply	747	747	747	747	747	747	747
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	2,097	2,465	2,782	3,024	3,167	3,222	3,229
	Existing Municipal and Industrial Supply							
	Groundwater	2,097	2,465	2,782	3,024	3,167	3,222	3,229
	Surface water	0	0	0	0	0	0	0
	Total Municipal and Industrial Supply	2,097	2,465	2,782	3,024	3,167	3,222	3,229
	Municipal and Industrial Balance	0	0	0	0	0	0	0
	Agriculture Demand	772	771	771	770	769	768	768
	Existing Agricultural Supply							
	Groundwater	100	99	99	98	97	96	96
	Surface water	672	672	672	672	672	672	672
	Total Agriculture Supply	772	771	771	770	769	768	768
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	2,869	3,236	3,553	3,794	3,936	3,990	3,997
	Total Supply							
	Groundwater	2,197	2,564	2,881	3,122	3,264	3,318	3,325
	Surface water	672	672	672	672	672	672	672
	Total Supply	2,869	3,236	3,553	3,794	3,936	3,990	3,997
	Total Balance	0	0	0	0	0	0	0

Table 4A-7
Brooks County
Municipal Water Demand and Supply by City/County
(acft)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Falfurrias							
Demand	1,661	2,135	2,515	2,795	2,957	3,021	3,032
Supply	1,661	2,135	2,515	2,795	2,957	3,021	3,032
Groundwater	1,661	2,135	2,515	2,795	2,957	3,021	3,032
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
County-Other							
Demand	309	180	106	62	37	22	13
Supply	309	180	106	62	37	22	13
Groundwater	309	180	106	62	37	22	13
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Total for Brooks County							
Demand	1,970	2,315	2,621	2,857	2,994	3,043	3,045
Supply	1,970	2,315	2,621	2,857	2,994	3,043	3,045
Groundwater	1,970	2,315	2,621	2,857	2,994	3,043	3,045
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—

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4A.3.4 Comparison of Demand to Supply – Duval County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-8 for all categories of water use. Table 4A-9 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 2,323 acft in 2000 to 2,463 acft in 2030 and decreases to 2,223 acft in 2060.
- Mining demand increases from 4,544 acft in 2000, to 7,119 acft in 2030, to 8,553 acft in 2060.
- For the period 2000 to 2060, irrigation demand decreases from 4,524 acft to 4,064 acft; livestock demand is constant at 873 acft.

Supplies

- Surface water for livestock needs is provided from on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer, except for Freer which has groundwater supplies from the Catahoula formation.

Comparison of Demand to Supply

- Groundwater supply for Duval County-Mining is limited by Coastal Bend Region drawdown criteria, described in Section 3.4. Duval County-Mining can receive 51% of their projected groundwater use in 2060 and still meet drawdown criteria, which accounts for the difference in groundwater supplies to the county and projected groundwater use for Duval County (Section 3.4).
- Due to limited groundwater availability without exceeding drawdown criteria and increased demand, mining has near- and long-term shortages with the highest projected shortage of 4,205 acft in 2060.

Table 4A-8.
Duval County
Population, Water Supply, and Water Demand Projections

Population Projection		2000	2010	2020	2030	2040	2050	2060
		13,120	13,881	14,528	14,882	14,976	14,567	13,819
Supply and Demand by Type of Use		**2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-9)	2,323	2,400	2,453	2,463	2,428	2,345	2,223
	Municipal Existing Supply							
	Groundwater	2,323	2,400	2,453	2,463	2,428	2,345	2,223
	Surface water	0	0	0	0	0	0	0
	Total Existing Municipal Supply	2,323	2,400	2,453	2,463	2,428	2,345	2,223
	Municipal Balance	0	0	0	0	0	0	0
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
	Manufacturing Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water							
	Total Manufacturing Supply	0	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water							
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	4,544	5,860	6,630	7,119	7,610	8,108	8,553
	Mining Existing Supply							
	Groundwater	4,544	4,122	4,112	4,146	4,224	4,299	4,348
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	4,544	4,122	4,112	4,146	4,224	4,299	4,348
	Mining Balance	0	(1,738)	(2,518)	(2,973)	(3,386)	(3,809)	(4,205)
Agriculture	Irrigation Demand	4,524	4,444	4,365	4,289	4,212	4,138	4,064
	Irrigation Existing Supply							
	Groundwater	4,524	4,444	4,365	4,289	4,212	4,138	4,064
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	4,524	4,444	4,365	4,289	4,212	4,138	4,064
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	873	873	873	873	873	873	873
	Livestock Existing Supply							
	Groundwater	87	87	87	87	87	87	87
	Surface water	786	786	786	786	786	786	786
	Total Livestock Supply	873	873	873	873	873	873	873
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	6,867	8,260	9,083	9,582	10,038	10,453	10,776
	Existing Municipal and Industrial Supply							
	Groundwater	6,867	6,522	6,565	6,609	6,652	6,644	6,571
	Surface water	0	0	0	0	0	0	0
	Total Municipal and Industrial Supply	6,867	6,522	6,565	6,609	6,652	6,644	6,571
	Municipal and Industrial Balance	0	(1,738)	(2,518)	(2,973)	(3,386)	(3,809)	(4,205)
	Agriculture Demand	5,397	5,317	5,238	5,162	5,085	5,011	4,937
	Existing Agricultural Supply							
	Groundwater	4,611	4,531	4,452	4,376	4,299	4,225	4,151
	Surface water	786	786	786	786	786	786	786
	Total Agriculture Supply	5,397	5,317	5,238	5,162	5,085	5,011	4,937
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	12,264	13,577	14,321	14,744	15,123	15,464	15,713
	Total Supply							
	Groundwater	11,478	11,053	11,017	10,985	10,951	10,869	10,722
	Surface water	786	786	786	786	786	786	786
	Total Supply	12,264	11,839	11,803	11,771	11,737	11,655	11,508
	Total Balance	0	(1,738)	(2,518)	(2,973)	(3,386)	(3,809)	(4,205)

Table 4A-9.
Duval County
Municipal Water Demand and Supply by City/County
(acft)

City/County	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Benavides							
Demand	315	326	333	334	330	319	302
Supply	315	326	333	334	330	319	302
Groundwater	315	326	333	334	330	319	302
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Freer							
Demand	624	645	659	663	655	633	600
Supply	624	645	659	663	655	633	600
Groundwater	624	645	659	663	655	633	600
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
San Diego							
Demand	471	479	482	479	467	449	426
Supply	471	479	482	479	467	449	426
Groundwater	471	479	482	479	467	449	426
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
County-Other							
Demand	913	950	979	987	976	944	895
Supply	913	950	979	987	976	944	895
Groundwater	913	950	979	987	976	944	895
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Total for Duval County							
Demand	2,323	2,400	2,453	2,463	2,428	2,345	2,223
Supply	2,323	2,400	2,453	2,463	2,428	2,345	2,223
Groundwater	2,323	2,400	2,453	2,463	2,428	2,345	2,223
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—

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4A.3.5 Comparison of Demand to Supply – Jim Wells County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-10 for all categories of water use. Table 4A-11 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 8,562 acft in 2000 to 9,756 acft in 2030 and decreases to 9,433 acft in 2060.
- Mining demand increases from 347 acft in 2000 to 550 acft in 2060.
- For the period 2000 to 2060, irrigation demand decreases from 3,731 acft to 1,717 acft; livestock demand is constant at 1,064 acft.

Supplies

- Surface water is provided to the City of Alice from the CCR/LCC System by the City of Corpus Christi; livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer. San Diego groundwater supply is obtained from Duval County.

Comparison of Demand to Supply

- There are sufficient municipal supplies available through 2060 for Alice, Orange Grove, San Diego, and Premont.
- County-Other shows immediate and long-term shortages to 2060. Groundwater supply to County-Other users is limited by well capacity (Section 3.4), which results in groundwater supplies to the county being 170 acft less than projected groundwater use for Jim Wells County in 2060.
- There are sufficient water supplies through 2060 to meet projected mining, irrigation, and livestock demands.

Table 4A-10.
Jim Wells County
Population, Water Supply, and Water Demand Projections

	Population Projection	2000	2010	2020	2030	2040	2050	2060
		39,326	42,434	45,303	47,149	47,955	47,615	46,596
	Supply and Demand by Type of Use	**2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-11)	8,562	9,068	9,526	9,756	9,761	9,640	9,433
	Municipal Existing Supply							
	Groundwater	3,203	3,295	3,376	3,418	3,418	3,397	3,359
	Surface water	5,281	5,606	5,912	6,076	6,102	6,033	5,904
	Total Existing Municipal Supply	8,484	8,901	9,288	9,494	9,520	9,430	9,263
	Municipal Balance	(78)	(167)	(238)	(262)	(241)	(210)	(170)
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
	Manufacturing Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	347	423	461	484	507	530	550
	Mining Existing Supply							
	Groundwater	347	423	461	484	507	530	550
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	347	423	461	484	507	530	550
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	3,731	3,278	2,878	2,528	2,221	1,953	1,717
	Irrigation Existing Supply							
	Groundwater	3,731	3,278	2,878	2,528	2,221	1,953	1,717
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	3,731	3,278	2,878	2,528	2,221	1,953	1,717
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	1,064	1,064	1,064	1,064	1,064	1,064	1,064
	Livestock Existing Supply							
	Groundwater	106	106	106	106	106	106	106
	Surface water	958	958	958	958	958	958	958
	Total Livestock Supply	1,064	1,064	1,064	1,064	1,064	1,064	1,064
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	8,909	9,491	9,987	10,240	10,268	10,170	9,983
	Existing Municipal and Industrial Supply							
	Groundwater	3,550	3,718	3,837	3,902	3,926	3,927	3,909
	Surface water	5,281	5,606	5,912	6,076	6,102	6,033	5,904
	Total Municipal and Industrial Supply	8,831	9,324	9,749	9,978	10,028	9,960	9,813
	Municipal and Industrial Balance	(78)	(167)	(238)	(262)	(240)	(210)	(170)
	Agriculture Demand	4,795	4,342	3,942	3,592	3,285	3,017	2,781
	Existing Agricultural Supply							
	Groundwater	3,837	3,384	2,984	2,634	2,327	2,059	1,823
	Surface water	958	958	958	958	958	958	958
	Total Agriculture Supply	4,795	4,342	3,942	3,592	3,285	3,017	2,781
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	13,704	13,833	13,929	13,832	13,553	13,187	12,764
	Total Supply							
	Groundwater	7,387	7,102	6,821	6,536	6,253	5,986	5,732
	Surface water	6,239	6,564	6,870	7,034	7,060	6,991	6,862
	Total Supply	13,626	13,666	13,691	13,570	13,313	12,977	12,594
	Total Balance	(78)	(167)	(238)	(262)	(240)	(210)	(170)

Table 4A-11.
Jim Wells County
Municipal Water Demand and Supply by City/County
(acft)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Alice[1]							
Demand	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Supply	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Groundwater	—	—	—	—	—	—	—
Surface Water	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Balance	—	—	—	—	—	—	—
Orange Grove							
Demand	353	374	394	405	406	402	393
Supply	353	374	394	405	406	402	393
Groundwater	353	374	394	405	406	402	393
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Premont							
Demand	807	858	905	931	935	925	905
Supply	807	858	905	931	935	925	905
Groundwater	807	858	905	931	935	925	905
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
San Diego							
Demand	99	103	105	106	105	103	101
Supply	99	103	105	106	105	103	101
Groundwater	99	103	105	106	105	103	101
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
County-Other							
Demand	2,022	2,127	2,210	2,238	2,213	2,177	2,130
Supply	1,944	1,960	1,972	1,976	1,972	1,967	1,960
Groundwater	1,944	1,960	1,972	1,976	1,972	1,967	1,960
Surface Water	—	—	—	—	—	—	—
Balance	(78)	(167)	(238)	(262)	(241)	(210)	(170)

Table 4A-11 (Concluded)

City/County	2000	2010	2020	2030	2040	2050	2060
Total for Jim Wells County							
Demand	8,562	9,068	9,526	9,756	9,794	9,640	9,433
Supply	8,484	8,901	9,288	9,494	9,520	9,430	9,263
Groundwater	3,203	3,295	3,376	3,418	3,418	3,397	3,359
Surface Water	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Balance	(78)	(167)	(238)	(262)	(241)	(210)	(170)

[1] According to the City of Alice's contract with the City of Corpus Christi, the City provides supply equal to the greater supply of the previous years plus 10 percent. This amount was greater than demand; therefore supply was set equal to demand. The City of Alice's estimated average day WTP capacity of 6.2 MGD (or 6,944 acft/yr) is not expected to limit surface water availability.

4A.3.6 Comparison of Demand to Supply – Kenedy County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-12 for all categories of water use. Table 4A-13 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 46 acft in 2000 to 53 acft in 2060.
- Mining demand is constant at 1 acft from 2000 to 2060.
- For the period 2000 to 2060, irrigation is constant at 107 acft and livestock demand is constant at 901 acft.

Supplies

- Surface water for livestock needs is provided from on-farm and local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- All municipal, industrial, and agriculture demands are met through 2060.

Table 4A-12. Kenedy County Population, Water Supply, and Water Demand Projections

	Population Projection	2000	2010	2020	2030	2040	2050	2060
		414	467	495	523	527	529	537
	Supply and Demand by Type of Use	**2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-13)	46	50	52	53	53	52	53
Municipal	Municipal Existing Supply							
Municipal	Groundwater	46	50	52	53	53	52	53
Municipal	Surface water	0	0	0	0	0	0	0
Municipal	Total Existing Municipal Supply	46	50	52	53	53	52	53
Municipal	Municipal Balance	0	0	0	0	0	0	0
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
Industrial	Manufacturing Existing Supply							
Industrial	Groundwater	0	0	0	0	0	0	0
Industrial	Surface water	0	0	0	0	0	0	0
Industrial	Total Manufacturing Supply	0	0	0	0	0	0	0
Industrial	Manufacturing Balance	0	0	0	0	0	0	0
Industrial	Steam-Electric Demand	0	0	0	0	0	0	0
Industrial	Steam-Electric Existing Supply							
Industrial	Groundwater	0	0	0	0	0	0	0
Industrial	Surface water	0	0	0	0	0	0	0
Industrial	Total Steam-Electric Supply	0	0	0	0	0	0	0
Industrial	Steam-Electric Balance	0	0	0	0	0	0	0
Industrial	Mining Demand	1	1	1	1	1	1	1
Industrial	Mining Existing Supply							
Industrial	Groundwater	1	1	1	1	1	1	1
Industrial	Surface water	0	0	0	0	0	0	0
Industrial	Total Mining Supply	1	1	1	1	1	1	1
Industrial	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	107	107	107	107	107	107	107
Agriculture	Irrigation Existing Supply							
Agriculture	Groundwater	107	107	107	107	107	107	107
Agriculture	Surface water	0	0	0	0	0	0	0
Agriculture	Total Irrigation Supply	107	107	107	107	107	107	107
Agriculture	Irrigation Balance	0	0	0	0	0	0	0
Agriculture	Livestock Demand	901	901	901	901	901	901	901
Agriculture	Livestock Existing Supply							
Agriculture	Groundwater	90	90	90	90	90	90	90
Agriculture	Surface water	811	811	811	811	811	811	811
Agriculture	Total Livestock Supply	901	901	901	901	901	901	901
Agriculture	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	47	51	53	54	54	53	54
Total	Existing Municipal and Industrial Supply							
Total	Groundwater	47	51	53	54	54	53	54
Total	Surface water	0	0	0	0	0	0	0
Total	Total Municipal and Industrial Supply	47	51	53	54	54	53	54
Total	Municipal and Industrial Balance	0	0	0	0	0	0	0
Total	Agriculture Demand	1,008	1,008	1,008	1,008	1,008	1,008	1,008
Total	Existing Agricultural Supply							
Total	Groundwater	197	197	197	197	197	197	197
Total	Surface water	811	811	811	811	811	811	811
Total	Total Agriculture Supply	1,008	1,008	1,008	1,008	1,008	1,008	1,008
Total	Agriculture Balance	0	0	0	0	0	0	0
Total	Total Demand	1,055	1,059	1,061	1,062	1,062	1,061	1,062
Total	Total Supply							
Total	Groundwater	244	248	250	251	251	250	251
Total	Surface water	811	811	811	811	811	811	811
Total	Total Supply	1,055	1,059	1,061	1,062	1,062	1,061	1,062
Total	Total Balance	0	0	0	0	0	0	0

Table 4A-13.
Kenedy County
Municipal Water Demand and Supply by City/County
(acft)

City/County	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
County-Other							
Demand	46	50	52	53	53	52	53
Supply	46	50	52	53	53	52	53
Groundwater	46	50	52	53	53	52	53
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Total for Kenedy County							
Demand	46	50	52	53	53	52	53
Supply	46	50	52	53	53	52	53
Groundwater	46	50	52	53	53	52	53
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—

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4A.3.7 Comparison of Demand to Supply – Kleberg County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-14 for all categories of water use. Table 4A-15 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 5,415 acft in 2000 to 7,020 acft in 2060.
- Mining demand increases from 2,127 acft in 2000 to 2,207 acft in 2030 to 2,232 acft in 2060.
- For the period 2000 to 2060, irrigation demand decreases from 1,002 acft to 410 acft; livestock demand is constant at 1,900 acft.

Supplies

- Surface water is supplied to municipal users from the CCR/LCC/Lake Texana System by the City of Corpus Christi via the STWA; some livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- The City of Kingsville supplies its own groundwater and purchases surface water from the STWA and has no projected shortages through 2060.
- Due to increasing demand, County-Other users show a shortage from 2020 through 2060. Groundwater supply to County-Other users is limited by well capacity.
- Groundwater supply to City of Kingsville and Kleberg County-other users is limited by well capacity, which results in groundwater supplies to the county being 155 acft less than projected groundwater use for Kleberg County in 2060 (Section 3.4)
- There are sufficient mining, irrigation, and livestock supplies through 2060.

Table 4A-14.
Kleberg County
Population, Water Supply, and Water Demand Projections

	Population Projection	2000	2010	2020	2030	2040	2050	2060
		31,549	36,959	40,849	43,370	44,989	47,118	47,212
	Supply and Demand by Type of Use	**2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-15)	5,415	6,051	6,436	6,664	6,762	7,008	7,020
	Municipal Existing Supply							
	Groundwater	3,976	4,196	4,318	4,364	4,392	4,432	4,434
	Surface water	1,439	1,855	2,087	2,219	2,262	2,423	2,431
	Total Existing Municipal Supply	5,415	6,051	6,405	6,583	6,654	6,855	6,865
	Municipal Balance	0	0	(31)	(81)	(108)	(153)	(155)
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
	Manufacturing Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	2,127	2,917	2,934	2,207	2,216	2,225	2,232
	Mining Existing Supply							
	Groundwater	2,127	2,917	2,934	2,207	2,216	2,225	2,232
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	2,127	2,917	2,934	2,207	2,216	2,225	2,232
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	1,002	866	745	644	555	477	410
	Irrigation Existing Supply							
	Groundwater	1,002	866	745	644	555	477	410
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	1,002	866	745	644	555	477	410
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	1,900	1,900	1,900	1,900	1,900	1,900	1,900
	Livestock Existing Supply							
	Groundwater	190	190	190	190	190	190	190
	Surface water	1,710	1,710	1,710	1,710	1,710	1,710	1,710
	Total Livestock Supply	1,900	1,900	1,900	1,900	1,900	1,900	1,900
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	7,542	8,968	9,370	8,871	8,978	9,233	9,252
	Existing Municipal and Industrial Supply							
	Groundwater	6,103	7,114	7,252	6,571	6,608	6,657	6,666
	Surface water	1,439	1,855	2,087	2,219	2,262	2,423	2,431
	Total Municipal and Industrial Supply	7,542	8,969	9,339	8,790	8,870	9,080	9,097
	Municipal and Industrial Balance	0	1	(31)	(81)	(108)	(153)	(155)
	Agriculture Demand	2,902	2,766	2,645	2,544	2,455	2,377	2,310
	Existing Agricultural Supply							
	Groundwater	1,192	1,056	935	834	745	667	600
	Surface water	1,710	1,710	1,710	1,710	1,710	1,710	1,710
	Total Agriculture Supply	2,902	2,766	2,645	2,544	2,455	2,377	2,310
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	10,444	11,734	12,015	11,415	11,433	11,610	11,562
	Total Supply							
	Groundwater	7,295	8,170	8,187	7,405	7,353	7,324	7,266
	Surface water	3,149	3,565	3,797	3,929	3,972	4,133	4,141
	Total Supply	10,444	11,735	11,984	11,334	11,325	11,457	11,407
	Total Balance	0	1	(31)	(81)	(108)	(153)	(155)

Table 4A-15.
Kleberg County
Municipal Water Demand and Supply by City/County
(acft)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Kingsville							
Demand	4,440	4,570	4,601	4,604	4,569	4,616	4,619
Supply	4,440	4,570	4,601	4,604	4,569	4,616	4,619
Groundwater	3,219	3,219	3,219	3,219	3,219	3,219	3,219
Surface Water	1,221	1,351	1,382	1,385	1,350	1,397	1,400
Balance	—	—	—	—	—	—	—
Ricardo WSC							
Demand	296	682	955	1,130	1,236	1,390	1,397
Supply	296	682	955	1,130	1,236	1,390	1,397
Groundwater	78	179	250	296	324	364	366
Surface Water	218	503	705	834	912	1,026	1,031
Balance	—	—	—	—	—	—	—
County-Other							
Demand	679	799	880	930	957	1,002	1,004
Supply	679	799	849	849	849	849	849
Groundwater	679	799	849	849	849	849	849
Surface Water	—	—	—	—	—	—	—
Balance	—	—	(31)	(81)	(108)	(153)	(155)
Total for Kleberg County							
Demand	5,415	6,051	6,436	6,664	6,762	7,008	7,020
Supply	5,415	6,051	6,405	6,583	6,654	6,855	6,865
Groundwater	3,976	4,196	4,318	4,364	4,392	4,432	4,434
Surface Water	1,439	1,855	2,087	2,219	2,262	2,423	2,431
Balance	—	—	(31)	(81)	(108)	(153)	(155)

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4A.3.8 Comparison of Demand to Supply – Live Oak County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-16 for all categories of water use. Table 4A-17 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 2,350 acft in 2000 to 2,796 acft in 2030 and decreases to 2,213 acft in 2060.
- Manufacturing demands increase from 1,767 acft in 2000 to 2,194 acft in 2060.
- Mining demand increases from 3,105 acft to 5,341 acft from 2000 to 2060.
- For the period 2000 to 2060, irrigation demand decreases from 3,539 acft to 2,277 acft; livestock demand is constant at 833 acft.

Supplies

- Surface water is supplied from the CCR/LCC/Lake Texana System and City of Three Rivers water rights on the Nueces River firm supply of 700 acft/yr; some livestock needs are met with on-farm/local sources.
- In January 2004, Choke Canyon WSC was purchased by the City of Three Rivers. Choke Canyon WSC water demands are split between Live Oak and McMullen Counties. Surface water supplies from City of Three Rivers supplement groundwater supplies to meet former Choke Canyon WSC customer needs.
- Groundwater supplies are from the Carrizo-Wilcox and Gulf Coast Aquifers.

Comparison of Demand to Supply

- Three Rivers has a surplus of 3,453 acft in 2000 and 3,463 acft in 2060, after meeting their water demands for Choke Canyon WSC and City of Three Rivers. Due to this surplus, the overall municipal demand for the county is met through 2060.
- Live Oak County-Other users show a shortage from 2020 to 2040, due to groundwater supplies being limited by well capacity.
- Mining has near- and long-term shortages through 2060 due to increasing water demand. Groundwater supplies for Live Oak-Mining are limited by Coastal Bend Region drawdown criteria, described in Section 3.4. Live Oak- Mining can receive 67 percent of their projected groundwater use in 2060 and still meet drawdown criteria.
- Manufacturing has immediate and long-term shortages through 2060 due to increasing water demand and groundwater supplies limited by drawdown criteria. Live Oak-Manufacturing can receive 63% of their projected groundwater use in 2060 and still meet drawdown criteria.
- Irrigation has immediate and long-term shortages, limited by availability of groundwater.
- In 2060, the groundwater supplies to the county are less than projected groundwater use for Live Oak County (Section 3.4) attributable to supply reductions described above for Live Oak County Mining, Manufacturing, and Irrigation users.
- Livestock has sufficient supply through 2060.

Table 4A-16.
Live Oak County
Population, Water Supply, and Water Demand Projections

	Population Projection	Year 2000	2010	2020	2030	2040	2050	2060
		12,309	13,735	14,929	15,386	15,018	13,808	12,424
	Supply and Demand by Type of Use	**Year 2000 (acft)**	**2010 (acft)**	**2020 (acft)**	**2030 (acft)**	**2040 (acft)**	**2050 (acft)**	**2060 (acft)**
Municipal	Municipal Demand (See Table 4A-17)	2,350	2,573	2,750	2,796	2,693	2,459	2,213
	Municipal Existing Supply							
	Groundwater	1,768	1,896	1,972	1,985	1,945	1,805	1,645
	Surface water	4,050	4,045	4,043	4,042	4,043	4,046	4,049
	Total Existing Municipal Supply	5,818	5,941	6,015	6,027	5,988	5,851	5,694
	Municipal Balance	3,468	3,368	3,265	3,231	3,295	3,392	3,481
Industrial	Manufacturing Demand	1,767	1,946	1,998	2,032	2,063	2,088	2,194
	Manufacturing Existing Supply							
	Groundwater	754	809	715	673	648	631	630
	Surface water	800	800	800	800	800	800	800
	Total Manufacturing Supply	1,554	1,609	1,515	1,473	1,448	1,431	1,430
	Manufacturing Balance	(213)	(337)	(483)	(559)	(615)	(657)	(764)
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	3,105	3,894	4,319	4,583	4,845	5,108	5,341
	Mining Existing Supply							
	Groundwater	3,105	3,830	3,841	3,655	3,611	3,604	3,586
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	3,105	3,830	3,841	3,655	3,611	3,604	3,586
	Mining Balance	0	(64)	(478)	(928)	(1,234)	(1,504)	(1,755)
Agriculture	Irrigation Demand	3,539	3,289	3,056	2,840	2,639	2,451	2,277
	Irrigation Existing Supply							
	Groundwater	2,649	2,462	2,287	2,126	1,975	1,835	1,704
	Surface water	200	200	200	200	200	200	200
	Total Irrigation Supply	2,849	2,662	2,487	2,326	2,175	2,035	1,904
	Irrigation Balance	(690)	(627)	(569)	(514)	(464)	(416)	(373)
	Livestock Demand	833	833	833	833	833	833	833
	Livestock Existing Supply							
	Groundwater	417	417	417	417	417	417	417
	Surface water	416	416	416	416	416	416	646
	Total Livestock Supply	833	833	833	833	833	833	833
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	7,222	8,413	9,067	9,411	9,601	9,655	9,748
	Existing Municipal and Industrial Supply							
	Groundwater	5,627	6,535	6,528	6,313	6,204	6,040	5,861
	Surface water	4,850	4,845	4,843	4,842	4,843	4,846	4,849
	Total Municipal and Industrial Supply	10,477	11,380	11,371	11,155	11,047	10,886	10,710
	Municipal and Industrial Balance	3,255	2,967	2,304	1,744	1,446	1,231	962
	Agriculture Demand	4,372	4,122	3,889	3,673	3,472	3,284	3,110
	Existing Agricultural Supply							
	Groundwater	3,066	2,879	2,704	2,543	2,392	2,252	2,121
	Surface water	616	616	616	616	616	616	616
	Total Agriculture Supply	3,682	3,495	3,320	3,159	3,008	2,868	2,737
	Agriculture Balance	(690)	(627)	(569)	(514)	(464)	(416)	(373)
	Total Demand	11,594	12,535	12,956	13,084	13,073	12,939	12,858
	Total Supply							
	Groundwater	8,693	9,414	9,232	8,856	8,596	8,292	7,982
	Surface water	5,466	5,461	5,459	5,458	5,459	5,462	5,465
	Total Supply	14,159	14,875	14,691	14,314	14,055	13,754	13,447
	Total Balance	2,565	2,340	1,835	1,230	982	815	589

Note: City of Three Rivers acquired Choke Canyon WSC in January 2004. Choke Canyon WSC supply/demands in Live Oak County are met by the City of Three Rivers (Live Oak County).

Table 4A-17.
Live Oak County
Municipal Water Demand and Supply by City/County
(acft)

City/County	2000	2010	2020	2030	2040	2050	2060
Choke Canyon WSC							
Demand	360	397	425	435	421	384	346
Supply	365	406	430	437	422	386	350
Groundwater	193	179	174	171	168	165	163
Surface Water[1]	172	227	256	266	254	221	187
Balance	5	9	5	2	1	2	4
El Oso WSC							
Demand	189	206	220	223	215	196	176
Supply	189	206	220	223	215	196	176
Groundwater	189	206	220	223	215	196	176
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
George West							
Demand	642	703	754	767	738	675	608
Supply	642	703	754	767	738	675	608
Groundwater	642	703	754	767	738	675	608
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
McCoy WSC							
Demand	50	54	57	58	56	51	46
Supply	60	60	60	60	60	60	60
Groundwater[2]	60	60	60	60	60	60	60
Surface Water	—	—	—	—	—	—	—
Balance	10	6	3	2	4	9	14
Three Rivers							
Demand	425	465	498	505	485	444	399
Supply	3,878	3,818	3,787	3,776	3,789	3,825	3,862
Groundwater	—	—	—	—	—	—	—
Surface Water[3]	3,878	3,818	3,787	3,776	3,789	3,825	3,862
Balance	3,453	3,353	3,289	3,271	3,304	3,381	3,463

Table 4A-16 (Concluded)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
County-Other							
Demand	684	748	796	808	778	709	638
Supply	684	748	764	764	764	709	638
Groundwater	684	748	764	764	764	709	638
Surface Water	—	—	—	—	—	—	—
Balance	—	—	(32)	(44)	(14)	—	—
Total for Live Oak County							
Demand	2,350	2,573	2,750	2,796	2,693	2,459	2,213
Supply	5,818	5,941	6,015	6,027	5,988	5,851	5,694
Groundwater	1,768	1,896	1,972	19,85	19,45	1,805	1,645
Surface Water	4,050	4,045	4,043	4,042	4,043	4,046	4,049
Balance	3,468	3,368	3,265	3,231	3,295	3,392	3,481

[1]Surface water supplied by City of Three Rivers.
[2]Groundwater supplies from the Carrizo-Wilcox aquifer.
[3]700 acft/yr is supplied by City of Three Rivers and remainder by City of Corpus Christi.

4A.3.9 Comparison of Demand to Supply – McMullen County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-18 for all categories of water use. Table 4A-19 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 175 acft in 2000 to 190 acft in 2020 and then decreases to 152 acft in 2060.
- Mining demand increases from 176 acft to 218 acft from 2000 to 2060.
- Livestock demand is constant at 659 acft.

Supplies

- In January 2004, Choke Canyon WSC was purchased by the City of Three Rivers. Choke Canyon WSC water demands are split between Live Oak and McMullen Counties. Surface water supplies from City of Three Rivers supplement groundwater supplies to meet former Choke Canyon WSC customer needs.
- Groundwater supplies are from the Carrizo-Wilcox and Gulf Coast Aquifers.
- Surface water for livestock needs is met by on-farm/local sources.

Comparison of Demand to Supply

- All municipal, industrial, and agricultural demands are met through 2060.
- Groundwater availability is from four source aquifers: Gulf Coast (1,200 acft/yr); Carrizo-Wilcox (7,909 acft/yr); Queen City (1,105 acft/yr); and Sparta (600 acft/yr). The highest amount of groundwater needed to satisfy demands is 487 acft/yr in 2060.
- The largest source, the Carrizo-Wilcox Aquifer, is somewhat difficult to access due to depth, water chemistry, and temperature (140° F).
- All municipal, industrial, and agricultural demands are met through 2060.

