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CHAPTER 2.0: POPULATION PROJECTIONS AND WATER DEMAND PROJECTIONS

One primary goal of the regional water planning process is to identify water supply development strategies that will be reliable during times of drought for all users in the State. Quantifying existing and future water demands is the initial step in the planning effort. Each regional planning group works with the Texas Water Development Board (TWDB) to develop population and water demand projections for the 50-year planning horizon, and this chapter documents the methodology and results of this effort by the Lower Colorado Regional Water Planning Group.

Throughout this chapter, total regional projections are presented and further delineated for each municipal and non-municipal water user group within the region. Projections are also shown for each county as well as the four river basins and two coastal basins partially located in the Lower Colorado Region. In subsequent chapters of the plan, these projections are compared with estimates of currently available water supplies to identify water needs and water management strategies to meet these needs.

The Lower Colorado Region has experienced rapid population expansion in recent decades and this trend is expected to continue over the planning horizon. Total regional population projections estimate a near-doubling of population to more than 3.2 million people by 2070, as shown in *Table 2.1* below. As population increases, the planning area will likely see an associated increase in water demands for municipal, manufacturing, and steam-electric uses. Thus population is the principal driver of the projected total water demand increase in the planning area, from approximately 1.18 million acre-feet in the year 2020 to 1.46 million acre-feet in the year 2070.

Table 2.1 Population and Water Demand Projections for the Lower Colorado Region

Regional Projections	2020	2030	2040	2050	2060	2070
POPULATION	1,737,227	2,064,522	2,381,949	2,658,492	2,928,400	3,243,127
Municipal Water Demand (ac-ft/yr)	306,560	359,194	411,761	458,588	505,009	558,949
Manufacturing Water Demand (ac-ft/yr)	56,019	70,050	86,259	96,283	106,487	117,851
Irrigation Water Demand (ac-ft/yr)	607,433	590,740	574,530	558,789	543,507	528,715
Steam-Electric Water Demand (ac-ft/yr)	178,453	185,235	187,410	194,802	200,413	207,319
Mining Water Demand (ac-ft/yr)	20,848	26,104	27,991	29,757	31,893	34,961
Livestock Water Demand (ac-ft/yr)	14,012	14,012	14,012	14,012	14,012	14,012
TOTAL WATER DEMAND	**1,183,325**	**1,245,335**	**1,301,963**	**1,352,231**	**1,401,321**	**1,461,807**

2.1 TEXAS WATER DEVELOPMENT BOARD GUIDELINES FOR REVISIONS TO POPULATION AND WATER DEMAND PROJECTIONS

The Texas Water Development Board (TWDB) distributed draft non-municipal water demand projections via an October 2011 memorandum for the regional planning group's review. A second TWDB memorandum in March 2013 accompanied the TWDB's draft recommended population projections and associated municipal water demand projections. These communications also described the projection methodologies and steps a regional planning group must follow in making projection revision requests, if necessary. Once submitted to TWDB, the projection revision requests were also reviewed by the Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and the Texas Department of Agriculture prior to being approved by TWDB.

TWDB rules require that projection analyses be performed for each identified municipal and non-municipal water user group. Municipal water user groups include municipalities with a population of 500 or more, individual utilities providing more than 280 acre-feet per year of water for municipal use, and Collective Reporting Units consisting of group utilities having a common association. All smaller communities and rural areas are combined and referred to as a "county-other" water user group for each county (e.g., Travis County-Other, etc.) Non-municipal water user groups include manufacturing, irrigation, steam-electric power generation, mining, and livestock water use and are also referred to within each county (i.e., Bastrop County Mining, Bastrop County Manufacturing, etc.) The planning process also requires that regions designate wholesale water providers, which are persons or entities having contracts to sell more than 1,000 acre-feet of water wholesale. The planning group has designated two wholesale water providers within the region: the Lower Colorado River Authority (LCRA) and the City of Austin (COA). Associated water demands for these wholesale providers are identified within the plan and discussed in detail in Section 2.5 of this chapter.

The Lower Colorado Regional Water Planning Group Population and Water Demand Committee analyzed all TWDB-provided draft population and water demand projections and recommended any appropriate changes for the planning group's approval. Upon review of TWDB draft projections, the committee recommended revisions to the population and water demand projections for all water use categories. The detailed methodologies and resulting projections of this process are discussed in the following sections of this chapter.

2.2 POPULATION PROJECTIONS

Population increases typically directly drive municipal water demand increases. Establishing accurate population estimates and projections is a fundamental step in the regional water planning process. Population prediction is of particular importance in the Lower Colorado Region, where strong population growth is occurring and anticipated to continue, most notably in the City of Austin and surrounding metropolitan areas. The population projections in this plan were developed in accordance with TWDB guidelines, utilizing the 2010 U.S. Census data and growth projections established by the Office of the State Demographer, and supported with supplemental local data where available. This section details the methodology applied by the planning group and TWDB to develop the final TWDB-approved population projections for the Lower Colorado Region.

2.2.1 Methodology

As with other projections during this planning effort, TWDB staff distributed draft population data and projections for planning group review. In a projection process independent of regional and state water planning, the Texas State Data Center and Office of the State Demographer developed county-level population projections from 2011 to 2050. These projections utilized the 2010 U.S. Census Data and recent and projected demographic trends and served as the TWDB base data for municipal population projections. The TWDB staff further extrapolated the State Demographer projections to 2060 and 2070 to meet the planning horizon requirements of the 2017 State Water Plan. TWDB staff then disaggregated population projections for municipal water user groups, which include entities and water systems of a certain threshold size as discussed in the introduction to *Section 2.1*. County-other population is a sum of populations not designated within a specific municipal water user group for each county.

The Population and Water Demand Committee for the Lower Colorado Regional Water Planning Group relied on regional knowledge and solicited input from county and water user group representatives to determine the need for revisions to the TWDB draft population projections. The committee also considered information from the LCRA's Water Supply Resource Plan planning effort and the data from 2011 Region K Plan, Texas State Data Center, U. S. Census Bureau, the State Demographer, and Capitol Area Planning Council of Governments. TWDB required that revision requests be supported by specific data criteria, such as evidence of a Census undercount or expansion of a service area due to annexation activities. Additionally, TWDB required that individual revisions to water user group populations result in no net increase of population projections within the region and state.

The planning group requested revisions to certain population projections, based on the information received. Some of the revisions were denied, some were approved, and others were partially approved. Further details are provided in *Appendix 2C* which contains the Lower Colorado Region population and demand revision requests as submitted to TWDB. The final TWDB-approved population projections are summarized in the following section.

2.2.2 Regional Population Projections

Projections of population growth in the Lower Colorado Region indicate a nearly 87% increase in total population from approximately 1.7 million in 2020 to 3.2 million in the year 2070 as shown in *Figure 2.1*. Projections by county are delineated in *Table 2.2* for each decade from 2020 through 2070. Each of the 14 counties in the region are projected to grow over the planning period, with Travis County accounting for a majority of the total regional population throughout the planning horizon. As the greater Austin metropolitan area grows, counties such as Bastrop, Hays, and Williamson also account for substantial population increases in the planning region. Notably slower population growth is likely in more rural areas of the region, such as Mills and San Saba Counties.

Figure 2.1: Lower Colorado Region Population Projections

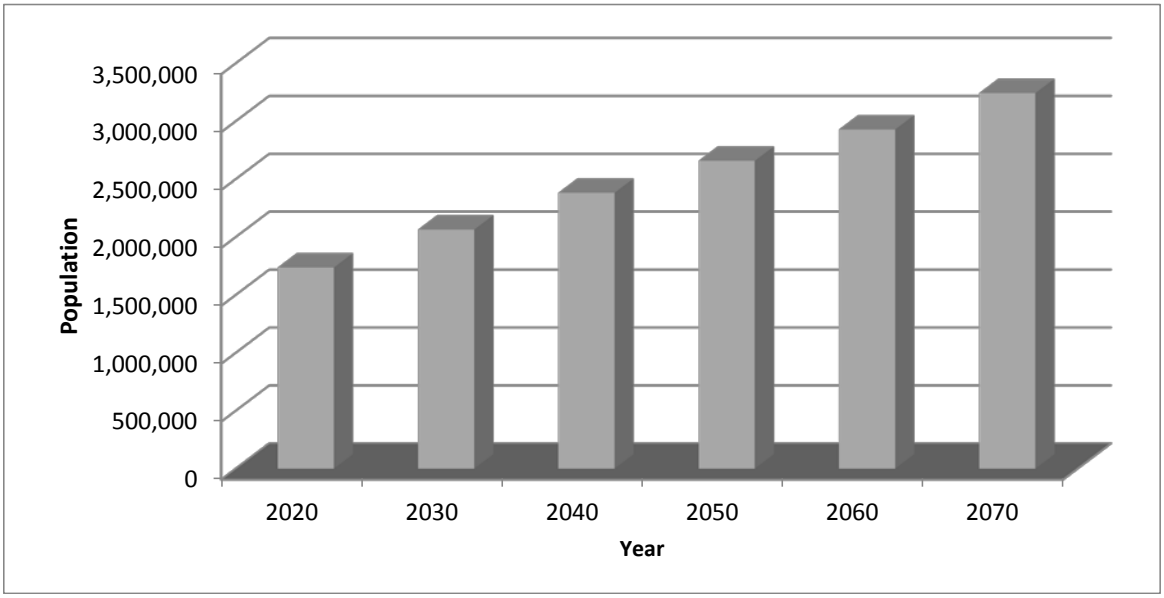


Table 2.2 Population Projections by County*

County	2020	2030	2040	2050	2060	2070
Bastrop	95,487	125,559	164,648	217,608	289,140	384,244
Blanco	13,015	15,475	16,917	17,672	18,175	18,472
Burnet	53,114	64,268	73,673	82,668	90,571	97,426
Colorado	21,884	22,836	23,544	24,582	25,449	26,293
Fayette	28,373	32,384	35,108	37,351	39,119	40,476
Gillespie	26,795	28,852	30,548	32,536	34,365	36,142
Hays (p)	55,584	73,243	94,747	121,629	152,007	186,579
Llano	21,291	22,453	22,422	22,035	22,779	23,549
Matagorda	39,166	41,226	42,548	43,570	44,296	44,815
Mills	4,912	5,076	5,213	5,417	5,625	5,859
San Saba	6,484	6,793	6,833	6,722	6,879	7,039
Travis	1,273,260	1,508,642	1,732,860	1,897,769	2,033,120	2,185,909
Wharton (p)	27,184	28,928	30,322	31,529	32,643	33,629
Williamson (p)	70,678	88,787	102,566	117,404	134,232	152,695
TOTAL	**1,737,227**	**2,064,522**	**2,381,949**	**2,658,492**	**2,928,400**	**3,243,127**

(p) Denotes that the county is shared between multiple regions. The population shown is only the portion within the Lower Colorado Region.

* Population projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A*.

The regional planning area covers a portion of four major river basins and two coastal basins and population projections for each basin are shown in *Table 2.3*. Of these, approximately 91 percent of the total population in the year 2070 is projected to reside within the Colorado River Basin, constituting a substantial impact on the water resources within that basin.

Table 2.3 Population Projections by River Basin

River Basin	2020	2030	2040	2050	2060	2070
Brazos	83,316	103,981	120,061	137,285	156,482	177,366
Brazos-Colorado	47,089	49,751	51,651	53,260	54,587	55,683
Colorado	1,573,387	1,873,782	2,170,798	2,426,563	2,674,332	2,965,663
Colorado-Lavaca	12,176	12,833	13,269	13,613	13,871	14,066
Guadalupe	9,044	10,649	11,740	12,513	13,205	13,882
Lavaca	12,215	13,526	14,430	15,258	15,923	16,467
TOTAL	**1,737,227**	**2,064,522**	**2,381,949**	**2,658,492**	**2,928,400**	**3,243,127**

All population projections for the Lower Colorado Region by water user group are provided in Appendix 2A. Chapter 11 provides a comparison of the 2011 and 2016 Lower Colorado Regional Water Plan population projections. Appendix 2B provides the per capita daily use for each municipal water user group.

2.3 WATER DEMAND PROJECTIONS

Total water demand for the Lower Colorado Region is projected to increase 24 percent to approximately 1.45 million acre-feet per year by 2070 as shown in *Figure 2.2*. While demands such as municipal, manufacturing, and steam-electric generation are anticipated to increase due to population growth and economic activity, other water demand categories are projected to decline. For instance, irrigation water demand constitutes 51 percent of the region's total water demand in 2020, but decreases over the planning horizon will have an impact in the reduction of the relative share of this use to 36 percent of the region's total demand by 2070. The distribution of water demands in the region for all decades is shown in *Figure 2.3*, as projected for the years 2020 through 2070.

