2010

RIO GRANDE
REGIONAL WATER PLANNING GROUP

Rio Grande Regional Water Plan

Final Plan:
October 1, 2010

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EXECUTIVE SUMMARY

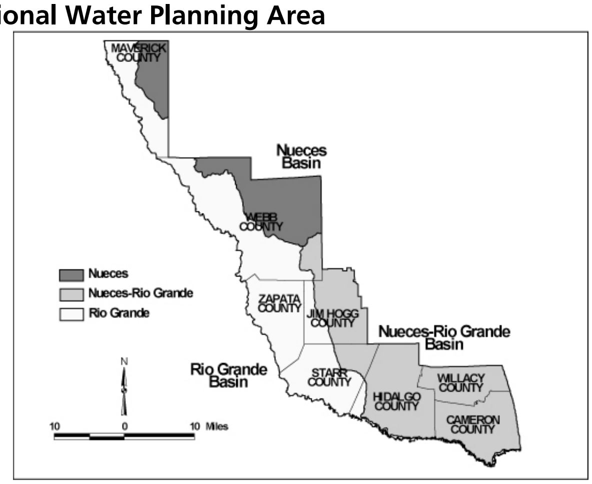
Introduction: Overview of the Regional Water Planning Process

In 1997, the 75th Texas Legislature enacted Senate Bill 1 (SB 1), often referred to as the Brown-Lewis Water Management Plan after its Senate and House sponsors. The legislation grew out of the drought of the early to mid 1990s and the increasing public awareness of rapidly growing water demands in the state. The issues and concerns addressed in SB 1 included state, regional, and local planning for water conservation, water supply and drought management, administration of state water rights programs, interbasin transfer policy, groundwater management, water marketing, state financial assistance for water-related projects, and state programs for water data collection and dissemination.

SB 1 radically altered the manner in which state water plans are prepared, establishing a "bottom up" approach based on regional water plans that are prepared and adopted by appointed regional water planning groups (RWPGs) representing 11 different stakeholder interests. There are 16 RWPGs; the members serve without compensation. The planning process is coordinated by the Texas Water Development Board (TWDB), which assembles the 16 regional water plans into one comprehensive State Water Plan.

Initially designated by TWDB as "Region M," the Rio Grande Regional Water Planning Area (or the Rio Grande Region) consists of the eight counties adjacent to or in proximity to the middle and lower Rio Grande. They are: Cameron, Hidalgo, Jim Hogg, Maverick, Starr, Webb, Willacy, and Zapata (see Exhibit 1).

Exhibit 1: Rio Grande Regional Water Planning Area



The Rio Grande RWPG now consists of 19 members representing all 11 interest group categories specified in SB 1 (see Exhibit 2 for membership as of April 1, 2010). In addition to its voting membership, the Rio Grande RWPG includes non-voting members representing state agencies and the Mexican federal government.

Exhibit 2: Rio Grande Regional Water Planning Group

INTEREST	NAME	RESIDENT COUNTY
Public	Mary Lou Campbell, Secretary* Mercedes	Hidalgo
Counties	John Wood County Commissioner, Brownsville	Cameron
Municipalities	Roberto Gonzalez* Water Works, Eagle Pass	Maverick
	John Bruciak, General Manager Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez City of Laredo	Webb
Industries	Donald K. McGhee Hydro Systems, Inc., Harlingen	Cameron
Agriculture	Robert E. Fulbright* Hinnant & Fulbright, Hebbronville	Jim Hogg
	Ray Prewett Texas Citrus Mutual, Mission	Hidalgo
Environmental	Sonia Najera The Nature Conservancy	Cameron
Small Business	Carlos Garza AEC Engineering, LLC., Edinburg	Hidalgo
Electric Generating Utilities	Ella de la Rosa Magic Valley Electric Cooperative	Hidalgo
River Authorities	James Darling, Vice-Chairman* Rio Grande Regional Water Authority	Hidalgo
Water Districts	Sonny Hinojosa HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Charles Browning North Alamo Water Supply Corp., Edinburg	Hidalgo
Other	Glenn Jarvis, Chair* Attorney, McAllen	Hidalgo

The first round of regional water planning culminated with the State Water Plan of 2002. The second round of planning began later that year and ended in 2006 with the incorporation of revised regional water plans into the 2007 State Water Plan "Water for Texas." This third round of regional water planning took place from 2007 to 2010. The results of these efforts will be included in the 2011 State Water Plan. The third round of regional water planning involved updating population and water demand projections, and analyses of new water management strategies.

Chapter Summaries

The remainder of this Executive Summary provides a synopsis of each chapter.