Table 4A-18.
McMullen County
Population, Water Supply, and Water Demand Projections

	Population Projection	2000	2010	2020	2030	2040	2050	2060
		851	920	957	918	866	837	793

	Supply and Demand by Type of Use	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand (See Table 4A-19)	175	186	190	180	168	160	152
	Municipal Existing Supply							
	Groundwater	203	203	203	203	203	203	203
	Surface water	13	18	20	21	20	17	14
	Total Existing Municipal Supply	216	221	223	224	223	220	217
	Municipal Balance	41	35	33	44	55	60	65
Industrial	Manufacturing Demand	0	0	0	0	0	0	0
	Manufacturing Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Manufacturing Supply	0	0	0	0	0	0	0
	Manufacturing Balance	0	0	0	0	0	0	0
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	176	195	203	207	211	215	218
	Mining Existing Supply							
	Groundwater	176	195	203	207	211	215	218
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	176	195	203	207	211	215	218
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	0	0	0	0	0	0	0
	Irrigation Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Irrigation Supply	0	0	0	0	0	0	0
	Irrigation Balance	0	0	0	0	0	0	0
	Livestock Demand	659	659	659	659	659	659	659
	Livestock Existing Supply							
	Groundwater	66	66	66	66	66	66	66
	Surface water	593	593	593	593	593	593	593
	Total Livestock Supply	659	659	659	659	659	659	659
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	351	381	393	387	379	375	370
	Existing Municipal and Industrial Supply							
	Groundwater	379	398	406	410	414	418	421
	Surface water	13	18	20	21	20	17	14
	Total Municipal and Industrial Supply	392	416	426	431	434	435	435
	Municipal and Industrial Balance	41	35	33	44	55	60	65
	Agriculture Demand	659	659	659	659	659	659	659
	Existing Agricultural Supply							
	Groundwater	66	66	66	66	66	66	66
	Surface water	593	593	593	593	593	593	593
	Total Agriculture Supply	659	659	659	659	659	659	659
	Agriculture Balance	0	0	0	0	0	0	0
	Total Demand	1,010	1,040	1,052	1,046	1,038	1,034	1,029
	Total Supply							
	Groundwater	445	464	472	476	480	484	487
	Surface water	606	611	613	614	613	610	607
	Total Supply	1,051	1,075	1,085	1,090	1,093	1,094	1,094
	Total Balance	41	35	33	44	55	60	65

Table 4A-19.
McMullen County
Municipal Water Demand and Supply by City/County
(acft)

City/County	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Choke Canyon WSC							
Demand	40	43	44	42	39	37	35
Supply	47	52	54	55	54	51	48
Groundwater	34	34	34	34	34	34	34
Surface Water	13	18	20	21	20	17	14
Balance	7	9	10	13	15	14	13
County-Other							
Demand	135	143	146	138	129	123	117
Supply	169	169	169	169	169	169	169
Groundwater	169	169	169	169	169	169	169
Surface Water	—	—	—	—	—	—	—
Balance	34	26	23	31	40	46	52
Total for McMullen County							
Demand	175	186	190	180	168	160	152
Supply	216	221	223	224	223	220	217
Groundwater	203	203	203	203	203	203	203
Surface Water	13	18	20	21	20	17	14
Balance	41	35	33	44	55	60	65

[1]Most groundwater supplies are from the Carrizo-Wilcox aquifer.

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4A.3.10 Comparison of Demand to Supply – Nueces County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-20 for all categories of water use. Table 4A-21 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 62,702 acft in 2000 to 103,018 acft in 2060.
- Manufacturing demand increases from 39,763 acft in 2000 to 63,313 acft in 2060.
- Mining demand increases from 1,275 acft in 2000 to 1,724 acft in 2060; steam-electric demand increases from 8,799 acft in 2000 to 27,664 acft in 2060. Steam-Electric water demands include Lon Hill and potential, future steam-electric power plants as accounted for by TWDB studies.
- For the period 2000 to 2060, irrigation demand decreases from 1,680 acft to 692 acft; livestock demand is constant at 279 acft.

Supplies

- Surface water is supplied from the CCR/LCC/Lake Texana System by the City of Corpus Christi, SPMWD, STWA, and Nueces County WCID #3; some livestock needs are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.

Comparison of Demand to Supply

- River Acres WSC has shortages from 2000 to 2060, with the greatest shortage of 590 acft in 2060. These shortages are attributable to contract limits with Nueces WCID #3.
- County-Other receives water supplies from the City of Corpus Christi, STWA, and Nueces County WCID #3. Their projected water demands decrease and surface water supplies remain constant based on contracts.
- Manufacturing has shortages ranging from 5,946 acft/yr in 2020 to 39,550 acft/yr in 2060. A 2020 shortage is attributable to water treatment plant constraints at the O.N. Stevens Plant. For later decades, the shortages are attributable to both raw water and water treatment plant constraints. For more detailed discussion, see Section 4A.2.1.
- Steam-Electric has shortages ranging from 1,982 acft/yr in 2020 to 13,183 acft/yr in 2060. A 2020 shortage is attributable to water treatment plant constraints on the O.N. Stevens Plant. For later decades, the shortages are attributable to both raw water and water treatment plant constraints.
- Mining has long-term shortages from 2030 through 2060, ranging from 570 acft/yr in 2030 to 1,624 acft/yr in 2060.
- There are sufficient irrigation and livestock supplies through 2060.

Table 4A-20. Nueces County Population, Water Supply, and Water Demand Projections

Population Projection	2000	2010	2020	2030	2040	2050	2060
	313,645	358,278	405,492	447,014	483,692	516,265	542,327

	Supply and Demand by Type of Use	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand (See Table 4A-21)	62,702	70,609	78,691	85,697	91,988	97,882	103,018
	Municipal Existing Supply							
	Groundwater	325	276	235	178	155	140	132
	Surface water	82,129	79,235	78,201	85,310	91,648	97,554	102,679
	Total Existing Municipal Supply	82,454	79,511	78,436	85,488	91,803	97,694	102,811
	Municipal Balance	19,752	8,902	(255)	(209)	(185)	(188)	(207)
Industrial	Manufacturing Demand	39,763	46,510	50,276	53,425	56,500	59,150	63,313
	Manufacturing Existing Supply							
	Groundwater	972	1,137	1,229	1,306	1,381	1,446	1,548
	Surface water	38,791	45,373	41,636	36,916	32,741	27,144	22,215
	Total Manufacturing Supply	39,763	46,510	42,865	38,222	34,122	28,590	23,763
	Manufacturing Balance	0	0	(7,411)	(15,203)	(22,378)	(30,560)	(39,550)
	Steam-Electric Demand	8,799	7,316	14,312	16,733	19,683	23,280	27,664
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	8,799	7,316	12,330	11,978	12,224	13,093	14,481
	Total Steam-Electric Supply	8,799	7,316	12,330	11,978	12,224	13,093	14,481
	Steam-Electric Balance	0	0	(1,982)	(4,755)	(7,459)	(10,187)	(13,183)
	Mining Demand	1,275	1,472	1,555	1,599	1,641	1,682	1,724
	Mining Existing Supply							
	Groundwater	74	85	90	93	95	98	100
	Surface water	1,201	1,387	1,465	936	0	0	0
	Total Mining Supply	1,275	1,472	1,555	1,029	95	98	100
	Mining Balance	0	0	0	(570)	(1,546)	(1,584)	(1,624)
Agriculture	Irrigation Demand	1,680	1,449	1,250	1,077	928	801	692
	Irrigation Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water[1]	4,007	4,007	4,007	4,007	4,007	4,007	4,007
	Total Irrigation Supply	4,007	4,007	4,007	4,007	4,007	4,007	4,007
	Irrigation Balance	2,327	2,558	2,757	2,930	3,079	3,206	3,315
	Livestock Demand	279	279	279	279	279	279	279
	Livestock Existing Supply							
	Groundwater	80	80	80	80	80	80	80
	Surface water	199	199	199	199	199	199	199
	Total Livestock Supply	279	279	279	279	279	279	279
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	112,539	125,907	144,834	157,454	169,812	181,994	195,719
	Existing Municipal and Industrial Supply							
	Groundwater	1,371	1,498	1,554	1,577	1,631	1,684	1,780
	Surface water	130,920	133,311	133,632	135,140	136,613	137,791	139,375
	Total Municipal and Industrial Supply	132,291	134,311	135,186	136,717	138,244	139,475	141,155
	Municipal and Industrial Balance	19,752	8,902	(9,648)	(20,737)	(31,568)	(42,519)	(54,564)
	Agriculture Demand	1,959	1,728	1,529	1,356	1,207	1,080	971
	Existing Agricultural Supply							
	Groundwater	80	80	80	80	80	80	80
	Surface water	4,206	4,206	4,206	4,206	4,206	4,206	4,206
	Total Agriculture Supply	4,286	4,286	4,286	4,286	4,286	4,286	4,286
	Agriculture Balance	2,327	2,558	2,757	2,930	3,079	3,206	3,315
	Total Demand	114,498	127,635	146,363	158,810	171,019	183,074	196,690
	Total Supply							
	Groundwater	1,451	1,578	1,634	1,657	1,711	1,764	1,860
	Surface water	135,126	137,517	137,838	139,346	140,819	141,997	143,581
	Total Supply	136,577	139,095	139,472	141,003	142,530	143,761	145,441
	Total Balance	22,079	11,460	(6,891)	(17,807)	(28,489)	(39,313)	(51,249)

[1] Includes 569 acft surface water supply from run-of-river water rights in the Nueces-Rio Grande Coastal Basin.

Table 4A-21.
Nueces County
Municipal Water Demand and Supply by City/County
(acft)

City/County	2000	2010	2020	2030	2040	2050	2060
Agua Dulce							
Demand	115	112	110	107	105	103	103
Supply	115	112	110	107	105	103	103
Groundwater	—	—	—	—	—	—	—
Surface Water	115	112	110	107	105	103	103
Balance	—	—	—	—	—	—	—
Aransas Pass							
Demand	12	26	41	53	64	73	81
Supply	12	26	41	53	64	73	81
Groundwater	—	—	—	—	—	—	—
Surface Water	12	26	41	53	64	73	81
Balance	—	—	—	—	—	—	—
Bishop							
Demand	459	444	433	422	411	404	404
Supply	551	444	433	422	411	404	404
Groundwater	131	127	124	121	117	115	115
Surface Water	420	317	309	301	294	289	289
Balance	92	—	—	—	—	—	—
Corpus Christi							
Demand	55,629	61,953	68,212	73,592	78,422	82,961	86,962
Supply	75,979	71,254	68,212	73,592	78,422	82,961	86,962
Groundwater	—	—	—	—	—	—	—
Surface Water	75,979	71,254	68,212	73,592	78,422	82,961	86,962
Balance	20,350	9,301	—	—	—	—	—
Driscoll							
Demand	97	122	148	171	191	208	224
Supply	97	122	148	171	191	208	224
Groundwater	—	—	—	—	—	—	—
Surface Water	97	122	148	171	191	208	224
Balance	—	—	—	—	—	—	—
Nueces County WCID #4							
Demand	977	1,913	2,884	3,729	4,460	5,124	5,655
Supply	977	1,913	2,884	3,729	4,460	5,124	5,655
Groundwater	—	—	—	—	—	—	—
Surface Water	977	1,913	2,884	3,729	4,460	5,124	5,655
Balance	—	—	—	—	—	—	—

Table 4A-20 (Concluded)

City/County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Port Aransas							
Demand	1,601	2,606	3,655	4,558	5,355	6,068	6,637
Supply	1,601	2,606	3,655	4,558	5,355	6,068	6,637
Groundwater	—	—	—	—	—	—	—
Surface Water	1,601	2,606	3,655	4,558	5,355	6,068	6,637
Balance	—	—	—	—	—	—	—
River Acres WSC							
Demand	314	429	546	646	736	813	881
Supply	291	291	291	291	291	291	291
Groundwater	—	—	—	—	—	—	—
Surface Water	291	291	291	291	291	291	291
Balance	(23)	(138)	(255)	(355)	(445)	(522)	(590)
Robstown							
Demand	2,153	2,110	2,067	2,024	1,982	1,953	1,953
Supply	2,153	2,110	2,067	2,024	1,982	1,953	1,953
Groundwater	—	—	—	—	—	—	—
Surface Water	2,153	2,110	2,067	2,024	1,982	1,953	1,953
Balance	—	—	—	—	—	—	—
County-Other							
Demand	1,345	894	595	395	262	175	118
Supply	678	633	595	541	522	509	501
Groundwater	194	149	111	57	38	25	17
Surface Water	484	484	484	484	484	484	484
Balance	(667)	(261)	—	146	260	334	383
Total for Nueces County							
Demand	62,702	70,609	78,691	85,697	91,988	97,882	103,018
Supply	82,454	79,511	78,436	85,488	91,803	97,694	102,811
Groundwater	325	276	235	178	155	140	132
Surface Water	82,129	79,235	78,201	85,310	91,648	97,554	102,679
Balance	19,752	8,902	(255)	(209)	(185)	(188)	(207)

4A.3.11 Comparison of Demand to Supply – San Patricio County

A summary of population, water demands, water supply, and shortages are shown by decade for the 2000 through 2060 period in Table 4A-22 for all categories of water use. Table 4A-23 includes a summary of municipal demands.

Demands

- For the period 2000 to 2060, municipal demand increases from 8,873 acft in 2000 to 16,191 acft in 2060.
- Manufacturing demand increases from 12,715 acft in 2000 to 22,283 acft in 2060.
- Mining increases from 85 acft in 2000 to 117 acft in 2060.
- For the period 2000 to 2060, irrigation demand increases from 4,565 acft to 14,195 acft; livestock demand is constant at 564 acft.

Supplies

- Surface water is supplied from the CCR/LCC/Lake Texana System by the City of Corpus Christi; the SPMWD has a contract to purchase 40,000 acft of water annually from the City of Corpus Christi; some livestock demands are met with on-farm/local sources.
- Groundwater supplies are from the Gulf Coast Aquifer.
- Groundwater supply for irrigation was set equal to the maximum pumping from 2000 to 2006 (i.e. estimated well capacity).

Comparison of Demand to Supply

- Lake City is projected to have shortages from 2020 through 2060. Groundwater supply to Lake City is limited by well capacity, which results in groundwater supplies to the county being 37 acft less than projected groundwater use for San Patricio County in 2060 (Section 3.4).
- Supplies for irrigation are constrained by well capacity, resulting in an irrigation shortage of 750 acft/yr in 2030, increasing to 4,414 acft/yr in 2060.
- There are sufficient mining supplies through the year 2060.
- Manufacturing has projected shortages from 2,081 acft/yr in 2040 to 6,455 acft in 2060 as a result of both raw water constraints and treatment plants' constraints.

Table 4A-22.
San Patricio County
Population, Water Supply, and Water Demand Projections

Population Projection	2000	2010	2020	2030	2040	2050	2060
	67,138	80,701	95,381	109,518	122,547	134,806	146,131

	Supply and Demand by Type of Use	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand (See Table 4A-23)	8,873	10,070	11,423	12,661	13,813	14,997	16,191
	Municipal Existing Supply							
	Groundwater	1,967	2,044	2,124	2,190	2,242	2,320	2,411
	Surface water	6,906	8,026	9,299	10,460	11,554	12,649	13,745
	Total Existing Municipal Supply	8,873	10,070	11,423	12,650	13,796	14,969	16,156
	Municipal Balance	0	0	(1)	(11)	(19)	(28)	(37)
Industrial	Manufacturing Demand	12,715	15,096	16,699	18,111	19,505	20,733	22,283
	Manufacturing Existing Supply							
	Groundwater	9	11	12	13	14	15	16
	Surface water	12,706	15,085	16,687	18,098	17,410	17,365	15,812
	Total Manufacturing Supply	12,715	15,096	16,699	18,111	17,424	17,380	15,828
	Manufacturing Balance	0	0	0	0	(2,081)	(3,353)	(6,455)
	Steam-Electric Demand	0	0	0	0	0	0	0
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	0	0	0	0	0	0	0
	Total Steam-Electric Supply	0	0	0	0	0	0	0
	Steam-Electric Balance	0	0	0	0	0	0	0
	Mining Demand	85	99	105	108	111	114	117
	Mining Existing Supply							
	Groundwater	85	99	105	108	111	114	117
	Surface water	0	0	0	0	0	0	0
	Total Mining Supply	85	99	105	108	111	114	117
	Mining Balance	0	0	0	0	0	0	0
Agriculture	Irrigation Demand	4,565	8,631	9,534	10,531	11,633	12,850	14,195
	Irrigation Existing Supply							
	Groundwater	4,565	8,631	9,534	9,698	9,698	9,698	9,698
	Surface water[1]	83	83	83	83	83	83	83
	Total Irrigation Supply	4,648	8,714	9,617	9,781	9,781	9,781	9,781
	Irrigation Balance	83	83	83	(750)	(1,852)	(3,069)	(4,414)
	Livestock Demand	564	564	564	564	564	564	564
	Livestock Existing Supply							
	Groundwater	57	57	57	57	57	57	57
	Surface water	507	507	507	507	507	507	507
	Total Livestock Supply	564	564	564	564	564	564	564
	Livestock Balance	0	0	0	0	0	0	0
Total	Municipal and Industrial Demand	21,673	25,265	28,227	30,880	33,429	35,844	38,591
	Existing Municipal and Industrial Supply							
	Groundwater	2,061	2,154	2,241	2,311	2,367	2,449	2,544
	Surface water	19,612	23,111	25,986	28,558	28,964	30,014	29,557
	Total Municipal and Industrial Supply	21,673	25,265	28,227	30,869	31,331	32,463	32,101
	Municipal and Industrial Balance	0	0	0	(11)	(2,098)	(3,381)	(6,490)
	Agriculture Demand	5,129	9,195	10,098	11,095	12,197	13,414	14,759
	Existing Agricultural Supply							
	Groundwater	4,622	8,688	9,591	9,755	9,755	9,755	9,755
	Surface water	590	590	590	590	590	590	590
	Total Agriculture Supply	5,212	9,278	10,181	10,345	10,345	10,345	10,345
	Agriculture Balance	83	83	83	(750)	(1,852)	(3,069)	(4,414)
	Total Demand	26,802	34,460	38,325	41,975	45,626	49,258	53,350
	Total Supply							
	Groundwater	6,683	10,842	11,832	12,066	12,122	12,204	12,299
	Surface water	20,202	23,701	26,576	29,148	29,554	30,604	30,147
	Total Supply	26,885	34,543	38,408	41,214	41,676	42,808	42,446
	Total Balance	83	83	83	(761)	(3,950)	(6,450)	(10,904)

[1] Surface water supplies from run-of-river water rights in the San Antonio-Nueces Coastal Basin.

Table 4A-23.
San Patricio County
Municipal Water Demand and Supply by City/County
(acft)

City/County	2000	2010	2020	2030	2040	2050	2060
Aransas Pass							
Demand	1,210	1,405	1,615	1,828	2,016	2,201	2,386
Supply	1,210	1,405	1,615	1,828	2,016	2,201	2,386
Groundwater	—	—	—	—	—	—	—
Surface Water	1,210	1,405	1,615	1,828	2,016	2,201	2,386
Balance	—	—	—	—	—	—	—
Gregory							
Demand	249	239	231	223	216	210	210
Supply	249	239	231	223	216	210	210
Groundwater	—	—	—	—	—	—	—
Surface Water	249	239	231	223	216	210	210
Balance	—	—	—	—	—	—	—
Ingleside							
Demand	873	1,294	1,771	2,202	2,607	3,016	3,395
Supply	873	1,294	1,771	2,202	2,607	3,016	3,395
Groundwater	—	—	—	—	—	—	—
Surface Water	873	1,294	1,771	2,202	2,607	3,016	3,395
Balance	—	—	—	—	—	—	—
Ingleside on the Bay							
Demand	74	92	112	130	148	164	181
Supply	74	92	112	130	148	164	181
Groundwater	—	—	—	—	—	—	—
Surface Water	74	92	112	130	148	164	181
Balance	—	—	—	—	—	—	—
Lake City							
Demand	70	79	89	99	107	116	125
Supply	70	79	88	88	88	88	88
Groundwater	70	79	88	88	88	88	88
Surface Water	—	—	—	—	—	—	—
Balance	—	—	(1)	(11)	(19)	(28)	(37)
Mathis							
Demand	671	648	632	615	598	586	586
Supply	800	648	632	615	598	586	586
Groundwater	—	—	—	—	—	—	—
Surface Water	671	648	632	615	598	586	586
Balance	—	—	—	—	—	—	—

Table 4A-22 (Concluded)

City/County	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Odem							
Demand	319	330	347	361	372	389	408
Supply	319	330	347	361	372	389	408
Groundwater	—	—	—	—	—	—	—
Surface Water	319	330	347	361	372	389	408
Balance	—	—	—	—	—	—	—
Portland							
Demand	1,976	2,399	2,869	3,290	3,716	4,106	4,498
Supply	1,976	2,399	2,869	3,290	3,716	4,106	4,498
Groundwater	—	—	—	—	—	—	—
Surface Water	1,976	2,399	2,869	3,290	3,716	4,106	4,498
Balance	—	—	—	—	—	—	—
Sinton							
Demand	1,036	1,052	1,062	1,076	1,086	1,108	1,135
Supply	1,036	1,052	1,062	1,076	1,086	1,108	1,135
Groundwater	1,036	1,052	1,062	1,076	1,086	1,108	1,135
Surface Water	—	—	—	—	—	—	—
Balance	—	—	—	—	—	—	—
Taft							
Demand	559	586	619	648	672	703	736
Supply	559	586	619	648	672	703	736
Groundwater	—	—	—	—	—	—	—
Surface Water	559	586	619	648	672	703	736
Balance	—	—	—	—	—	—	—
County-Other							
Demand	1,836	1,946	2,077	2,189	2,277	2,398	2,533
Supply	1,836	1,946	2,077	2,189	2,277	2,398	2,533
Groundwater	861	913	974	1,026	1,068	1,124	1,188
Surface Water	975	1,033	1,103	1,163	1,209	1,274	1,345
Balance	—	—	—	—	—	—	—
Total for San Patricio County							
Demand	8,873	10,070	11,423	12,661	13,815	14,997	16,193
Supply	8,873	10,070	11,423	12,650	13,796	14,969	16,156
Groundwater	1,967	2,044	2,124	2,190	2,242	2,320	2,411
Surface Water	6,906	8,026	9,299	10,460	11,554	12,649	13,745
Balance	—	—	(1)	(11)	(19)	(28)	(37)

4A.4 Wholesale Water Providers — Comparison of Demand and Supply

The Coastal Bend Region has four wholesale water providers. These include the City of Corpus Christi (City), San Patricio Municipal Water District (SPMWD), South Texas Water Authority (STWA), and Nueces County WCID #3.

The City of Corpus Christi provides water to SPMWD and STWA, who then supply water to their customers, as shown in Figure 4A-1. SPMWD receives up to 40,000 acft/yr of raw and treated water from the City according to their contract. The most typical contract between the City and its customers includes providing water at the greater amount supplied in previous years plus 10 percent. When projecting customer supplies (2010 to 2060), it was assumed that either: (1) supply increased each year by 10 percent, or (2) supply was equal to demand, whichever is less.

4A.5 Safe Yield Supply to Demands

The Coastal Bend Region adopted use of safe yield supply for the three largest wholesale water providers: City of Corpus Christi, SPMWD, and STWA and their customers. The safe yield supplies assume a reserve of 75,000 acft (i.e., 7 percent CCR/LCC/Lake Texana System storage) as a drought management strategy to plan for future droughts greater than the drought of record. Table 4A-24 shows the safe yield water supply for each Wholesale Water Provider, the amount of water supplied to each customer, and resulting water surplus or shortage after meeting customer needs. This analysis is shown for both the raw water and treated water components of the City of Corpus Christi and SPMWD systems. However, treated and raw water shortages are not additive, but are instead shown in the table only to differentiate raw water source shortages. As discussed earlier, the larger of the raw water or treated water plant capacity shortages by decade are used for planning purposes. STWA and their customers receive only treated water supplies. The City of Corpus Christi water supply for 2010 is 205,000 acft, which includes supplies from the CCR/LCC/Lake Texana System and a base amount of 41,840 acft/yr and up to 12,000 acft/yr on an interruptible basis from Lake Texana. This System supply diminishes to 200,000 acft by 2060 because of reservoir sedimentation.

The City of Corpus Christi, after meeting demands and/or contracts with its customers, has raw water supply shortages from 2030 to 2060, indicating a need for increased source water supplies. In addition, beginning in 2020, the City has shortages associated with the treated water customers, indicating that the current treatment plant capacity is not sufficient to meet future treated water needs. The shortages are applied to industrial users in Nueces County (Manufacturing, Mining, and Steam-

Table 4A-24.
Surface Water Allocation/Wholesale

Wholesale Water Provider (Water User/County)	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
City of Corpus Christi							
Raw Water Supply/Needs Analysis							
Safe Yield Supply (CCR/LCC Texana System)	**206,000**	**205,000**	**204,000**	**203,000**	**202,000**	**201,000**	**200,000**
Current Treatment Capacity[1]	127,248	127,248	127,248	127,248	127,248	127,248	127,248
Raw Water Available for Sales	78,752	77,752	76,752	75,752	74,752	73,752	72,752
Raw Water Contract Sales							
Municipal							
Jim Wells County							
City of Alice	5,281	5,606	5,912	6,076	6,102	6,033	5,904
Bee County							
City of Beeville	2,529	2,619	2,691	2,722	2,699	2,683	2,618
San Patricio County							
City of Mathis	671	648	632	615	598	586	586
San Patricio MWD	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Live Oak County							
City of Three Rivers	3,363	3,363	3,363	3,363	3,363	3,363	3,363
Non-Municipal							
Manufacturing (Nueces County)[2]	9,698	11,343	12,262	13,030	13,780	14,426	15,441
Total Raw Water Demand	**51,542**	**53,579**	**54,860**	**55,806**	**56,542**	**57,091**	**57,912**
Treated Water Supply/Needs Analysis							
O.N. Stevens WTP Capacity[1]	**127,248**	**127,248**	**127,248**	**127,248**	**127,248**	**127,248**	**127,248**
Treated Water Contract Sales							
Municipal							
San Patricio County							
San Patricio MWD[3]	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Nueces County							
Nueces County WCID #4[4]	977	1,913	2,884	3,729	4,460	5,124	5,655
City of Corpus Christi	55,629	61,953	68,212	73,592	78,422	82,961	86,962
County-Other[5,6]	116	116	116	116	116	116	116
Kleberg County							
South Texas Water Authority	2,284	2,619	2,867	3,011	3,065	3,236	3,260
Non-Municipal							
Mining (Nueces County)[5]	1,201	1,387	1,465	1,506	1,546	1,584	1,624
Manufacturing (Nueces County)[7]	29,093	34,030	36,785	39,089	41,339	43,278	46,324
Steam-Electric (Nueces County)[8]	8,799	7,316	14,312	16,733	19,683	23,280	27,664
Total Treated Water Demand	**108,099**	**119,334**	**136,641**	**147,776**	**158,631**	**169,579**	**181,605**

Table 4A-24 (Continued)

Wholesale Water Provider (Water User/County)	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Treated Water Surplus/Shortage (applied to Nueces County Mining, Manufacturing and Steam-Electric)	**19,149**	**7,914**	**(9,393)**	**(20,528)**	**(31,383)**	**(42,331)**	**(54,357)**
Total Water Supply/Needs Analysis							
Safe Yield Supply (CCR/LCC Texana System)	**206,000**	**205,000**	**204,000**	**203,000**	**202,000**	**201,000**	**200,000**
Total Raw Water and Treated Water Demands	**159,641**	**172,913**	**191,501**	**203,582**	**215,173**	**226,670**	**239,517**
Total Raw Water Surplus/Shortage	**46,359**	**32,087**	**12,499**	**(582)**	**(13,173)**	**(25,670)**	**(39,517)**
San Patricio Municipal Water District							
Raw Water Supply/Needs Analysis							
Contract Purchases from City of Corpus Christi	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**
Current Treatment Capacity[9]	20,003	20,003	20,003	20,003	20,003	20,003	20,003
Purchased Treated Water from City	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Total Treated Water Supply	30,003	30,003	30,003	30,003	30,003	30,003	30,003
Raw Water Available for Sales	9,997	9,997	9,997	9,997	9,997	9,997	9,997
Raw Water Contract Sales							
Non-Municipal							
Manufacturing (San Patricio County)[10]	7,841	7,841	7,841	7,841	7,841	7,841	7,841
Total Raw Water Demand	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**	**7,841**
Treated Water Supply/Needs Analysis							
Total Treated Water Supply	**30,003**	**30,003**	**30,003**	**30,003**	**30,003**	**30,003**	**30,003**
Treated Water Contract Sales							
Municipal							
Nueces County							
City of Aransas Pass	12	26	41	53	64	73	81
Port Aransas	1,601	2,606	3,655	4,558	5,355	6,068	6,637
San Patricio County							
City of Aransas Pass	1,210	1,405	1,615	1,828	2,016	2,201	2,386
City of Gregory	249	239	231	223	216	210	210
City of Ingleside	873	1,294	1,771	2,202	2,607	3,016	3,395
City of Ingleside on the Bay	74	92	112	130	148	164	181
City of Portland	1,976	2,399	2,869	3,290	3,716	4,106	4,498
City of Odem	319	330	347	361	372	389	408
City of Taft	559	586	619	648	672	703	736
County-Other	975	1,033	1,103	1,163	1,209	1,274	1,345

Table 4A-24 (Continued)

Wholesale Water Provider (Water User/County)	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Aransas County							
City of Aransas Pass	146	168	186	195	190	179	169
City of Fulton	261	307	346	365	359	336	318
City of Rockport	1,357	1,590	1,778	1,868	1,823	1,712	1,620
County-Other	1,338	1,524	1,686	1,740	1,687	1,575	1,491
Non-Municipal							
Manufacturing (San Patricio County)[11]	4,865	7,244	8,846	10,257	11,650	12,877	14,426
Total Treated Water Demand	**15,815**	**20,839**	**25,205**	**28,881**	**32,084**	**34,883**	**37,901**
Treated Water Surplus/Shortage (applied to Aransas County-Other and San Patricio County Manufacturing)	**14,188**	**9,164**	**4,798**	**1,122**	**(2,081)**	**(4,880)**	**(7,898)**
Total Water Supply/Needs Analysis							
Total Water Supply	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**	**40,000**
Total Raw Water and Treated Water Demands	**23,656**	**28,680**	**33,046**	**36,722**	**39,925**	**42,724**	**45,742**
Total Raw Water Surplus/Shortage	**16,344**	**11,320**	**6,954**	**3,278**	**75**	**(2,724)**	**(5,742)**
South Texas Water Authority							
Total Surface Water Right	0	0	0	0	0	0	0
Contract Purchases	2,284	2,619	2,867	3,011	3,065	3,236	3,260
Contract Sales							
Municipal							
Nueces County							
City of Agua Dulce	115	112	110	107	105	103	103
City of Driscoll	97	122	148	171	191	208	224
City of Bishop	420	317	309	301	294	289	289
County-Other[5,12]	213	213	213	213	213	213	213
Kleberg County							
City of Kingsville	1,221	1,352	1,382	1,385	1,350	1,397	1,400
Ricardo WSC	218	503	705	834	912	1,026	1,031
Total Contract Sales	**2,284**	**2,619**	**2,867**	**3,011**	**3,065**	**3,236**	**3,260**
Surplus/Shortage	—	—	—	—	—	—	—
Nueces County WCID #3							
Total Surface Water Right (firm yield)[13]	7,103	7,103	7,103	7,103	7,103	7,103	7,103
Contract Sales							
Municipal							
Nueces County							

Table 4A-24 (Concluded)

Wholesale Water Provider (Water User/County)	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
County-Other[5,14]	155	155	155	155	155	155	155
City of Robstown	2,153	2,110	2,067	2,024	1,982	1,953	1,953
River Acres WSC[15]	291	291	291	291	291	291	291
Non-Municipal							
Nueces County Irrigation[16]	1,680	1,449	1,250	1,077	928	801	692
Total Contract Sales	**4,279**	**4,005**	**3,763**	**3,547**	**3,356**	**3,200**	**3,091**
Surplus/Shortage	**2,824**	**3,098**	**3,340**	**3,556**	**3,747**	**3,903**	**4,012**

1 Average day treatment capacity calculated as 159 MGD with a peaking capacity of 1.4:1 (159MGD/1.4 = 113.6MGD or 127,248 acft/yr). The max day to average day (peaking factor) of 1.4 is the average peaking factor of the plant for the time period 2004 to 2009.