Figure 2.2: Lower Colorado Region Total Water Demand Projections

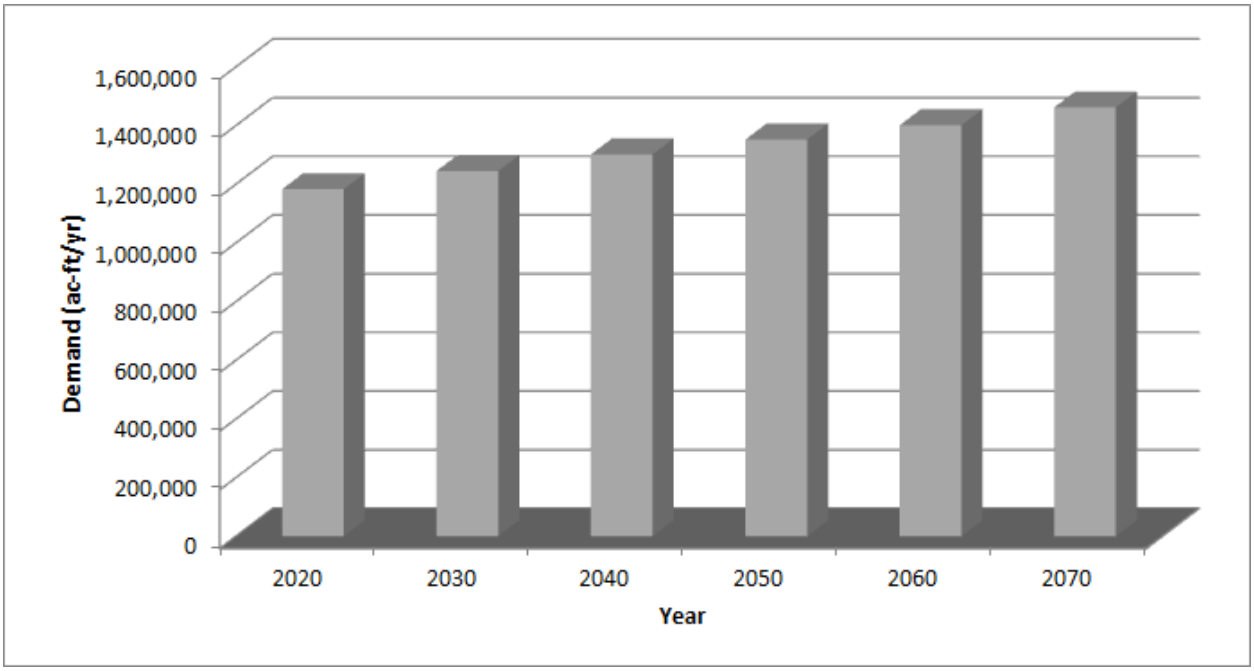
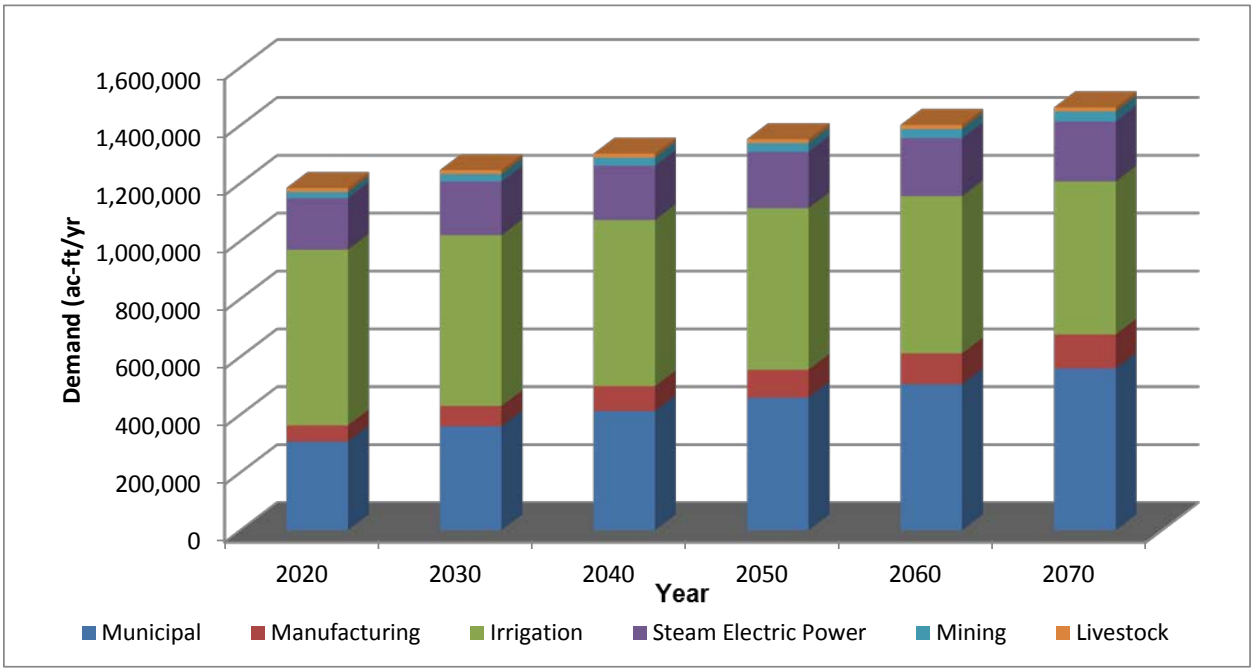


Figure 2.3: Total Water Demand by Type of Use



2.3.1 Municipal Water Demand Projections

2.3.1.1 Methodology

After population is established for each water user group, the second key variable in the TWDB's municipal water demand projections is per capita daily use, which represents the average number of gallons of water used per person per day (also noted commonly as gallons per capita daily and abbreviated as GPCD.) Municipal water demand projections are the product of population projections and per capita daily use projections for each water user group.

The per capita daily use estimate is unique for each municipal reporting entity and determined using responses to the TWDB's 2011 Water Use Survey. The year 2011 is generally considered a "dry-year" for much of the State of Texas and this dataset is assumed to be representative of water use during times of drought. In projecting per capita daily use for future decades of the planning horizon, the TWDB reduced per capita use assuming future water efficiency savings due to federal standards of plumbing fixtures and appliances. The GPCD values and the calculated municipal water demand savings due to plumbing codes and water-efficient appliances for Region K can be found in *Appendix 2B.*

These projections were approved by the TWDB for use in the 2016 Lower Colorado Regional Water Plan and are presented for each municipal water user group by county, river basin, and decade in *Appendix 2A.*

2.3.1.2 Regional Municipal Water Demand Projections

Municipal water demand for the Lower Colorado Region is projected to increase by approximately 252,389 acre-feet per year from 2020 through 2070 as shown in *Figure 2.4*. Due to the TWDB's water efficiency savings assumptions which project reductions in per capita water use, municipal demand is projected to increase approximately 82 percent over the planning horizon while the population projections increase 87 percent. The most substantive municipal demand increases are projected to occur in the City of Austin and surrounding metropolitan areas, including Travis, Bastrop, Hays, and Williamson counties. The distribution of municipal water demand projections for all 14 counties in the Lower Colorado Region is presented in *Table 2.4.*

Figure 2.4: Lower Colorado Region Municipal Water Demand Projections

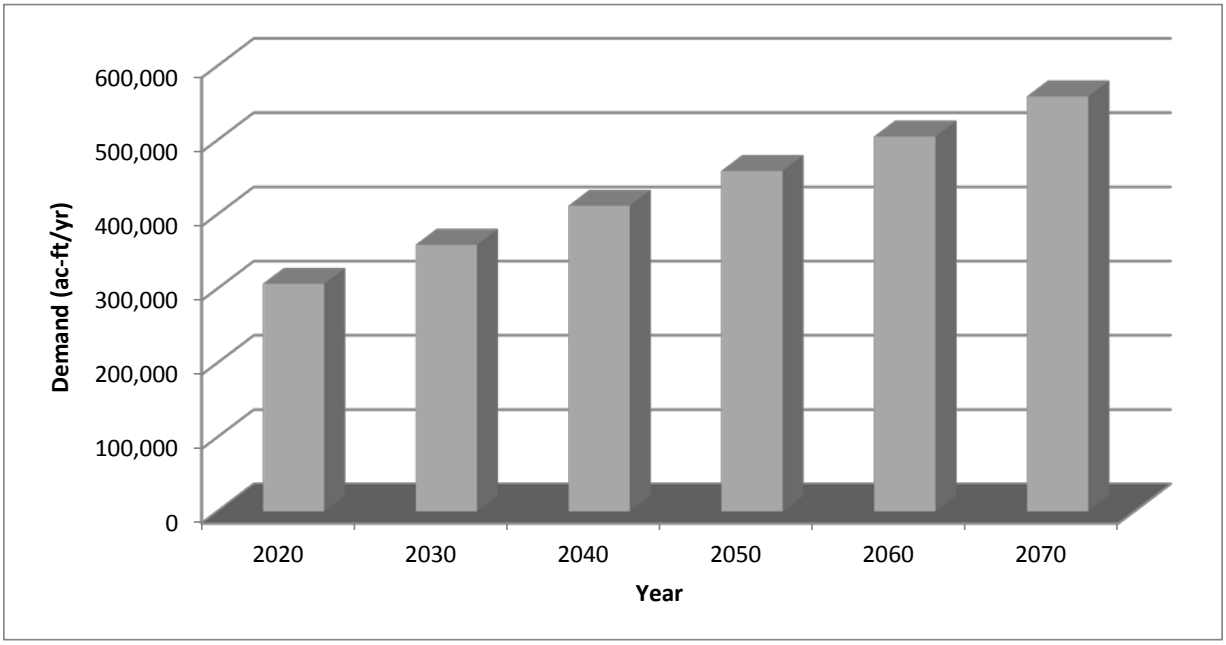


Table 2.4 Municipal Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	15,732	20,149	26,036	34,163	45,264	60,058
Blanco	1,811	2,094	2,254	2,336	2,398	2,438
Burnet	10,823	13,235	15,538	17,510	19,204	20,601
Colorado	3,689	3,746	3,781	3,902	4,031	4,162
Fayette	4,079	4,511	4,792	5,046	5,274	5,455
Gillespie	4,969	5,225	5,438	5,737	6,043	6,349
Hays (p)	10,548	13,997	18,311	23,849	30,279	37,687
Llano	4,306	4,479	4,436	4,337	4,476	4,625
Matagorda	5,123	5,193	5,202	5,259	5,332	5,394
Mills	754	754	753	775	802	835
San Saba	1,622	1,670	1,657	1,623	1,658	1,696
Travis	227,879	266,070	303,161	331,059	354,312	380,499
Wharton (p)	4,050	4,163	4,255	4,398	4,543	4,678
Williamson (p)	11,175	13,908	16,147	18,594	21,393	24,472
TOTAL	**306,560**	**359,194**	**411,761**	**458,588**	**505,009**	**558,949**

(p) Denotes that the county is shared between multiple regions. The municipal demand shown is only the portion within the Lower Colorado Region.

* Municipal water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A*.

The majority of current and projected municipal water demand is located in the Colorado River Basin, approximately 93 percent by 2070. These municipal water demand projections geographically correlate with the population centers of the region and are shown by river basin in *Table 2.5*.

Table 2.5 Municipal Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	13,276	16,384	18,959	21,768	24,931	28,385
Brazos-Colorado	6,677	6,811	6,883	7,033	7,195	7,340
Colorado	281,768	330,792	380,476	424,120	466,993	517,129
Colorado-Lavaca	1,461	1,479	1,483	1,498	1,522	1,543
Guadalupe	1,270	1,454	1,578	1,672	1,766	1,863
Lavaca	2,108	2,274	2,382	2,497	2,602	2,689
TOTAL	**306,560**	**359,194**	**411,761**	**458,588**	**505,009**	**558,949**

2.3.2 Manufacturing Water Demand Projections

2.3.2.1 Methodology

For regional water planning purposes, manufacturing water use is considered to be the cumulative water demand by county and river basin for all industries within specified industrial classifications (SIC) as calculated by the TWDB. Manufacturing water use projections that were developed by the TWDB were used as the default projections for the Lower Colorado Region. In developing draft manufacturing demand projections, TWDB staff utilized 2004-2008 data from TWDB's Water Use Survey. In counties where reported employment from the companies returning surveys was low compared to manufacturing employment data reported by the Bureau of Economic Analysis, surveyed water use was adjusted to account for non-responses. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base year estimate.

2.3.2.2 Regional Manufacturing Water Demand Projections

Annual manufacturing water demand in the Lower Colorado Region is projected to more than double over the planning horizon, increasing from 56,019 acre-feet per year in 2020 to 117,851 acre-feet per year in 2070. These demands are predominantly associated with existing and future anticipated industries in Travis County, where in 2070 manufacturing water demand is projected to account for over 77 percent of the total manufacturing demand in the region. The expected usage of water for manufacturing purposes in Matagorda County comprises the second largest share of manufacturing demand in the region. Projected total regional manufacturing demand is shown in *Figure 2.5*, while *Table 2.6* presents the projected manufacturing water demand distributed by county in the region.