- Chapter 1 presents a description of the regional water planning area. This includes information regarding current water uses and major water demand centers, sources of surface and groundwater supply, agricultural and natural resources, and the demographic and socioeconomic characteristics of the region. Also included are summaries of existing regional water plans, recommendations in the current state water plan, and local water plans, as well as an assessment of threats to agricultural and natural resources.

- Chapter 2 presents current and projected population and water demands. This information is reported by city and county and for the portion of each river basin within the Rio Grande Region. Water demand projections are presented for six water use categories: municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock.
- Chapter 3 provides a total analysis of the region's water supply.
- Chapter 4 identifies and evaluates selected water management strategies based on needs.
- Chapter 5 analyzes the impacts of water management strategies on key parameters of water quality and the impacts of moving water from rural and agricultural areas.
- Chapter 6 describes consolidated water conservation and drought management recommendations of the regional water plan.
- Chapter 7 describes how the regional plan is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources.
- Chapter 8 presents recommendations for unique stream segments, reservoir site, and legislative options.
- Chapter 9 provides recommendations to the Legislature on funding for water infrastructure.
- Chapter 10 describes public participation, facilitation, and plan implementation issues.

Physical Description of the Rio Grande Region

The climate of the Rio Grande Region ranges from a humid subtropical regime in the eastern portion of the region to a tropical and subtropical regime in the remaining portion of the region. Prevailing winds are southeasterly throughout the year and the warm tropical air from the Gulf of Mexico produces hot and humid summers and relatively mild and dry winters.

Average annual net lake evaporation in the Rio Grande Region varies from 40 to 44 inches at the coast to approximately 60 to 64 inches at the central portion of the region near southern Webb County. The amount of rainfall varies across the Lower Rio Grande Region from an average of 28 inches at the coast to 18 inches in the northwestern portion of the region. Most precipitation occurs during the spring from April through June, and during the late summer and early fall, from August through October.

The Rio Grande Region is located entirely within the Western Gulf Coastal Plains of the United States, an elevated sea bottom with low topographic relief. Topography in the region ranges from a rolling, undulating relief in the northwestern portion becoming progressively flatter near the Gulf Coast. The Rio Grande flows southeasterly through the region before turning east to its confluence with the Gulf of Mexico.

In general, soils in the Rio Grande Region generally consist of calcareous to neutral clays, clay loams and sandy loams.

The Lower Rio Grande Valley is the northern boundary of much of the semitropical biota of Mexico. A number of plant and animal species from the more xeric and mesic areas to the west and northeast, respectively, converge in the area.

The lower Laguna Madre is a hypersaline bay, most of which lies in the eastern portions of Cameron and Willacy counties. Shallow depth, extensive seagrass meadows, and tidal flats characterize it. The lower Laguna Madre supports a wide variety of marine aquatic organisms and wildlife.

Public and private interests have created several refuges and preserves in the Lower Rio Grande Valley to protect remaining vegetation and the habitats of endangered and threatened species. These include the Lower Rio Grande Valley National Wildlife Corridor/Refuge, Laguna Atascosa National Wildlife Refuge (NWR), Santa Ana NWR, Anzalduas County Park, Falcon State Park (SP), Bentsen-Rio Grande Valley SP, Boca Chica SP, Las Palomas Wildlife Management Area (WMA), Arroyo Colorado WMA, Sabal Palm Audubon Center and Sanctuary, the Nature Conservancy's Chihuahua Woods Preserve, and the SouthBay Coastal Preserve.

Demographic and Socioeconomic Characteristics of the Rio Grande Region

The South Texas border region has seen significant growth over the past 40 years. Gross regional product in this region quadrupled from $5.3 billion in 1970 to $20.3 billion in the 2000's. During the same period, employment in the South Texas border region was 177,000, but by 2008 had grown to 537,000. In 2000, the region accounted for 6.7 percent of the population and 4.4 percent of the state's employment base.

Exhibit 3: Rio Grande Region Counties Eligible for EDAP Assistance

Under Section 17.923 of the Water Code
Texas Water Development Board

Counties	Average Unemployment Rate 2006-2008 (%)	Percent Above State Rate	Average Per Capita Income 2006-2008 ($)	Percent Below State Rate
Texas Average	4.7	n/a	36,940	n/a
Cameron	6.5	39.3	19,146	-48.2
Hidalgo	7.1	51.1	17,853	-51.7
Maverick	11.8	151.1	16,231	-56.1
Starr	11.4	142.6	13,464	-63.6
Webb	5.2	10.6	20,843	-43.6
Willacy	8.8	87.2	19,740	-46.6
Zapata	5.7	21.3	16,978	-54.0

The TWDB has classified seven out of the eight counties in the Rio Grande Region as eligible for assistance through the Economically Distressed Assistance Program (EDAP). EDAP eligibility is limited to counties with an unemployment rate higher than 25 percent of the state average over the latest three-year period and an average per capita income rate 25 percent below the state average.