2 Calculated based on 25% of the Nueces County Manufacturing demand being for raw water. This is based on City billing records for 2001 through 2005.

3 Corpus Christi's contract with San Patricio MWD specifies that 10,000 acft/yr will be treated water, the remaining 30,000 acft/yr is raw water.

4 The TWDB provides separate decadal water demands for Nueces County WCID #4 and the City of Port Aransas. Based on conversations with the City of Corpus Christi and the San Patricio Municipal Water District (SPMWD) in February 2005, the City is shown to provide water supplies to Nueces County WCID #4 and SPMWD is shown to provide water supplied to Port Aransas to meet demands. Of the total demand for both entities in Year 2060, the TWDB projections show Nueces County WCID #4 having 46% of the demand with 54% for the City of Port Aransas.

5 Wholesale water provider does not meet full demand (i.e. additional supply from groundwater).

6 Includes Violet WSC.

7 Calculated based on 75% of the Nueces County Manufacturing demand being for treated water. This is based on City billing records for 2001 through 2005.

8 Steam-Electric water demands include Lon Hill and potential, future steam-electric power plants as accounted by TWDB studies. As a conservative estimate, future steam-electric water demands are assumed to be provided treated water.

9 Average day treatment capacity calculated as 25MGD with a peaking capacity of 1.4:1 (25MGD/1.4 = 17.9MGD or 20,003 acft/yr).

10 Based on total raw water contracts of 7MGD.

11 Remaining Manufacturing demand (San Patricio County) after accounting for raw water sales.

12 Includes Coastal Bend Youth City, Nueces County WCID #5, Nueces WSC, and other rural water users.

13 Surface water right volume has been increased from 3,665 acft/yr to 7,103 acft/yr with the condition that the additional volume can only be used for non-municipal purposes.

14 Includes City of San Pedro.

15 Limited by contract. May opt to increase contract amount to cover needs.

16 Includes all of the projected irrigation demands in Nueces County.

Electric), as shown in Table 4A-20. SPMWD, authorized to receive 40,000 acft/yr of water from the City of Corpus Christi, meets the demands of its customers and has a raw water surplus through 2040. After 2040, SPMWD will need to obtain additional raw water supplies. Similar to the City of Corpus Christi, SPMWD has shortages associated with treated water supplies beginning in 2040, indicating that the current treatment plant capacity is not sufficient to meet future treated water needs. SPMWD's shortages are applied to Aransas County-Other and San Patricio County Manufacturing as shown in Table 4A-3 and Table 4A-22, respectively. STWA receives treated water supplies to meet the demands of its customers, consistent with the terms of the present contracts, and has no projected shortages. Nueces County WCID #3 receives dependable supply through run-of-river water rights and is able to meet contracts with its customers and have a surplus through 2060.

4A.6 Region Summary

When comparing total available supplies to total demands, the region shows a current surplus until 2020. By the year 2020, a shortage of 7,912 acft exists and increases to a shortage of 68,499 acft by 2060 (Table 4A-25). A portion of this shortage is associated with treatment plant capacity constraints and is not necessarily a raw water shortage.

4A.6.1 Municipal and Industrial Summary

On a regional basis, Municipal and Industrial entities (Manufacturing, Steam-Electric, and Mining) show a surplus of 9,929 acft in 2010, although shortages of 409 acft are anticipated for remotely located Manufacturing entities and 1,801 acft for remotely located Mining entities. Due to increasing manufacturing demands, there are shortages of 22,372 acft by 2030 for municipal and industrial users increasing to 66,137 acft by 2060. Shortages in supplies provided by the City of Corpus Christi via the CCR/LCC/Lake Texana System were accumulated in industrial (mining, steam-electric, and/or manufacturing) demands in San Patricio and Nueces Counties, and Aransas County-Other.

Municipal demands account for approximately 47 percent of total demands in the region. Surface water accounts for approximately 87 percent of 2060 municipal supplies, with groundwater accounting for 13 percent. Although there is a region-wide municipal surplus, several cities and County-Others are experiencing near- and/or long-term shortages. These shortages are summarized in Table 4A-26.

Manufacturing demands account for 27 percent of total demands in 2060. The majority of these demands, 97 percent, are in Nueces and San Patricio Counties. Aransas, Bee, and Live Oak Counties make up the remaining 3 percent. Surface water supplies provide 94 percent of total manufacturing supplies in 2060; groundwater 6 percent. Region-wide there is a manufacturing supply deficit of 409 acft in 2010 increasing to 46,905 acft by 2060.

Table 4A-25.
Coastal Bend Region Summary
Population, Water Supply, and Water Demand Projections

Population Projection	Year						
	2000	2010	2020	2030	2040	2050	2060
	541,184	617,143	693,940	758,427	810,650	853,954	885,665

	Supply and Demand by Type of Use	Year						
		2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Municipal	Municipal Demand	99,950	111,495	122,861	132,063	139,425	146,036	151,474
	Municipal Existing Supply							
	Groundwater	17,684	18,641	19,387	19,758	19,838	19,701	19,414
	Surface water	105,449	104,993	106,249	115,018	122,387	127,681	133,596
	Total Existing Municipal Supply	123,133	123,634	125,636	134,776	142,225	147,382	153,010
	Municipal Surplus (Shortage)	23,183	12,139	2,775	2,713	2,800	1,346	1,536
Industrial	Manufacturing Demand	54,481	63,820	69,255	73,861	78,371	82,283	88,122
	Manufacturing Existing Supply							
	Groundwater	1,931	2,153	2,152	2,188	2,239	2,288	2,390
	Surface water	52,297	61,258	59,123	55,814	50,951	45,309	38,827
	Total Manufacturing Supply	54,228	63,411	61,275	58,002	53,190	47,597	41,217
	Manufacturing Surplus (Shortage)	(253)	(409)	(7,980)	(15,859)	(25,181)	(34,686)	(46,905)
	Steam-Electric Demand	8,799	7,316	14,312	16,733	19,683	23,280	27,664
	Steam-Electric Existing Supply							
	Groundwater	0	0	0	0	0	0	0
	Surface water	8,799	7,316	12,330	11,978	12,224	13,093	14,481
	Total Steam-Electric Supply	8,799	7,316	12,330	11,978	12,224	13,093	14,481
	Steam-Electric Surplus (Shortage)	0	0	(1,982)	(4,755)	(7,549)	(10,187)	(13,183)
	Mining Demand	11,897	15,150	16,524	16,640	17,490	18,347	19,114
	Mining Existing Supply							
	Groundwater	10,696	11,962	12,063	11,233	11,324	11,450	11,530
	Surface water	1,201	1,387	1,465	936	0	0	0
	Total Mining Supply	11,897	13,349	13,528	12,169	11,324	11,450	11,530
	Mining Surplus (Shortage)	0	(1,801)	(2,996)	(4,471)	(6,166)	(6,897)	(7,584)
Agriculture	Irrigation Demand	21,971	25,884	26,152	26,671	27,433	28,450	29,726
	Irrigation Existing Supply							
	Groundwater	19,359	23,566	24,091	24,005	23,864	23,540	23,032
	Surface water	4,332	4,332	4,332	4,332	4,332	4,332	4,332
	Total Irrigation Supply	23,691	27,898	28,423	28,337	28,196	27,872	27,364
	Irrigation Surplus (Shortage)	1,720	2,014	2,271	1,666	763	(578)	(2,362)
	Livestock Demand	8,838	8,838	8,838	8,838	8,838	8,838	8,838
	Livestock Existing Supply							
	Groundwater	1,258	1,258	1,258	1,258	1,258	1,258	1,258
	Surface water	7,580	7,580	7,580	7,580	7,580	7,580	7,580
	Total Livestock Supply	8,838	8,838	8,838	8,838	8,838	8,838	8,838
	Livestock Surplus (Shortage)	0	0	0	0	0	0	0
Total	Municipal & Industrial Demand	175,127	197,781	222,952	239,297	254,969	269,946	286,374
	Existing Municipal & Industrial Supply							
	Groundwater	30,311	32,756	33,602	33,179	33,401	33,439	33,334
	Surface water	167,746	174,954	179,167	183,746	185,562	186,083	186,904
	Total Municipal & Industrial Supply	198,057	207,710	212,769	216,925	218,963	219,522	220,238
	Municipal & Industrial Surplus (Shortage)	22,930	9,929	(10,183)	(22,372)	(36,006)	(50,425)	(66,137)
	Agriculture Demand	30,809	34,722	34,990	35,509	36,271	37,288	38,564
	Existing Agricultural Supply							
	Groundwater	20,617	24,824	25,349	25,263	25,122	24,798	24,290
	Surface water	11,912	11,912	11,912	11,912	11,912	11,912	11,912
	Total Agriculture Supply	32,529	36,736	37,261	37,175	37,034	36,710	36,202
	Agriculture Surplus (Shortage)	1,720	2,014	2,271	1,666	763	(578)	(2,362)
	Total Demand	205,936	232,503	257,942	274,806	291,240	307,234	324,938
	Total Supply							
	Groundwater	50,928	57,580	58,951	58,442	58,523	58,237	57,624
	Surface water	179,658	186,866	191,079	195,658	197,474	197,995	198,816
	Total Supply	230,586	244,446	250,030	254,100	255,997	256,232	256,440
	Total Surplus (Shortage)	24,650	11,943	(7,912)	(20,706)	(35,243)	(51,003)	(68,499)

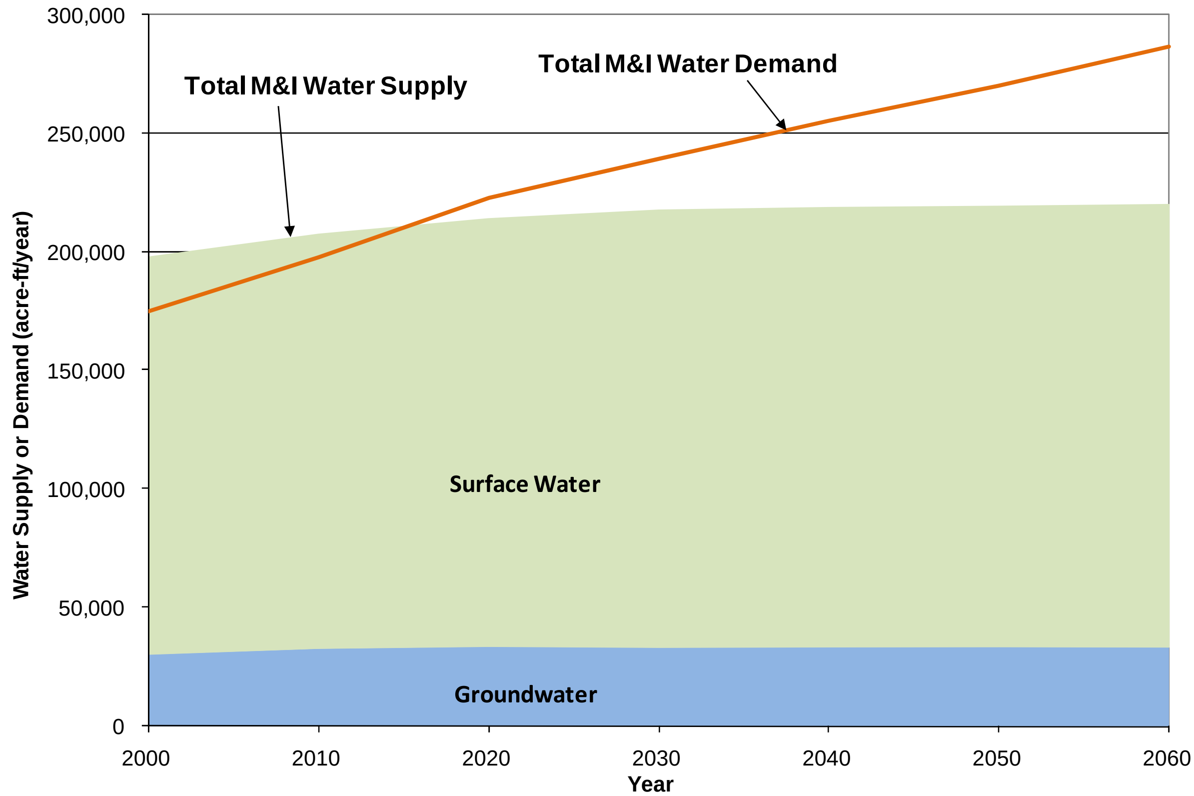

Figure 4A-3. Municipal and Industrial Supply and Demand

Table 4A-26. Cities/County-Other with Projected Water Shortages

County/City	***Projected Shortages (acft)***		
	2010	***2030***	***2060***
Aransas County			
County-Other	—	—	(1,443)
Jim Wells County			
County-Other	(167)	(262)	(170)
Kleberg County			
County-Other	—	(81)	(155)
Live Oak County			
County-Other	—	(44)	—
Nueces County			
River Acres WSC	(138)	(355)	(590)
County-Other	(261)	—	—
San Patricio County			
Lake City	—	(11)	(37)

Nueces County shows manufacturing shortages beginning between 2010 and 2020; and San Patricio shows manufacturing shortages beginning between 2030 and 2040. In 2060, Nueces and San Patricio Counties have shortages of 39,550 acft and 6,455 acft, respectively (Table 4A-27). Aransas and Live Oak Counties show both near- and long-term manufacturing shortages from 2010 through 2060. Aransas County shows modest manufacturing shortages of 72 acft in 2010 increasing to 136 acft by 2060. Live Oak County-Manufacturing has shortages of 337 acft in 2010 and 764 acft by 2060.

Table 4A-27.
Manufacturing with Projected Water Shortages

	Projected Shortages (acft)		
County	**2010**	**2030**	**2060**
Aransas County	(72)	(97)	(136)
Live Oak County	(337)	(559)	(764)
Nueces County	—	(15,203)	(39,550)
San Patricio County	—	—	(6,455)

As for the remaining industrial demands, there are insufficient surface water supplies to meet steam-electric demands, all of which is in Nueces County, beginning in 2020. Steam-Electic in Nueces County is projected to have a shortage of 1,982 acft/yr in 2020, increasing to 13,183 acft/yr in 2060 (Table 4A-28).

Table 4A-28.
Steam-Electric with Projected Water Shortages

	Projected Shortages (acft)		
County	**2010**	**2030**	**2060**
Nueces County	—	(4,755)	(13,183)

The regional mining demand, 19,114 acft, accounts for only 6 percent of total demand in 2060. Region-wide there is insufficient groundwater to meet mining demands, with shortages increasing each decade from 1,801 in 2010 to 7,584 in 2060. Duval and Live Oak Counties show immediate and long-term shortages from 2010 to 2060. Nueces County shows mining shortages beginning in 2030. Mining shortages are summarized in Table 4A-29.

Table 4A-29.
Mining with Projected Water Shortages

County	Projected Shortages (acft)		
	2010	2030	2060
Duval County	(1,738)	(2,973)	(4,205)
Live Oak County	(64)	(928)	(1,755)
Nueces	—	(570)	(1,624)

4A.6.2 Agriculture Summary

Due to increasing irrigation demands and limited current well capacity, irrigation is showing a current surplus of 2,014 acft in 2010 and a shortage of 2,362 acft in 2060.[1] Irrigation demand increases over the 50-year planning period and in 2060 represents 9 percent of total demand. Surface water supplies are 15 percent of total irrigation supplies with groundwater accounting for 85 percent of the total. Irrigation shortages are summarized in Table 4A-30.

Table 4A-30.
Irrigation with Projected Water Shortages

County/City	Projected Shortages (acft)		
	2010	2030	2060
Bee County	—	—	(890)
Live Oak County	(627)	(514)	(373)
San Patricio County	—	(750)	(4,414)

Livestock demand remains constant at 8,838 acft over the 50-year planning period and in 2060 represents 3 percent of total demand. For each county, groundwater was allocated based on 1997 use. Surface water supplies were assumed to consist of local, on-farm sources and used to meet demands.

[1] Irrigation shortages on a regional basis are reduced by surpluses in Nueces County. However, it is more appropriate in Region N to consider irrigation shortages on a county-wide basis where the demands occur, since most irrigation water supplies are from local groundwater wells and it is often costly and impractical to transport irrigation water supplies across county lines.

4A.6.3 Summary

Overall, the Coastal Bend Region has sufficient supplies to meet the demands of the six water user groups through 2010. However, as discussed in the previous section, various water user groups are showing shortages throughout the 50-year planning period. Water groups with shortages in 2030 and 2060 are presented in Figure 4A-4.

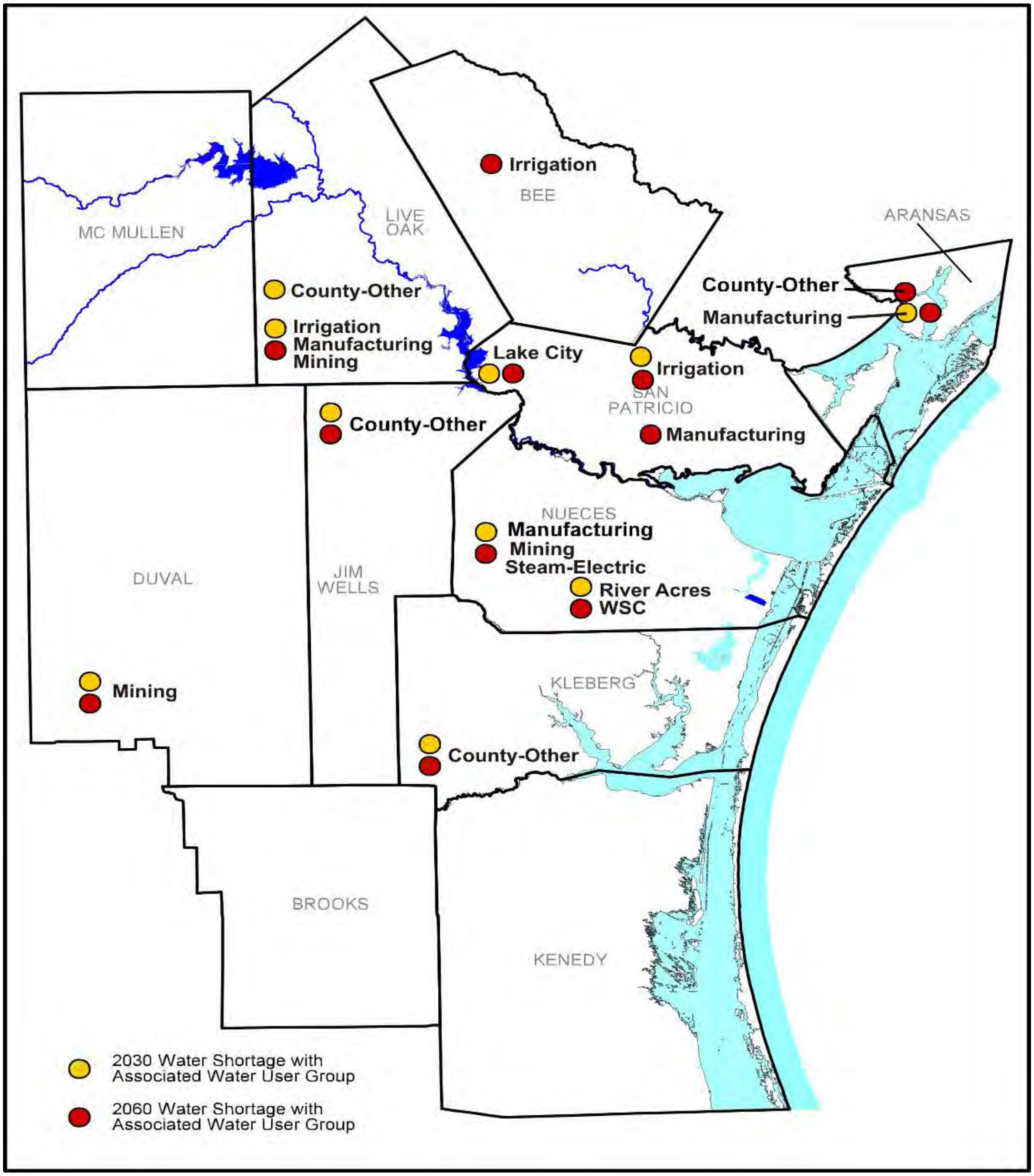

Figure 4A-4. Location and Type of Use for 2030 and 2060 Water Supply Shortages

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Section 4B
Water Supply Plans

4B.1 Summary of Water Management Strategies

A total of 20 water management strategies were investigated during the development of the Coastal Bend Regional Water Plan. At their regular public meeting on June 11, 2009, the Coastal Bend Regional Water Planning Group approved their process for identifying and evaluating potentially feasible water management strategies for the Coastal Bend Region. Many of these strategies include several water supply options within the main strategy. Strategies are summarized in Tables 4B.1-1 and 4B.1-2. The potentially feasible water management strategies selected by the CBRWPG for the 2011 Plan, are based on those identified in the 2006 Plan, in addition to new projects identified by Wholesale Water Providers and other water user groups. Results from studies since the 2006 Plan assisted in the selection process of potentially feasible water management strategies.

Table 4B.1-1 shows potential strategies for Wholesale Water Providers in Region N with shortages and Table 4B.1-2 shows potential strategies for other service areas. In both tables, strategies that were selected for inclusion as recommended or alternatives strategies in the plan are in bold. All strategies are compared with respect to four areas of concern: (1) additional water supply; (2) unit cost of treated water; (3) degree of water quality improvement; and (4) environmental issues and special concerns. A graphical comparison of how each significant strategy compares to the others with respect to unit cost and water supply quantity is shown in Figure 4B.1-1. A detailed description of the analysis of each strategy is included in Section 4C in Volume II of this report (refer to Sections 4C.1 through 4C.20). In these detailed descriptions, each strategy was evaluated with respect to ten impact categories, as required by TWDB rules. These categories are shown in Table 4B.1-3.

Recommended plans to meet the specific needs of the cities and other water user groups during the planning period (2000 through 2060) are presented in the following sections. The water management strategies summarized in Tables 4B.1-1 and 4B.1-2 and discussed in detail in Section 4C (Volume II of this report) provided the options for building each plan to meet the specific shortages. The plans are organized by county and water user group in the following sections (Sections 4B.2 – 4B.12).

Table 4B.1-1.
Potential Water Management Strategies to Meet Long-Term Needs for Wholesale Water Providers

WMS ID	Water Management Strategy	Additional Water Supply (acft/yr)	Total Project Cost	Annual Cost	Unit Cost of Additional Treated Water ($ per acft/yr)	Degree of Water Quality Improvement	Environmental Issues/ Special Concerns
N-1	**Municipal Water Conservation**	up to 1,428	Variable; Regional Cost up to $1,052,529[1]	Variable	$423-$448	No Change	Possible reduction in return flows to bay and estuary.
N-3	**Manufacturing Water Conservation**						
N-3-1	Blending of Texana Water	up to 2,050	Not Applicable	Not Applicable	Not Applicable[2]	Significant Improvement	None
N-3-2	Outlet works to remove high TDS from Calallen Pool	150-730	$2,904,000	$511,000[3]	$700-$2,146 [3]	Significant Improvement	None
N-3-3	Intake Modifications	150-300	$7,694,000	$875,000[3]	$2,916-$5,506 [3]	Significant Improvement	None
N-3-4	Pipeline from LCC to Calallen	19,600-23,900	$159,655,000	up to $24,715,000[3]	$1,070-$1,203 [3]	Significant Improvement	Potentially significant environmental impacts/Construction and maintenance of pipeline corridors
N-4	**Mining Water Conservation**	up to 259	Highly Variable	Highly Variable	Variable	No Change	None
N-5	**Reclaimed Wastewater Supplies**	250	Not Applicable	$206,500[5,9]	$826[5]	No Change	Potential reduction of freshwater inflows to estuary/Construction and maintenance of pipeline corridors
N-7	**Gulf Coast Aquifer Supplies**						
	Groundwater supplies from Bee and/or San Patricio Counties	up to 18,000	$59,245,000	$15,354,000[3,9]	$853 [3,4]	Some Degradation	Potential for increased freshwater inflows to estuary
N-8	**Multi-Year ASR along STWA Pipeline**	Negligible	Not Applicable[6]	Not Applicable[6]	-	No Change	Minor impacts
	Seasonal ASR in CC Distribution System	None	Variable				
N-10	**Pipeline from CCR to LCC[10]**	33,700	$138,067,000	$26,821,000[3,9]	$679 [3]	No Change	Reduction in stream flows between CCR and LCC
N-11	**Off-channel Reservoir near Lake Corpus Christi[10]**	30,340	$105,201,950	$21,696,800[3,9]	$715 [3]	No Change	Direct impact to 4,000 to 6,000 acres, depending on reservoir size
N-12	**Voluntary Redistribution and USACOE Nueces Feasibility Study**	Variable	Variable	Variable	Variable	Variable	Possible cost reduction with federal participation. Ecosystem restoration benefits. Portion of projects may be used for additional inflows to Nueces Bay and Estuary.
N-13	**Stage II of Lake Texana**						
	Palmetto Bend (On-Channel)	22,964[11]	$232,828,000	$27,855,000[3,9]	$1,213 [3]	No Change	Direct impact to 4,769 acres
	Lavaca River Diversion and Off-Channel Reservoir	26,242[11]	$224,183,000	$26,971,000[3,9]	$1,027 [3]	No Change	Direct impact to around 3,000 acres.
N-14	**Garwood Pipeline**	35,000	$112,798,000	$23,958,000[3,9]	$685 [3]	No Change	Construction and maintenance of pipeline corridors and off-channel storage
N-17	**Desalination**						
	Desalination of Seawater[7,10]	28,000	$260,914,000	$47,498,000	$1,696	Significant Improvement	Brine from desalt plant requires disposal. Construction and maintenance of pipeline corridor
N-19	**O.N. Stevens WTP Improvements**	32,996 in 2060	$31,324,000[8]	$7,554,000	$146 in 2060	No change	None
N-20	**Brackish Groundwater Desalination[10]**	18,000	$108,331,000	$17,584,000	$977	Significant Improvement	Brine from desalt plant requires disposal. Construction and maintenance of pipeline corridor

[1] Assumes unit costs of $423 to $448/acft.
[2] Cost of Manufacturing Water Conservation not determined.
[3] Cost has been adjusted to include treatment. Cost for treatment is estimated at $326 per acft.
[4] Cost based on 18,000 acft supply.
[5] See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Treatment cost of $326/acft have been added.
[6] ASR is not recommended as a viable water management strategy to provide water supply. Costs are not included.
[7] Additional water supply is unlimited. Supply numbers and unit costs are shown for a 25 MGD facility.
[8] Total project cost includes improvements to the following WTP components: raw influent, raw water intake pump station, and O.N. Stevens solids handling facilities.
[9] Annual costs calculated as the unit cost times the additional water supply volume. For Gulf Coast Aquifer Supplies the full 18,000 acft/yr yield was used. For both the Lake Texana options the annual cost is based on the full yield of the project. Annual costs for the portion of supplies allotted to the Coastal Bend wholesale water providers is less as shown in Sections 4B.11 and 4B.12.
[10] There is federal participation opportunities for these projects. Federal participation is assumed in water supply plans (Section 4B) and Section 4C.10.
[11] Full yield shown for projects. Only portion of project identified for Region N.

Table 4B.1-2.
Potential Water Management Strategies to Meet Long-Term Needs for Local Service Areas

WMS	Water Management Strategy	Additional Water Supply (acft/yr)	Total Project Cost	Annual Cost	Unit Cost of Additional Treated Water ($ per acft/yr)	Degree of Water Quality Improvement	Environmental Issues/ Special Concerns
N-1	**Municipal Water Conservation**	up to 2,415	Variable; Regional Cost up to $1,052,529[1]	Variable	$423-$448	No Change	Possible reduction in return flows to bay and estuary.
N-2	**Irrigation Water Conservation**	up to 342	$1,095,700	$3,900 - $78,000	$228[2]	No Change	None
N-4	**Mining Water Conservation**	up to 2,343	Highly Variable	Highly Variable	Variable	No Change	None
N-5	**Reclaimed Wastewater Supplies**	250	Not Applicable	$206,500[3]	$826[3]	No Change	Potential reduction of freshwater inflows to estuary/Construction and maintenance of pipeline corridors
N-7	**Gulf Coast Aquifer Supplies**						
	Drill additional well	Variable	Variable; up to $8,110,000[4]	Variable; up to $925,000[4]	Variable	Some Degradation	Minor impacts
	Brackish groundwater desalination (local projects)	Variable	Variable; up to $12,250,000[5]	Variable; up to $2,207,000[5]	Variable	Significant Improvement	Brine from desalt plant requires disposal by evaporation, deep well injection, blending, or discharging to saltwater body.
N-12	**Voluntary Redistribution/ Reallocation**	Variable	Variable; as needed	Variable; as needed	$685[6]	Variable	None
N-18	**Potential System Interconnections**						
	Duval County	974-2,520	Up to $30,113,000	Up to $4,823,000	$1,161-$1,914	Some Negative Impact	Construction and maintenance of pipeline corridor.
	Jim Wells County	246-1,434	Up to $10,824,000	Up to $1,929,000	$1,345-$2,248	Some Negative Impact	Construction and maintenance of pipeline corridor.
	Brooks County	2554	$16,195,000	$3,523,000	$1,379	Some Negative Impact	Construction and maintenance of pipeline corridor.
	San Patricio County	125-1,120	$2,517,000 to $3,136,000	$401,000 to $1,018,000	$909- $3,208	Some Negative Impact	Construction and maintenance of pipeline corridor.

[1] Assumes unit costs of $423 to $448/acft.