Figure 2.5: Lower Colorado Region Manufacturing Water Demand Projections

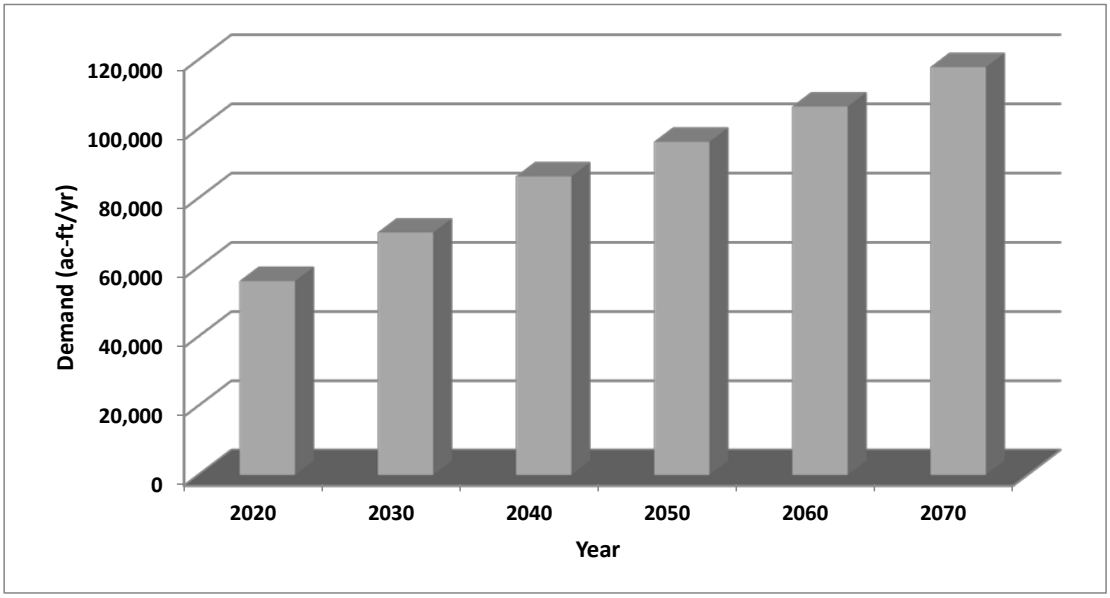


Table 2.6 Manufacturing Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	194	227	262	295	319	345
Blanco	20	20	20	20	20	20
Burnet	1,109	1,248	1,384	1,502	1,636	1,782
Colorado	383	409	433	453	489	528
Fayette	358	395	431	462	501	543
Gillespie	1,049	1,102	1,151	1,192	1,276	1,366
Hays (p)	347	398	449	495	537	583
Llano	3	3	3	3	3	3
Matagorda	16,253	16,991	17,686	18,259	19,267	20,342
Mills	2	2	2	2	2	2
San Saba	8	8	8	8	8	8
Travis	35,790	48,710	63,858	72,991	81,781	91,630
Wharton (p)	503	537	572	601	648	699
Williamson (p)	0	0	0	0	0	0
TOTAL	**56,019**	**70,050**	**86,259**	**96,283**	**106,487**	**117,851**

(p) Denotes that the county is shared between multiple regions. The manufacturing demand shown is only the portion within the Lower Colorado Region.

* Manufacturing water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A.*

Manufacturing water demand in the region occurs predominantly in the Colorado and Brazos-Colorado River Basins as shown in *Table 2.7*.

Table 2.7 Manufacturing Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	0	0	0	0	0	0
Brazos-Colorado	1,157	1,221	1,283	1,335	1,424	1,518
Colorado	53,958	67,855	83,934	93,848	103,880	115,058
Colorado-Lavaca	163	170	177	183	192	203
Guadalupe	15	16	18	20	21	22
Lavaca	726	788	847	897	970	1,050
TOTAL	**56,019**	**70,050**	**86,259**	**96,283**	**106,487**	**117,851**

2.3.3 Irrigation Water Demand Projections

2.3.3.1 Methodology

The irrigation water use projections that were developed by TWDB were used as the default projections except in cases where more representative and current information was submitted. The TWDB projections utilized an average of TWDB's 2005-2009 irrigation water use estimates as a base. TWDB staff developed annual water use estimates at a county level by applying a calculated evapotranspiration-based "crop water need" estimate to reported irrigated acreage from the Farm Service Agency. Estimates were then adjusted based on surface water release data from TCEQ, Texas Water Masters and comments from Groundwater Conservation Districts. The rate of change for projections from the 2011 Regional Water Plan was then applied to the new base. The Lower Colorado Region submitted requests for changes to the TWDB for irrigation demand projections in Burnet, Colorado, Matagorda, and Wharton counties. The revision request to Burnet County irrigation projections utilized the TWDB 2020 draft projection but requested that irrigation rates be held constant, rather than decline, over the planning horizon. The planning group also requested modification of irrigation projections in Colorado, Matagorda, and Wharton counties based on analysis of historical demands over the past twenty year period. Further details are provided in *Appendix 2C* which contains the Lower Colorado Region population and demand revision requests as submitted to TWDB.

2.3.3.2 Regional Irrigation Water Demand Projections

Irrigation water demand for the Lower Colorado Region is projected to decrease from 607,433 acre-feet per year in 2020 to 528,715 acre-feet per year in 2070. Irrigation water demand is concentrated in Colorado, Matagorda, and Wharton Counties and is largely used to meet irrigation needs for rice farming. Over the next 50 years, a decrease in irrigation water demand is projected due to improvements in irrigation efficiency and reductions in irrigated acres due to urbanization. *Figure 2.6* presents the projected regional irrigation demands, and *Table 2.8* presents the projected irrigation water demands by county.

Figure 2.6: Lower Colorado Region Irrigation Water Demand Projections

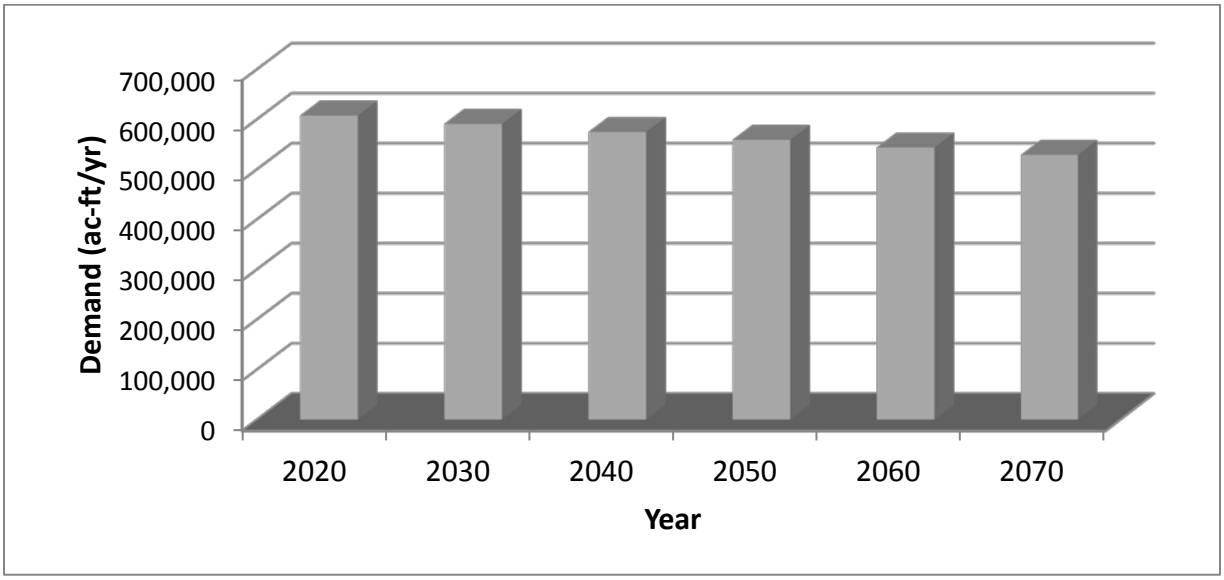


Table 2.8 Irrigation Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	852	742	649	565	492	443
Blanco	256	240	225	217	213	204
Burnet	1,504	1,504	1,504	1,504	1,504	1,504
Colorado	165,846	161,385	157,044	152,819	148,709	144,708
Fayette	623	583	545	511	480	453
Gillespie	2,058	2,031	2,003	1,978	1,953	1,928
Hays (p)	107	107	107	107	107	107
Llano	1,936	1,902	1,870	1,840	1,810	1,781
Matagorda	209,087	203,382	197,830	192,428	187,171	182,055
Mills	3,074	3,008	2,943	2,879	2,817	2,759
San Saba	5,539	5,361	5,188	5,018	4,856	4,709
Travis	4,322	3,975	3,657	3,364	3,097	2,885
Wharton (p)	212,229	206,520	200,965	195,559	190,298	185,179
Williamson (p)	0	0	0	0	0	0
TOTAL	**607,433**	**590,740**	**574,530**	**558,789**	**543,507**	**528,715**

(p) Denotes that the county is shared between multiple regions. The irrigation demand shown is only the portion within the Lower Colorado Region.

* Irrigation water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in Lower Colorado Region are provided in *Appendix 2A.*

The Lower Colorado Region's irrigation water demand projections are concentrated in the Brazos-Colorado and Colorado-Lavaca Coastal Basins, with the Colorado and Lavaca River Basins constituting a significant secondary portion of irrigation water demand, and are presented by basin in *Table 2.9*.

Table 2.9 Irrigation Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	2,018	1,982	1,946	1,912	1,879	1,849
Brazos-Colorado	256,669	249,728	242,976	236,404	230,009	223,786
Colorado	120,728	117,201	113,801	110,523	107,364	104,370
Colorado-Lavaca	139,409	135,620	131,931	128,342	124,850	121,451
Guadalupe	180	165	154	143	136	127
Lavaca	88,429	86,044	83,722	81,465	79,269	77,132
TOTAL	**607,433**	**590,740**	**574,530**	**558,789**	**543,507**	**528,715**

2.3.4 Steam-Electric Water Demand Projections

2.3.4.1 Methodology

The TWDB based draft steam-electric power generation water demands on projections from the 2011 Regional Water Plans and the 2008 TWDB report *Water Demand Projections for Power Generation in Texas*. Recent data from the Public Utilities Commission of Texas on plant announcements, retirements, and capacity changes were incorporated to adjust the base. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base. Of the 14 counties in the Lower Colorado Region, only Bastrop, Fayette, Llano, Matagorda, Travis, and Wharton Counties have or are projected to have any steam-electric water demand in the planning horizon. The Lower Colorado Region Population and Water Demand Committee sought information from steam-electric generators and other sources and consequently requested TWDB reductions to steam-electric projections for each of the counties that have steam-electric water demand except Wharton County, where no changes were requested. Further details are provided in *Appendix 2C*.

2.3.4.2 Regional Steam-Electric Water Demand Projections

Steam-electric water demand is projected to increase from 178,453 acre-feet per year in 2020 to 207,319 acre-feet per year 2070. The projected total regional steam-electric demands are shown in *Figure 2.7,* and *Table 2.10* presents the distributed steam-electric water demand for each county in the region.

Figure 2.7: Lower Colorado Region Steam Electric Water Demand Projections

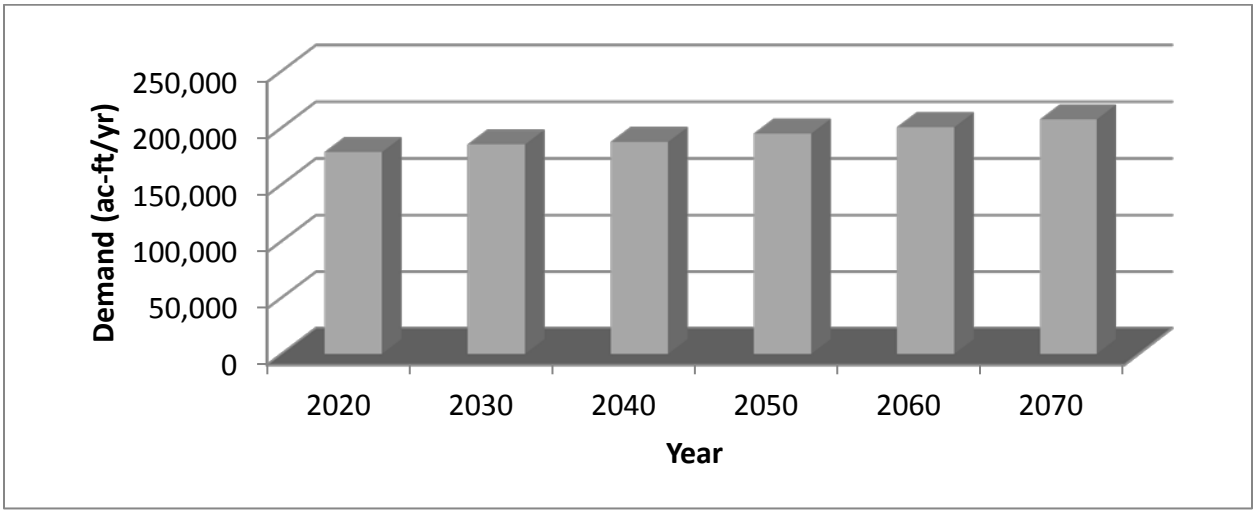


Table 2.10 Steam-Electric Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	14,000	16,720	16,720	16,720	16,720	16,720
Blanco	0	0	0	0	0	0
Burnet	0	0	0	0	0	0
Colorado	0	0	0	0	0	0
Fayette	35,702	35,702	37,802	44,102	48,602	53,402
Gillespie	0	0	0	0	0	0
Hays (p)	0	0	0	0	0	0
Llano	2,500	2,500	2,500	2,500	2,500	2,500
Matagorda	105,000	105,000	105,000	105,000	105,000	105,000
Mills	0	0	0	0	0	0
San Saba	0	0	0	0	0	0
Travis	18,500	22,500	22,500	23,500	24,500	26,500
Wharton (p)	2,751	2,813	2,888	2,980	3,091	3,197
Williamson (p)	0	0	0	0	0	0
TOTAL	**178,453**	**185,235**	**187,410**	**194,802**	**200,413**	**207,319**

(p) Denotes that the county is shared between multiple regions. The steam-electric demand shown is only the portion within the Lower Colorado Region.