Current and Projected Population & Water Demand for the Rio Grande Region

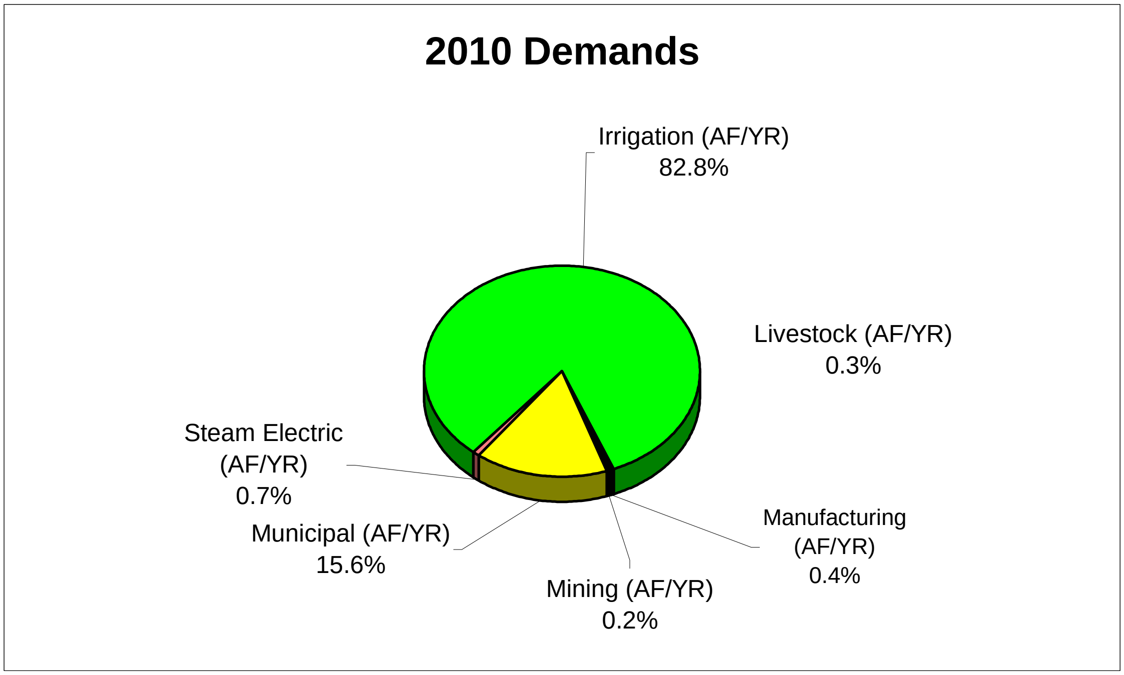
The TWDB projects population in the eight counties comprising the Rio Grande Regional Water Planning Area will more than double from 2010 to 2060.

Exhibit 4: County Population Projections

County Name	2010	2020	2030	2040	2050	2060
Cameron	424,762	510,697	599,672	688,532	777,607	862,511
Hidalgo	775,858	987,920	1,225,227	1,481,812	1,761,811	2,048,909
Jim Hogg	5,593	5,985	6,286	6,538	6,468	6,225
Maverick	58,252	67,929	77,165	85,292	92,831	99,091
Staff	69,379	83,583	98,262	113,102	127,802	141,961
Webb	257,647	333,451	418,332	511,710	613,774	721,586
Willacy	22,763	25,212	27,455	29,276	30,542	31,205
Zapata	14,025	16,217	18,415	20,486	22,354	23,733
Totals	**1,628,279**	**2,030,994**	**2,470,814**	**2,936,748**	**3,433,188**	**3,935,223**

Total annual water demand for the region is projected to decrease from 2010 until 2030, and then steadily *increase* until 2060. This trend is attributable to diminishing irrigated acreage and rising urban populations, especially in the Rio Grande Valley, as land use changes from agriculture to urbanization. Water demand for irrigation in the region is projected to fall from the current 82.8% of total water use to 59.1% by 2060. During the same period, municipal water demands are projected to increase from almost 16% to almost 38%.