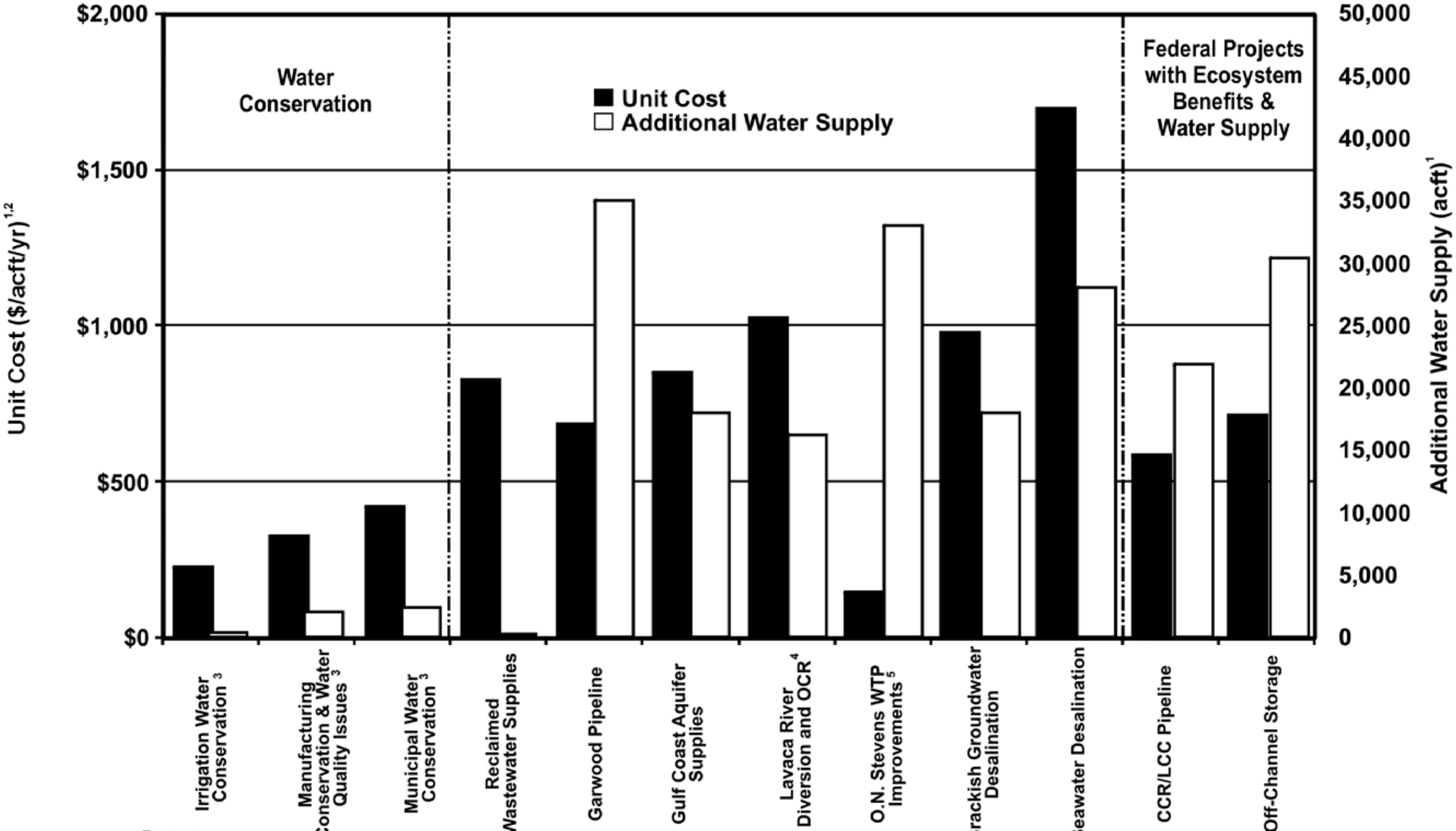
[2] Unit cost for raw water supplies.

[3] See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Treatment cost of $326/acft have been added.

[4] Costs based on drilling 23 wells for San Patricio County – Irrigation.

[5] Estimated cost for 3 MGD facility. In Section 4B, the largest local brackish groundwater desalination plant considered was for Freer. The project cost for the 1.2 MGD plant i s $6,899,000. This results in an annual cost of $1,121,000 for a unit cost of $834 per acft.

[6] Unit cost of $685 per acft assumed to be comparable to cost of Garwood water. Costs should be revised in the future, as rate study information becomes available .



Footnotes:
[1]Some strategies have more than one alternative.
[2]Costs include $326 for water treatment, except for municipal and irrigation water conservation.
[3]Costs and water supplies for Municipal, Manufacturing, and Irrigation Water Conservation are variable based on best management practice selected.
[4]The firm yield of project is 26,262 (Table 4B.1-1); however, 10,000 acft/yr is proposed for consistency for Region P/L uses. The amount shown in figure above is amount estimated to be available for Region N purposes (16,262 acft/yr).
[5]Amount of supply varies. Figure shows 2060 supply and cost.

Figure 4B.1-1. Comparison of Unit Costs and Water Supply Quantities for Potential Water Management Strategies for Coastal Bend

Table 4B.1-3.
Summary of Impact Categories for
Evaluation of Water Management Strategies

a.	Water Supply 1. Quantity 2. Reliability 3. Cost of Treated Water
b.	Environmental factors 1. Instream flows 2. Bay and Estuary Inflows 3. Wildlife Habitat 4. Wetlands 5. Threatened and Endangered Species 6. Cultural Resources 7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents
c.	Impacts to State water resources
d.	Threats to agriculture and natural resources in region
e.	Recreational impacts
f.	Equitable comparison of strategies
g.	Interbasin transfers
h.	Third party social and economic impacts from voluntary redistribution of water
i.	Efficient use of existing water supplies and regional opportunities
j.	Effect on navigation

According to the TWDB,[1] regional planning is a reconnaissance-level effort and a detailed investigation of project impacts is beyond the scope and mandate of this effort. The impacts, costs, and benefit of large-scale projects such as reservoirs or major diversions would, if implemented, undergo additional and extensive evaluation during permitting under Section 404 of the Clean Water Act, the National Environmental Protection Action, and any other applicable federal, state, or local regulations.

Drought Management is not a recommended water management strategy to meet projected water needs in the Coastal Bend Region, in part because it cannot be demonstrated to

[1] TWDB Memo, "Texas Water Development Board Comments for the Coastal Bend Regional Water Planning Group (Region N) Initially Prepared Plan, Contract No. 2002-483-459," September 28, 2005.

be an economically feasible strategy. The TWDB socioeconomic impact analysis of unmet water needs in Coastal Bend Region shows total losses[2] (Table 4B.1-4) due to unmet water needs (shortages) of $17,656 per acft/yr in 2010 increasing to $108,168 per acft/yr in 2060.

Table 4B.1-4
Projected Water Needs (Shortages) and Business, Personal Income, and Tax Losses from Unmet Water Needs in the Coastal Bend Region

Year	*Projected Water Need (Shortage) (acft/yr)*	*Total Losses* ($millions/yr)*	*Cost per acft*
2010	3,404	60.1	$17,656
2020	14,084	452.02	$32,095
2030	27,102	1,691.56	$62,415
2040	41,949	2,612.98	$62,289
2050	57,994	6,317.69	$108,937
2060	75,744	8,193.04	$108,168

* Sum of business and personal income losses, and taxes lost as provided by the TWDB.
Source: TWDB, "Socioeconomic Impacts of Projected Water Shortages for the Coastal Bend Regional Water Planning Area", January 2010.

Clearly, the cost for water to meet projected water needs is only a fraction of the total loss associated with business, personal income, and tax revenue losses from not having the quantities of water needed. For example, in 2010 income losses are $57,260,000 (or $16,821 per acft of shortage), and tax losses are $2,840,000 (or $835 per acft of shortage)[3] while short-term costs of water for recommended water management strategies in the 2011 Regional Water Plan range from $90 per acft for Municipal Conservation (using more water efficient showerheads and aerators), up to $5,506/acft/yr[4] for modifying industrial intake structures near Calallen Pool.

The Water Conservation water management strategies recommended in the 2011 Regional Water Plan, together with the other water management strategies appear to the CBRWPG to be superior to the use of Drought Management strategies that are costly to the economy and the people of the region, and unpredictable as to time of occurrence and duration.

[2] Includes business production and sales impacts, personal income losses, and tax losses identified by the TWDB in "Socioeconomic Impacts of Projected Water Shortages for the Coastal Bend Regional Water Planning Area," January 2010.
[3] Calculated based on Table 15 on page 29 in TWDB report and total projected regional water needs.
[4] Unit cost has been adjusted to include treatment. Cost for treatment is estimated at $326 per acft.

The uncertainty and the cost associated therewith is not acceptable to the CBRWPG, thus Drought Management is not included as a recommended water management strategy. However, the CBRWPG recommends that entities with drought management plans implement their plans during droughts.

Socioeconomic impacts of unmet needs will be evaluated by the TWDB and costs of unmet needs will be provided to represent regional impacts of leaving water needs entirely unmet, representing a worst-case scenario. Costs of unmet needs are included in the water supply plan when recommended to meet shortages, such as for Live Oak County Mining and Duval County Mining. The draft TWDB report is included as Appendix F. A summary of the plans for the Region's four Wholesale Water Providers is presented in Section 4B.13.

Additionally, future projects involving authorization from either the TCEQ and/or TWDB which are not specifically addressed in the plan are considered to be consistent with the plan under the following circumstances:

1. TWDB receives applications for financial assistance for many types of water supply projects, including water conservation, and when appropriate, wastewater reuse strategies. Other projects involve repairing, replacing, or expanding treatment plants, pump stations, pipelines and water storage facilities including ASR. The RWPG considers projects that do not involve the development of or connection to a new water source to be consistent with the regional water plan even though not specifically recommended in the plan.
2. TCEQ considers water rights applications for various types of uses (e.g., recreation, navigation, irrigation, hydroelectric power, industrial, recharge, municipal and others). Many of these applications are for small amounts of water, some are temporary, and some are even non-consumptive. Because waters of the Nueces River Basin are fully appropriated to the City of Corpus Christi and others, any new water rights application for consumptive water use from this Basin will need to protect the existing water rights or provide appropriate mitigation to existing water right owners. Throughout the Coastal Bend Region the types of small projects that may arise are so unpredictable that the RWPG is of the opinion that each project should be considered by the TWDB and TNRCC on their merits, and that the Legislature foresaw this situation and provided appropriate language for each agency to deal with it.

(Note: The provision related to TCEQ is found in Texas Water Code §11.134. It provides that the Commission shall grant an application to appropriate surface water, including amendments, only if the proposed appropriator addresses a water supply need in a manner consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant. For TWDB funding, Texas Water Code §16.053(j) states that after January 5, 2002 TWDB may provide financial assistance to a water supply project only after the Board determines that the needs to be addressed by the project will be addressed in a manner that is consistent with that appropriate regional water plan. The TWDB may waive this provision if conditions warrant.)

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4B.2 Aransas County Water Supply Plan

Table 4B.2-1 lists each water user group in Aransas County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 4B.2-1.
Aransas County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2060 (acft/yr)	Comment
City of Aransas Pass	0	0	Supply equals demand
City of Fulton	0	0	Supply equals demand
City of Rockport	0	0	Supply equals demand
County-Other	0	(1,443)	Projected shortages in 2050 and 2060 — see plan below
Manufacturing	(97)	(136)	Projected shortages from 2010 to 2060 — see plan below
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	none	none	No demands projected
Livestock	0	0	Supply equals demand

[1] From Tables 4A-2 and 4A-3, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.2.1 City of Aransas Pass

The City of Aransas Pass is in Aransas, Nueces, and San Patricio Counties; consequently, its water demand and supply values are split into the tables for each county. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass and no changes in water supply are recommended.

4B.2.2 City of Fulton

The City of Fulton has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Fulton and no changes in water supply are recommended.

4B.2.3 City of Rockport

The City of Rockport has a contract with the SPMWD to purchase treated water. The contract allows the City of Rockport to purchase only the water that it needs. No shortages in annual water supplies are projected for the City of Rockport and no changes in water supplies are recommended.

4B.2.4 County-Other

4B.2.4.1 Description

- Source: Groundwater – Gulf Coast Aquifer
  Surface Water – CCR/LCC/Texana System purchased from the SPMWD and run-of-river rights from San Antonio-Nueces River Basin
- Estimated Reliable Supply: 236 to 276 acft/yr (groundwater)
  49 to 1,740 acft/yr (surface water)
- System Description: Served by SPMWD and groundwater supplies with estimated well capacity of 295 acft/yr

4B.2.4.2 Options Considered

The County-Other demand projection category is intended to capture the demands of single-family rural municipal demands as well as demands for small rural water supply systems. The Aransas County-Other water user group has projected shortages of 1,527 acft/yr in 2050 and 1,443 acft/yr in 2060. Their shortages are attributed to shortages for SPMWD, based on customer needs exceeding existing maximum contracted supply of 40,000 acft from City of Corpus Christi as well as SPMWD water treatment constraints. Table 4B.2-2 lists the water management strategy to meet customer needs (Aransas County-Other), references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for County-Other in Aransas County. The Water Management Strategies for SPMWD are discussed in Section 4B.12.12.

Table 4B.2-2.
Water Management Strategies Considered for Aransas County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Increase contracted amount provided by Wholesale Water Providers	up to 1,527	N/A	$442-$471[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Unit cost based on development of water management strategies for wholesale water providers in Table 4B.11-7.
N/A — Not applicable; wholesale water provider will bear cost of project.

4B.2.4.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend Regional Water Planning Group (CBRWPG) and TWDB, the following water supply plan is recommended to meet the projected 2050 and 2060 shortages for County-Other in Aransas County:

- Increase contracted amount provided by Wholesale Water Provider (SPMWD)

In addition to the management strategies listed above, the CBRWPG supports strategies for increased conservation and reuse of existing supplies.

4B.2.4.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.2-3.

Table 4B.2-3.
Recommended Plan Costs by Decade for Aransas County-Other

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	—	—	—	—	(1,527)	(1,443)
Increase Contracted Amount provided by Wholesale Water Provider (San Patricio Municipal Water District)						
Supply From Plan Element (acft/yr)	—	—	—	—	1,527	1,443
Total Annual Cost ($/yr)	—	—	—	—	$674,900	$679,700
Total Unit Cost ($/acft)	—	—	—	—	$442	$471

[1]Unit cost based on development of water management strategies for wholesale water providers in Table 4B.11-7.

4B.2.5 Manufacturing

4B.2.5.1 Description

- Source: Groundwater – Gulf Coast Aquifer
- Estimated Reliable Supply: 195 acft/yr (groundwater)
- System Description: Various manufacturing operations

4B.2.5.2 Options Considered

The Aransas County manufacturing water user group has projected shortages of 72 acft/yr in 2010, 97 acft/yr in 2030, and 136 acft/yr in 2060. Their shortages are attributed to limited well capacity of 195 acft/yr estimated using the procedure in Section 4A.2.2. Table 4B.2-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Aransas County- Manufacturing.

Table 4B.2-4.
Water Management Strategies Considered for Aransas County-Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s) (Section 4C.7)	200	$257,000[2]	$135[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7, Table 4C.7-14. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment..

4B.2.5.3 Water Supply Plan

Working within the planning criteria established by the CBRWPG and TWDB, the following water supply plan is recommended to meet the projected 2010 to 2060 shortages for Aransas County-Manufacturing:

- Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)

In addition to the management strategy listed above, the CBRWPG supports strategies for increased conservation and reuse of existing supplies.

4B.2.5.4 Costs

The recommended Water Supply Plan, including anticipated costs, is summarized by decade in Table 4B.2-5.

Table 4B.2-5.
Recommended Plan Costs by Decade for Aransas County-Manufacturing

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	(72)	(86)	(97)	(107)	(116)	(136)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	200	200	200	200	200	200
Total Annual Cost ($/yr)[2]	$27,000	$27,000	$27,000	$5,000	$5,000	$5,000
Total Unit Cost ($/acft)[2]	$135	$135	$135	$25	$25	$25

1 Supply from additional wells supplied at constant annual rate (Section 4C.7.2.1).
2 Source of Cost Estimate: Section 4C.7. Table 4C.7-14. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2030 assumes debt service has been paid.

4B.2.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.2.7 Mining

The mining water demands in Aransas County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining users and no changes in water supply are recommended.

4B.2.8 Irrigation

No irrigation demand exists or is projected for the county.

4B.2.9 Livestock

The livestock water demands in Aransas County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.3 Bee County Water Supply Plan

Table 4B.3-1 lists each water user group in Bee County and their corresponding surplus or shortage in years 2030 and 2060. Irrigation is projected to have a shortage during the planning period, as shown in Table 4B.3-1.

Table 4B.3-1.
Bee County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
City of Beeville	0	0	Supply equals demand
El Oso WSC	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	0	0	Supply equals demand
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	(890)	Projected shortages in 2050 and 2060 — see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A-4 and 4A-5, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.3.1 City of Beeville

The City of Beeville contracts with City of Corpus Christi to purchase raw water from the CCR/LCC System. The contract allows the City of Beeville to purchase only the water that it needs. No shortages are projected for the City of Beeville and no changes in water supply are recommended.

4B.3.2 El Oso WSC

El Oso Water Supply Corporation is located in both Bee and Live Oak Counties; consequently, its water demand and supply values are split into tables for each county. The El Oso Water Supply Corporation receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for El Oso Water Supply Corporation and no changes in water supply are recommended.

4B.3.3 County-Other

Bee County-Other demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for County-Other entities and no changes in water supply are recommended.

4B.3.4 Manufacturing

There are small manufacturing water demands in Bee County. These demands are met by groundwater from the Gulf Coast Aquifer. According to the local groundwater conservation district[1], more water is being used for manufacturing activities in Bee County. Due to time constraints and TWDB guidance, these manufacturing water demands were not evaluated in detail for the 2011 Plan but should be considered in future planning efforts. No shortages are projected for manufacturing and no changes in water supply are recommended.

4B.3.5 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.3.6 Mining

There are small mining water demands in Bee County. These demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended. According to the local groundwater conservation district[1], the development of natural gas from the shale in the Eagleford Group has begun in Bee County. Water demands associated with these mining activities are not included in projected TWDB water demands, but may impact local groundwater use in the Carrizo Aquifer. The impacts of developing gas wells in the Eagleford shale on groundwater supplies in the Coastal Bend Region should be considered in future planning efforts.

[1] Correspondence from Bee GCD in November 2009.

4B.3.7 Irrigation

4B.3.7.1 Description

- Source: Groundwater – Gulf Coast Aquifer; Surface water – Surface water rights
- Estimated Reliable Supply: Maximum of 5,311 acft/yr (groundwater); 42 acft/yr (surface water)
- System Description: Various irrigation operations

4B.3.7.2 Options Considered

The Bee County irrigation water user group has projected shortages of 299 acft/yr in 2050 and 890 acft/yr in 2060. Their shortages are attributed to limited well capacity of 5,311 acft/yr estimated using the procedure described in Section 4A.2.2. Table 4B.3-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Bee County-Irrigation. Irrigation water conservation was considered; however, it was not recommended due to the fact that according to data developed by the TWDB and local GCD data the irrigation water application efficiency in Bee County already exceeds 80%, equal to the maximum efficiency achieved with this strategy.

Table 4B.3-2.
Water Management Strategies Considered for Bee County-Irrigation

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s) (Section 4C.7)	2,016	$1,763,000[2]	$100[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7, Table 4C.7-9. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment.

4B.3.7.3 Water Supply Plan

Working within the planning criteria established by the CBRWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 and 2060 shortages for Bee County-Irrigation:

- Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.3.7.4 Costs

The recommended Water Supply Plan, including anticipated costs, is summarized by decade in Table 4B.3-3.

Table 4B.3-3.
Recommended Plan Costs by Decade for Bee County-Irrigation

Plan Element	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Projected Surplus/(Shortage) (acft/yr)	—	—	—	—	(299)	(890)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	—	—	—	—	2,016	2,016
Total Annual Cost ($/yr)[2]	—	—	—	—	$202,000	$202,000
Total Unit Cost ($/acft)[2]	—	—	—	—	$100	$100

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-9. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment.

4B.3.8 Livestock

The livestock water demands in Bee County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

4B.4 Brooks County Water Supply Plan

Table 4B.4-1 lists each water user group in Brooks County and their corresponding surplus or shortage in years 2030 and 2060. All water user groups in Brooks County have an adequate supply, as shown in Table 4B.4-1.

Table 4B.4-1.
Brooks County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
City of Falfurrias	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	0	0	No demands projected
Steam-Electric	0	0	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A-6 and 4A-7, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.4.1 City of Falfurrias

The City of Falfurrias receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the City of Falfurrias. The water demands for the City of Falfurrias increase over the planning period. In 2000, the City of Falfurrias had a per capita per day usage of 280 gallons per capita per day (gpcd) which is projected to decrease to 265 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060 (Section 4C.1). The estimated water saved with additional water conservation increases from 1 acft/yr in Year 2010 to 309 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $283 in Year 2010 to $130,882 in Year 2060 (See Table 4C.1-7).

4B.4.2 County-Other

The Brooks County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Brooks County-Other and no changes in water supply are recommended.

4B.4.3 Manufacturing

No manufacturing demand exists or is projected for the county.

4B.4.4 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.4.5 Mining

The mining water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

4B.4.6 Irrigation

The irrigation water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

4B.4.7 Livestock

The livestock water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

4B.5 Duval County Water Supply Plan

Table 4B.5-1 lists each water user group in Duval County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 4B.5-1.
Duval County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2060 (acft/yr)	Comment
City of Benavides	0	0	Supply equals demand
City of Freer	0	0	Supply equals demand
City of San Diego	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	(2,973)	(4,205)	Projected shortages for entire planning period— see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A-8 and 4A-9, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.5.1 City of Benavides

The City of Benavides receives groundwater supplies from the Goliad Sands of the Gulf Coast Aquifer. No shortages are projected for the City of Benavides. Although projections indicate that Benavides' current wells will produce adequate supply to meet their anticipated demand, there is local concern that the quality of the water produced by the city's wells will decline to the point that advanced treatment will be necessary to stay in compliance with regulatory water quality guidelines. If the City of Benavides requires groundwater desalination for their highest water demand over the planning period, a 0.6 MGD reverse osmosis membrane system would be sufficient as discussed in Section 4C.7.2.3. If no additional infrastructure is required, it is estimated then the total capital cost for a membrane water treatment plant will be

$3,127,000, and total project cost will be $4,633,000. Total annual cost will be $688,000, resulting in a unit cost of $1,024 per acft, or $3.14 per 1,000 gallons, assuming full utilization of the treatment plant.

4B.5.2 City of Freer

The City of Freer receives groundwater supplies from the Catahoula Tuff. No shortages are projected for the City of Freer. Although projections indicate that Freer's current wells will produce adequate supply to meet their anticipated demand, there is local concern that the quality of the water produced by the city's wells will decline to the point that advanced treatment will be necessary to stay in compliance with regulatory water quality guidelines. If the City of Freer requires groundwater desalination for their highest water demand over the planning period, a 1.2 MGD reverse osmosis membrane system would be sufficient as discussed in Section 4C.7.2.3. If no additional infrastructure is required, it is estimated then the total capital cost for a membrane water treatment plant will be $4,733,000, and total project cost will be $6,899,000. Total annual cost will be $1,121,000, resulting in a unit cost of $834 per acft, or $2.56 per 1,000 gallons, assuming full utilization of the treatment plant.

4B.5.3 City of San Diego

The City of San Diego is in both Duval and Jim Well Counties; consequently, its water demand and supply values are split into tables for each county. The City of San Diego receives groundwater supplies from the Goliad Sands of the Gulf Coast Aquifer. The City of Alice has run a 16-inch water transmission line to Hwy 281 bypass, approximately 8 to 9 miles from the City of San Diego.[1] This pipeline could be extended to provide water supply from the City of Alice to San Diego.

No shortages are projected for the City of San Diego. Although projections indicate that San Diego's current wells will produce adequate supply to meet their anticipated demand, there is local concern that the quality of the water produced by the city's wells will decline to the point that advanced treatment will be necessary to stay in compliance with regulatory water quality guidelines. If the City of San Diego requires groundwater desalination for their highest water demand over the planning period, a 1 MGD reverse osmosis membrane system would be

[1] Conservation with Carl Crull, July 2005.

Sufficient as discussed in Section 4C.7.2.3. If no additional infrastructure is required, it is estimated that the total capital cost for a membrane WTP will be $4,313,000, and total project cost will be $6,304,000. Total annual cost will be $1,000,000, resulting in a unit cost of $893 per acft, or $2.74 per 1,000 gallons assuming full utilization of the treatment plant.

4B.5.4 County-Other

Duval County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the Duval County-Other. In 2000 Duval County-Other has a per capita per day usage of 191 gallons per capita per day (gpcd) and an estimated usage of 178 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 6 acft/yr in Year 2010 to 63 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $2,431 in Year 2010 to $26,467 in Year 2060(See Table 4C.1-7).

4B.5.5 Manufacturing

No manufacturing demand exists or is projected for the county.

4B.5.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.5.7 Mining

4B.5.7.1 Description

- Source: Groundwater – Gulf Coast Aquifer;
- Estimated Reliable Supply: 4,122 to 4,348 acft/yr; and
- System Description: Various mining operations.

4B.5.7.2 Options Considered

The Duval County mining water user group has projected shortages of 1,738 acft/yr in 2010 which increases to 4,205 acft/yr in 2060. Their shortages are attributed to reducing pumping to meet drawdown constraints established by the CBRWPG. Table 4B.5-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Duval County-Mining.

Table 4B.5-2.
Water Management Strategies Considered for Duval County-Mining

Option	***Yield (acft/yr)***	***Approximate Cost[1]***	
		Total	***Unit ($/acft)***
Mining Water Conservation (Section 4C.4)	147 to 1,283	N/A[2]	N/A[2]
No Action	—	$22,370,000 to $54,120,000[3]	$12,870[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Costs are unavailable for Mining Water Conservation Best Management Practices (Section 4C.4).
[3] Total economic impact of not meeting needs (i.e. "no action" alternative) was provided by the TWDB (see Appendix F). Annual impact of not meeting needs is presented by decade in Table 4B.5-3. Unit cost was calculated based on annual cost provided by the TWDB and shortage calculated.
N/A = Not applicable.
TBD= To be determined.

4B.5.7.3 Water Supply Plan

Working within the planning criteria established by the CBRWPG and TWDB, the following water supply plan is recommended to reduce the projected 2010 to 2060 shortages for Duval County-Mining:

- Mining Water Conservation (which might include water reuse)
- No Action

Mining water conservation is only able to meet a portion of the projected shortage. It is probable that Duval County mining users could avoid excessive drawdowns by spreading out the area of their wells, instead of concentrating them in a small area represented by a cluster of adjacent cells. This option is discussed in Section 4C.7.2, including costs to drill an additional 11 wells to meet the projected shortages. The costs estimates take into consideration size and depth of wells.

In addition to the management strategy listed above, the CBRWPG supports strategies for reuse of existing supplies.

4B.5.7.4 Costs

For mining water conservation, the Water Conservation Implementation Task Force Guide includes a list of Best Management Practices for industries (included in Section 4C.4) but does not include specific costs. Therefore, no additional capital costs can be reasonably calculated for the mining water plan. The recommended Water Supply Plan, including anticipated supplies to meet shortages is summarized by decade in Table 4B.5-3.

Table 4B.5-3.
Recommended Plan Costs by Decade for Duval County-Mining

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(1,738)	(2,518)	(2,973)	(3,386)	(3,809)	(4,205)
Mining Water Conservation						
Supply From Plan Element (acft/yr)	147	332	534	761	1,014	1,283
Annual Cost ($/yr)[1]	N/A	N/A	N/A	N/A	N/A	N/A
Unit Cost ($/acft)[1]	N/A	N/A	N/A	N/A	N/A	N/A
No Action						
Annual Cost ($/yr)[2]	$22,370,000	$32,410,000	$38,260,000	$43,580,000	$49,020,000	$54,120,000
Unit Cost ($/acft)	$12,870	$12,870	$12,870	$12,870	$12,870	$12,870

[1] Costs are unavailable for Mining Water Conservation Best Management Practices (Section 4C.4). Conservation savings and costs are by nature facility specific. Since mining entities are presented on a county basis and are not individually identified, identification of costs for specific water management strategies are not appropriate.
[2] Includes lost income and lost business taxes associated with not meeting needs as provided in the TWDB Socioeconomic Impact Report (Appendix F). Unit cost was calculated based on annual cost provided by the TWDB and shortage calculated.
N/A = Not applicable

4B.5.8 Irrigation

Irrigation demands in Duval County are declining over the planning period. The county-wide decline in water use is likely due to expected reductions in irrigated land in the future, however this would imply a reversal of the trend observed in reported irrigated acreage from 1994 to 2000 (Section 4C.2). These demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

4B.5.9 Livestock

The livestock water demands in Duval County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.6 Jim Wells County Water Supply Plan

Table 4B.6-1 lists each water user group in Jim Wells County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 4B.6-1.
Jim Wells County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
City of Alice	0	0	Supply equals demand
City of Orange Grove	0	0	Supply equals demand
City of Premont	0	0	Supply equals demand
City of San Diego	0	0	Supply equals demand
County-Other	(262)	(170)	Projected shortages for entire planning period — see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A-10 and 4A-11, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.6.1 City of Alice

The City of Alice has a contract to purchase water from the City of Corpus Christi via Lake Corpus Christi. The City also maintains a small reservoir in town, Lake Alice, which serves as temporary storage of waters from Lake Corpus Christi. This reservoir is fed naturally by a small watershed and has no effective firm yield. No shortages are projected for the City of Alice. In 2000 the City of Alice had a per capita per day usage of 248 gallons per capita per day (gpcd) and a projected usage of 234 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060 (Section 4C.1). The City of Alice is currently studying ways to reduce water use. The estimated water saved with additional water conservation increases from 50 acft/yr in Year 2010 to 585 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $21,240 in Year 2010 to $247,695 in Year 2060 (See Table 4C.1-7).

4B.6.2 City of Orange Grove

The City of Orange Grove's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Orange Grove. In 2000 the City of Orange Grove had a per capita per day usage of 245 gallons per capita per day (gpcd) and a projected usage of 230 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060 (Section 4C.1). The estimated water saved with additional water conservation increases from 3 acft/yr in Year 2010 to 38 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $1,087 in Year 2010 to $15,869 in Year 2060 (See Table 4C.1-7).

4B.6.3 City of Premont

The City of Premont's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Premont. In 2000 the City of Premont had a per capita per day usage of 260 gallons per capita per day (gpcd) and a projected usage of 246 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060 (Section 4C.1). The estimated water saved with additional water conservation increases from 9 acft/yr in Year 2010 to 92 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $3,813 in Year 2010 to $39,077 in Year 2060 (See Table 4C.1-7).

4B.6.4 City of San Diego

The City of San Diego is in both Duval and Jim Well Counties; consequently, its water demand and supply values are split into tables for each county. The City of San Diego receives groundwater supplies from the Goliad Sands of the Gulf Coast Aquifer. The City of Alice has run a 16-inch water transmission line to Hwy 281 bypass, approximately 8 to 9 miles from the City of San Diego.[1] This pipeline could be extended to provide water supply from the City of Alice to San Diego.

No shortages are projected for the City of San Diego. Although projections indicate that San Diego's current wells will produce adequate supply to meet their anticipated demand, there is local concern that the quality of the water produced by the city's wells will decline to the point that advanced treatment will be necessary to stay in compliance with regulatory water quality guidelines as discussed in Section 4C.7.2.3. If the City of San Diego requires groundwater desalination for their highest water demand over the planning period, a 1 MGD reverse osmosis membrane system would be sufficient. If no additional infrastructure is required, it is estimated that the total capital cost for a membrane WTP will be $4,313,000, and total project cost will be $6,304,000. Total annual cost will be $1,000,000, resulting in a unit cost of $893 per acft, or $2.74 per 1,000 gallons assuming full utilization of treatment plant.

4B.6.5 County-Other

4B.6.5.1 Description

- Source: Groundwater - Gulf Coast Aquifer;
- Estimated Reliable Supply: 1,944- 1,976 acft/yr; and
- System Description: Limited by well capacity in Nueces-Rio Grande River Basin.

4B.6.5.2 Options Considered

The County-Other demand projection category is intended to capture the demands of single-family rural municipal demands as well as demands for small rural water supply systems. Jim Wells County-Other users have projected shortages of 167 acft/yr in 2010 increasing to 170 acft/yr in 2060. Near-term (2010) and long-term shortages (2060) are about 8 percent of demand. Table 4B.6-2 lists the water management strategies, references to the report sections discussing the strategy, total project cost, and unit costs that were considered for meeting the Jim Wells County Other shortages.

[1] Conservation with Carl Crull, July 2005.

Table 4B.6-2.
Water Management Strategies Considered for Jim Wells County-Other

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s) (Section 4C.7)	565	$980,000[2]	$213[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-5, 0.6 MGD WTP, fully utilized. Cost estimates are based on size and depth of well(s) to meet needs.