* Steam-electric water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A.*

The majority of the Lower Colorado Region's steam-electric power generation facilities are located along the Colorado River, and nearly all steam-electric demands are within the Colorado River Basin. The projected steam-electric water demand by basin is shown in *Table 2.11*.

Table 2.11 Steam-Electric Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	0	0	0	0	0	0
Brazos-Colorado	351	413	488	580	691	797
Colorado	178,102	184,822	186,922	194,222	199,722	206,522
Colorado-Lavaca	0	0	0	0	0	0
Guadalupe	0	0	0	0	0	0
Lavaca	0	0	0	0	0	0
TOTAL	**178,453**	**185,235**	**187,410**	**194,802**	**200,413**	**207,319**

2.3.5 Mining Water Demand Projections

2.3.5.1 Methodology

TWDB mining water usage projections were developed through a TWDB-contracted study with the Bureau of Economic Geology. The study estimated current mining water use and projected that use across the planning horizon utilizing data collected from trade organizations, government agencies, and other industry representatives. Individual projections were made for sectors including oil and gas, aggregates, coal and lignite, and other mining activities. These projections were then summed for each county. The Lower Colorado Region requested revisions to TWDB draft mining projections, for Blanco, Colorado, Llano, Mills, and Williamson counties, based on information provided by Lower Colorado Region members. The TWDB staff approved the revision request. Further details on the revision request are provided in Appendix 2C.

2.3.5.2 Regional Mining Water Demand Projections

Mining water demands for the Lower Colorado Region are projected to increase almost 68 percent over the planning horizon, to 34,961 acre-feet per year in 2070. The total projected regional mining water demands are shown in *Figure 2.8*, and *Table 2.12* presents the projected mining water demand distributed for each county. As in other areas of Texas, hydraulic fracturing activities are expected to influence mining water demands in the future, although this activity is difficult to anticipate and quantify in many instances.

Mining water demand in the Lower Colorado Region is predominantly located in the Colorado River Basin, and the demands by river basin are shown in *Table 2.13*.

Figure 2.8: Lower Colorado Region Mining Water Demand Projections

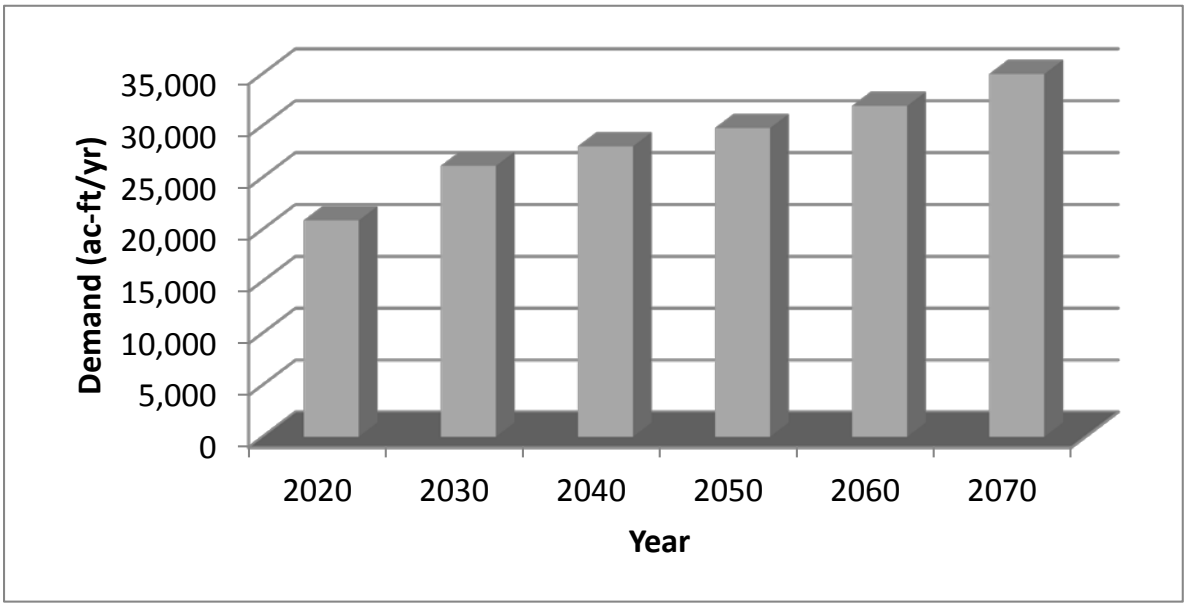


Table 2.12 Mining Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	2884	6813	7498	8263	9085	9996
Blanco	5	5	5	5	5	5
Burnet	4490	5412	6379	7255	8263	9412
Colorado	5325	5378	5433	5487	5542	5597
Fayette	2526	2032	1465	918	359	350
Gillespie	4	4	4	4	4	4
Hays (p)	845	1075	1361	1445	1654	1893
Llano	3	3	3	3	3	3
Matagorda	96	100	75	55	35	22
Mills	4	4	4	4	4	4
San Saba	1088	1093	944	900	864	838
Travis	3502	4108	4762	5374	6046	6817
Wharton (p)	71	74	55	41	26	17
Williamson (p)	5	3	3	3	3	3
TOTAL	**20,848**	**26,104**	**27,991**	**29,757**	**31,893**	**34,961**

(p) Denotes that the county is shared between multiple regions. The mining demand shown is only the portion within the Lower Colorado Region.

* Mining water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A.*

Table 2.13 Mining Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	1,303	1,767	2,050	2,315	2,616	2,958
Brazos-Colorado	252	257	234	218	199	189
Colorado	18,327	23,002	24,702	26,286	28,204	30,890
Colorado-Lavaca	41	42	32	23	15	10
Guadalupe	305	483	496	512	532	585
Lavaca	620	553	477	403	327	329
TOTAL	**20,848**	**26,104**	**27,991**	**29,757**	**31,893**	**34,961**

2.3.6 Livestock Water Demand Projections

2.3.6.1 Methodology

The TWDB livestock water demand projections utilized an average of TWDB's 2005-2009 livestock water use estimates as a base. Water use estimates apply a water use coefficient for each livestock category to county level inventory estimates from the Texas Agricultural Statistics Service. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base. The Lower Colorado Region requested minor increases to most county livestock demand estimates, based on knowledge and input from Lower Colorado Region members. The TWDB approved the revision request. Further details are provided in *Appendix 2C*.

2.3.6.2 Regional Livestock Water Demand Projections

Livestock water demand for the Lower Colorado Region represents a small portion of total regional water demand and is projected to remain constant over the 50-year planning period. This constant projected demand of 14,012 acre-feet per year is reflected in *Figure 2.9*. Livestock water demand by county is presented in *Table 2.14*, and the rural counties indicate more livestock farming activities.

Figure 2.9: Lower Colorado Region Livestock Water Demand Projections

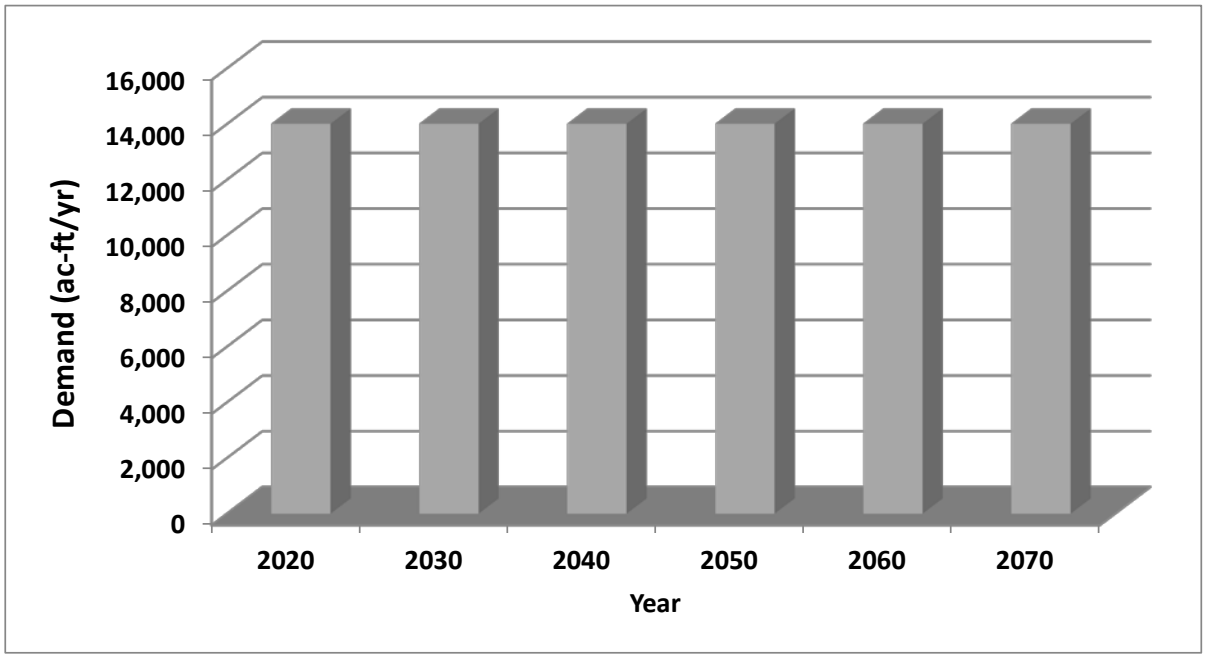


Table 2.14 Livestock Water Demand Projections by County* (ac-ft/yr)

County	2020	2030	2040	2050	2060	2070
Bastrop	1,522	1,522	1,522	1,522	1,522	1,522
Blanco	564	564	564	564	564	564
Burnet	835	835	835	835	835	835
Colorado	1,590	1,590	1,590	1,590	1,590	1,590
Fayette	2,397	2,397	2,397	2,397	2,397	2,397
Gillespie	1,062	1,062	1,062	1,062	1,062	1,062
Hays (p)	220	220	220	220	220	220
Llano	751	751	751	751	751	751
Matagorda	1,503	1,503	1,503	1,503	1,503	1,503
Mills	944	944	944	944	944	944
San Saba	1,191	1,191	1,191	1,191	1,191	1,191
Travis	704	704	704	704	704	704
Wharton (p)	728	728	728	728	728	728
Williamson (p)	1	1	1	1	1	1
TOTAL	**14,012**	**14,012**	**14,012**	**14,012**	**14,012**	**14,012**

(p) Denotes that the county is shared between multiple regions. The livestock demand shown is only the portion within the Lower Colorado Region.

* Livestock water demand projections by city, county, and portion of a river basin within a county for each of the 14 counties in the Lower Colorado Region are provided in *Appendix 2A.*

Livestock water demand in the Lower Colorado Region is located predominantly in the Colorado River Basin and noted in *Table 2.15*.

Table 2.15 Livestock Water Demand Projections by River Basin (ac-ft/yr)

River Basin	2020	2030	2040	2050	2060	2070
Brazos	727	727	727	727	727	727
Brazos-Colorado	1,238	1,238	1,238	1,238	1,238	1,238
Colorado	10,043	10,043	10,043	10,043	10,043	10,043
Colorado-Lavaca	788	788	788	788	788	788
Guadalupe	365	365	365	365	365	365
Lavaca	851	851	851	851	851	851
TOTAL	**14,012**	**14,012**	**14,012**	**14,012**	**14,012**	**14,012**

2.4 ENVIRONMENTAL WATER DEMANDS

Although not an official water demand use category in TWDB rules, environmental water demands are recognized as a significant consideration in regional water planning by the Lower Colorado Region. These demands are considered necessary to preserve a healthy aquatic ecosystem within the region. In particular, planning for and meeting environmental water demands have been determined necessary to protect the habitat associated with the Lower Colorado River and Matagorda Bay.

2.4.1 The Story/History of Matagorda Bay [1, 2, 3, 4, 5]

Matagorda Bay has an interesting and varied history. The earliest map that contained the Texas Gulf Coast was by Alonzo Alvarez de Pineda in 1513. The next explorer was probably Cabeza de Vaca in 1528 followed by Don Luis de Moscoso de Alverado in 1542. The ill-fated LaSalle expedition in 1685 resulted in an active renewal of interest by the Spanish government. In a subsequent expedition by Alonzo de Leon in 1689, the first recorded description of the "Raft" in the Colorado River appeared; refer to *Figure 2.10* for a map of Matagorda Bay in 1705.