Exhibit 5: Total Water Demands by Type of Use, 2010 and 2060



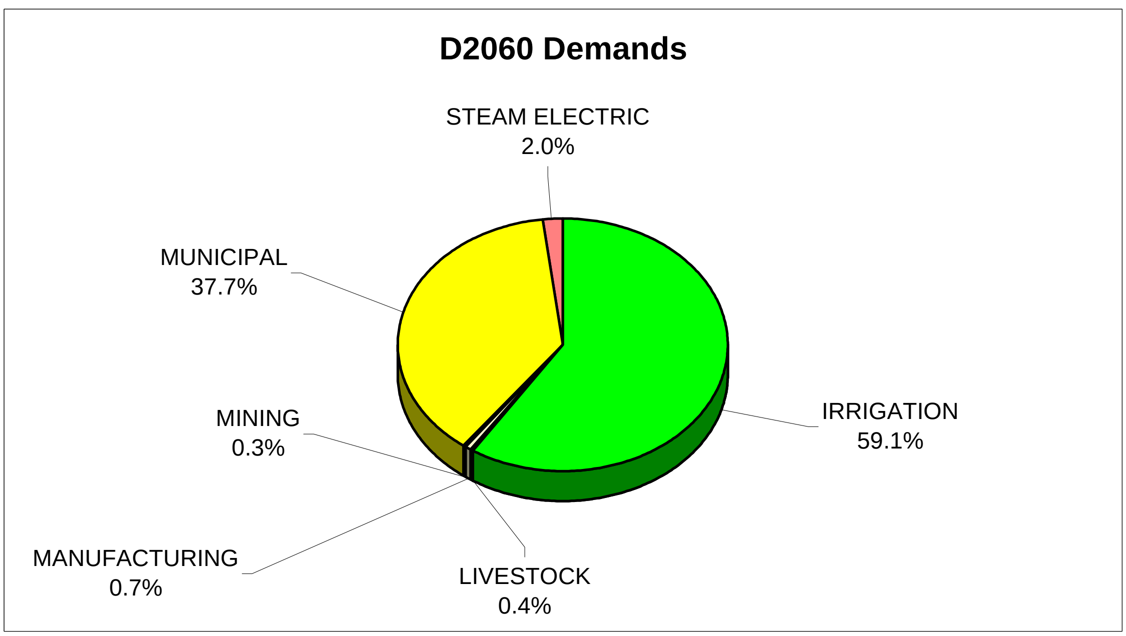


Exhibit 6: Water Demand Projections (acre-feet/year)

Water Demand Projections	2010	2020	2030	2040	2050	2060
Irrigation (AF/YR)	1,163,634	1,082,232	981,748	981,748	981,748	981,748
Livestock (AF/YR)	5,817	5,817	5,817	5,817	5,817	5,817
Manufacturing (AF/YR)	7,509	8,274	8,966	9,654	10,256	11,059
Mining (AF/YR)	4,186	4,341	4,433	4,523	4,612	4,692
Municipal (AF/YR)	288,323	349,410	416,396	487,858	565,475	646,006
Steam Electric (AF/YR)	13,463	16,864	19,716	23,192	27,430	32,598
Total Water Demand (AF/YR)	1,482,932	1,466,938	1,437,076	1,512,792	1,595,338	1,681,920

Evaluation of the Adequacy of Current Water Supplies

Current Rio Grande Supplies

The Rio Grande Region in Texas encompasses portions of three river basins: the Rio Grande, Nueces, and Nueces-Rio Grande Coastal. However, practically all of the surface water available to and used within the region is from the Rio Grande. Nearly all of the dependable surface water supply is from the combined yield of the Amistad and Falcon International Reservoirs, the two major reservoirs on the Rio Grande. Most of the inflow to this reservoir system comes from the Rio Conchos in the State of Chihuahua, Mexico, and the Pecos River in Texas. The estimated firm yield of the reservoir system (i.e., the amount of water available in the drought of record) for the U.S was approximately 1.01 million acre-feet per year.

This represents more than 94 percent of the total amount of water presently available to the region from all sources (e.g., groundwater, reuse, Rio Grande tributaries, and other local sources). Over time, however, the total dependable water supply from the Rio Grande is projected to decrease significantly, largely as a consequence of reduced conservation storage capacity due to sedimentation of the Amistad/Falcon Reservoir System. Between the years 2010-2060, the firm yield of the reservoir system is projected to decrease by nearly 32,500 acre-feet (approximately 3 percent).

Because of the manner in which available supplies from the Amistad/Falcon Reservoir System are managed and allocated, the impact of declining supplies will be borne directly by irrigation and mining water users. Under the water rights system for the middle and lower Rio Grande, domestic-municipal-industrial (DMI) water rights have a very high degree of reliability. A DMI reserve of 225,000 acre-feet is continually maintained in the reservoir system. By comparison, irrigation and mining water rights are residual users of stored water from the reservoirs.