4B.6.5.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for the Jim Wells County-Other users:

- Gulf Coast Aquifer Supplies – Drill additional well(s).

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.6.5.4 Costs

Groundwater supplies for Jim Wells County-Other users are currently limited by well capacity. Two new wells would be required to meet the projected shortages for Jim Wells County-Other. The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.6-3.

Table 4B.6-3.
Recommended Plan Costs by Decade for Jim Wells County-Other

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	(167)	(238)	(262)	(241)	(210)	(170)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	565	565	565	565	565	565
Total Annual Cost ($/yr)[2]	$120,000	$120,000	$120,000	$35,000	$35,000	$35,000
Total Unit Cost ($/acft)[2]	$213	$213	$213	$62	$62	$62

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-5, 0.6 MGD WTP, fully utilized. Cost estimates are based on

size and depth of well(s) to meet needs. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2030 assumes debt service has been paid.

4B.6.6 Manufacturing

No manufacturing demand exists or is projected for the county.

4B.6.7 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.6.8 Mining

Mining demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

4B.6.9 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

4B.6.10 Livestock

The livestock water demands in Jim Wells County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.7 Kenedy County Water Supply Plan

Table 4B.7-1 lists each water user group in Kenedy County and their corresponding surplus or shortage in years 2030 and 2060. All water user groups in Kenedy County have an adequate supply, as shown in Table 4B.7-1.

Table 4B.7-1.
Kenedy County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
County-Other	0	0	Supply equals demand
Manufacturing	0	0	No demands projected
Steam-Electric	0	0	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A-12 and 4A-13, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.7.1 County-Other

The Kenedy County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Kenedy County-Other entities and no changes in water supply are recommended.

4B.7.2 Manufacturing

No manufacturing demand exists or is projected for the county.

4B.7.3 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.7.4 Mining

The mining water demands in Kenedy County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

4B.7.5 Irrigation

The irrigation water demands in Kenedy County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

4B.7.6 Livestock

The livestock water demands in Kenedy County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

4B.8 Kleberg County Water Supply Plan

Table 4B.8-1 lists each water user group in Kleberg County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 4B.8-1.
Kleberg County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2060 (acft/yr)	Comment
City of Kingsville	0	0	Supply equals demand
Ricardo WSC	0	0	Supply equals demand
County-Other	(81)	(155)	Projected shortages from 2020 to 2060 — see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

[1] From Tables 4A-14 and 4A-15, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.8.1 City of Kingsville

The City of Kingsville has a contract with the South Texas Water Authority (STWA) to purchase treated surface water from the CCR/LCC/Texana System. The City also has five wells with a combined capacity of 6.3 MGD (or 7,055 acft/yr) that pump groundwater from the Gulf Coast Aquifer. South Texas Water Authority provides water to the Ricardo Water Supply Corporation via a pass through agreement with the City of Kingsville. However, since the City of Kingsville does not meet its water needs with 100% surface water, the Ricardo WSC is receiving groundwater supplies from Kingsville's wells.[1] The current contract between the City and the STWA allows Kingsville to purchase up to $350,000 of treated water. This feature of the contract was used in 2020 and beyond to ensure sufficient water supplies to meet the City's needs through 2060. No shortages are projected for Kingsville and no changes in water supply are recommended.

[1] Correspondence from Carola Serrato, May 2005.

4B.8.2 Ricardo WSC

STWA provides water to the Ricardo Water Supply Corporation via a pass through agreement with the City of Kingsville. However, since the City of Kingsville does not meet its water needs with 100% surface water, the Ricardo WSC is receiving groundwater supplies from the City of Kingsville's wells.[2] Ricardo WSC is in the process of preparing the final easement acquisition for additional dedicated surface water line to connect directly to STWA's 42" treated water line. Ricardo WSC demands are met with surface water supplies and groundwater from the Gulf Coast Aquifer. No shortages are projected for Ricardo WSC and no changes in water supply are recommended.

4B.8.3 County-Other

4B.8.3.1 Description

- Source: Groundwater - Gulf Coast Aquifer;
- Estimated Reliable Supply: 849 acft/yr (groundwater); and
- System Description: Individual Wells.

4B.8.3.2 Options Considered

County-Other demands in Kleberg County have shortages of 31 acft/yr in 2020 which increase to 155 acft/yr in 2060. Long-term shortages in 2060 are about 15 percent of demand. Table 4B.8-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for County-Other in Kleberg County.

Table 4B.8-2.
Water Management Strategies Considered for Kleberg County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)(Section 4C.7)	400	$587,000[2]	$185[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-6, 0.4 MGD water treatment plant, fully utilized. Cost estimates are based on size and depth of well(s) to meet needs.

[2] Correspondence from Carola Serrato, May 2005.

4B.8.3.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for County-Other in Kleberg County:

- Gulf Coast Aquifer Groundwater Supplies- Drill additional well(s).

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.8.3.4 Costs

The County-Other demand projection category is intended to capture the demands of single-family rural municipal demands as well as demands for small rural water supply systems. The recommended Water Supply Plan, including anticipated costs is summarized by decade in Table 4B.8-3.

Table 4B.8-3.
Recommended Plan Costs by Decade for Kleberg County-Other

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	—	(31)	(81)	(108)	(153)	(155)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	—	400	400	400	400	400
Total Annual Cost ($/yr)[2]	—	$74,000	$74,000	$74,000	$23,000	$23,000
Total Unit Cost ($/acft)[2]	—	$185	$185	$185	$58	$58

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.

[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-6, 0.4 MGD water treatment plant, fully utilized. Cost estimates are based on size and depth of well(s) to meet needs. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2040 assumes debt service has been paid.

4B.8.4 Manufacturing

No manufacturing demand exists or is projected for the county.

4B.8.5 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.8.6 Mining

Mining water demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

4B.8.7 Irrigation

Irrigation demands in Kleberg County are declining over the planning period. These demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

4B.8.8 Livestock

The livestock demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

4B.9 Live Oak County Water Supply Plan

Table 4B.9-1 lists each water user group in Live Oak County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 4B.9-1.
Live Oak County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2060 (acft/yr)	Comment
Choke Canyon WSC	2	4	Projected surplus — supplies and demands split between Live Oak and McMullen Counties
El Oso WSC	0	0	Supply equals demand
City of George West	0	0	Supply equals demand
McCoy WSC	2	14	Projected surplus
City of Three Rivers	3,271	3,463	Projected surplus
County-Other	(44)	0	Projected shortages in 2020, 2030, and 2040 — see plan below
Manufacturing	(559)	(764)	Projected shortages from 2010 to 2060 — see plan below
Steam-Electric	none	none	No demands projected
Mining	(928)	(1,755)	Projected shortages from 2010 to 2060 — see plan below
Irrigation	(514)	(373)	Projected shortages from 2010 to 2060 — see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A-16 and 4A-17, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.9.1 Choke Canyon WSC

Choke Canyon WSC has service areas in Live Oak and McMullen Counties, with a portion of their total water demand and supplies allocated to each county (Tables 4A-16 and 4A-18). In January 2004, Choke Canyon WSC was purchased by the City of Three Rivers. Choke Canyon water supply demands are met with groundwater from the Gulf Coast Aquifer and surface water supplies from the City of Three Rivers. No shortages are projected for Choke Canyon WSC and no changes in water supply are recommended.

4B.9.2 El Oso WSC

El Oso Water Supply Corporation is located in both Bee and Live Oak Counties; consequently, its water demand and supply values are split into tables for each county. The El Oso Water Supply Corporation receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for El Oso Water Supply Corporation and no changes in water supply are recommended.

4B.9.3 City of George West

The City of George West's demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for George West. In 2000 the City of George West had a per capita per day usage of 227 gallons per capita per day (gpcd) and a projected usage of 213 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 5 acft/yr in Year 2010 to 57 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $1,961 in Year 2010 to $24,166 in Year 2060(See Table 4C.1-7).

4B.9.4 McCoy WSC

McCoy WSC's demands are met with groundwater from the Carrizo-Wilcox Aquifer. No shortages are projected for McCoy WSC and no changes in water supply are recommended.

4B.9.5 City of Three Rivers

The City of Three Rivers' demands are met with surface water rights on the Nueces River. No shortages are projected for Three Rivers. In 2000 the City of Three Rivers had a per capita per day usage of 202 gallons per capita per day (gpcd) and a projected usage of 188 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 3 acft/yr in Year

2010 to 34 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $1,068 in Year 2010 to $14,508 in Year 2060(See Table 4C.1-7).

Part of the City of Three River's surplus has been reallocated to Manufacturing use in the county (Table 4B.9-2).

Table 4B.9-2.
Reallocation of Surplus Supplies by Decade for City of Three Rivers

Plan Element	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Original Projected Surplus (acft/yr)	3,353	3,289	3,271	3,304	3,381	3,463
Reallocated Surplus (acft/yr)	337[1]	483[1]	559[1]	615[1]	657[1]	764[1]
Remaining Projected Surplus (acft/yr)	3,016	2,806	2,712	2,689	2,724	2,699

[1] Reallocated to Live Oak-Manufacturing users (Section 4B.9.7)

4B.9.6 County-Other

4B.9.6.1 Description

- Source: Groundwater - Gulf Coast Aquifer
- Estimated Reliable Supply: 764 acft per year
- System Description: Individual Wells and Small Water Supply Systems

4B.9.6.2 Options Considered

County-Other demand in Live Oak County has shortages of 32 acft/yr in 2020, which is reduced in subsequent decades to 14 acft/yr in 2040. Projected groundwater demands decrease after 2030, and groundwater supplies are sufficient to meet projected demands in 2050 and 2060. Groundwater supplies are limited by the estimated well capacity, based on the procedure in Section 4A.2. Table 4B.9-3 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for County-Other in Live Oak County.

Table 4B.9-3.
Water Management Strategies Considered for Live Oak County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s) (Section 4C.7)	80	$315,000[2]	$438[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-7, 0.1 MGD water treatment plant fully utilized. Cost estimates are based on size and depth of well(s) to meet needs.

4B.9.6.3 Water Supply Plan

Working within the planning criteria established by the CBRWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for County-Other in Live Oak County:

- Gulf Coast Aquifer Groundwater Supplies – Drill Additional Well(s).

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.9.6.4 Costs

The function of the County-Other demand projection category is to capture the demands of single family rural municipal demands as well as demands for small rural water supply systems. The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.9-4.

Table 4B.9-4.
Recommended Plan Costs by Decade for Live Oak County-Other

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	—	(32)	(44)	(14)	—	—
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	—	80	80	80	80	80
Total Annual Cost ($/yr)[2]	—	$35,000	$35,000	$35,000	$8,000	$8,000
Total Unit Cost ($/acft)[2]	—	$438	$438	$438	$100	$100

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-7, 0.1 MGD water treatment plant fully utilized. Cost estimates are based on size and depth of well(s) to meet needs. Reduction in cost after Year 2040 assumes debt service has been paid.

4B.9.7 Manufacturing

4B.9.7.1 Description

- Source: Groundwater - Gulf Coast Aquifer and Nueces Basin run-of-the-river surface water rights for manufacturing use (owned by the City of Three Rivers)
- Estimated Reliable Supply: 800 acft/yr (surface water)
  630 to 809 acft/yr (groundwater)
- System Description: Individual Wells and various manufacturing operations

4B.9.7.2 Options Considered

Manufacturing demand in Live Oak County has shortages during the entire planning period and increase from 337 acft/yr in 2010 to 764 acft/yr in 2060. Groundwater supplies are limited by drawdown criteria established by the CBRWPG (Section 3). Table 4B.9-5 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Manufacturing in Live Oak County.

Table 4B.9-5.
Water Management Strategies Considered for Live Oak County-Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution of City of Three Rivers surplus (Section 4C.12)	337 to 764	N/A[2]	$685[3]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Costs not applicable (see discussion in Section 4C.12.2).
3 Unit cost of $685 per acft assumed to be comparable to the cost of Garwood water.
N/A = Not applicable.

4B.9.7.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for County-Other in Live Oak County:

- Voluntary Redistribution of City of Three Rivers surplus.

It is probable that Live Oak manufacturing users could avoid excessive drawdowns by spreading out the area of their wells, instead of concentrating them in a small area represented by a cluster of adjacent cells. This option is discussed in Section 4C.7.2, including costs to drill an additional two (2) wells to meet the projected shortages.

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.9.7.4 Costs

The recommended Water Supply Plan is summarized by decade in Table 4B.9-6.

Table 4B.9-6.
Recommended Plan Costs by Decade for Live Oak County-Manufacturing

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(337)	(483)	(559)	(615)	(657)	(764)
Voluntary Redistribution of City of Three Rivers Surplus						
Supply From Plan Element (acft/yr)	337	483	559	615	657	764
Total Annual Cost ($/yr)	$230,800	$330,900	$382,900	$421,300	$450,000	$523,300
Total Unit Cost ($/acft)[1]	$685	$685	$685	$685	$685	$685
[1] Unit cost of $685 per acft assumed to be comparable to cost of Garwood water.						

4B.9.8 Steam-Electric

No steam-electric demand exists or is currently projected for the county.

4B.9.9 Mining

According to the local groundwater conservation district[1], the development of natural gas from the shale in the Eagleford Group has begun in Live Oak County. Water demands associated with these mining activities are not included in projected TWDB water demands, but may impact local groundwater use in the Carrizo Aquifer. Furthermore, uranium mining is in the initial phases of exploration in Live Oak County and is anticipated to use additional groundwater supplies. The impacts of developing gas wells in the Eagleford shale and uranium mining activities on groundwater supplies in the Coastal Bend Region should be considered in future planning efforts.

[1] Correspondence from Live Oak UWCD in November 2009.

4B.9.9.1 Description

- Source: Groundwater – Gulf Coast Aquifer
- Estimated Reliable Supply: 3,105 to 3,841 acft/yr
- System Description: Various mining operations

4B.9.9.2 Options Considered

The mining supply in Live Oak County has shortages for the entire planning period and increase from 64 acft per year in 2010 to 1,755 acft per year in 2060. Groundwater supplies are limited by drawdown criteria established by the CBRWPG (Section 3). Table 4B.9-7 lists the water management strategies, references to the report sections discussing the strategy, total project cost, and unit costs that were considered for meeting the Live Oak County mining shortages.

Table 4B.9-7.
Water Management Strategies Considered for Live Oak County-Mining

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Mining Water Conservation (Section 4C.4)	97 to 801[2]	N/A[2]	N/A[2]
No Action	—	$1,050,000 to $7,700,000[3]	$2,197 to $4,388[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Yield based on 15 percent reduction in demand recommended by CBRWPG (Section 4C.4.2).
[3] Total economic impact of not meeting needs (i.e. "no action" alternative) was provided by the TWDB (see Appendix F). Annual impact of not meeting regional needs is presented by decade in Table 4B.9-8. Unit cost was calculated based on annual cost provided by the TWDB and shortage calculated.
N/A = Not applicable.

4B.9.9.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected near-term and long-term shortages for Live Oak County mining:

- Mining Water Conservation (which might include water reuse), and
- No Action.

Mining water conservation is only able to meet a portion of the projected shortage.

It is probable that Live Oak mining users could avoid excessive drawdowns by spreading out the area of their wells, instead of concentrating them in a small area represented by a cluster of adjacent cells. This option is discussed in Section 4C.7.2, including costs to drill an additional five wells to meet the projected shortages. The costs estimates take into consideration size and depth of wells.

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.9.9.4 Costs

For mining water conservation, the Water Conservation Implementation Task Force Guide includes a list of Best Management Practices for industries (included in Section 4C.4) but does not include specific costs. Therefore, no additional capital costs can be reasonably calculated for the mining water plan. The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.9-8.

Table 4B.9-8.
Recommended Plan Costs by Decade for Live Oak County-Mining

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(64)	(478)	(928)	(1,234)	(1,504)	(1,755)
Mining Water Conservation						
Supply From Plan Element (acft/yr)	97	216	344	485	639	801
Annual Cost ($/yr)[1]	N/A	N/A	N/A	N/A	N/A	N/A
Unit Cost ($/acft)[1]	N/A	N/A	N/A	N/A	N/A	N/A
No Action						
Annual Cost ($/yr)[2]	-	$1,050,000	$2,040,000	$2,710,000	$6,600,000	$7,700,000
Unit Cost ($/acft)[2]		$2,197	$2,197	$2,197	$4,388	$4,388

[1] Costs are unavailable for Mining Water Conservation Best Management Practices (Section 4C.4). Conservation savings and costs are by nature facility specific. Since mining entities are presented on a county basis and are not individually identified, identification of costs for specific water management strategies are not appropriate.
[2] Includes lost output, lost income, and lost business taxes associated with not meeting needs as provided in the TWDB Socioeconomic Impact Report (Appendix F). Unit cost was calculated based on annual cost provided by the TWDB and shortage calculated.
N/A = Not Applicable

4B.9.10 Irrigation

4B.9.10.1 Description

- Source: Groundwater - Gulf Coast Aquifer;
- Estimated Reliable Supply: 1,704 to 2,649 acft/yr (groundwater); and
- System Description: Various on-farm irrigation systems.

4B.9.10.2 Options Considered

The Irrigation supply in Live Oak County shows a projected shortage for the entire planning period. Due to projected water demand declines for irrigation users in Live Oak County, shortages decrease from 827 acft/yr in 2010 to 573 acft/yr in 2060. The county-wide decline in water use is likely due to expected reductions in irrigated land in the future, however this would imply a reversal of the trend observed in reported irrigated acreage from 1994 to 2000 (Section 4C.2). Shortages are approximately 25 percent of demand in 2010 and 2060. Groundwater supplies are limited by the approach used to calculate groundwater and surface water supplies based on 2000 use (Section 4A.2). Table 4B.9-9 lists the water management strategies, references to the report sections discussing the strategy, total project cost, and unit costs that were considered for meeting the Live Oak County Irrigation shortages.

Table 4B.9-9.
Water Management Strategies Considered for Live Oak County-Irrigation

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Irrigation Conservation (Section 4C.2)	17 to 342[2]	Variable[2]	$228[2]
Gulf Coast Aquifer Supplies – Drill Additional Well(s) (Section 4C.7)	1,210	$1,058,000[3]	$100[3]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 4C.2. Irrigation Conservation is estimated to cost $78,000 per year in Year 2060 to implement furrow irrigation best management practice to achieve a water savings of 342 acft at an average cost of $228 per acft. LESA/LEPA are less expensive options.
3 Source of Cost Estimate: Section 4C.7, Table 4C.7-10. Cost estimates are based on size and depth of well(s) to meet needs.

4B.9.10.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for Irrigation in Live Oak County:

- Irrigation Conservation (Furrow/LESA/LEPA); and
- Gulf Coast Aquifer Groundwater Supplies- Drill Additional Well(s).

Although irrigation demands are projected to decrease, the affects of irrigation conservation will not be significant in earlier decades. To meet near-term shortages drilling three additional wells will provide the additional water supply to meet projected shortages. Irrigation conservation savings are anticipated to increase from 17 acft/yr in 2010 to 342 acft/yr in 2060 (Section 4C.2). In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.9.10.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.9-10.

Table 4B.9-10.
Recommended Plan Costs by Decade for Live Oak County-Irrigation

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(627)	(569)	(514)	(464)	(416)	(373)
Irrigation Conservation						
Supply From Plan Element (acft/yr)	17	52	103	169	248	342
Annual Cost ($/yr)	$3,900	$11,900	$23,500	$38,500	$56,500	$78,000
Unit Cost ($/acft)[1]	$228	$228	$228	$228	$228	$228
Gulf Coast Aquifer Groundwater Supplies – Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[2]	1,210	1,210	1,210	1,210	1,210	1,210
Annual Cost ($/yr)[3]	$121,000	$121,000	$121,000	$29,000	$29,000	$29,000
Unit Cost ($/acft)[3]	$100	$100	$100	$24	$24	$24
Total Annual Cost ($/yr)	$124,900	$132,900	$144,500	$67,500	$85,500	$107,000
Total Unit Cost ($/acft)[4]	$102	$105	$110	$49	$59	$69

[1] Costs shown based on implementing furrow dikes as a water conservation strategy (Section 4C.2).
[2] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[3] Source of Cost Estimate: Section 4C.7, Table 4C.7-10. Cost estimates are based on size and depth of well(s) to meet needs. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2030 assumes debt service has been paid.
[4] Weighted average unit cost of the one or two management strategies that have associated total annual costs, based on projected supply needed.

4B.9.11 Livestock

The livestock demands in Live Oak County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.10 McMullen County Water Supply Plan

Table 4B.10-1 lists each water user group in McMullen County and their corresponding surplus or shortage in years 2030 and 2060. All water user groups in McMullen County have an adequate supply, as shown in Table 4B.10-1.

Table 4B.10-1. McMullen County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
Choke Canyon WSC	13	13	Projected surplus — supplies and demands split between Live Oak and McMullen Counties
County-Other	31	52	Projected surplus
Manufacturing	0	0	No demands projected
Steam-Electric	0	0	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	No demands projected
Livestock	0	0	Supply equals demand

[1] From Tables 4A-18 and 4A-19, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.10.1 Choke Canyon WSC

In January 2004, Choke Canyon WSC was purchased by the City of Three Rivers. The TWDB did not provide updated population and water demands for planning groups to use in developing the 2011 Plan, since the TWDB does not have updated census data for the current planning effort. Therefore, Choke Canyon WSC demands used in the 2011 Plan are the same as those shown in the 2006 Plan. For future planning efforts, Choke Canyon WSC should be removed as a separate water user group and the projected population and water demands for Choke Canyon WSC should be added to the City of Three Rivers projections.

Choke Canyon WSC has service areas in Live Oak and McMullen Counties, with a portion of their total water demand and supplies allocated to each county (Tables 4A-17 and 4A-19). Choke Canyon WSC water demands are met with groundwater from the Gulf Coast Aquifer and surface water supplies from the City of Three Rivers. No shortages are projected for Choke Canyon WSC and no changes in water supply are recommended.

4B.10.2 County-Other

The McMullen County-Other municipal users receive groundwater supplies from the Carrizo-Wilcox, Queen City, and Sparta Aquifers. No shortages are projected for McMullen County-Other entities. In 2000 McMullen County-Other had a per capita per day usage of 201 gallons per capita per day (gpcd) which is projected to decrease to 187 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 1 acft/yr in Year 2010 to 10 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $272 in Year 2010 to $4,264 in Year 2060 (See Table 4C.1-7).

4B.10.3 Manufacturing

No manufacturing demand exists or is projected for the county. According to the local groundwater conservation district[1], water is being used for manufacturing activities in McMullen County. Due to time constraints and TWDB guidance, these manufacturing water demands were not evaluated in detail for the 2011 Plan but should be considered in future planning efforts.

4B.10.4 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.10.5 Mining

Mining water demands in McMullen County show a small increase over the planning period from 195 acft/yr in 2010 to 218 acft/yr in 2060. These demands are met by groundwater from the Carrizo-Wilcox Aquifer. No shortages are projected for mining and no changes in water supply are recommended. According to the local groundwater conservation district[1], the development of natural gas from the shale in the Eagleford Group has begun in McMullen County. Water demands associated with these mining activities are not included in projected TWDB water demands, but may impact local groundwater use in the Carrizo Aquifer. The impacts of developing gas wells in the Eagleford shale on groundwater supplies in the Coastal Bend Region should be considered in future planning efforts.

[1] Correspondence from McMullen GCD in November 2009.

4B.10.6 Irrigation

No irrigation demand exists or is projected for the county.

4B.10.7 Livestock

The livestock water demands in McMullen County are met by groundwater from the Carrizo-Wilcox, Gulf Coast, Queen City, and Sparta Aquifers and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.11 Nueces County Water Supply Plan

Table 4B.11-1 lists each water user group in Nueces County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize water from wholesale water providers.

Table 4B.11-1.
Nueces County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2060 (acft/yr)	Comment
City of Agua Dulce	0	0	Supply equals demand
City of Aransas Pass	0	0	Supply equals demand
City of Bishop	0	0	Supply equals demand
City of Corpus Christi	0	0	Projected surplus through 2010, then supply equals demand
City of Driscoll	0	0	Supply equals demand
Nueces County WCID #4	0	0	Supply equals demand
City of Port Aransas	0	0	Supply equals demand
River Acres WSC	(355)	(590)	Projected shortage from 2010 to 2060 — see plan below
City of Robstown	0	0	Supply equals demand
County-Other	146	383	Projected shortage in 2010; Projected surplus from 2030 through 2060
Manufacturing	(15,203)	(39,550)	Projected shortage – see plan below
Steam-Electric	(4,755)	(13,183)	Projected shortage – see plan below
Mining	(570)	(1,624)	Projected shortage from 2030 to 2060 – see plan below
Irrigation	2,930	3,315	Projected Surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4A-20 and 4A-21, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.11.1 City of Agua Dulce

The City of Agua Dulce has a contract with the South Texas Water Authority (STWA) to purchase treated surface water from the CCR/LCC/Texana System. No shortages are projected for the City of Agua Dulce and no changes in water supply are recommended.

4B.11.2 City of Aransas Pass

The City of Aransas Pass is in Aransas, Nueces and San Patricio Counties; consequently, the water demand and supply values are split into the tables for each county. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water from the CCR/LCC/Texana System. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass and no changes in water supply are recommended.

4B.11.3 City of Bishop

The City of Bishop has a contract with STWA to purchase treated surface water. Additionally, the City pumps groundwater from the Gulf Coast Aquifer. No shortages are projected for the City of Bishop and no changes in water supply are recommended.

4B.11.4 City of Corpus Christi

The City of Corpus Christi meets its demands with its own water rights in the CCR/LCC System and through a contract with the Lavaca-Navidad River Authority (LNRA) that provides water from Lake Texana. Although no shortages are projected for the City's own municipal needs, the City also provides surface water to SPMWD, STWA, and manufacturing and steam-electric water user groups in Nueces and San Patricio Counties. The City's contract with LNRA expires in 2035; however, it is anticipated that this contract will be renewed when it expires. Therefore, water supply tables in Section 4 and in the water supply plans for Nueces County-Manufacturing (Section 4B.11.10) and San Patricio County-Manufacturing (Section 4B.12.11) include Lake Texana contract water as existing supply throughout the 60-year planning horizon.

In addition to these water supply sources, the City has a permit to divert up to 35,000 acft/yr of run-of-river water under its interbasin transfer permit on the Colorado River (via the Garwood Irrigation Co.). While the City owns the water right on the Colorado River, it does not have the facilities to divert and convey this water to the City. In the long-term (beyond 2030), the City will have to access this water—either directly or via a trade—to help offset the manufacturing shortages in Nueces and San Patricio Counties.

4B.11.5 City of Driscoll

The City of Driscoll has a contract with STWA to purchase treated surface water from the CCR/LCC/Texana System. No shortages are projected for the City of Driscoll and no changes in water supply are recommended.

4B.11.6 Nueces County WCID #4

The Nueces County WCID #4 has contracts with City of Corpus Christi and SPMWD to purchase treated surface water from the CCR/LCC/Texana System and serves the City of Port Aransas. Nueces County WCID #4 and Port Aransas water demands were separately identified by the TWDB. Water supplies for Nueces County WCID #4 are provided by City of Corpus Christi. Water supplies for Port Aransas are provided by SPMWD. No shortages are projected for the Nueces County WCID #4. In 2000 Nueces County WCID #4 had a per capita per day usage of 187 gallons per capita per day (gpcd) and a projected usage of 177 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 56 acft/yr in Year 2030 to 384 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $25,130 in Year 2010 to $171,880 in Year 2060 (See Table 4C.1-7).

4B.11.7 City of Port Aransas

The Nueces County WCID #4 has contracts with City of Corpus Christi and SPMWD to purchase treated surface water from the CCR/LCC System and serves the City of Port Aransas. Nueces County WCID #4 and Port Aransas water demands were separately identified by the TWDB. Water supplies for Nueces County WCID #4 are provided by City of Corpus Christi. Water supplies for Port Aransas are provided by SPMWD. No shortages are projected for Port Aransas. In 2000 the City of Port Aransas had a per capita per day usage of 424 gallons per capita per day (gpcd) and a projected usage of 413 gpcd in 2060 (after built-in savings for low flow plumbing fixtures), based on TWDB water demand and population projections. A possible reason for the high usage is due to a high influx of tourists. The CBRWPG recommends additional water conservation of 15 percent by 2060 for all municipal entities with reported use greater than 165 gpcd in 2060. The estimated water saved with additional water conservation increases from 28 acft/yr in Year 2010 to 843 acft/yr in Year 2060 (See Table 4C.1-4). The cost of water savings for additional water conservation ranges from $12,682 in Year 2010 to $377,721 in Year 2060 (See Table 4C.1-7).

4B.11.8 River Acres WSC

4B.11.8.1 Description

- Source: Surface Water — Nueces River (via Nueces County WCID #3);
- Estimated Reliable Supply: 291 acft/yr (surface water); and
- System Description: Small Water Supply Systems.

4B.11.8.2 Options Considered

River Acres WSC in Nueces County has a shortage for the entire planning period and increases from 138 acft/yr in 2010 to 590 acft/yr in 2060. River Acres WSC receives surface water supplies from Nueces County WCID #3. Nueces County WCID #3 has projected surpluses sufficient to meet River Acres WSC needs (Section 4A.4). Table 4B.11-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for River Acres WSC.

Table 4B.11-2.
Water Management Strategies Considered for River Acres WSC

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution- increase contracted amount from Nueces County WCID #3 (Section 4C.12)	138 to 590	N/A[2]	$798[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Unit cost of $798 per acft is to treat water for municipal use. Cost provided by Nueces County WCID #3.
N/A = Not applicable.

4B.11.8.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected 2010 through 2060 shortages for River Acres WSC:

- Voluntary Redistribution- increase contracted amount from Nueces County WCID #3

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.11.8.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.11-3.

Table 4B.11-3. Recommended Plan Costs by Decade for River Acres WSC

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(138)	(255)	(355)	(445)	(522)	(590)
Voluntary Redistribution – increase contracted amount from Nueces County WCID #3						
Supply From Plan Element (acft/yr)	138	255	355	445	522	590
Total Annual Cost ($/yr)	$110,200	$203,500	$283,300	$355,200	$416,600	$470,900
Total Unit Cost ($/acft)[1]	$798	$798	$798	$798	$798	$798
[1] Unit cost for treated water provided by Nueces County WCID #3.						

4B.11.9 City of Robstown

The City of Robstown has a contract with the Nueces County WCID #3 to purchase treated surface water from the Nueces River. No shortages are projected for the City of Robstown and no changes in water supply are recommended.

4B.11.10 County-Other

4B.11.10.1 Description

- Source: Surface Water – CCR/LCC/Texana System (via Corpus Christi, & STWA)
  – Nueces River (via Nueces County WCID #3)
  Groundwater – Gulf Coast Aquifer

- Estimated Reliable Supply: 484 acft/yr (surface water)
  17 to 194 acft/yr (groundwater)
- System Description: Individual Wells and Small Water Supply Systems

4B.11.10.2 Options Considered

County-Other demand in Nueces County has a shortage of 261 acft/yr in 2010. The Nueces County-Other water demands may have been underestimated, as reflected by decreasing demands over the planning period which contradicts water demand trends for water supply corporations included in Nueces County-Other projections. These water demand projections should be reevaluated for future water planning efforts. There is a surplus projected from 2030 through 2060 to counterbalance low water demand estimates. Table 4B.11-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Nueces County-Other.

Table 4B.11-4.
Water Management Strategies Considered for Nueces County-Other

Option	*Yield (acft/yr)*	*Approximate Cost[1]*	
		Total	*Unit ($/acft)*
Increase contracted amount provided by Wholesale Water Providers	261	$0[2]	$652[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Assumes $2.00 per 1,000 gallons.