The raft was a vast accumulation of drift logs, snags, whole trees, and brush in sections miles in length and 40 to 50 feet thick growing at a rate of about 500 feet per year. In the years after the establishment of Matagorda by Stephen F. Austin's initial colony (Austin 300) the raft continued to grow, refer to *Figure 2.11* for a map of Austin's Colony and Matagorda Bay. The U.S. Army Corps of Engineers (USACE) was enrolled to clear the raft to enable river navigation from Matagorda, the number two port in Texas, inland to central Texas. In 1853 the decision was made to bypass the raft by digging a canal parallel to the river. This allowed riverboat traffic for about six years, but by 1860 the growing raft again prevented navigation. The intervention of the civil war prevented any additional work on the raft. While

[1] *Bay City and Matagorda County – A History*, Pages 4, 8, 16, 165, 166
[2] *Corralling the Colorado*, Page 7
[3] *Historic Matagorda County*, Pages 135, 139
[4] Originally authored by Haskell Simon, Vice Chairman Region K, modified for this report
[5] Additional information from *Flood to Faucet* and interviews with Earl Eidelbach, LCRA from *The Daily Tribune*

the periodic floods had always been a problem, the restoration of the raft, which grew to an estimated 40 miles in length and extended into Wharton County, greatly exacerbated flooding damage.

In 1923 Governor Pat Neff approved legislation that resulted in the retaining of General George W. Goethus, who built the Panama Canal. His plan was to clear a path along the East Bank, removing key logs and allowing the force of the river to clear the raft. Not much was accomplished until a major flood came in 1929. In one massive flushing action the huge mass was washed into Matagorda Bay.

The delta formed by this enormous conglomeration of sediment and debris that had been washed into Matagorda Bay and continued to grow outward into the Bay until it connected the mainland to Matagorda Peninsula, forming a five mile long land bridge, land locking the Seaport of Matagorda and dividing Matagorda Bay into East Matagorda Bay and West Matagorda Bay.

In 1935 the Drainage District cut a channel through the peninsula connecting the Colorado River to the Gulf of Mexico. This caused most of the natural flow of the river to go directly into the Gulf of Mexico, refer to *Figure 2.12* for a map of the development of the Colorado River Delta.

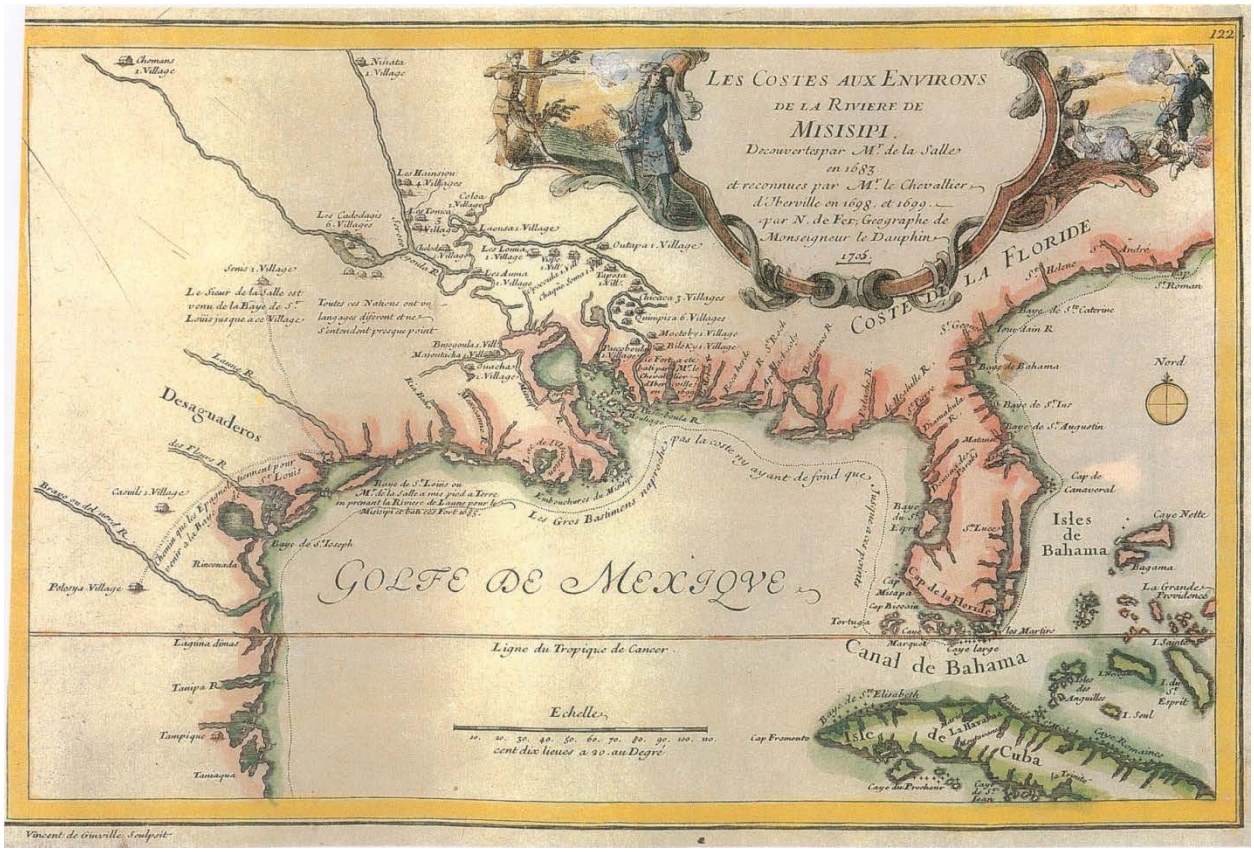
In 1990 the USACE agreed to the next major alteration affecting Matagorda Bay. In order to construct a jetty system at the mouth of the Colorado River in the Gulf of Mexico, a diversion channel was added to the overall design as recommended by the resource agencies. This would divert essentially 100 percent of the river flow into the east end of West Matagorda Bay. This project was completed in 1991. The USACE also closed Parker's Cut (Tiger Island Cut), the channel connecting the Colorado River to West Matagorda Bay, refer to *Figures 2.13* and *2.14*.

Recently, efforts were made to reopen Parker's Cut to accommodate recreational fishing by shortening travel time to the fishing areas. The resource agencies oppose the reopening believing it would be detrimental to fisheries production. Finally a compromise was reached that would open a channel into the Bay just North of the diversion dam. This would allow access to the Bay without going through the locks, but with minimal diversion of fresh water.

In less than 75 years major alterations have been made that dramatically and dynamically changed the characteristics of the Bay. The river flow into Matagorda Bay was reduced significantly, and then it was back to almost 100 percent discharge into West Matagorda Bay by the early 1990s. There are other sources that contribute to the freshwater inflows of Matagorda Bay in addition to the contributions by the Colorado River, but these flows have not been measured and are occasionally overlooked.

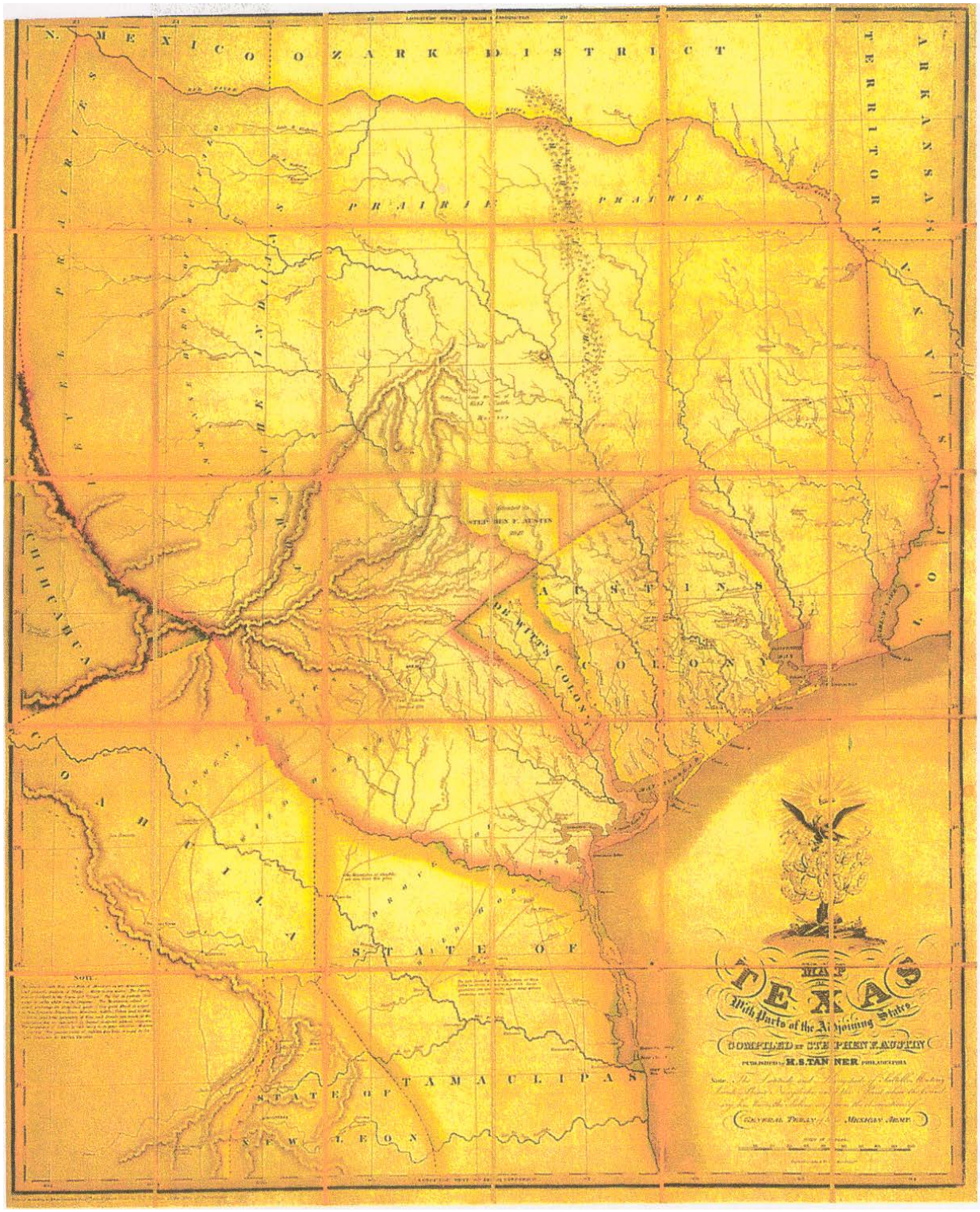
It is difficult to determine the effect of these changes on the Bay's performance. Most entities seem to agree that short-term analysis or comparisons will not yield significant "cause and effects." Certainly with the major changes in the geography and hydrology of the Bay, it is questionable how useful older data may be. One thing is certain; Matagorda Bay, unlike other Texas Bays, has seen major changes in the last 75 years.

Figure 2.10: Matagorda Bay in 1705



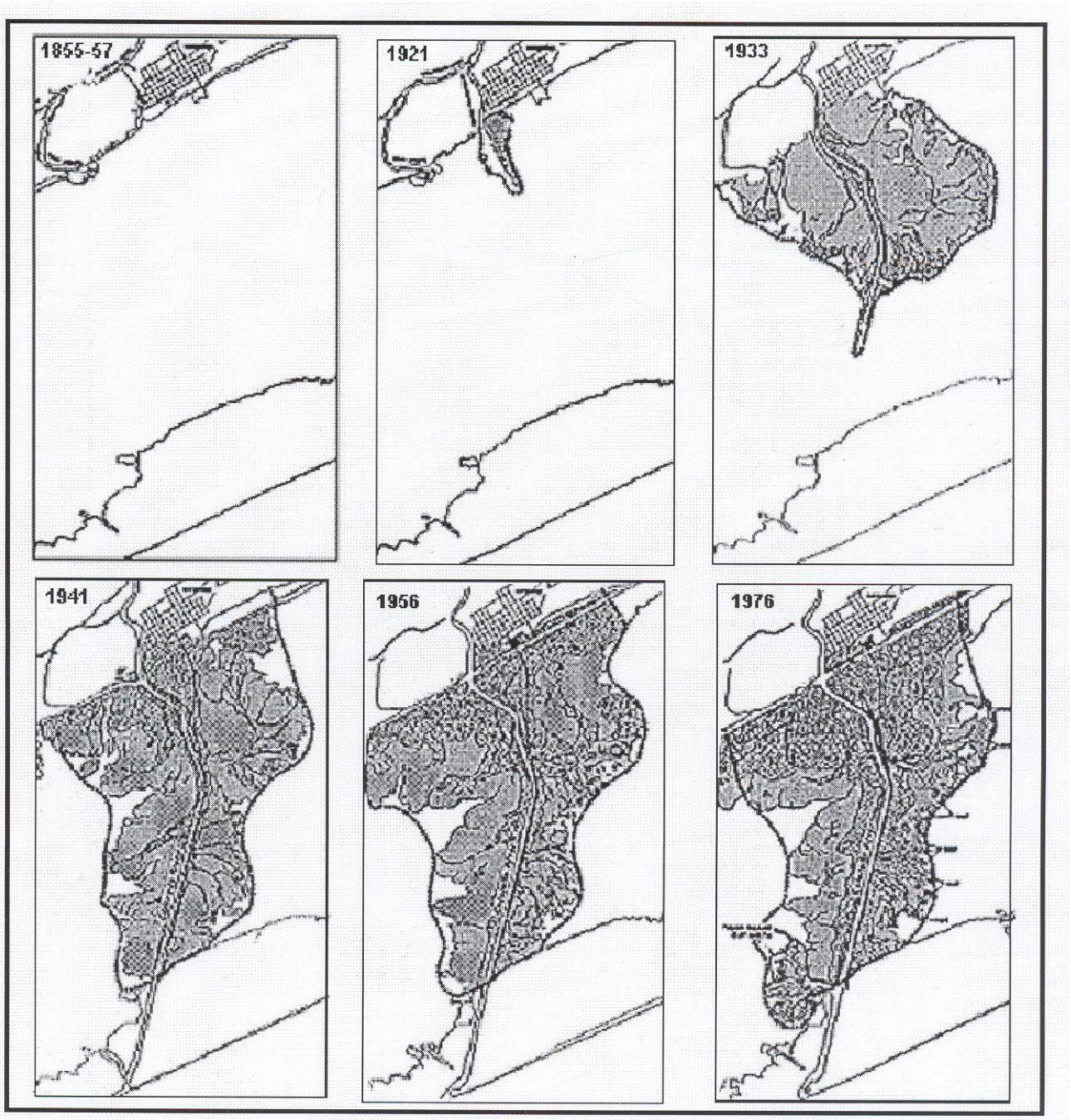
Nicolas de Fer 1705 – Collection of F. Carrington Weems Houston, Texas as shown in *Maps of Texas and the Southwest 1513-1900* by James C. Martin and Robert Sidney Martin, Page 49.