4B.11.10.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected 2010 shortages for County-Other in Nueces County:

- Increase contracted amount provided by Wholesale Water Provider (City of Corpus Christi)

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.11.10.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.11-5.

Table 4B.11-5.
Recommended Plan Costs by Decade for Nueces County-Other

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Projected Surplus/(Shortage) (acft/yr)	(261)	—	—	—	—	—
Increase Contracted Amount provided Wholesale Water Provider (City of Corpus Christi)						
Supply From Plan Element (acft/yr)	261	—	—	—	—	—
Total Annual Cost ($/yr)	$170,200	—	—	—	—	—
Total Unit Cost ($/acft)	$652	—	—	—	—	—

4B.11.11 Manufacturing

4B.11.11.1 Description

The City of Corpus Christi provides the surface water for manufacturing in Nueces County from the CCR/LCC/Texana System. Additional manufacturing supplies are from the Gulf Coast Aquifer. The City also provides surface water for manufacturing in San Patricio County. *In the analysis that follows, the manufacturing needs of Nueces and San Patricio Counties are considered jointly*. Since water management strategies for this water user will likely be developed by Wholesale Water Providers, the total project costs and supplies are shown in the water supply plan. Appendix C.6 delineates water management strategy supplies and costs by water user group and county. A shortage in manufacturing supply occurs in 2020.

4B.11.11.2 Options Considered

Over 90 percent of the water supplied to Manufacturing users in Nueces and San Patricio Counties is from the CCR/LCC/Lake Texana System via Wholesale Water Providers (City of Corpus Christi and SPMWD). Beginning in 2020, shortages begin to appear and grow to a combined 46,005 acft/yr in 2060 (39,550 acft/yr in Nueces County and 6,455 acft/yr in San Patricio County). Table 4B.11-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for manufacturing in Nueces and San Patricio Counties.

4B.11.11.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is one potential plan to meet the projected 2020 through 2060 shortages for manufacturing in Nueces and San Patricio Counties:

- Manufacturing Water Conservation;
- O.N. Stevens Water Treatment Plant Improvements;
- Reclaimed Wastewater Supplies;
- Garwood Pipeline;
- Off-Channel Reservoir;
- Gulf Coast Aquifer Groundwater Supplies; and
- Lavaca River Diversion and Off-Channel Reservoir.

In addition to these recommended projects, four projects are considered to be alternative water management strategies.

- CCR/LCC Pipeline;
- Stage II of Lake Texana;
- Brackish Groundwater Desalination; and
- Seawater Desalination.

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.11.11.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.11-7.

Table 4B.11-6. Water Management Strategies Considered for Manufacturing in Nueces and San Patricio Counties

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Manufacturing Conservation (Section 4C.3)	up to 2,050	N/A	N/A
O.N. Stevens Water Treatment Plant Improvements (Section 4C.19)	32,996 to 42,329	$31,324,000[2]	$459 to $524[2]
Reclaimed Wastewater Supplies (Section 4C.5)	250	N/A	$826[3]
Gulf Coast Aquifer Groundwater Supplies (Section 4C.7)	up to 18,000	$59,245,000[4]	$853[4]
Lavaca River Diversion & Off-Channel Reservoir (Section 4C.13)[5]	16,242	$224,183,000	$1,027
Garwood Pipeline (Section 4C.14)	35,000	$112,798,000[6]	$685[6]
Off-Channel Reservoir[7]	30,340[8]	$105,201,950[8]	$715[8]
CCR/LCC Pipeline[7]	21,905[9]	$48,324,000[9]	$588[9]
Stage II Lake Texana (Palmetto Bend) (Section 4C.13)[5]	12,964	$232,828,000	$1,213
Brackish Groundwater Desalination[10]	18,000	$108,331,000	$977
Seawater Desalination[10]	28,000	$260,914,000	$1,696

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered by wholesale water provider to the water supply entity or entities. Unit cost is for full utilization of project capacity.

2 Total project cost includes improvements to the following WTP components: raw influent, raw water intake pump station, and O.N. Stevens solids handling facilities. Unit cost includes $326/acft for treatment.

3 See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project. Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

4 Source of Cost Estimate: Section 4C.7, Table 4C.7-17. Unit cost includes $326/acft for treatment. Treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

5 Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft for the Lavaca River Diversion and $887/acft for the Stage II of Lake Texana plus $326/acft for treatment. Total cost shown is not prorated between regions; however, it is understood that Region N is responsible for a portion of the total project cost.

6 Source of Cost Estimate: Section 4C.14, Table 4C.14-2. Unit cost = $326/acft for treatment + $359/acft for raw water supply development.

7 Total costs and unit costs are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

8 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 46,677 acft/yr, the total project cost is $300,577,000 and the unit cost is $896/acft including treatment.

9 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 33,700 acft/yr, the total project cost is $138,067,000 and the unit cost is $728/acft including treatment.

10 Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

4B.11.12 Steam-Electric

The steam-electric users in Nueces County are provided water by City of Corpus Christi. Steam-electric users in Nueces County are projected to have shortages beginning in 2020. Since water management strategies for this water user will likely be developed by Wholesale Water Providers, the total project costs and supplies are shown in the water supply plan. Appendix C.6 delineates water management strategy supplies and costs by water user group and county.

4B.11.12.1 Description of Supply

- Source: Surface water – CCR/LCC System via City of Corpus Christi
- Estimated Reliable Supply: 7,316 to 14,481 acft/yr (surface water)
- System Description: Various steam-electric power operations

4B.11.12.2 Options Considered

The Nueces County steam-electric water user group has shortages of 1,982 acft/yr in 2020 increasing to 13,183 acft/yr in 2060, respectively. Table 4B.11-8 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for steam-electric in Nueces County.

Table 4B.11-7. Potential Plan Costs by Decade for Manufacturing in Nueces and San Patricio Counties[1]

Plan Element	2010	2020	2030	2040	2050	2060
Recommended Water Management Strategies						
Projected Surplus/(Shortage)[2] (acft/yr)	—	(7,411)	(15,203)	(24,459)	(33,913)	(46,005)
Manufacturing Water Conservation[3]						
Supply From Plan Element (acft/yr)	1,260	1,418	1,576	1,734	1,892	2,050
Annual Cost ($/yr)	—	—	—	—	—	—
Unit Cost ($/acft)	—	—	—	—	—	—
O.N. Stevens Water Treatment Plant Improvements[4]						
Supply From Plan Element (acft/yr)	42,329	40,048	38,102	36,366	34,817	32,996
Annual Cost ($/yr)	$21,334,000	$20,625,000	$19,965,000	$16,692,000	$16,190,000	$15,574,000
Unit Cost ($/acft)	$504	$515	$524	$459	$465	$472
Reclaimed Wastewater Supplies[5]						
Supply From Plan Element (acft/yr)	250	250	250	250	250	250
Annual Cost ($/yr)	$206,500	$206,500	$206,500	$206,500	$206,500	$206,500
Unit Cost ($/acft)	$826	$826	$826	$826	$826	$826
Garwood Pipeline						
Supply From Plan Element (acft/yr)	—	35,000	35,000	35,000	35,000	35,000
Annual Cost ($/yr)	—	$23,958,000	$23,958,000	$23,958,000	$14,054,000	$14,054,000
Unit Cost ($/acft)	—	$685	$685	$685	$402	$402
Off-Channel Reservoir[6]						
Supply From Plan Element (acft/yr)	—	—	30,340	30,340	30,340	30,340
Annual Cost ($/yr)	—	—	$21,696,800	$21,696,800	$21,696,800	$17,536,500
Unit Cost ($/acft)	—	—	$715	$715	$715	$578
Gulf Coast Aquifer Groundwater Supplies						
Supply From Plan Element (acft/yr)			11,000	11,000	11,000	18,000
Annual Cost ($/yr)			$9,383,000	$9,383,000	$9,383,000	$10,188,000
Unit Cost ($/acft)			$853[7]	$853[7]	$853[7]	$566[7]
Lavaca River Diversion and Off-Channel Reservoir[8]						
Supply From Plan Element (acft/yr)	—	—	—	—	—	16,242
Annual Cost ($/yr)	—	—	—	—	—	$16,681,000
Unit Cost ($/acft)	—	—	—	—	—	$1,027
Total Annual Cost ($/yr)	$7,760,500	$31,718,500	$62,798,300	$60,067,300	$50,163,300	$63,489,000
Total Unit Cost ($/acft)	$177	$414	$540	$523	$442	$471
Alternative Water Management Strategies						
CCR/LCC Pipeline[9]						
Supply From Plan Element (acft/yr)	—	—	—	21,905	21,905	21,905
Annual Cost ($/yr)	—	—	—	$12,869,980	$12,869,980	$12,869,980
Unit Cost ($/acft)	—	—	—	$588	$588	$588
Stage II Lake Texana (Palmetto Bend)						
Supply From Plan Element (acft/yr)	—	—	—	—	—	12,964
Annual Cost ($/yr)	—	—	—	—	—	$15,725,000
Unit Cost ($/acft)	—	—	—	—	—	$1,213
Brackish Groundwater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	18,000	18,000	18,000
Annual Cost ($/yr)	—	—	—	$17,584,000	$17,584,000	$17,584,000
Unit Cost ($/acft)	—	—	—	$977	$977	$977

Table 4B.11-7 (Concluded)

Plan Element	2010	2020	2030	2040	2050	2060
Seawater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	28,000	28,000	28,000
Annual Cost ($/yr)	—	—	—	$47,498,000	$47,498,000	$47,498,000
Unit Cost ($/acft)	—	—	—	$1,696	$1,696	$1,696

1 Supplies shown exceed shortages in the event growth in demands exceeds TWDB projections or supplies are reduced under the City's contract with LNRA for Lake Texana water. Supplies and costs shown in this table represent full project yields. For delineation by water user group, see Appendix C.6.

2 Surplus/(Shortage) includes manufacturing for both Nueces and San Patricio Counties. Note: Shortages for Nueces County- Steam and Electric, Nueces County- Mining, and Aransas County- Other are identified in separate tables (i.e. total combined shortage is 62,255 acft/yr in Year 2060).

3 Water supply represents water saved by blending of Lake Texana water with Nueces River water. There may be an opportunity for additional water savings of up to 591 acft/yr with an interconnection to the Mary Rhodes Pipeline for industries with intakes in the Nueces River (See Section 4C.3). Annual cost of interconnection pipeline to MRP is $132,000. Impacts to other water users would need to be considered, prior to implementing project.

4 Supplies include 16,000 acft/yr generated with new sludge handling ponds and additional treated water supplies with improvements of plant capacity from 159 MGD to 200 MGD (average day) constrained by existing raw water supplies. Costs include $326/acft for treatment.

5 Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project (See Section 4C.5). Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

6 Annual costs and unit cost are based on Federal funding participation of 65 percent. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration. $326/acft added for treatment of water supplied. Costs reduced in Year 2060 with debt service paid for pipeline. Debt service is 40 years for reservoir.

7 Assumes full utilization of project. Unit cost based on 18,000 acft project + $326/acft for treatment (See Section 4C.7) although treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

8 Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft and $326/acft for treatment.

9 Annual costs and unit cost are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

10 Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

Table 4B.11-8.
Water Management Strategies Considered for Steam-Electric in Nueces County

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
O.N. Stevens Water Treatment Plant Improvements (Section 4C.19)	32,996 to 42,329	$31,324,000[2]	$459 to $524[2]
Reclaimed Wastewater Supplies (Section 4C.5)	250	N/A	$826[3]
Gulf Coast Aquifer Groundwater Supplies (Section 4C.7)	up to 18,000	$59,245,000[4]	$853[4]
Lavaca River Diversion & Off-Channel Reservoir (Section 4C.13)[5]	16,242	$224,183,000	$1,027
Garwood Pipeline (Section 4C.14)	35,000	$112,798,000[6]	$685[6]
Off-Channel Reservoir[7]	30,340[8]	$105,201,950[8]	$715[8]
CCR/LCC Pipeline[7]	21,905[9]	$48,324,000[9]	$588[9]
Stage II Lake Texana (Palmetto Bend) (Section 4C.13)[5]	12,964	$232,828,000	$1,213
Brackish Groundwater Desalination[10]	18,000	$108,331,000	$977
Seawater Desalination[10]	28,000	$260,914,000	$1,696

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered by wholesale water provider to the water supply entity or entities. Unit cost is for full utilization of project capacity.

2 Total project cost includes improvements to the following WTP components: raw influent, raw water intake pump station, and O.N. Stevens solids handling facilities. Unit cost includes $326/acft for treatment.

3 See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project. Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

4 Source of Cost Estimate: Section 4C.7, Table 4C.7-17. Unit cost includes $326/acft for treatment. Treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

5 Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft for the Lavaca River Diversion and $887/acft for the Stage II of Lake Texana plus $326/acft for treatment. Total cost shown is not prorated between regions; however, it is understood that Region N is responsible for a portion of the total project cost.

6 Source of Cost Estimate: Section 4C.14, Table 4C.14-2. Unit cost = $326/acft for treatment + $359/acft for raw water supply development.

7 Total costs and unit costs are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

8 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 46,677 acft/yr, the total project cost is $300,577,000 and the unit cost is $896/acft including treatment.

9 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 33,700 acft/yr, the total project cost is $138,067,000 and the unit cost is $728/acft including treatment.

10 Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

4B.11.12.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is one potential plan to meet the projected 2020 through 2060 shortages for steam-electric in Nueces County:

- O.N. Stevens Water Treatment Plant Improvements;
- Reclaimed Wastewater Supplies;
- Garwood Pipeline;
- Off-Channel Reservoir;
- Gulf Coast Aquifer Groundwater Supplies; and
- Lavaca River Diversion and Off-Channel Reservoir.

In addition to these recommended projects, four projects are considered to be alternative water management strategies.

- CCR/LCC Pipeline;
- Stage II of Lake Texana;
- Brackish Groundwater Desalination; and
- Seawater Desalination.

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.11.12.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.11-9.

4B.11.13 Mining

4B.11.13.1 Description of Supply

- Source: Groundwater – Gulf Coast Aquifer
  Surface water – CCR/LCC System via City of Corpus Christi and small Nueces River Basin run-of-river water rights for mining users in Nueces County
- Estimated Reliable Supply: 74 to 100 acft/yr (groundwater)
  0 to 1,465 acft/yr (surface water)
- System Description: Various mining operations

Table 4B.11-9. Potential Plan Costs by Decade for Steam-Electric in Nueces County[1]

Plan Element	2010	2020	2030	2040	2050	2060
Recommended Water Management Strategies						
Projected Surplus/(Shortage)[2] (acft/yr)	—	(1,982)	(4,755)	(7,459)	(10,187)	(13,183)
O.N. Stevens Water Treatment Plant Improvements[3]						
Supply From Plan Element (acft/yr)	42,329	40,048	38,102	36,366	34,817	32,996
Annual Cost ($/yr)	$21,334,000	$20,625,000	$19,965,000	$16,692,000	$16,190,000	$15,574,000
Unit Cost ($/acft)	$504	$515	$524	$459	$465	$472
Reclaimed Wastewater Supplies[4]						
Supply From Plan Element (acft/yr)	250	250	250	250	250	250
Annual Cost ($/yr)	$206,500	$206,500	$206,500	$206,500	$206,500	$206,500
Unit Cost ($/acft)	$826	$826	$826	$826	$826	$826
Garwood Pipeline						
Supply From Plan Element (acft/yr)	—	35,000	35,000	35,000	35,000	35,000
Annual Cost ($/yr)	—	$23,958,000	$23,958,000	$23,958,000	$14,054,000	$14,054,000
Unit Cost ($/acft)	—	$685	$685	$685	$402	$402
Off-Channel Reservoir[5]						
Supply From Plan Element (acft/yr)	—	—	30,340	30,340	30,340	30,340
Annual Cost ($/yr)	—	—	$21,696,800	$21,696,800	$21,696,800	$17,536,500
Unit Cost ($/acft)	—	—	$715	$715	$715	$578
Gulf Coast Aquifer Groundwater Supplies						
Supply From Plan Element (acft/yr)			11,000	11,000	11,000	18,000
Annual Cost ($/yr)			$9,383,000	$9,383,000	$9,383,000	$10,188,000
Unit Cost ($/acft)			$853[6]	$853[6]	$853[6]	$566[6]
Lavaca River Diversion and Off-Channel Reservoir[7]						
Supply From Plan Element (acft/yr)	—	—	—	—	—	16,242
Annual Cost ($/yr)	—	—	—	—	—	$16,681,000
Unit Cost ($/acft)	—	—	—	—	—	$1,027
Total Annual Cost ($/yr)	$7,760,500	$31,718,500	$62,798,300	$60,067,300	$50,163,300	$63,489,000
Total Unit Cost ($/acft)	$177	$414	$540	$523	$442	$471
Alternative Water Management Strategies						
CCR/LCC Pipeline[8]						
Supply From Plan Element (acft/yr)	—	—	—	21,905	21,905	21,905
Annual Cost ($/yr)	—	—	—	$12,869,980	$12,869,980	$12,869,980
Unit Cost ($/acft)	—	—	—	$588	$588	$588
Stage II Lake Texana (Palmetto Bend)						
Supply From Plan Element (acft/yr)	—	—	—	—	—	12,964
Annual Cost ($/yr)	—	—	—	—	—	$15,725,000
Unit Cost ($/acft)	—	—	—	—	—	$1,213

Table 4B.11-9 (Concluded)

Plan Element	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Brackish Groundwater Desalination[9]						
Supply From Plan Element (acft/yr)	—	—	—	18,000	18,000	18,000
Annual Cost ($/yr)	—	—	—	$17,584,000	$17,584,000	$17,584,000
Unit Cost ($/acft)	—	—	—	$977	$977	$977
Seawater Desalination[9]						
Supply From Plan Element (acft/yr)	—	—	—	28,000	28,000	28,000
Annual Cost ($/yr)	—	—	—	$47,498,000	$47,498,000	$47,498,000
Unit Cost ($/acft)	—	—	—	$1,696	$1,696	$1,696

[1] Supplies exceed shortages in case water growth patterns and demands exceed TWDB projections or supplies are reduced under the City's contract with LNRA for Lake Texana water. Supplies and costs shown in this table represent full project yields. For delineation by water user group, see Appendix C.6.

[2] Surplus/(Shortage) includes steam-electric for Nueces County only. Note: Shortages for Nueces and San Patricio County- Manufacturing, Nueces County- Mining, and Aransas County- Other are identified in separate tables (i.e. total combined shortage is 62,255 acft/yr in Year 2060).

[3] Supplies include 16,000 acft/yr generated with new sludge handling ponds and additional treated water supplies with improvements of plant capacity from 159 MGD to 200 MGD (average day) constrained by existing raw water supplies. Costs include $326/acft for treatment.

[4] Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project (See Section 4C.5). Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield.

[5] Annual costs and unit cost are based on Federal funding participation of 65 percent. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration. $326/acft added for treatment of water supplied. Costs reduced in Year 2060 with debt service paid for pipeline. Debt service is 40 years for reservoir.

[6] Assumes full utilization of project. Unit cost based on 18,000 acft project + $326/acft for treatment (See Section 4C.7) although treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

[7] Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft and $326/acft for treatment.

[8] Annual costs and unit cost are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

[9] Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

4B.11.13.2 Options Considered

Since water management strategies for this water user will likely be developed by Wholesale Water Providers, the total project costs and supplies are shown in the water supply plan. Appendix C.6 delineates water management strategy supplies and costs by water user group and county.

The Nueces County mining water user group has shortages of 570 acft/yr in 2030 increasing to 1,624 acft/yr in 2060, respectively. Table 4B.11-10 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for mining in Nueces County.

4B.11.13.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is one potential plan to meet the projected 2030 through 2060 shortages for mining in Nueces County:

- Mining Water Conservation;
- O.N. Stevens Water Treatment Plant Improvements;
- Reclaimed Wastewater Supplies;
- Garwood Pipeline;
- Off-Channel Reservoir;
- Gulf Coast Aquifer Groundwater Supplies; and
- Lavaca River Diversion and Off-Channel Reservoir.

Table 4B.11-10.
Water Management Strategies Considered for Mining in Nueces County

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Mining Conservation (Section 4C.4)	up to 259	N/A	N/A
O.N. Stevens Water Treatment Plant Improvements (Section 4C.19)	32,996 to 42,329	$31,324,000[2]	$459 to $524[2]
Reclaimed Wastewater Supplies (Section 4C.5)	250	N/A	$826[3]
Gulf Coast Aquifer Groundwater Supplies (Section 4C.7)	up to 18,000	$59,245,000[4]	$853[4]
Lavaca River Diversion & Off-Channel Reservoir (Section 4C.13)[5]	16,242	$224,183,000	$1,027
Garwood Pipeline (Section 4C.14)	35,000	$112,798,000[6]	$685[6]
Off-Channel Reservoir[7]	30,340[8]	$105,201,950[8]	$715[8]
CCR/LCC Pipeline[7]	21,905[9]	$48,324,000[9]	$588[9]
Stage II Lake Texana (Palmetto Bend) (Section 4C.13)[5]	12,964	$232,828,000	$1,213
Brackish Groundwater Desalination[10]	18,000	$108,331,000	$977
Seawater Desalination[10]	28,000	$260,914,000	$1,696

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered by the wholesale water provider to the water supply entity or entities. Unit cost is for full utilization of project capacity.

2 Total project cost includes improvements to the following WTP components: raw influent, raw water intake pump station, and O.N. Stevens solids handling facilities. Unit cost includes $326/acft for treatment.

3 See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project. Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

4 Source of Cost Estimate: Section 4C.7, Table 4C.7-17. Unit cost includes $326/acft for treatment. Treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

5 Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft for the Lavaca River Diversion and $887/acft for the Stage II of Lake Texana plus $326/acft for treatment. Total cost shown is not prorated between regions; however, it is understood that Region N is responsible for a portion of the total project cost.

[6] Source of Cost Estimate: Section 4C.14, Table 4C.14-2. Unit cost = $326/acft for treatment + $359/acft for raw water supply development.
[7] Total costs and unit costs are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.
[8] Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 46,677 acft/yr, the total project cost is $300,577,000 and the unit cost is $896/acft including treatment.
[9] Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 33,700 acft/yr, the total project cost is $138,067,000 and the unit cost is $728/acft including treatment.
[10] Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

In addition to these recommended projects, four projects are considered to be alternative water management strategies.

- CCR/LCC Pipeline;
- Stage II of Lake Texana;
- Brackish Groundwater Desalination; and
- Seawater Desalination.

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.11.13.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.11-11.

4B.11.14 Irrigation

Irrigation demands in Nueces County are met with surface water supplies from Rio Grande-Nueces Basin run-of-river water supplies and Nueces County WCID #3 water permits from the Nueces River. There are no shortages in irrigation use in Nueces County and no changes in water supply are recommended.

4B.11.15 Livestock

The livestock demands in Nueces County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

Table 4B.11-11. Potential Plan Costs by Decade for Mining in Nueces County[1]

Plan Element	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Recommended Water Management Strategies						
Projected Surplus/(Shortage)[2] (acft/yr)	—	—	(570)	(1,546)	(1,584)	(1,624)
Mining Water Conservation[3]						
Supply From Plan Element (acft/yr)	37	78	120	164	210	259
Annual Cost ($/yr)	—	—	—	—	—	—
Unit Cost ($/acft)	—	—	—	—	—	—
O.N. Stevens Water Treatment Plant Improvements[4]						
Supply From Plan Element (acft/yr)	42,329	40,048	38,102	36,366	34,817	32,996
Annual Cost ($/yr)	$21,334,000	$20,625,000	$19,965,000	$16,692,000	$16,190,000	$15,574,000
Unit Cost ($/acft)	$504	$515	$524	$459	$465	$472
Reclaimed Wastewater Supplies[5]						
Supply From Plan Element (acft/yr)	250	250	250	250	250	250
Annual Cost ($/yr)	$206,500	$206,500	$206,500	$206,500	$206,500	$206,500
Unit Cost ($/acft)	$826	$826	$826	$826	$826	$826
Garwood Pipeline						
Supply From Plan Element (acft/yr)	—	35,000	35,000	35,000	35,000	35,000
Annual Cost ($/yr)	—	$23,958,000	$23,958,000	$23,958,000	$14,054,000	$14,054,000
Unit Cost ($/acft)	—	$685	$685	$685	$402	$402
Off-Channel Reservoir[6]						
Supply From Plan Element (acft/yr)	—	—	30,340	30,340	30,340	30,340
Annual Cost ($/yr)	—	—	$21,696,800	$21,696,800	$21,696,800	$17,536,500
Unit Cost ($/acft)	—	—	$715	$715	$715	$452
Gulf Coast Aquifer Groundwater Supplies						
Supply From Plan Element (acft/yr)			11,000	11,000	11,000	18,000
Annual Cost ($/yr)			$9,383,000	$9,383,000	$9,383,000	$10,188,000
Unit Cost ($/acft)			$853[7]	$853[7]	$853[7]	$566[7]
Lavaca River Diversion and Off-Channel Reservoir[8]						
Supply From Plan Element (acft/yr)	—	—	—	—	—	16,242
Annual Cost ($/yr)	—	—	—	—	—	$16,681,000
Unit Cost ($/acft)	—	—	—	—	—	$1,027
Total Annual Cost ($/yr)	$7,760,500	$31,718,500	$62,798,300	$60,067,300	$50,163,300	$63,489,000
Total Unit Cost ($/acft)	$177	$414	$540	$523	$442	$471
Alternative Water Management Strategies						
CCR/LCC Pipeline[9]						
Supply From Plan Element (acft/yr)	—	—	—	21,905	21,905	21,905
Annual Cost ($/yr)	—	—	—	$12,869,980	$12,869,980	$12,869,980
Unit Cost ($/acft)	—	—	—	$588	$588	$588
Stage II Lake Texana (Palmetto Bend)						
Supply From Plan Element (acft/yr)	—	—	—	—	—	12,964
Annual Cost ($/yr)	—	—	—	—	—	$15,725,000
Unit Cost ($/acft)	—	—	—	—	—	$1,213

Table 4B.11-11 (Concluded)

Plan Element	*2010*	*2020*	*2030*	*2040*	*2050*	*2060*
Brackish Groundwater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	18,000	18,000	18,000
Annual Cost ($/yr)	—	—	—	$17,584,000	$17,584,000	$17,584,000
Unit Cost ($/acft)	—	—	—	$977	$977	$977
Seawater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	28,000	28,000	28,000
Annual Cost ($/yr)	—	—	—	$47,498,000	$47,498,000	$47,498,000
Unit Cost ($/acft)	—	—	—	$1,696	$1,696	$1,696

[1] Supplies exceed shortages in case water growth patterns and demands exceed TWDB projections or supplies are reduced under the City's contract with LNRA for Lake Texana water. Supplies and costs shown in this table represent full project yields. For delineation by water user group, see Appendix C.6.

[2] Surplus/(Shortage) includes mining for Nueces County only. Note: Shortages for Nueces and San Patricio County- Manufacturing, Nueces County- Steam and Electric, and Aransas County- Other are identified in separate tables (i.e. total combined shortage is 62,255 acft/yr in Year 2060).

[3] Water supply represents water saved by implementing best management practices to reduce demand by 15% (Section 4C.4). Cost are unavailable for Mining Water Conservation Best Management Practices (Section 4C.4). Conservation savings and costs are by nature facility specific. Since mining entities are presented on a county basis and are not individually identified, identification of costs for specific water management strategies are not appropriate.

[4] Supplies include 16,000 acft/yr generated with new sludge handling ponds and additional treated water supplies with improvements of plant capacity from 159 MGD to 200 MGD (average day) constrained by existing raw water supplies. Costs include $326/acft for treatment.

[5] Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project (See Section 4C.5). Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield.

[6] Annual costs and unit cost are based on Federal funding participation of 65 percent. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration. $326/acft added for treatment of water supplied. Costs reduced in Year 2060 with debt service paid for pipeline. Debt service is 40 years for reservoir.

[7] Assumes full utilization of project. Unit cost based on 18,000 acft project + $326/acft for treatment (See Section 4C.7) although treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

[8] Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft and $326/acft for treatment.

[9] Annual costs and unit cost are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

[10] Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

4B.12 San Patricio County Water Supply Plan

Table 4B.12-1 lists each water user group in San Patricio County and their corresponding surplus or shortage in years 2030 and 2060. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 4B.12-1.
San Patricio County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
City of Aransas Pass	0	0	Supply equals demand
City of Gregory	0	0	Supply equals demand
City of Ingleside	0	0	Supply equals demand
City of Ingleside on the Bay	0	0	Supply equals demand
Lake City	(11)	(37)	Projected shortages from 2020 to 2060 — see plan below
City of Mathis	0	0	Supply equals demand
City of Odem	0	0	Supply equals demand
City of Portland	0	0	Supply equals demand
City of Sinton	0	0	Supply equals demand
City of Taft	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	0	(6,455)	Projected shortages from 2040 to 2060 — see plan below
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	(750)	(4,414)	Projected shortages from 2030 to 2060 – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4A-22 and 4A-23, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

4B.12.1 City of Aransas Pass

The City of Aransas Pass is in Aransas, Nueces and San Patricio Counties, consequently, its water demand and supply values are split into the tables for each county. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water from the CCR/LCC/Texana System. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass and no changes in water supply are recommended.

4B.12.2 City of Gregory

The City of Gregory has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Gregory and no changes in water supply are recommended.

4B.12.3 City of Ingleside

The City of Ingleside has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Ingleside and no changes in water supply are recommended.

4B.12.4 City of Ingleside on the Bay

The City of Ingleside on the Bay has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Ingleside on the Bay and no changes in water supply are recommended.

4B.12.5 Lake City

4B.12.5.1 Description

- Source: Groundwater – Gulf Coast Aquifer;
- Estimated Reliable Supply: 88 acft/yr; and
- System Description: Limited by well capacity.

4B.12.5.2 Options Considered

Lake City users have projected shortages of 11 acft/yr in 2030 increasing to 37 acft/yr in 2060. Table 4B.12-2 lists the water management strategies, references to the report sections discussing the strategy, total project cost, and unit costs that were considered for meeting the Lake City's shortages.

Table 4B.12-2.
Water Management Strategies Considered for Lake City

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Gulf Coast Aquifer Supplies — Drill Additional Well (Section 4C.7)	80	$343,000	$444[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7, Table 4C.7-8, 0.07 MGD water treatment plant fully utilized. Cost estimates are based on size and depth of well(s) to meet needs.

4B.12.5.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages for the Lake City:

- Gulf Coast Aquifer Supplies- Drill one additional well.

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.12.5.4 Costs

Groundwater supplies for Lake City users are currently limited by well capacity. One new well would be required to meet the projected shortages for Lake City. The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.12-3.

Table 4B.12-3.
Recommended Plan Costs by Decade for Lake City

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	—	(1)	(11)	(19)	(28)	(37)
Gulf Coast Aquifer Supplies-Drill additional well						
Supply From Plan Element (acft/yr)[1]	—	80	80	80	80	80
Total Annual Cost ($/yr)[2]	—	$36,000	$36,000	$36,000	$6,000	$6,000
Total Unit Cost ($/acft)[2]	—	$444	$444	$444	$75	$75

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-8, 0.07 MGD water treatment plant fully utilized. Cost estimates are based on size and depth of well(s) to meet needs. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2040 assumes debt service has been paid.

4B.12.6 City of Mathis

The City of Mathis has a contract with the City of Corpus Christi to purchase raw water from the CCR/LCC System. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Mathis and no changes in water supply are recommended.

4B.12.7 City of Odem

The City of Odem has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Odem and no changes in water supply are recommended.

4B.12.8 City of Portland

The City of Portland has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Portland and no changes in water supply are recommended.

4B.12.9 City of Sinton

The City of Sinton meets its demands with groundwater pumped from the Gulf Coast Aquifer. The City has three wells with a total capacity of 3.67 MGD, or 2,055 acft/yr. The City of Sinton is expected to only pump water needed to meet projected demands. No shortages are projected for the City of Sinton and no changes in water supply are recommended

4B.12.10 City of Taft

The City of Taft has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Taft and no changes in water supply are recommended.

4B.12.11 County-Other

County-Other demands are met with surface water from the CCR/LCC/Texana System provided by the SPMWD and groundwater from the Gulf Coast Aquifer. No shortages are projected for County-Other entities and no changes in water supply are recommended.

4B.12.12 Manufacturing

4B.12.12.1 Description

The City of Corpus Christi provides the surface water for manufacturing in Nueces County from the CCR/LCC/Texana System. Additional manufacturing supplies are from the Gulf Coast Aquifer. The City also provides surface water for manufacturing in San Patricio County. *In the analysis that follows, the manufacturing needs of Nueces and San Patricio Counties are considered jointly*. Since water management strategies for this water user will likely be developed by Wholesale Water Providers, the total project costs and supplies are shown in the water supply plan. Appendix C.6 delineates water management strategy supplies and costs by water user group and county. A shortage in manufacturing supply occurs in 2020.

4B.12.12.2 Options Considered

Over 90 percent of the water supplied to Manufacturing users in Nueces and San Patricio Counties is from the CCR/LCC/Lake Texana System via Wholesale Water Providers (City of Corpus Christi and SPMWD). Beginning in 2020, shortages begin to appear and grow to a combined 46,005 acft/yr in 2060 (39,550 acft/yr in Nueces County and 6,455 acft/yr in San Patricio County). Table 4B.12-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for manufacturing in Nueces and San Patricio Counties.

4B.12.12.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is one potential plan to meet the projected 2020 through 2060 shortages for manufacturing in Nueces and San Patricio Counties:

- Manufacturing Water Conservation;
- O.N. Stevens Water Treatment Plant Improvements;
- Reclaimed Wastewater Supplies;
- Garwood Pipeline;
- Off-Channel Reservoir;
- Gulf Coast Aquifer Groundwater Supplies; and
- Lavaca River Diversion and Off-Channel Reservoir.

Table 4B.12-4.
Water Management Strategies Considered for Manufacturing in Nueces and San Patricio Counties

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Manufacturing Conservation (Section 4C.3)	up to 2,050	N/A	N/A
O.N. Stevens Water Treatment Plant Improvements (Section 4C.19)	32,996 to 42,329	$31,324,000[2]	$459 to $524[2]
Reclaimed Wastewater Supplies (Section 4C.5)	250	N/A	$826[3]
Gulf Coast Aquifer Groundwater Supplies (Section 4C.7)	up to 18,000	$59,245,000[4]	$853[4]
Lavaca River Diversion & Off-Channel Reservoir (Section 4C.13)[5]	16,242	$224,183,000	$1,027
Garwood Pipeline (Section 4C.14)	35,000	$112,798,000[6]	$685[6]
Off-Channel Reservoir[7]	30,340[8]	$105,201,950[8]	$715[8]
CCR/LCC Pipeline[7]	21,905[9]	$48,324,000[9]	$588[9]
Stage II Lake Texana (Palmetto Bend) (Section 4C.13)[5]	12,964	$232,828,000	$1,213
Brackish Groundwater Desalination[10]	18,000	$108,331,000	$977
Seawater Desalination[10]	28,000	$260,914,000	$1,696

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered by the wholesale water provider to the water supply entity or entities. Unit cost is for full utilization of project capacity.

2 Total project cost includes improvements to the following WTP components: raw influent, raw water intake pump station, and O.N. Stevens solids handling facilities. Unit costs include $326/acft for treatment.

3 See Section 4C.5. Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project. Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

4 Source of Cost Estimate: Section 4C.7, Table 4C.7-17. Unit cost includes $326/acft for treatment. Treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

5 Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft for the Lavaca River Diversion and $887/acft for the Stage II of Lake Texana plus $326/acft for treatment. Total cost shown is not prorated between regions; however, it is understood that Region N is responsible for a portion of the total project cost.

6 Source of Cost Estimate: Section 4C.14, Table 4C.14-2. Unit cost = $326/acft for treatment + $359/acft for raw water supply development.

7 Total costs and unit costs are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

8 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 46,677 acft/yr, the total project cost is $300,577,000 and the unit cost is $896/acft including treatment.

9 Yield and costs shown assume Federal and/or State participation of 65%. Without this funding, the full yield of the project is 33,700 acft/yr, the total project cost is $138,067,000 and the unit cost is $728/acft including treatment.

10 Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

In addition to these recommended projects, four projects are considered to be alternative water management strategies.

- CCR/LCC Pipeline;
- Stage II of Lake Texana;
- Brackish Groundwater Desalination; and
- Seawater Desalination.

In addition to the management strategies listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.12.12.4 Costs

The recommended Water Supply Plan including anticipated costs is summarized by decade in Table 4B.12-5.

4B.12.13 Steam-Electric

No steam-electric demand exists or is projected for the county.

4B.12.14 Mining

The mining demands in San Patricio County are met by groundwater from Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

4B.12.15 Irrigation

4B.12.15.1 Description

- Source: Groundwater – Gulf Coast Aquifer; Surface water – Surface water rights;
- Estimated Reliable Supply: Maximum of 9,698 acft/yr (groundwater); 83 acft/yr (surface water); and
- System Description: Various irrigation operations.

Table 4B.12-5.
Potential Plan Costs by Decade for Manufacturing in Nueces and San Patricio Counties[1]

Plan Element	2010	2020	2030	2040	2050	2060
Recommended Water Management Strategies						
Projected Surplus/(Shortage)[2] (acft/yr)	—	(7,411)	(15,203)	(24,459)	(33,913)	(46,005)
Manufacturing Water Conservation[3]						
Supply From Plan Element (acft/yr)	1,260	1,418	1,576	1,734	1,892	2,050
Annual Cost ($/yr)	—	—	—	—	—	—
Unit Cost ($/acft)	—	—	—	—	—	—
O.N. Stevens Water Treatment Plant Improvements[4]						
Supply From Plan Element (acft/yr)	42,329	40,048	38,102	36,366	34,817	32,996
Annual Cost ($/yr)	$21,334,000	$20,625,000	$19,965,000	$16,692,000	$16,190,000	$15,574,000
Unit Cost ($/acft)	$504	$515	$524	$459	$465	$472
Reclaimed Wastewater Supplies[5]						
Supply From Plan Element (acft/yr)	250	250	250	250	250	250
Annual Cost ($/yr)	$206,500	$206,500	$206,500	$206,500	$206,500	$206,500
Unit Cost ($/acft)	$826	$826	$826	$826	$826	$826
Garwood Pipeline						
Supply From Plan Element (acft/yr)	—	35,000	35,000	35,000	35,000	35,000
Annual Cost ($/yr)	—	$23,958,000	$23,958,000	$23,958,000	$14,054,000	$14,054,000
Unit Cost ($/acft)	—	$685	$685	$685	$402	$402
Off-Channel Reservoir[6]						
Supply From Plan Element (acft/yr)	—	—	30,340	30,340	30,340	30,340
Annual Cost ($/yr)	—	—	$21,696,800	$21,696,800	$21,696,800	$17,536,500
Unit Cost ($/acft)	—	—	$715	$715	$715	$578
Gulf Coast Aquifer Groundwater Supplies						
Supply From Plan Element (acft/yr)			11,000	11,000	11,000	18,000
Annual Cost ($/yr)			$9,383,000	$9,383,000	$9,383,000	$10,188,000
Unit Cost ($/acft)			$853[7]	$853[7]	$853[7]	$566[7]
Lavaca River Diversion and Off-Channel Reservoir[8]						
Supply From Plan Element (acft/yr)	—	—	—	—	—	16,242
Annual Cost ($/yr)	—	—	—	—	—	$16,681,000
Unit Cost ($/acft)	—	—	—	—	—	$1,027
Total Annual Cost ($/yr)	$7,760,500	$31,718,500	$62,798,300	$60,067,300	$50,163,300	$63,489,000
Total Unit Cost ($/acft)	$177	$414	$540	$523	$442	$471
Alternative Water Management Strategies						
CCR/LCC Pipeline[9]						
Supply From Plan Element (acft/yr)	—	—	—	21,905	21,905	21,905
Annual Cost ($/yr)	—	—	—	$12,869,980	$12,869,980	$12,869,980
Unit Cost ($/acft)	—	—	—	$588	$588	$588
Stage II Lake Texana (Palmetto Bend)						
Supply From Plan Element (acft/yr)	—	—	—	—	—	12,964
Annual Cost ($/yr)	—	—	—	—	—	$15,725,000
Unit Cost ($/acft)	—	—	—	—	—	$1,213
Brackish Groundwater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	18,000	18,000	18,000
Annual Cost ($/yr)	—	—	—	$17,584,000	$17,584,000	$17,584,000
Unit Cost ($/acft)	—	—	—	$977	$977	$977

Table 4B.12-5 (Concluded)

Plan Element	2010	2020	2030	2040	2050	2060
Seawater Desalination[10]						
Supply From Plan Element (acft/yr)	—	—	—	28,000	28,000	28,000
Annual Cost ($/yr)	—	—	—	$47,498,000	$47,498,000	$47,498,000
Unit Cost ($/acft)	—	—	—	$1,696	$1,696	$1,696

[1] Supplies shown exceed shortages in the event growth in demands exceeds TWDB projections or supplies are reduced under the City's contract with LNRA for Lake Texana water. Supplies and costs shown in this table represent full project yields. For delineation by water user group, see Appendix C.6.

[2] Surplus/(Shortage) includes manufacturing for both Nueces and San Patricio Counties. Note: Shortages for Nueces County-Steam and Electric, Nueces County- Mining, and Aransas County- Other are identified in separate tables (i.e. total combined shortage is 62,255 acft/yr in Year 2060).

[3] Water supply represents water saved by blending of Lake Texana water with Nueces River water. There may be an opportunity for additional water savings of up to 591 acft/yr with an interconnection to the Mary Rhodes Pipeline for industries with intakes in the Nueces River (See Section 4C.3). Annual cost of interconnection pipeline to MRP is $132,000. Impacts to other water users would need to be considered, prior to implementing MRP interconnection project.

[4] Supplies include 16,000 acft/yr generated with new sludge handling ponds and additional treated water supplies with improvements of plant capacity from 159 MGD to 200 MGD (average day) constrained by existing raw water supplies. Costs include $326/acft for treatment.

[5] Costs to maintain ongoing Nueces Delta studies are $500,000 per year (assumed cost associated with Allison Demonstration Project is 25 percent). Water supply for Allison Project based on ratio of yield recovered by a 2-MGD project as compared to an 8.8-MGD project (See Section 4C.5). Costs to supply Allison discharge to delta includes $326/acft for treatment of additional yield. Annual cost not subject to 20 year debt service.

[6] Annual costs and unit cost are based on Federal funding participation of 65 percent. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration. $326/acft added for treatment of water supplied. Costs reduced in Year 2060 with debt service paid for pipeline. Debt service is 40 years for reservoir.

[7] Assumes full utilization of project. Unit cost based on 18,000 acft project + $326/acft for treatment (See Section 4C.7) although treatment may not be required if separate pipeline is constructed so that groundwater would not be blended with water in Mary Rhodes pipeline.

[8] Supplies are estimated based on assuming Region P/L industrial needs of 10,000 acft/yr. Unit costs are estimated based on a raw water cost of $701/acft and $326/acft for treatment.

[9] Annual costs and unit cost are based on Federal or State funding participation of 65 percent for debt service costs. Water supplied is 65 percent of project potential, with 35 percent dedicated for ecosystem restoration or State/Federal purpose. $326/acft added for treatment of water supplied for CCR/LCC Pipeline option.

[10] Projects may have opportunities for federal or state participation. However, based on assumptions of 65% of federal or state funding participation for debt service costs and water supplies of 65% of project potential (with 35% dedicated for ecosystem restoration or state/federal purposes), federal or state participation would not be anticipated to reduce annual unit costs of water and therefore is not included in the cost estimate.

4B.12.15.2 Options Considered

The San Patricio County irrigation water user group has projected shortages of 750 acft/yr in 2030 and 4,414 acft/yr in 2060. Their shortages are attributed to limited well capacity of 9,698 acft/yr estimated using the procedure in Section 4A.2.2. Table 4B.12-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for San Patricio County-Irrigation. Irrigation water conservation was considered; however, it was not recommended due to the fact that according to data developed by the TWDB and local GCD data the irrigation water application efficiency in San Patricio County already exceeds 80%, equal to the maximum efficiency achieved with this strategy.

Table 4B.12-6.
Water Management Strategies Considered for San Patricio County-Irrigation

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s) (Section 4C.7)	9,275	$8,110,000[2]	$100[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft/yr) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 4C.7, Table 4C.7-11. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment.

4B.12.15.3 Water Supply Plan

Working within the planning criteria established by the Coastal Bend RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 through 2060 shortages for San Patricio County-Irrigation:

- Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)

In addition to the management strategy listed above, the RWPG supports strategies for increased conservation and reuse of existing supplies.

4B.12.15.4 Costs

The recommended Water Supply Plan, including anticipated costs, is summarized by decade in Table 4B.12-7.

Table 4B.12-7.
Recommended Plan Costs by Decade for San Patricio County-Irrigation

Plan Element	2010	2020	2030	2040	2050	2060
Projected Surplus/(Shortage) (acft/yr)	—	—	(750)	(1,852)	(3,069)	(4,414)
Gulf Coast Aquifer Groundwater Supplies — Drill Additional Well(s)						
Supply From Plan Element (acft/yr)[1]	—	—	9,000	9,000	9,000	9,000
Total Annual Cost ($/yr)[2]	—	—	$925,000	$925,000	$925,000	$218,000
Total Unit Cost ($/acft)[2]	—	—	$100	$100	$100	$24

[1] Supply from additional wells set equal to approximately twice the projected shortage to account for peaking.
[2] Source of Cost Estimate: Section 4C.7. Table 4C.7-11. Cost estimates are based on size and depth of well(s) to meet needs and do not include any additional treatment. Assumes debt service based on RWP guidelines. Reduction in cost after Year 2050 assumes debt service has been paid.

4B.12.16 Livestock

The livestock water demands in San Patricio County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

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4B.13 Wholesale Water Provider Water Supply Plans

Table 4B.13-1 lists each Wholesale Water Provider and their corresponding surplus or shortage in years 2030 and 2060. For each Wholesale Water Provider with a projected shortage, a water supply plan has been developed.

Table 4B.13-1. Wholesale Water Provider Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2060 (acft/yr)	
City of Corpus Christi	(20,528)	(54,357)	Projected shortage — see plan below
San Patricio MWD	1,122	(7,898)	Projected shortage — see plan below
South Texas Water Authority	0	0	Supply equals demand
Nueces County WCID #3	3,556	4,012	Projected surplus

[1] Surplus/(Shortage) for each Wholesale Water Provider calculated by taking total surface water availability (constrained by water treatment plant capacity) less municipal retail and wholesale demands, steam-electric demands, manufacturing demands, and/or mining demands. (Table 4A-24).

4B.13.1 City of Corpus Christi

As the primary provider of surface water to the Coastal Bend Region, the City of Corpus Christi is the major Wholesale Water Provider in the region. Corpus Christi has 200,000 acft in available safe yield supply in 2060 through its own water right in the CCR/LCC System and a contract with LNRA from Lake Texana. This availability constitutes 93 percent of the total surface water availability in the region. Additionally, the City has a permit to divert up to 35,000 acft/yr run-of-river water under its interbasin transfer permit on the Colorado River (via the Garwood Irrigation Co.). While the City owns the water right on the Colorado River, it does not have the facilities to divert and convey this water to the City; therefore, the 35,000 acft is not included in the existing surface water availability in the region.

The City provides treated and raw water from the CCR/LCC/Texana System to the water user groups and other entities shown in Table 4B.13-2.

Table 4B.13-2.
Purchasers of Water from the City of Corpus Christi

Water User Group / Entity	***County***
San Patricio MWD	San Patricio
South Texas Water Authority	Kleberg, Nueces
City of Alice	Jim Wells
City of Beeville	Bee
City of Mathis	San Patricio
City of Three Rivers	Live Oak
Nueces County WCID #4 (Port Aransas)	Nueces
Nueces County-Other	Nueces
Steam-Electric	Nueces
Manufacturing	Nueces
Mining	Nueces

A comparison of Corpus Christi's demand and supply is presented in Section 4A.5 and is an analysis of the City's retail municipal demands and supplies available to meet those demands. The shortage listed in Table 4B.13-1 reflects the entire City's demands—both municipal retail and wholesale, as well as steam-electric, manufacturing and mining demands, as well as taking water treatment plant constraints into consideration. The shortage begins in 2030 and is due to large manufacturing and mining demands in Nueces and San Patricio Counties. For a list of the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in Nueces and San Patricio Counties in Section 4B.11.11.

The City has surpluses of 7,914 acft/yr in 2010 and a projected shortage of 9,393 acft/yr in 2020 (Table 4A-24). Part of the City of Corpus Christi's surplus has been reallocated to Nueces County-Other use (see Table 4B.11-3).

Table 4B.13-3.
Reallocation of Surplus Supplies by Decade for City of Corpus Christi (as Wholesale Water Provider)[1]

Plan Element	2010	2020	2030	2040	2050	2060
Original Projected Surplus (acft/yr)	7,914	—	—	—	—	—
Reallocated Surplus (acft/yr)	261[1]	—	—	—	—	—
Remaining Projected Surplus (acft/yr)	7,653	—	—	—	—	—

[1] Reallocated to Nueces County-Other users (Section 4B.11)

4B.13.2 San Patricio Municipal Water District

The San Patricio Municipal Water District (SPMWD) is the second largest Wholesale Water Provider in the region. SPMWD has a contract with the City of Corpus Christi to purchase water from both the CCR/LCC System and Lake Texana. SPMWD treats this water and provides it to the water user groups and other entities shown in Table 4B.13-4.

Table 4B.13-4.
Purchasers of Water from San Patricio MWD

Water User Group / Entity	County
City of Aransas Pass	Aransas, Nueces, San Patricio
City of Gregory	San Patricio
City of Ingleside	San Patricio
City of Ingleside by the Bay	San Patricio
City of Odem	San Patricio
City of Portland	San Patricio
City of Rockport	Aransas
City of Taft	San Patricio
Port Aransas	Nueces
County-Other	Aransas, San Patricio
City of Fulton	Aransas
Manufacturing	San Patricio

The shortage listed in Table 4B.13-1 reflects all of SPMWD's demands—both municipal retail and wholesale, as well as manufacturing demands. The shortage also takes into account water treatment plant constraints. The shortage begins in 2050 and is due to large manufacturing demands in San Patricio County and Aransas County-Other demands. For the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in Nueces and San Patricio Counties in Section 4B.11.1 and 4B.12.12.

4B.13.3 South Texas Water Authority

The South Texas Water Authority (STWA) is the third largest Wholesale Water Provider in the region. STWA has a contract with the City of Corpus Christi to purchase treated water from both the CCR/LCC System and Lake Texana. STWA provides this water to the water user groups and other entities shown in Table 4B.13-5.

Table 4B.13-5.
Purchasers of Water from South Texas Water Authority

Water User Group / Entity	*County*
City of Agua Dulce	Nueces
City of Driscoll	Nueces
City of Bishop	Nueces
Nueces County-Other[1]	Nueces
City of Kingsville	Kleberg
Ricardo WSC	Kleberg

[1] Includes Teen Challenge, LCS Detention Center, Nueces County WCID #5, Nueces WSC, Coastal Acres LLC and other rural water users.

There are no shortages listed in Table 4B.13-1 for South Texas Water Authority.

4B.13.4 Nueces County WCID #3

The Nueces County WCID #3 is the smallest Wholesale Water Provider in the region. Nueces County WCID #3 receives a firm yield of 7,103 acft/yr from its Nueces Basin run-of-river rights. Nueces County WCID #3 provides this water to the water user groups and other entities shown in Table 4B.13-6.

Table 4B.13-6.
Purchasers of Water from Nueces County WCID #3

Water User Group / Entity	County
City of Robstown	Nueces
River Acres WSC	Nueces
Nueces County-Other	Nueces

After meeting customer demands, Nueces County WCID #3 shows surpluses of 3,098 acft in 2010 increasing to 4,012 acft by 2060. Part of the Nueces County WCID #3 surplus has been reallocated to River Acres WSC (Table 4B.13-7).

Table 4B.13-7.
Reallocation of Surplus Supplies by Decade for Nueces County WCID #3
(as Wholesale Water Provider)[1]

Plan Element	2010	2020	2030	2040	2050	2060
Original Projected Surplus (acft/yr)	3,098	3,340	3,556	3,747	3,903	4,012
Reallocated Surplus (acft/yr)	138[1]	255[1]	355[1]	445[1]	522[1]	590[1]
Remaining Projected Surplus (acft/yr)	2,960	3,085	3,201	3,302	3,381	3,422

[1] Reallocated to River Acres WSC (Section 4B.11.8)

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Section 5
Impacts of Water Management Strategies on Key Parameters of Water Quality [31 TAC § 357.7(a)12] and Impacts of Moving Water from Rural and Agricultural Areas [31 TAC § 357.7(a)8(G)]

The guidelines for the 2011 Regional Water Plans include describing major impacts of recommended and alternative water management strategies on key parameters of water quality identified by the regional water planning group. This also includes consideration of third party social and economic impacts associated with voluntary redistribution of water from rural and agricultural areas, and affects of ground and surface water interrelationships on water resources of the state. Furthermore, 2011 Regional Water Plans should consider statutory provisions regarding interbasin transfers of surface water including summation of water needs in basins of origin and receiving basins.

5.1 Impacts of Water Management Strategies on Key Parameters of Water Quality

As part of the 2006 regional water planning process, the Coastal Bend Region identified key parameters of water quality to consider for water management strategies. The selection of key water quality parameters are based on water quality concerns identified in the Nueces River Authority's Basin Highlights Report, water user concerns expressed during Regional Water Planning Group meetings, and water quality studies conducted for water management strategies included in previous and current Plans and other regional studies. The Coastal Bend Region identified water quality parameters for six water management strategies, as shown in Figures 5-1 and 5-2.

The major impacts of recommended water management strategies on these key parameters of water quality are described in greater detail in the respective water management strategy summary (Section 4C). These identified water quality concerns present challenges that may need to be overcome before the water management strategy can be used as a water supply. For water quality parameters that cannot be fully addressed due to lack of available information or inconclusive water quality studies, the water management summary write-ups include recommendations for further studies prior to implementation as a water management strategy.

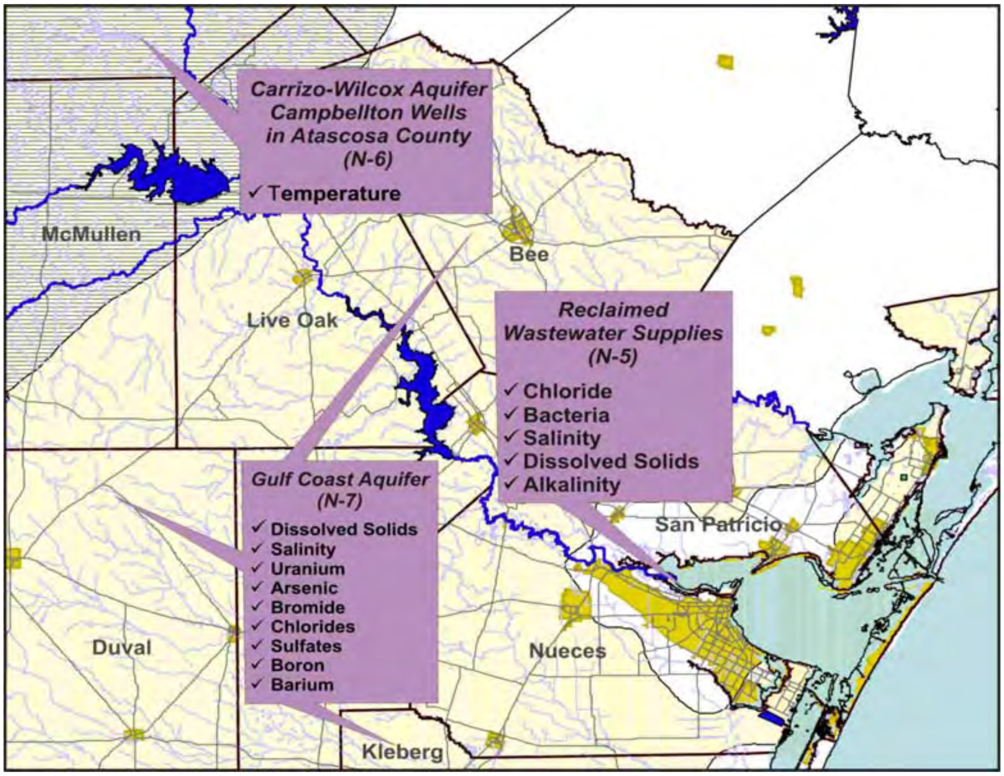

Figure 5-1. Water Quality Parameters to Consider for Water Management Strategies

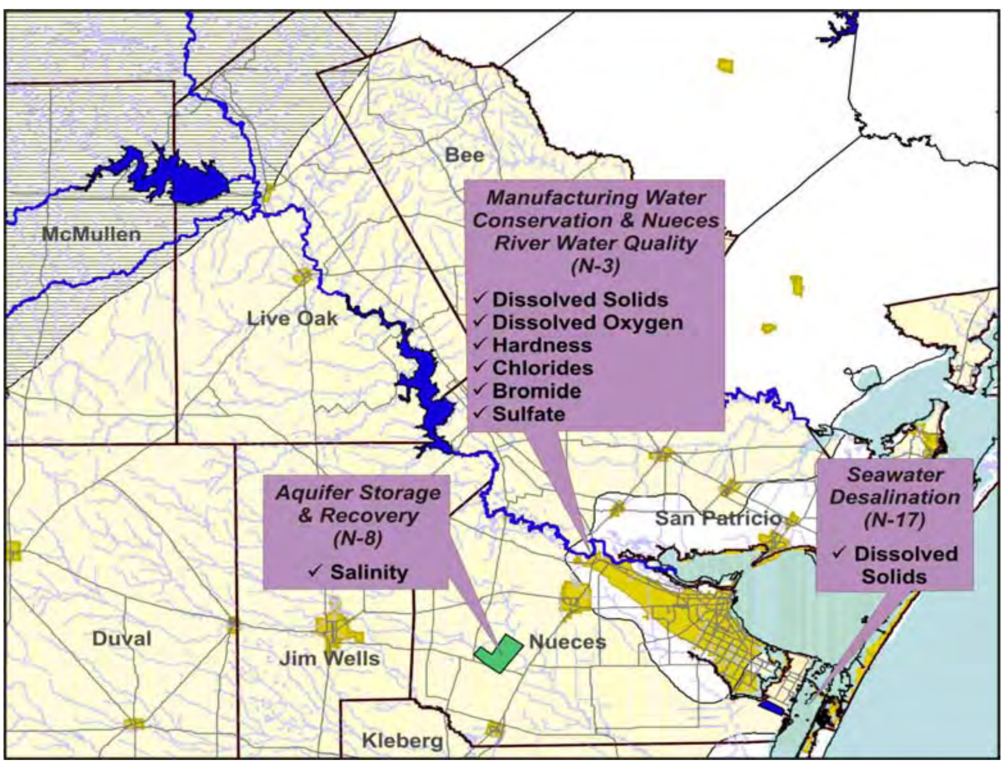

Figure 5-2. Water Quality Parameters to Consider for Water Management Strategies

5.2 Voluntary Redistribution of Water and Impacts of Moving Water from Rural and Agricultural Areas

Several opportunities for voluntary redistribution exist for the Coastal Bend Region, including: (1) reallocating surface water through utilization of unused supply and sales of existing water rights , (2) trading and transferring surface water rights with the South Central Texas Region (Region L), and (3) regional water supply opportunities associated with federal or state participation in projects as discussed in Section 4C.12.

Reallocation of unutilized surface water supply was recommended to meet both near-term and long-term shortages for Live Oak-Manufacturing and River Acres WSC. The 2011 Plan recommends the City of Three Rivers provide a portion of their un-utilized surface water to meet water needs for Live Oak-Manufacturing. The City of Three Rivers currently provides water to manufacturing users in Live Oak County and would likely require a contract modification to increase water supplies. Similarly, Nueces County WCID #3 currently provides water to River Acres WSC. Nueces County WCID #3 has unutilized surface water supply that could be provided to River Acres WSC to meet their needs and would likely require a contract modification. The impacts of voluntary redistribution of un-utilized surface water supply are expected to have minimal or no impacts on third party users or rural and agricultural areas.

Previous South Central Texas Regional Water Planning efforts considered a pipeline from Choke Canyon Reservoir to provide water to the South Central Texas Region in exchange for a desalination facility near the City of Corpus Christi. This water management strategy was not considered by the South Central Texas Region during this planning cycle.

Federal interests have studied several proposed South Central and Coastal Bend Region projects identified in this regional water plan to evaluate opportunities for flood mitigation, ecosystem restoration, water quality enhancements, and water supply benefits. The projects include desalination facilities, CCR/LCC Pipeline, Nueces Off-Channel Reservoir, recharge enhancement on the Upper Nueces, and brush management opportunities. State interests have participated in pilot programs and feasibility studies of seawater and brackish groundwater desalination projects in the South Texas region. The third party social and economic imp0acts resulting from voluntary redistribution will be considered in future studies.

The water management strategies recommended to meet water needs (Section 4B) do not include transferring water needed by rural and agricultural users and, therefore, are not considered to impact them. As discussed above, voluntary redistributions of unutilized surface water supplies for some rural and agricultural users are recommended and included in Section 4B – Water Supply Plans.

5.3 Groundwater and Surface Water Interrelationships Impacting Water Resources of the State

The Nueces River from Three Rivers to the Calallen Pool (including Lake Corpus Christi), hereafter referred to as the Lower Nueces Basin, is hydraulically connected to underlying Goliad Sands and alluvial sands of the Gulf Coast Aquifer. During the Phase I development of the 2011 Plan, studies were conducted to evaluate stream flow interaction with alluvial sands of the Gulf Coast Aquifer downstream of CCR to LCC using data collected during a field channel loss study as summarized in Appendix B. Groundwater and surface water interaction in the Lower Nueces Basin is very complex and could vary significantly based on seasonal events, antecedent drought or wet conditions and prolonged drought or wet conditions that could impact storage and released water from LCC. Additional studies were performed during the 2011 Regional Water Planning effort (presented in Section 4C.3) to evaluate groundwater and surface water interrelationships considered to potentially impact Lower Nueces Basin water quality that may affect water supplies diverted from the Calallen Pool. Studies are on-going by the City of Corpus Christi and others to help characterize and identify sources of water quality fluctuations in the Lower Nueces Basin. Key water quality parameters of consideration are shown in Figure 5-2.