Figure 2.11: Austin's Colony and Matagorda Bay



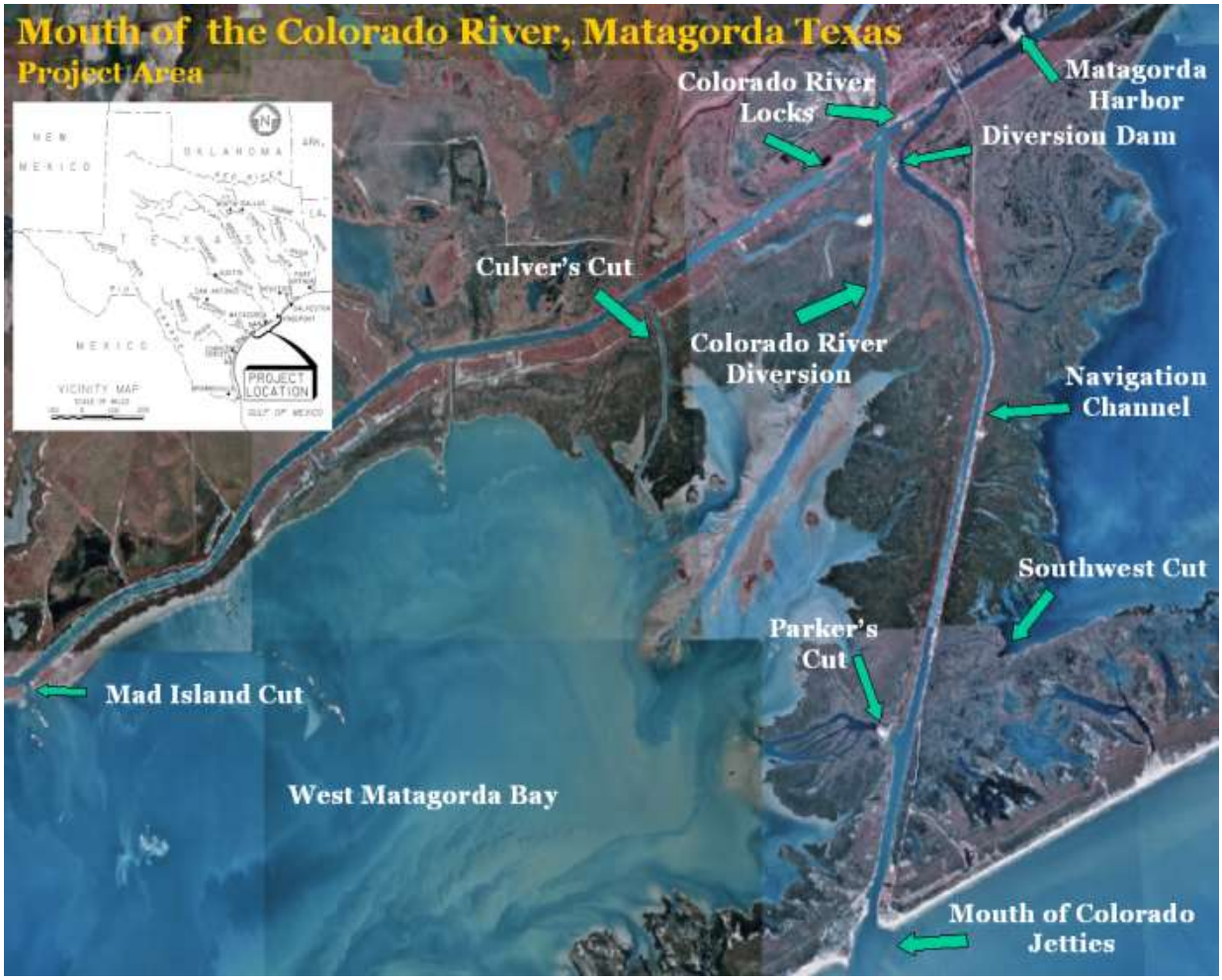
Stephen F. Austin, 1830 – The San Jacinto Museum of History as shown in *Maps of Texas and the Southwest 1513-1900* by James C. Martin and Robert Sidney Martin, Page 52.

Figure 2.12: Development of Colorado River Delta



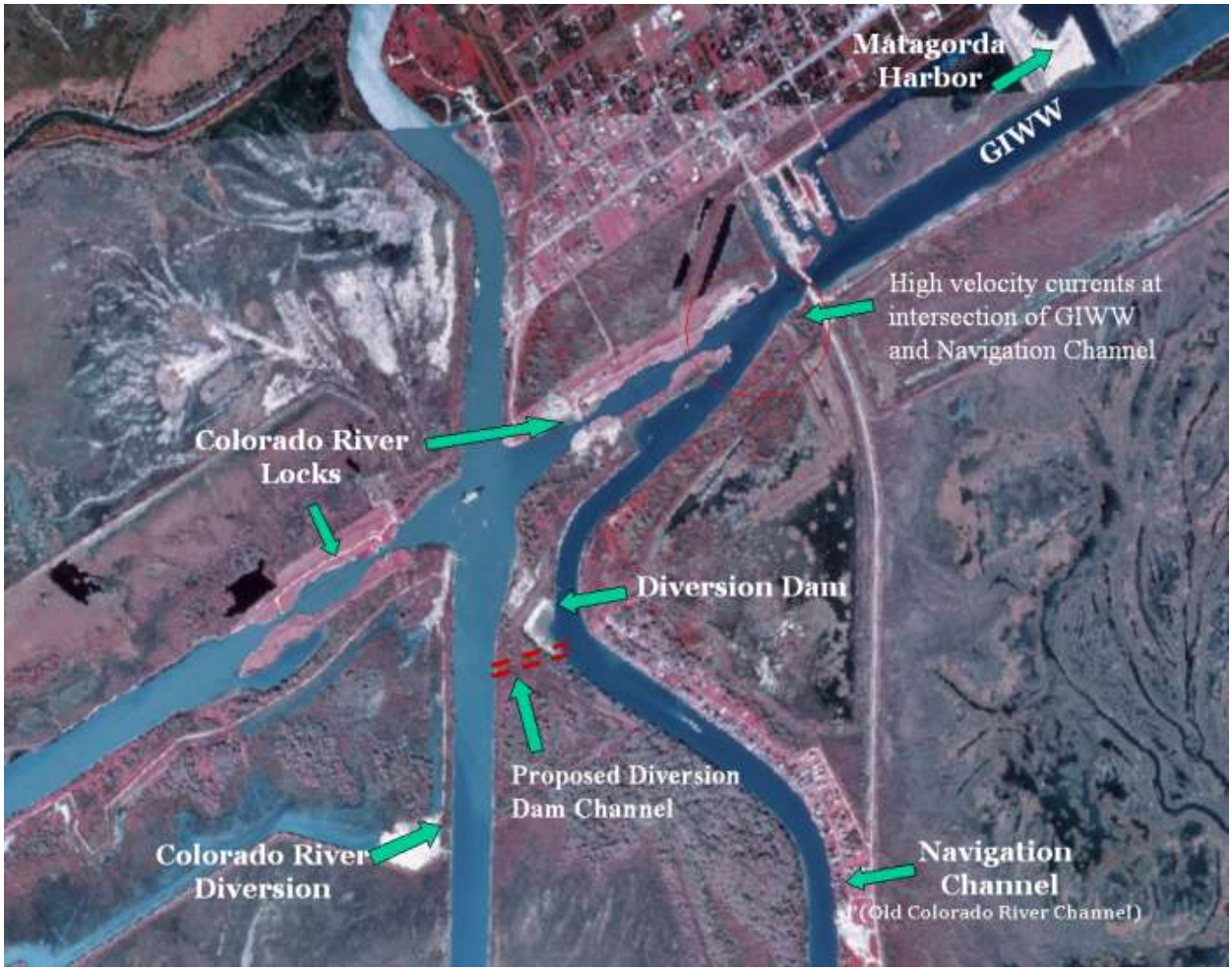
Delta Development – Mouth of Colorado River Project Assessment Report Coastal Technology Corporation (Adapted from USGS, Tobin & Kargl)

Figure 2.13: Mouth of the Colorado River, Matagorda Texas



USACE Galveston District webpage:
http://www.swg.usace.army.mil/items/ColoradoRiver/MOC.asp

Figure 2.14: Colorado River Diversion Channel and Navigation Channel



USACE Galveston District webpage:
http://www.swg.usace.army.mil/items/ColoradoRiver/MOC.asp

2.4.2 Lower Colorado River Authority Water Management Plan

LCRA operates under a Water Management Plan (WMP) that defines the Authority's water management programs and policies. More specifically, the WMP guides how water is allocated from lakes Travis and Buchanan during a drought, and is an operational plan designed to ensure LCRA can meet firm customer demands without shortage through a repeat of the Drought of Record. The WMP sets forth conditions under which LCRA can provide interruptible stored water for irrigated agriculture, and helps address the environmental flow needs of the lower Colorado River and Matagorda Bay. The WMP is developed by LCRA, reviewed and approved by the Texas Commission on Environmental Quality (TCEQ), and has evolved over the years in response to changing conditions and new information.

The current WMP was approved by TCEQ in 2010. After a lengthy stakeholder process, the LCRA Board of Directors in 2012 adopted proposed amendments to the 2010 WMP and submitted them to TCEQ for approval. In May 2014, TCEQ provided LCRA with a draft report containing proposed revisions to the amendments submitted by LCRA in 2012. The revisions being considered by the LCRA Board of Directors incorporate most of the concepts in the draft report from TCEQ, in addition to taking into account a 35,000 acre-foot per year demand expected to begin in 2015, when the city of Corpus Christi begins using its Garwood water rights.

Due to the ongoing severe drought in the Lower Colorado Basin, LCRA requested TCEQ grant emergency relief from the 2010 WMP during 2012, 2013, 2014, and 2015. TCEQ granted the emergency requests for each of the four years. The emergency orders reduced the possibility of reaching a Drought Worse than Drought of Record conditions under the WMP, which would trigger a requirement for LCRA's firm customers to implement pro rata curtailment and also possibly cause the waste of interruptible water by cutting off the water in mid-crop. As a result of the emergency orders, most downstream farmers did not receive stored water from the Highland Lakes during these years, and in 2014 and 2015, LCRA's requirements for maintaining minimum stream flows in the river for the Blue Sucker were temporarily reduced.

On August 20, 2014 the LCRA Board of Directors directed staff to meet with interested parties and stakeholders in August and September 2014 to review the modeling used in developing the staff recommendation and consider adjustments that are consistent with the following criteria:

- Maintaining combined storage above 600,000 acre-feet through a repeat of historic hydrology;
- Including additional hydrology through 2013;
- Adding a 35,000 acre-foot per year demand associated with Corpus Christi's Garwood water rights; and
- Including a three-tier regime for interruptible agricultural customers that considers storage and inflow conditions, plus the use of a look-ahead test. The structure includes three curtailment conditions: extraordinary drought, less severe drought and normal conditions, for decisions on whether and how much stored water from the Highland lakes would be available for interruptible customers.

The LCRA Board approved the revised WMP framework at its September 17, 2014 meeting. LCRA staff finalized the WMP revision for submission to the TCEQ, which must approve the WMP and any changes to it. The amended and restated application was submitted to TCEQ on October 31, 2014.

2.4.3 Current Instream Flow Requirements for the Colorado River[6]

The Lower Colorado Regional Water Planning Group does not have the resources to perform studies to determine appropriate instream flow requirements for the Colorado River. Therefore, data as previously developed by the Lower Colorado River Authority (LCRA) is presented here.

LCRA completed an analysis of instream flow needs for the Colorado River in June 1992. Based on those studies, LCRA generated instream flow recommendations for critical and target flows. These flows are included in the 2010 LCRA Water Management Plan.

Critical flow requirements are those necessary to maintain species population during severe drought conditions. From the LCRA analysis, it is recommended that a flow of at least 46 cfs be maintained at the Austin gage at all times. If this flow should occur for an extended period of time, then operational releases will be made by LCRA to temporarily alleviate these low flow conditions. Specifically, if flow at the Austin gage is less than 65 cfs daily average for 21 consecutive days, the LCRA will make operational releases from storage sufficient to maintain daily average flow at the Austin gage of at least 200 cfs for two consecutive days. If this operational release condition persists for three consecutive cycles (69 days), then a minimum average daily flow of at least 75 cfs will be maintained for the next 30 days. A mean daily flow of 100 cfs is also maintained at the Austin gage to the extent of inflows to Lakes Buchanan and Travis, except during times of drought, when a minimum mean daily flow of 75 cfs is maintained to the extent inflows are available. In addition to the flow requirements at the Austin gage, a mean daily discharge of 120 cfs will be maintained at the Bastrop gage. This minimum flow will be maintained in order to provide adequate water quality conditions in the Colorado River. During a six-week period within the months of March, April, and May, a minimum flow of 500 cfs will be maintained at the Bastrop gage.

Target flows, provided on a mean daily basis, are those necessary to provide an optimal range of habitat complexity for the support of a well-balanced native aquatic community. These flow regimes (described in *Table 2.16*) are considered optimal ranges and should be maintained whenever water resources are adequate. However, these flows should be classified as interruptible demand subject to curtailment during drought conditions. Since native fish species are adapted to normal seasonal variations in flow regimes, target flows were adjusted monthly to emulate the annual cycle.

In addition to critical and target flow requirements, periodic high flow conditions (or scouring flood flows) are needed to prevent siltation and dense macrophytic growth from occurring in the Colorado River.

Total commitments of the Combined Firm Yield from the Highland Lakes for instream flow maintenance will be an average of 27,380 ac-ft/yr, with a maximum of 51,100 ac-ft in any one year; 85,700 ac-ft in any two consecutive years; 114,2000 ac-ft in any three consecutive years; 147,700 ac-ft in any four consecutive years; 184,500 ac-ft in any five consecutive years; 212,200 ac-ft in any six consecutive years; 245,600 ac-ft in any seven consecutive years, and 273,800 ac-ft in any eight to ten consecutive years.

[6]Taken from information provided by the LCRA.

Table 2.16 Instream Flow Requirements for the Colorado River (2010 LCRA WMP)

Month	Critical Flows (cfs)		Target Flows (cfs)		
	Austin Gage [c]	Bastrop Gage	Bastrop Gage	Eagle Lake	Egypt
January	46	120	370	300	240
February	46	120	430	340	280
March	46	500 [b]	560	500 [a]	360
April	46	500 [b]	600	500 [a]	390
May	46	500 [b]	1,030	820	670
June	46	120	830	660	540
July	46	120	370	300	240
August	46	120	240	200	160
September	46	120	400	320	260
October	46	120	470	380	310
November	46	120	370	290	240
December	46	120	340	270	220

Source: LCRA 2010 *Water Management Plan*.

[a] Since target flow at Eagle Lake (based on overall community habitat availability) were insufficient to meet Blue Sucker (Cycleptus elongatus) spawning requirements during March and April, target flows were superseded by critical flow recommendations for this reach.

[b] This flow should be maintained for a continuous period of not less than six weeks during these months. A flow of 120 cfs will be maintained on all days not within the six week period.

[c] LCRA will maintain a mean daily flow of 100 cfs at the Austin gage at all times, to the extent of inflows each day to the Highland Lakes as measured by upstream gages, until the combined storage of Lakes Buchanan and Travis reaches 1.1 million acre-feet of water. A mean daily flow of 75 cfs, to the extent of inflows each day to the Highland Lakes as measured by upstream gages, will then be maintained until the combined storage of Lakes Buchanan and Travis reaches 1.0 million acre-feet of water, then a subsistence/critical flow of 46 cfs will be maintained at all times, regardless of inflows.

In addition, if the subsistence/critical flow of 46 cfs should occur for an extended period of time, then operational releases will be made by LCRA to temporarily alleviate the subsistence/critical flow conditions. Specifically, should the flow at the Austin gage be below a 65 cfs daily average for a period of 21 consecutive days, LCRA will make operational releases from storage sufficient to maintain daily average flow at the Austin gage of at least 200 cfs for two consecutive days. If this operational release conditions persists for three consecutive cycles (69 days), then a minimum average daily flow of at least 75 cfs will be maintained for the next 30 days.

In 2014, the LCRA Board adopted an amended version of their 2010 Water Management Plan and submitted it to TCEQ for approval. The amended plan is currently still undergoing the review and approval process. The instream flow requirements described in the amendment application for the Water Management Plan are somewhat different from the ones in the 2010 LCRA Water Management Plan, and so are presented below for information purposes.

A comprehensive instream flow study was completed in 2008 that recommended both subsistence flow conditions and base flow conditions, including base-dry and base-average conditions being met approximately 80% and 60% of the time, respectively. The flow recommendations at the Austin, Bastrop, Columbus, and Wharton gauge locations, as included in the draft amendment to the 2010 LCRA Water Management Plan, are provided in the table below.

Table 2.17 Instream Flow Recommendations from Draft Amendment to 2010 LCRA WMP

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Austin											
Subsistence	50	50	50	50	50	50	50	50	50	50	50	50
	Bastrop											
Subsistence	208	274	274	184	275	202	137	123	123	127	180	186
Base-Dry	313	317	274	287	579	418	347	194	236	245	283	311
Base-Average	433	497	497	635	824	733	610	381	423	433	424	450
	Columbus											
Subsistence	340	375	375	299	425	534	342	190	279	190	202	301
Base-Dry	487	590	525	554	966	967	570	310	405	356	480	464
Base-Average	828	895	1,020	977	1,316	1,440	895	516	610	741	755	737
	Wharton											
Subsistence	315	303	204	270	304	371	212	107	188	147	173	202
Base-Dry	492	597	531	561	985	984	577	314	410	360	486	470
Base-Average	838	906	1,036	1,011	1,397	1,512	906	522	617	749	764	746

2.4.4 Current Bay and Estuary Requirements

The Lower Colorado Regional Water Planning Group does not have the resources to perform the studies to determine appropriate freshwater inflow needs requirements for the Colorado-Lavaca estuary. Therefore, we present data that has been developed by LCRA and the state resource agencies, TPWD, TWDB, and TCEQ.

The Colorado-Lavaca estuary is the second largest estuary on the Texas Gulf Coast. This estuary, also known as the Matagorda Bay system, covers 352 square miles. While Matagorda Bay is the largest body of water, other major bays in the estuary system are Lavaca, East Matagorda, Keller, Carancahua, and Tres Palacios Bay.

In 1985 the Texas Legislature directed TPWD and TWDB to continue studies of the estuaries to determine freshwater inflow requirements to be considered in the allocation of the State's water resources. These studies were to have been completed by December 31, 1989. However, due to a lack of funding, changes in priorities, and other factors, they have been delayed. To expedite the completion of this study, LCRA entered into a cooperative agreement with TPWD, TWDB, and TNRCC (now TCEQ) in 1993. The LCRA agreed to modify existing methods used by TPWD and TWDB and to apply those methods to compute alternative freshwater needs for the estuary.

The freshwater inflow needs were estimated by a methodology developed in conjunction with the TPWD and TWDB, and is similar to methodologies used for other Texas estuaries. The first major element in this process is the development of statistical relationships for the interactions between freshwater inflows and important indicators of estuarine ecosystem conditions. The parameters that were considered in this analysis are: salinity, species productivity, and nutrient inflows. The next major step in this process involves using the statistical functions to compute optimal monthly and seasonal freshwater inflow needs. This is accomplished using TWDB's Texas Estuarine Mathematical Programming (TxEMP) Model. The TxEMP model estimates the freshwater inflow needs of an estuary by representing mathematically the varied and complex interactions between freshwater inflows and salinity, species productivity, and

nutrient inflows. The third major element in the process of developing inflow needs is the simulation of the salinity conditions throughout the estuary using the TxBLEND model developed by TWDB and modified by the LCRA. The application of the TWDB methodology and the resulting estimates of freshwater inflow needs are documented in "Freshwater Inflow Needs of the Matagorda Bay System" (LCRA 1997).

The freshwater inflow needs for the estuarine ecosystem associated with the Matagorda Bay system were estimated for two levels: target and critical. Target inflow needs were determined as the monthly and seasonal inflows that produced 98 percent of the maximum normalized population biomass for nine key estuarine finfish and shellfish species while maintaining specified salinity, population density, and nutrient inflow conditions. The critical inflow needs were determined by finding the minimum total annual inflow needed to keep salinity at or below 25 parts per thousand near the mouths of the Colorado and Lavaca Rivers. These inflow needs are termed critical since they provide a fishery sanctuary habitat during droughts.

Results of the 1997 needs analysis indicate that target freshwater inflows need to be approximately 2.0 million ac-ft/yr. Of this, it is estimated that the Colorado River will need to contribute 1,033,100 ac-ft annually. For critical freshwater inflow needs, approximately 171,000 ac-ft of the total required 287,400 ac-ft/yr must come from the Colorado River. The critical and target freshwater inflow needs from the 1997 study are included in the LCRA 2010 Water Management Plan and are presented below in *Table 2.18*.

LCRA's total commitments of the Combined Firm Yield from lakes Buchanan and Travis for bays and estuaries (estuarine inflows), reflected for this planning effort include an average of 6,060 ac-ft/yr, with a maximum of 20,660 ac-ft in any one year; 23,570 ac-ft in any two consecutive years; 23,680 ac-ft in any three consecutive years; 32,220 ac-ft in any four consecutive years; 40,800 ac-ft in any five consecutive years; 41,400 ac-ft in any six consecutive years; 47,800 ac-ft in any seven consecutive years, and 60,600 ac-ft in any eight to ten consecutive years (LCRA's bay and estuary commitments are in accordance with LCRA's 2010 water management plan).

Table 2.18 Colorado River Critical and Target Freshwater Inflow Needs for the Matagorda Bay System

Month	1997 FINS Freshwater Inflows (1,000 ac-ft)[1]	
	Critical	Target
January	14.26	44.1
February	14.26	45.3
March	14.26	129.1
April	14.26	150.7
May	14.26	162.2
June	14.26	159.3
July	14.26	107.0
August	14.26	59.4
September	14.26	38.8
October	14.26	47.4
November	14.26	44.4
December	14.26	45.2
Annual Totals	**171.1**	**1,033.1**

[1] Schedule of flows is designed to optimize biodiversity/productivity under normal rainfall. Under drought conditions, target flows should be curtailed in accordance to the severity of the drought and flows should be maintained at or above critical levels based on water quality considerations.

In 2014, the LCRA Board adopted an amended version of their 2010 Water Management Plan and submitted it to TCEQ for approval. The amended plan is currently still undergoing the review and approval process. The bay and estuary freshwater inflow requirements described in the amendment application for the Water Management Plan are computed from a different methodology than the ones in the 2010 LCRA Water Management Plan, and so are presented below for information purposes. The text and *Tables 2.19* and *2.20* provided below are taken directly from the 2012 Amendment to the 2010 LCRA Water Management Plan.

> "The Matagorda Bay Health Evaluation (MBHE) used the latest data and science to assess the relationship between various factors and bay conditions. Several measures of bay health were investigated, including salinity, habitat condition, species abundance, nutrient supply and benthic condition. The computer models and data analysis in the study were used to develop inflow criteria for the Colorado River. Salinity, habitat and benthic modeling were used to develop criteria for most levels, but additional measures of bay health were used wherever possible."

Table 2.19 Summary of Matagorda Bay Health Evaluation (MBHE) Inflow Levels

Inflow Level	Descriptions
Threshold	Refuge conditions for all species and habitat
MBHE-1	Maintain tolerable oyster reef health, benthic character, and habitat conditions
MBHE-2	Provide inflow variability and sustain oyster reef health, benthic condition, low estuarine marsh, and shellfish and forage fish habitat
MBHE-3	Provide inflow variability and support quality oyster reef health, benthic condition, low estuarine marsh, and shellfish and forage fish habitat
MBHE-4	Provide inflow variability and support high levels of primary productivity, and high quality oyster reef health, benthic condition, low estuarine marsh, and shellfish and forage fish habitat

"The recommended Colorado River inflows from the MBHE study were designed to cover the full range of inflow conditions into Matagorda Bay, with a regime that incorporates five levels of inflow, each with an associated desired achievement guideline. The lowest level, "Threshold," is a fixed monthly value to provide refuge conditions that would ideally be achieved 100% of the time. The remaining levels, MBHE-1 through MBHE-4, represent different inflow targets that were recommended to be achieved with the following frequencies: MBHE-1, 90%; MBHE-2, 75%; MBHE-3, 60%; and MBHE-4, 35%. The levels all include seasonal variability and incorporate influxes of fresh water into the Bay in the spring and fall that reflect the natural pattern of inflows into the bay."