5.4 Interbasin Transfers

A number of interbasin transfer permits exist in the Coastal Bend Regional Planning Area as discussed in Section 3.1.5. These permits include authorizations for diversions from river basins north of the planning region into the Nueces River Basin. Both major interbasin transfer permits provide water to the City of Corpus Christi and include supplies from the Lavaca-Navidad and Colorado River Basins. The City of Corpus Christi benefits from an interbasin transfer permit[1] and a contract with the Lavaca Navidad River Authority (LNRA) to divert 41,840 acft/yr on a firm basis and up to 12,000 acft/yr on an interruptible basis from Lake Texana in the Lavaca-Navidad River Basin to the City's O.N. Stevens Water Treatment Plant. In

[1] TCEQ, Certificate of Adjudication No. 16-2095C, held by Lavaca-Navidad River Authority and Texas Water Development Board (TWDB), October 21, 1996.

addition, a second permit[2] allows the diversion of up to 35,000 acft/yr of run-of-river water on the Colorado River. Analyses of this water right, one of the most senior in the Colorado River Basin, indicate that nearly the full 35,000 acft/yr is available from this run-of-river right without off-channel storage.[3]

This Plan includes recommended and alternative water management strategies for water supplies in the Coastal Bend Region that are being considered by the LNRA for development in the Lavaca- Navidad Basin including a Lavaca River Diversion and Off-Channel Reservoir (Lavaca River OCR) and Palmetto Bend Stage II. Water supply from Palmetto Bend Stage II requires an interbasin transfer from the Lavaca Region (Region P) to the Coastal Bend Region prior to project implementation. In accordance with Texas Water Code provisions, the projected shortage in the Lavaca Region is 67,740 acft/yr and is assigned to Jackson and Wharton County-Irrigation users.[4] The shortages are projected by Region P to be met by groundwater supplies. However, the LNRA has been approached by local industries requesting additional supplies of 10,000 acft/yr. Accordingly, the water supply from Palmetto Bend Stage II and Lavaca River OCR that is potentially available for Coastal Bend Region purposes is 12,964 acft/yr and 16,242 acft, respectively, which is reflected in the Section 4B water supply plans. Additional details regarding this potential interbasin transfer is included in Section 4C.13.

[2] TCEQ, Certificate of Adjudication No. 14-5434B, held by the City of Corpus Christi (via the Garwood Irrigation Company), October 13, 1998.
[3] HDR Engineering, Inc. (HDR), "Dependability and Impact Analyses of Corpus Christi's Purchase of the Garwood Irrigation Company Water Right," Draft Report for the City of Corpus Christi, September 1998.
[4] Lavaca Regional Planning Group Draft Initially Prepared Plan, draft estimates provided January 2010.

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Section 6
Water Conservation and
Drought Management Recommendations
[31 TAC §357.7(a)(11)]

The 2011 Coastal Bend Regional Water Plan (2011 Plan) includes water conservation and drought management recommendations pursuant to 31 Texas Administrative Code 357.7(a)11 and Texas Water Code 11.085. The guidelines require water user groups that obtain water from inter-basin transfers consider conservation as a water management strategy. The City of Corpus Christi (City) benefits from an interbasin transfer and contract with the Lavaca-Navidad River Authority (LNRA) to divert up to 53,840 acft/yr from Lake Texana in the Lavaca-Navidad River Basin, which includes a base contract of 41,840 acft/year and 12,000 acft/year on an interruptible basis. Although not considered as a current water supply, the City has a permit to divert up to 35,000 acft/year from the Colorado River Basin according to a purchase agreement with the Garwood Irrigation Company. The City's Water Conservation Plan (2009) addresses their goals and plan to conserve water. The City's Drought Contingency Plan (2009) identifies factors used to initiate a drought response and actions to be taken as part of the response (Section 5 of the plan). Both City Plans are included in Appendix E, along with a model water conservation and drought contingency plans.

The TCEQ provides guidance for Water Conservation and Drought Contingency Plans in 30 Texas Administrative Code Chapter 288, which requires entities applying for new water rights or an amendment to existing water right to prepare and implement a water conservation/drought contingency plan to be submitted with their application. Furthermore, 30 TAC Chapter 288, requires "specific, quantified five and ten year targets for water savings to be included in all water conservation plans to be submitted to the TCEQ no later than May 1, 2005." The rules go on to state that after the initial deadline, updated plans must be submitted every five years to coincide with the regional water planning cycles.

6.1 Water Conservation

The Coastal Bend Region has considered water conservation and drought management measures for each water user group with a need (projected water shortage) in accordance with Regional Water Planning Guidelines. The Coastal Bend Region recommends water conservation for municipal and non-municipal entities.

6.1.1 Municipal Water Conservation

The City of Corpus Christi, the largest municipal water user in the Coastal Bend Region, has demonstrated significant water savings attributable to water conservation efforts over the last decade. The City of Corpus Christi currently uses less water than comparable cities in the Central Texas region and is currently among the lowest in the state, for all climatological regions. The City's municipal water use was nearly 220 gallons per capita per day (gpcd) in 1990 and was reduced to 179 gpcd by 2000, a decrease of 41 gpcd in 10 years (or 19 percent). According to TWDB water use projections, the City of Corpus Christi water use is anticipated to decline to 165 gpcd by 2060.

The Coastal Bend Region encourages all municipal entities in the Coastal Bend Region to conserve water, regardless of per capita consumption. As part of the 2006 regional water planning process, the Coastal Bend Region recommended that water entities, with and without shortages, exceeding 165 gallons per capita per day reduce consumption by 15 percent by 2060 by using Best Management Practices (BMPs) provided by the Water Conservation Implementation Task Force. This criteria was used for the 2011 Plan. By reducing water use by 15 percent in addition to anticipated savings built into the TWDB projections for replacement of existing plumbing fixtures, the Coastal Bend Region is expected to reduce average consumption from 155 gpcd in 2000 to 137 gpcd by 2060 (a decrease of 12 percent). Assuming 100 percent participation in water conservation efforts for entities with greater than 165 gpcd, the anticipated regional savings is expected to increase from 104 acft/yr in Year 2010 to 2,415 acft/yr by Year 2060. A discussion of municipal conservation water savings, program costs, and unit costs for the Coastal Bend Region are included in Section 4C.1.

6.1.2 Non-municipal Water Conservation

In addition to the recommendation above for municipal water conservation, the Coastal Bend Region also recommended water conservation for industrial (manufacturing/mining) and irrigation users. The Coastal Bend Region recommended that manufacturing users continue to pursue opportunities to improve water quality, thereby reducing water consumption. Manufacturing entities can improve water quality through outlet works and intake modifications to reduce total dissolved solids, amongst other strategies as described in Section 4C.3. The Planning Group also recommended a 15 percent reduction in water demand for irrigation and mining entities with projected water needs that may be achieved using Best Management Practices (BMPs) identified by the Water Conservation Implementation Task Force.

There are three counties within the Coastal Bend Region with projected irrigation needs: Bee, Live Oak, and San Patricio. Irrigation conservation was considered for all three counties; however, according to data developed by the TWDB and local GCD data the irrigation water application efficiency in Bee and San Patricio Counties already exceeds 80%, equal to the maximum efficiency achieved with this strategy; therefore, no additional conservation is recommended for these two counties.[1] The total water savings for Live Oak County after 15 percent water demand reduction is 342 acft/yr, as shown in Table 6-1. There are multiple irrigation BMPs that irrigators can select from to attain this water savings, including furrow diking, low elevation spray applications (LESA), and low energy precision application (LEPA). The costs of these BMPs range from $109 per acft of water saved using LEPA systems to $228 per acft water saved using furrow dikes. A more detailed description of irrigation BMPs, costs, and water savings for the Coastal Bend Region are included in Section 4C.2.

Table 6-1.
Irrigation Water Conservation Savings

Counties using Irrigation Conservation	***Irrigation Shortages in 2060 (acft/yr)***		***Water Savings in 2060 (acft/yr)***
	Before Conservation	***After Conservation (Reducing Demand By 15 Percent)***	
Live Oak	(373)	(31)	342

There are three counties in the Coastal Bend Region with projected mining needs: Duval, Live Oak, and Nueces. The total water savings for these three counties after 15 percent water demand reduction is 2,343 acft/yr as shown in Table 6-2. There are multiple industrial BMPs identified by the Water Conservation Implementation Task Force, however data to quantify savings and costs is unavailable. The Coastal Bend Region recognizes that conservation savings and costs to implement mining BMPs are facility specific and assumes that mining users will implement those strategies that are practical, cost effective, and provide good water savings potential. A more detailed description of suggested mining BMPs for the Coastal Bend Region is included in Section 4C.4.

[1] Low-energy precision application systems (LEPA) analysis as an irrigation BMP is assumed to have the highest application efficiency rate of 80% (See Table 4C.2-4).

Table 6-2.
Mining Water Conservation Savings

Counties with Mining Needs	Irrigation Shortages in 2060 (acft/yr)		Water Savings in 2060 (acft/yr)
	Before Conservation	After Conservation (Reducing Demand By 15 Percent)	
Duval	(4,205)	(2,922)	1,283
Live Oak	(1,755)	(954)	801
Nueces	(1,624)	(1,365)	259
Total	**(7,584)**	**(5,241)**	**2,343**

6.2 Drought Management

All water supply entities and some major water right holders are required by Senate Bill 1 regulations to submit for approval to the Texas Commission for Environmental Quality (TCEQ) a Drought Contingency and Water Conservation Plan. These plans must detail the entities' plans to reduce water demand at times when the demand threatens the total capacity of the water supply delivery system or overall supplies are low (like during a drought).

The City of Corpus Christi's Drought Management Plan considers combined storage of the CCR/LCC System in determining whether to initiate a drought response. The City issues drought response measures based on 50 percent, 40 percent, 30 percent, and 20 percent of storage in the CCR/LCC System, as described in Table 3-10. Through water purchase agreements, the customers of the City of Corpus Christi (including wholesale water providers) are responsible to impose similar drought measures. Supplies from the CCR/LCC System are determined on the basis of minimum year availability and safe yield, respectively. Hence, the surface water supplies available to the three largest Coastal Bend wholesale water providers (City of Corpus Christi, San Patricio Municipal Water District, and South Texas Water Authority) are dependable during drought and have included drought provisions in the event that a future drought is greater in severity than the worst drought of record as discussed in Section 7.

Supplies from other surface water sources, such as run-of-river water rights for Nueces County WCID#3, the fourth wholesale water provider, are determined from analyses using TCEQ's Nueces River Water Availability Model and are dependable during drought.

The Nueces River Authority has on file, electronic copies of drought management plans for the following Coastal Bend region entities:

Wholesale Water Providers	**Date of Management Plan**
City of Corpus Christi	April 2009
San Patricio Municipal Water District	May 2005 (Amended)
South Texas Water Authority	April 2009
Other Entities	**Date of Management Plan**
City of Alice	July 2008
Aransas County MUD #1	April 2009
City of Aransas Pass	October 2008
City of Beeville	February 2000
City of Ingleside	July 2009
Nueces WSC	May 2009
City of Portland	March 2009
Rincon WSC	April 2009
City of Rockport	August 2009
City of Kingsville	April 2002
Ricardo WSC	June 2009

The Nueces River Authority also has on file, the Lavaca-Navidad River Authority Drought Contingency Plan, revised August 24, 2005.

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Section 7
Consistency with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources [31 TAC §357.7(a)(13) and §357.7(2)(C)

The 2011 Coastal Bend Regional Water Plan (2011 Plan) is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources and is developed based on guidance principles outlined in the Texas Administrative Code Chapter 358-State Water Planning Guidelines. The 2011 Plan was produced with an understanding of the importance of orderly development, management, and conservation of water resources and is consistent with all laws applicable to water use for the state and regional water planning areas. Furthermore, the plan was developed according to principles governing surface water and groundwater rights. The 2001 TCEQ Agreed Order governing freshwater pass-throughs to the Nueces Estuary was strictly adhered to for current surface water supply projects and future water management strategies. For groundwater, the 2011 Plan also recognized principles for groundwater use in Texas and the authority of groundwater conservation districts within the Coastal Bend Region. The rules of groundwater conservation districts in the region and regional drawdown constraints developed previously by the Coastal Bend Groundwater Advisory Panel were followed when determining groundwater availability. The CBRWPG recognizes the need to protect groundwater quality and recommends routine water quality monitoring near in situ uranium mining and deep well injection operations. Local groundwater management areas and groundwater conservation districts are in the process of developing desired future conditions and groundwater availability numbers for use in future regional water planning efforts.

The 2011 Plan identifies actions and policies necessary to meet the Coastal Bend Region's near and long-term water needs by developing and recommending water management strategies to meet their needs with reasonable cost, good water quality, and sufficient protection of agricultural and natural resources of the state. The Coastal Bend Region recommended water management strategies that considered public interest of the state, wholesale water providers, protection of existing water rights, and opportunities that encourage voluntary transfers of water resources while balancing economic, social, and ecological viability. When needs could not be met economically with water management strategies, a socioeconomic impact analysis was performed to estimate the economic loss associated with not meeting these needs (Appendix F).

The 2006 Plan considered environmental information resulting from site-specific studies and ongoing water development projects when evaluating water management strategies. Cumulative effects of water management strategies on Nueces River instream flows and inflows to the Nueces estuary were considered, as summarized in Appendix K. A list of endangered and threatened species in the Coastal Bend Region for each county was obtained from the U.S. Fish and Wildlife Service and discussed in Section 1. Possible habitats for endangered and threatened species were considered for each water management strategy (Section 4C). The 2001 Agreed Order includes operational procedures for Choke Canyon Reservoir and Lake Corpus Christi and requires passage of inflows to the Nueces Bay and Estuary based on maximum harvest studies and inflow recommendations to maintain the health of the Nueces Estuary.

Due to most areas having an underlying impervious clay layer, there has not been much opportunity for springs to form in the Coastal Bend Region.

The 2011 Plan consists of initiatives to respond to drought conditions, such as the City of Corpus Christi Drought Management Plan, which included modifying the operation of the CCR/LCC System during drought conditions as required by the Agreed Order to conserve water. As a further drought protection provision, the Coastal Bend Region adopted use of safe yield analyses for purposes of determining water supply. The use of safe yield analyses anticipates that a future drought may occur that is greater in severity than the worst drought of record and reserves a certain amount of water in storage (i.e., 7 percent of CCR/LCC System) for such an event. Use of safe yield for the major water supplies in the Nueces River Basin is justified based on previous droughts in the basin over the past 70 years. Figure 7-1 shows how 3-year average annual inflows for the major reservoir system have been reduced for each of the past four significant droughts.

The Coastal Bend Region conducted numerous meetings during the 2011 planning cycle, with meetings open to the public and decisions based on accurate, objective, and reliable information. The Region coordinated water planning and management activities with local, regional, state, and federal agencies and participated in interregional meetings with the South Central Texas Region (Region L) and Lavaca Region (Region P) to identify common needs and worked together with Region L and Region P to develop interregional strategies in an open, equitable, and efficient manner. The Coastal Bend Region considered recommendations of stream segments with unique ecological value by Texas Parks and Wildlife (Appendix G) and sites of unique value for reservoirs. At this time, the Coastal Bend Region recommends that no stream segments with unique ecological value be designated. The Planning Group developed policy recommendations for the 2011 Plan including protection of water quality, consideration of environmental issues, interbasin transfers, groundwater management, request for additional studies for water supply projects (such as desalination), and continued funding for regional water planning efforts. The Planning Group policy recommendations are included in Section 8.

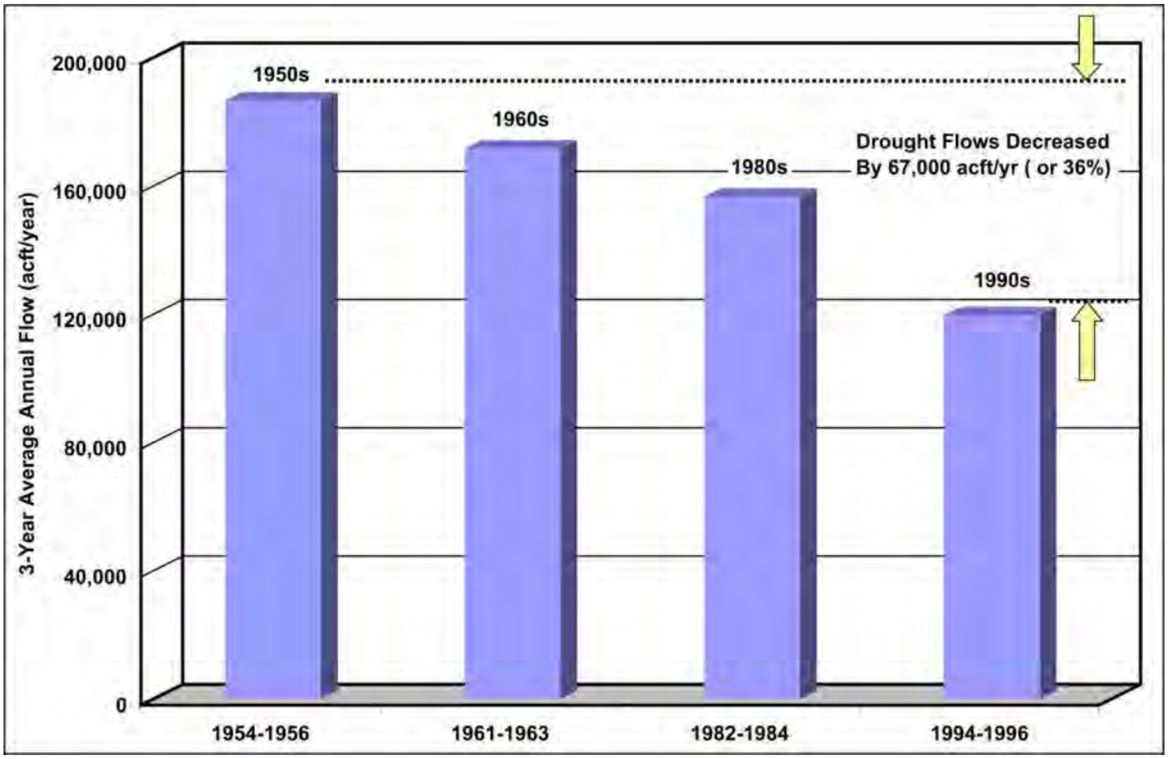

Figure 7-1. 3-Year Reservoir Inflows

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Section 8
Legislative Recommendations, Unique Stream Segments, and Reservoir Sites [31 TAC §357.7(a)(8-9); 31 TAC §357.8; 31 TAC §357.8]

Each of the 16 regional water planning groups may make recommendations to the TWDB regarding legislative and regional policy recommendations; identification of unique ecological stream segments; and identification of sites uniquely suited for reservoirs. The Coastal Bend RWPG selected a subcommittee to consider legislative and regional policy recommendations, which were adopted by the Coastal Bend Region. The following are the Coastal Bend Region's recommendations regarding these matters.

8.1 Legislative and Regional Policy Recommendations

Under the authority of Senate Bill 1, the Coastal Bend RWPG has developed the following legislative and regional policy recommendations.

8.1.1 General Policy Statement

I. The Texas Legislature is urged to declare that: i) all water resources of the State are hydrologically inter-related and should be managed on a "conjunctive use" basis, wherever possible; ii) existing water supplies should be more efficiently and effectively used through improved conservation and system operating policies; and iii) water re-use should be promoted, wherever practical, taking into account appropriate provisions for protection of downstream water rights, domestic and livestock uses, and environmental flows.

8.1.2 Interbasin Transfers

I. The Texas Legislature is urged to repeal the "Junior Rights" provision and the additional application requirements for interbasin transfers that were included in Senate Bill 1.

8.1.3 Desalination

I. The Texas Legislature is urged to direct TCEQ to investigate the current regulatory status of the "concentrate" or "reject water" produced during the desalination of brackish ground water, brackish surface water and seawater in industrial and municipal treatment processes and compare these to reject water requirements for the oil and gas industry and arrive at a common set of standards for the disposal of these waste products so that safe, economical methods of disposal will be available to encourage the application of these technologies in Texas.

II. The Texas Legislature is urged to direct TCEQ to work with TWDB and TPWD to develop information on the potential environmental impacts of concentrate discharges from seawater desalination facilities and to facilitate the permitting of these discharges into tidal waters where site specific information shows that minimal environment damage would occur.

III. Texas Legislature is urged to amend state laws governing the procurement of professional services by public agencies in order to allow municipalities, water districts, river authorities, smaller communities, and other public entities, provided that they have the expertise, to utilize alternatives to the traditional “Design-Bid-Build” methods for public work projects, including desalination facilities. For example, most large-scale desalination facilities built in the past 10 years are constructed using “Build-Own-Operate-Transfer” method, allowing for a cost-effective transfer of project risks to the private sector.[1]

8.1.4 Groundwater Management

I. The Texas Legislature is urged to provide funding for the Groundwater Management Areas to support their efforts towards the evaluation of groundwater availability and desired future conditions.

II. TWDB, TCEQ, and the Texas Railroad Commission are urged to expand and intensify their activities in collecting, managing, and disseminating information on groundwater conditions and aquifer characteristics throughout Texas.

III. TWDB is urged to continue funding for updates to the groundwater availability models, specifically the Central Gulf Coast GAM covering the Coastal Bend Region.

IV. The Texas Railroad Commission is urged to cooperate with TWDB and TCEQ to encourage oil and gas well drillers to furnish e-logs, well logs, and other information that might be available on shallow, groundwater bearing formations to facilitate the better identification of aquifer characteristics.

V. The Texas Legislature is urged to appropriate additional funds for TWDB to continue and expand their statewide groundwater data program and to appropriate new funds, through regional institutions such as Texas A&M University – Corpus Christi and Texas A&M University –Kingsville, for a regional research center to support research, data collection, monitoring, modeling, and outreach related to groundwater management activities in the Coastal Bend region of Texas.

VI. The Texas Legislature is urged to make funds available through regional water planning groups and groundwater conservation districts to educate the citizens of Texas about groundwater issues, as well as the powers and benefits of groundwater conservation districts.

VII. TCEQ is urged to amend rules and regulations to require routine water quality monitoring, by a non-partisan third-party, of mining operations and enforcement of

[1] “Large-Scale Seawater Desalination and Alternative Project Delivery”, Design-Build DATELINE, February 2005.

water quality standards, including in situ mining and those with deep well injection practices.

VIII. The Texas Legislature is urged to prohibit in-situ mining in aquifers that serve as drinking water sources for residents and livestock.

IX. The Railroad Commission is urged to continue its identification of improperly plugged and abandoned oil and gas wells that adversely affect local groundwater supplies. Funding should be provided to address known problems and/or force responsible parties to properly plug abandoned wells, including oil, gas, and water wells.

X. The TWDB is urged to consider local mining projects (such as natural gas from the Eagleford shale) when developing mining water demand projections in the future for regional planning. The TWDB is urged to provide guidance on how planning groups should address local mining water projects, especially those associated with gas production from the Eagleford shale or other projects with variable, and often indeterminate production timelines.

8.1.5 Surface Water Management

I. The Texas Legislature is urged to provide funding for the development of periodic updates to surface water availability models, (WAMs), with specific consideration to updating the Nueces River Basin WAM though any new drought period.

II. The TCEQ is urged to enforce existing rules and regulations with respect to water impoundments.

8.1.6 Regional Water Resources Data Collection and Information Management

I. The Texas Legislature is urged to provide SB1 planning funds, through the Coastal Bend RWPG to a regional institution, to support regional water resources data collection and activities to develop and maintain a “Regional Water Resources Information Management System” for the Coastal Bend area.

8.1.7 Role of the RWPGs

I. The RWPG should play a role in facilitating public information/public education activities that promote a wider understanding of state and regional water issues and the importance of long-range regional water planning.

II. The Texas Legislature is urged to continue funding the TWDB to provide support for state mandated regional water planning group activities.

III. Public entities in the Coastal Bend Water Planning Region are urged to provide their share of continued funding for the administrative support activities that facilitate the Coastal Bend RWPG activities.

8.2 Identification of River and Stream Segments Meeting Criteria for Unique Ecological Value

The Coastal Bend Region considered TPWD's recommendations regarding the identification of river and stream segments which meet criteria for unique ecological value (Appendix G). In December 2009, the Coastal Bend Region recommended that no river or stream segments within the Coastal Bend Region be identified at this time.

8.3 Identification of Sites Uniquely Suited for Reservoirs

The 2007 State Water Plan recommended 19 unique reservoir sites throughout the state, which were then designated by the 80th Texas Legislature in Senate Bill 3 as sites of unique value for reservoir construction.[2] Of these, 2 of the 19 sites are water management strategies considered in this Plan to provide future supplies to the Coastal Bend Region: Nueces off-channel reservoir and Palmetto Bend Stage II. The Nueces off-channel reservoir is a recommended water management strategy and Palmetto Bend Stage II is an alternative water management strategy. The Coastal Bend Region supports the legislative action to identify general areas for reservoir sites. However, the Coastal Bend Region does not recommend specific tracts of land for the Nueces off-channel reservoir or Palmetto Bend Stage II and encourages those wishing to pursue such options to discuss with property owners and mediate if necessary prior to Federal, State, or local recommendation of specific location(s).

No sites uniquely suited for on-channel reservoirs in the Nueces Basin were identified by the Coastal Bend Region. The Coastal Bend Region supports initiatives by Region P and Lavaca Navidad River Authority (LNRA) regarding Palmetto Bend Stage II or an off-channel variation thereof.

8.4 Additional Recommendations

The following additional recommendations are under consideration by the Coastal Bend RWPG:

[2] According to Texas State Water Code Sections 16.051(g), A state agency or political subdivision of the state may not obtain a fee title or an easement that would significantly prevent the construction of a reservoir on a designated site. The designation of a unique reservoir site under this subsection terminates on September 1, 2015, unless there is an affirmative vote by a proposed project sponsor to make expenditures necessary in order to construct or file applications for permits required in connection with the construction of the reservoir under federal or state law.

- Studies of the potential to develop a large-scale, multiyear ASR system in the Gulf Coast Aquifer should be continued to help drought-proof the Region.
- Studies of desalination options to further reduce the cost of using seawater and/or brackish groundwater should be continued.
- Studies should be undertaken to analyze the effects/costs of new EPA Safe Drinking Water Act requirements regarding the treatment of problematic constituents in groundwater on users in the Coastal Bend Region.
- Feasibility studies should be undertaken to optimize and reduce, if possible, the costs of water system interconnects for the cities of San Diego, Freer, Benavides, Premont, and Falfurrias to improve the quantity and quality of potable water available to these cities. Additionally, an evaluation should be undertaken of the feasibility of a regional desalination facility for the treatment of poor quality groundwater to improve the quality of potable water to these cities.
- Feasibility studies should be undertaken to identify opportunities/costs to develop regional groundwater systems that could utilize poor quality groundwater in conjunction with a desalination treatment plant to more effectively manage groundwater resources within the Coastal Bend Region.
- A detailed inventory of irrigation systems, crops, and acreage should be undertaken to more accurately estimate irrigation demands in the region.
- Environmental studies of the segments of the Frio and Nueces Rivers downstream of Choke Canyon Reservoir and upstream of Lake Corpus Christi should be undertaken to fully evaluate the potential impacts of reduced instream flows, including groundwater recharge, associated with the option to construct a pipeline between the two reservoirs.
- The Coastal Bend Region should work with Region P on environmental studies associated with the potential construction of Palmetto Bend Stage II.
- The Coastal Bend Region should perform environmental field studies of potentially unique stream segments and potential unique reservoir sites provided additional clarification is provided by the Texas Legislature regarding the repercussions of identifying a stream segment as unique.
- Support studies to closely monitor discharges from sand and gravel operations in the Lower Nueces River.
- Support studies of construction and implementation of pilot desalination plant to quantify and qualify impacts of operating a brackish desalination facility in the Coastal Bend Region.

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Section 9
Water Infrastructure Funding Recommendations
[31 TAC §357.7(a)(14)]

9.1 Introduction

Senate Bill 2 (77^{th} Texas Legislature) requires that regional water plans include a description of financing needed to implement recommended water management strategies and projects, including how local governments and others propose to pay for water management strategies identified in the plan. The TWDB issued an Infrastructure Financing Report (IFR) Survey requesting information from water user groups with reported water needs any time during the projected planning period from Year 2010 to 2060.

9.2 Objectives of the Infrastructure Financing Report

The primary objectives of the Infrastructure Financing Report are as follows:

- To determine the financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any State funding sources considered); and
- To determine what role(s) the RWPGs propose for the State in financing the recommended water supply projects.

9.3 Methods , Procedures, and Survey Responses

For the Coastal Bend Regional Water Planning Area, municipal water user groups having water needs and recommended water management strategies in the regional plan with an associated capital cost were surveyed using an on-line questionnaire provided by the TWDB. The Coastal Bend RWPG emailed three survey packages with supporting documentation that summarized recommended water management strategies identified in the initially prepared water plan — one to the City of Corpus Christi, one to San Patricio Municipal Water District; and one to the City of Lake City. The Coastal Bend Region had a 100% response rate (3 out of 3 surveys were completed). Supporting documentation is included in Appendix L.[1]

With respect to the role of the State in financing the recommended water supply projects, significant State participation is required in order to provide adequate funding for the implementation of water management strategies in the plan.

[1] Based on TWDB guidance, surveys were sent to wholesale water provider if their customers showed shortages.

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Section 10
Plan Adoption
[31 TAC §357.11-12]

10.1 Public Involvement Program

The public involvement program was incorporated at the onset of the CBRWPG water planning process in order to maximize the opportunity for public review and input into the process of developing the water plan as well as critique of the Initially Prepared Regional Water Plan.

The public involvement program included:

- An opportunity at all CBRWPG meetings for the public to comment on any aspect of the plan or planning process;
- Quarterly newsletters (see Appendix H):
  - 1. Fall 2008 (October 2008)
  - 2. Winter 2009 (February 2009)
  - 3. Spring 2010 (March 2010)
- Public Hearing for Initially Prepared Plan:
  April 8, 2010
  Johnny Calderon County Building
  710 Main Street, Robstown, Texas 78380
- Press releases and notices of public meetings; and
- Dedicated website for Coastal Bend RWPG information.

10.2 Coordination with Wholesale Water Providers

Information was provided by wholesale water providers located in the Coastal Bend Planning Region in June 2010 including their plans for future water supply projects for the CBRWPG water management planning process.

Representatives from water supply entities within the CBRWPG were also regularly notified of all CBRWPG meetings and public informational meetings.

10.3 Coastal Bend Regional Water Planning Group Meetings

The CBRWPG met at least quarterly in accordance with the approved bylaws. The CBRPWG has met on a more frequent basis as needed in order to facilitate and direct the water planning of the region. The following is a summary of the meetings:

Coastal Bend RWPG Meetings	
February 8, 2007	November 13, 2008
May 10, 2007	March 12, 2009
August 9, 2007	June 11, 2009
October 4, 2007	August 13, 2009
November 8, 2007	December 10, 2009
February 14, 2008	January 14, 2010
April 10, 2008	February 11, 2010
May 22, 2008	April 8, 2010
August 14, 2008	August 5, 2010

The CBRWPG requested that the TWDB execute the contract to develop the 2011 Regional Water Plan on February 15, 2008.

The CBRWPG also designated several subcommittees in order to expedite more specific work efforts and further increase the effectiveness and timeliness of the planning process. The following summarizes these committee and subcommittee meetings.

Executive Committee Meetings

- February 8, 2007
- May 10, 2007

Subcommittee on Policy Recommendations

- September 29,2009

The CBRWPG approved the Initially Prepared Plan on February 11, 2010 for submittal to the Texas Water Development Board. The CBRWPG approved responses to the comments received on the Initially Prepared Plan and approved the Final Plan on August 5, 2010. The comments received on the Coastal Bend Initially Prepared Plan with approved responses are included in Appendix M.

10.4 Regional Water Planning Group Chairs Conference Calls and Meetings

The Texas Water Development Board held a conference call meeting with Regional Water Planning Group chairs to provide guidance and respond to issues regarding the planning process on April 13, 2009.

10.5 Coordination with Other Regions

A coordination meeting between the Coastal Bend RWPG, the Lavaca RWPG, and the South Central Texas RWPG was held on April 8, 2009 in an effort to share information regarding water supply and water management strategies.

Harry Hafernick Recreation Center
Edna, Texas 77957

10.6 Coordination with Other Entities

An informational meeting with the Celanese-Bishop facility was held on February 19, 2009 to receive input and feedback on the development of certain water management strategies related to industry within the region. In addition, two similar meetings were also held with the City of Corpus Christi and other local industries on April 30, 2009 and September 24, 2009 to discuss water quality issues.

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