Table 2.20 Matagorda Bay Health Evaluation (MBHE) Inflow Values (acre-feet)

Inflow Category	Spring (3 month total)	Fall (3 month total)	Intervening (6 month total)	Monthly
Threshold	-	-	-	15,000
MBHE-1	114,000	81,000	105,000	-
MBHE-2	168,700	119,900	155,400	-
MBHE-3	246,200	175,000	226,800	-
MBHE-4	433,200	307,800	399,000	-

Additional details related to the incorporation of the Matagorda Bay Health Evaluation freshwater inflows into the LCRA Water Management Plan can be found in the 2012 or 2014 Amendment to the 2010 LCRA Water Management Plan on the LCRA website at www.lcra.org.

2.4.5 Current TCEQ Environmental Flow Requirements

House Bill (HB) 3 and Senate Bill (SB) 3, passed during the 80th Legislature in 2007, require the TCEQ to adopt environmental flow standards for the river basin and bay systems in Texas. From that, the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays Basin and Bay Stakeholder Committee (BBASC) and Basin and Bay Expert Science Team (BBEST) were formed.

The Final Environmental Flows Recommendations Report from the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays BBEST was completed on March 1, 2011. Then on August 30, 2011, the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays BBASC submitted the Environmental Flows Recommendation Report to the Texas Environmental Flows Advisory Group, co-chaired by Senator Troy Fraser and Senator Allen Ritter, and to the Executive Director of the TCEQ.

On August 8, 2012, the TCEQ adopted environmental flow standards for the Colorado and Lavaca Rivers, and Matagorda and Lavaca Bays that became effective on August 30, 2012. The standards can be found at http://www.tceq.state.tx.us/assets/public/legal/rules/rules/pdflib/298d.pdf. The priority date for the standards is March 1, 2011, and "will be used in the water availability determination for a new appropriation or for an amendment to an existing water right that increases the amount of water authorized to be stored, taken, or diverted…"

The current TCEQ environmental flow standards will be discussed further in Chapter 5, as part of the evaluation of water management strategies that involve a new appropriation or amendment to an existing water right.

2.5 WHOLESALE WATER PROVIDERS

Each regional water planning group designates wholesale water providers, which are persons or entities having contracts to sell more than 1,000 acre-feet of water wholesale. The Lower Colorado Region designated two wholesale water providers for the 2016 Plan: the Lower Colorado River Authority (LCRA) and the City of Austin (COA). Associated water demands for these wholesale water providers are identified within the plan. The City is also a water customer of the LCRA, and together these entities supply a large portion of the Lower Colorado Region's water needs.

The intent of TWDB water planning requirements is to ensure that there is an adequate future supply of water for each entity that receives all or a significant portion of its current water supply from another entity. This requires an analysis of projected water demands and currently available water supplies for the primary supplier, each of its wholesale customers, and all of the suppliers in the aggregate as a "system." For example, a city that serves both retail customers within its corporate limits as well as other nearby public water systems would need to have a supply source(s) that is adequate for the combined total of future retail water sales and future wholesale water sales. If there is a "system" deficit currently or in the future, then recommendations are to be included in the regional water plan with regard to strategies for meeting the "system" deficit.

2.5.1 City of Austin

The City of Austin provides water for municipal, manufacturing, and steam-electric water uses. The City's existing service area covers portions of Travis, Williamson, and Hays Counties. *Table 2.21* presents the municipal and manufacturing water demands for the City. These water demands consist of the City's service area water demands and its wholesale water commitments to various communities and retail water systems primarily located within its Extra-Territorial Jurisdiction. The wholesale commitments represent contract amounts as reported by the City. For a complete list of the City's wholesale water commitments refer to Chapter 3.

Table 2.21 Projected Municipal and Manufacturing Water Demands for City of Austin Service Area (ac-ft/yr)

County/WUG	2020	2030	2040	2050	2060	2070
Hays County						
Austin	13	127	249	631	1,519	2,749
Travis County						
Austin	157,445	182,933	209,973	229,887	246,590	266,411
Wholesale Commitments [1]	10,126	4,309	4,350	4,436	4,529	4,620
County-Other [2]	4,520	4,108	3,740	3,138	2,298	1,555
Manufacturing	35,430	48,350	63,498	72,631	81,421	91,270
Williamson County						
Austin	7,697	9,541	11,841	14,317	17,126	20,208
Wholesale Commitments [3]	892	863	839	826	823	823
County-Other [4]	2,586	3,504	3,467	3,451	3,444	3,441
Total	**218,709**	**253,735**	**297,957**	**329,317**	**357,750**	**391,077**

[1] The wholesale commitments in Travis County include the following WUGs: Creedmoor-Maha WSC, Lost Creek MUD, Manor, a portion of North Austin MUD #1, Northtown MUD, Rollingwood, Shady Hollow MUD, Sunset Valley, Travis County WCID #10, and a portion of Wells Branch MUD.

[2] County-Other in Travis County consists of several small communities, which are too small to be considered WUGs.

[3] The wholesale commitments in Williamson County include the following WUGs: a portion of North Austin MUD #1, and a portion of Wells Branch MUD.

[4] County-Other in Williamson County consists of several small communities, which are too small to be considered WUGs.

Travis County-Other water demands decrease due to annexations by the City, which correspondingly increase the City's water demand. The City is responsible for supplying a significant portion of the County-Other water in Travis County. This County-Other demand consists of demand for both individual service connections that are outside the city limits and demands for other public water systems served by the City.

Table 2.22 presents the City of Austin's proposed steam-electric water demands in Fayette and Travis Counties. The City's portion of the South Texas Project (STP) demand is included in the STP total steam-electric demand in Matagorda County.

Table 2.22 Projected Steam-Electric Water Demands for City of Austin Service Area (ac-ft/yr)

County/WUG	2020	2030	2040	2050	2060	2070
Fayette County						
Steam Electric [1]	14,702	14,702	14,702	18,702	20,702	22,702
Travis County						
Steam Electric	18,500	22,500	22,500	23,500	24,500	26,500
Total	**33,202**	**37,202**	**37,202**	**42,202**	**45,202**	**49,202**

[1] City of Austin portion - based on estimated current supply levels and approved projections.

2.5.2 Lower Colorado River Authority

LCRA supplies water for municipal, agricultural (irrigation), manufacturing, steam-electric, mining, and other water uses. The LCRA currently supplies water to entities in Bastrop, Burnet, Colorado, Fayette, Hays, Lampasas (Region G), Llano, Matagorda, San Saba, Travis, Wharton, and Williamson (the portion of Williamson in Region G) counties. *Table 2.23* presents a summary of LCRA commitments to water user groups in the Lower Colorado Region (Region K) and Region G.

As with the City of Austin, the municipal County-Other water commitments actually consist of water that is supplied to several smaller retail water customers.

Table 2.23 LCRA Water Commitment Summary (ac-ft/yr)

County/WUG	2020	2030	2040	2050	2060	2070
Bastrop County						
County-Other	744	744	744	744	744	744
Irrigation	955	955	955	955	955	955
Steam Electric	16,720	16,720	16,720	16,720	16,720	16,720
Burnet County						
Burnet	4,100	4,100	4,100	4,100	4,100	4,100
Cottonwood Shores	495	495	495	495	495	495
Granite Shoals	830	830	830	830	830	830
Horseshoe Bay (also in Llano Co.)	2,225	2,225	2,225	2,225	2,225	2,225
Marble Falls	3,000	3,000	3,000	3,000	3,000	3,000
Meadowlakes	75	75	75	75	75	75
County-Other	2,205	2,205	2,205	2,205	2,205	2,205
Irrigation	416	416	416	416	416	416
Manufacturing	500	500	500	500	500	500
Colorado County						
Irrigation [1, 10]	124,385	121,039	117,783	114,614	111,532	108,531
Fayette County						
County-Other	102	102	102	102	102	102
Steam Electric (LCRA)	38,101	38,101	38,101	38,101	38,101	38,101
Steam Electric (COA)	7,016	7,016	7,016	7,016	7,016	7,016
Gillespie County						
County-Other	56	56	56	56	56	56
Hays County						
Dripping Springs	506	506	506	506	506	506
Dripping Springs WSC	1,126	1,126	1,126	1,126	1,126	1,126
County-Other	1,401	1,401	1,401	1,401	1,401	1,401
Llano County						
Kingsland WSC (also in Burnet Co.)	1,150	1,150	1,150	1,150	1,150	1,150
Sunrise Beach Village	200	200	200	200	200	200
County-Other	3,586	3,586	3,586	3,586	3,586	3,586
Irrigation	1,514	1,514	1,514	1,514	1,514	1,514
Steam Electric	2,500	2,500	2,500	2,500	2,500	2,500
Mason County (Region F)						
Irrigation	59	59	59	59	59	59
Mining	2	2	2	2	2	2
Matagorda County						
Manufacturing	14,222	14,222	14,222	14,222	14,222	14,222
Irrigation [2, 10]	181,906	176,942	172,112	167,412	162,839	158,388
Steam Electric [3]	32,240	32,226	32,202	32,172	32,142	32,120

[1] The Colorado Irrigation interruptible commitment represents 75 percent of the Colorado County Irrigation demand.

[2] The Matagorda Irrigation interruptible commitment represents 87 percent of the Matagorda County Irrigation demand.

[3] The Matagorda Steam Electric value is based on the Region K Cutoff Model results for the average annual amount of LCRA backup supplies needed to supplement the STPNOC/LCRA water right during a repeat of the drought of record.

Table 2.23 LCRA Water Commitment Summary (ac-ft/yr) (Continued)

County/WUG	2020	2030	2040	2050	2060	2070
San Saba County						
County-Other	20	20	20	20	20	20
Travis County						
Austin - Municipal [4]	123,626	123,626	123,626	123,626	123,613	123,559
Austin - Steam Electric [5]	16,156	16,156	16,156	16,156	16,156	16,156
Briar Cliff Village	400	400	400	400	400	400
Cedar Park [6]	2,767	2,767	2,767	2,767	2,767	2,767
The Hills	1,600	1,600	1,600	1,600	1,600	1,600
Lago Vista	6,500	6,500	6,500	6,500	6,500	6,500
Lakeway	3,069	3,069	3,069	3,069	3,069	3,069
Loop 360 WSC	1,250	1,250	1,250	1,250	1,250	1,250
Pflugerville	12,000	12,000	12,000	12,000	12,000	12,000
Point Venture	360	360	360	360	360	360
Travis County MUD #14	4,316	4,316	4,316	4,316	4,316	4,316
Travis County WCID #17	9,299	9,299	9,299	9,299	9,299	9,299
Travis County WCID #18	1,736	1,736	1,736	1,736	1,736	1,736
Travis County WCID #20	1,135	1,135	1,135	1,135	1,135	1,135
West Travis County PUA [7]	9,450	9,450	9,450	9,450	9,450	9,450
County-Other	14,617	14,617	14,617	14,617	14,617	14,617
Irrigation	2,596	2,596	2,596	2,596	2,596	2,596
Manufacturing	282	282	282	282	282	282
Williamson County (Region G)						
Cedar Park [6] (also in Travis County)	15,233	15,233	15,233	15,233	15,233	15,233
Leander [8] (also in Travis County)	24,000	24,000	24,000	24,000	24,000	24,000
Brazos River Authority	25,000	25,000	25,000	25,000	25,000	25,000
Wharton County						
Irrigation [9, 10]	116,726	113,586	110,531	107,557	104,664	101,848
TOTAL	836,494	825,041	813,886	803,024	792,442	782,109

[4] The Austin-Municipal value is based on the Region K Cutoff Model results for the amount of LCRA backup supplies needed to supplement Austin's municipal water rights during a repeat of the drought of record.

[5] The Austin-Steam Electric value is based on the Region K Cutoff Model results for the amount of LCRA backup supplies needed to supplement Austin's steam-electric water rights during a repeat of the drought of record.

[6] Cedar Park is located in both Region K and Region G.

[7] West Travis County PUA serves multiple water user groups including the Village of Bee Cave, Barton Creek West WSC, and County-Other.

[8] Leander is located in both Region K and Region G.

[9] The Wharton Irrigation interruptible commitment represents 55 percent of the total Wharton County Irrigation demand.

[10] These are not firm commitments.

APPENDIX 2A

TWDB DB17 REPORTS
LCRWPG POPULATION AND WATER DEMAND PROJECTIONS

APPENDIX 2B

LOWER COLORADO REGIONAL WATER PLANNING AREA GALLONS PER CAPITA DAILY (GPCD)

REGION K MUNICIPAL WATER DEMAND SAVINGS DUE TO PLUMBING CODES AND WATER-EFFICIENT APPLIANCES

APPENDIX 2C

REVISION REQUEST SUBMITTALS TO THE TWDB BY REGIONAL WATER PLANNING GROUP REGARDING POPULATION, MUNICIPAL, AND NON-MUNICIPAL PROJECTIONS FOR THE 2016 REGIONAL WATER PLANNING CYCLE