An additional concern involves the operation of reservoirs in Mexico’s portion of the watershed that contributes flows to the Amistad/Falcon Reservoir System. Mexico has constructed an extensive system of reservoirs on the tributaries, especially in the Conchos River Basin. The combined storage capacity of all of Mexico’s major reservoirs on Rio Grande tributaries is approximately 2.5 times the country’s available conservation storage in Amistad and Falcon Reservoirs. This has serious implications in light of Mexico’s statement that it operates its tributary reservoirs not for the purpose of meeting its obligations under the 1944 Treaty but rather solely to capture water for meeting and expanding its own internal water demands.

Mexico has only recently repaid a long-term deficit in excess of 1 million acre-feet with respect to the minimum tributary inflows to the Rio Grande required by the Treaty. This situation calls into question the certainty the amount of Rio Grande water that will be available in the future to the Texas water right holders.

Other water supply sources for the region include:

- The Arroyo Colorado, which traverses Cameron, Hidalgo, and a small portion of Willacy counties, represents a second potential water supply. Use of the water in the Arroyo Colorado for municipal, industrial or irrigation purposes is severely limited because of poor quality conditions; its daily flows are comprised primarily of return flows from agriculture and municipalities and locally generated runoff. Nonetheless, the Arroyo Colorado is an important source of freshwater inflows to the lower Laguna Madre, which is both economically and ecologically important to the region.

- Groundwater, primarily from the Gulf Coast Aquifer. Most groundwater in the region is of poor quality and cannot be used for agriculture or municipal use without treatment. Technological advances are driving down the costs of desalinating brackish groundwater, and this supply has become an option for municipal use, particularly to meet peak demands
- Reuse or "reclaimed water," which provides about 13,000 acre-feet per year (one percent) for irrigation, manufacturing, and steam electric uses.

Exhibit 7 provides a summary of the total amounts of available current water supplies for the Rio Grande Region by water use category for each decade through 2060.

Exhibit 7: Current and projected water supplies for the Rio Grande Region (AF/yr)

Water Use Category	2010	2020	2030	2040	2050	2060
Irrigation	757,168	750,179	743,691	737,203	730,713	724,724
Municipal	323,884	327,654	330,487	331,411	331,247	331,118
Steam Electric	16,216	16,216	16,216	16,216	16,216	16,216
Livestock	5,817	5,817	5,817	5,817	5,817	5,817
Manufacturing	6,550	6,553	6,556	6,559	6,561	6,564
Mining	4,941	5,088	5,169	5,249	5,329	5,396
Region M Total	**1,114,576**	**1,111,507**	**1,107,936**	**1,102,455**	**1,095,883**	**1,089,835**

Identification, Evaluation, & Selection of Water Management Strategies Based on Needs

The Rio Grande Region faces significant water supply needs even though surpluses of water exist for some categories of use in some counties in some years. In general, deficits in municipal, manufacturing, and steam electric increase over the life of the planning study while irrigation deficits decline due to urbanization. A water supply "need" means that current or projected demands are greater than supply, producing a water supply "deficit" or shortage. Supply in "excess" of demand, on the other hand, results in a water supply "surplus" for the particular user.

Exhibit 8: Water Supply Needs for the Rio Grande Region by Category of Use (AF/yr)

Category Use	2010	2020	2030	2040	2050	2060
Municipal	26,479	64,277	115,311	177,900	252,083	330,625
Manufacturing	1,921	2,355	2,748	3,137	3,729	4,524
Irrigation	407,522	333,246	239,408	245,896	252,386	258,375
Steam Electric	0	1,980	4,374	7,291	11,214	16,382
Mining	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
TOTAL WATER NEEDS (AF/yr)	**435,922**	**401,858**	**361,841**	**434,224**	**519,412**	**609,906**

Exhibit 9: Water Supply Surpluses for the Rio Grande Region by Category of Use (AF/yr)

Catergory of Use	2010	2020	2030	2040	2050	2060
Municipal	59,848	42,521	29,811	21,558	18,064	15,737
Manufacturing	962	634	338	42	34	29
Irrigation	1,056	1,193	1,351	1,351	1,351	1,351
Steam Electric	2,753	1,332	874	315	0	0
Mining	755	747	736	726	717	704
Livestock	0	0	0	0	0	0
TOTAL WATER SURPLUSES (AF/yr)	**65,374**	**46,427**	**33,110**	**23,992**	**20,166**	**17,821**

Opportunities for developing additional water supplies for municipal use are limited in the Rio Grande Region because of hydrologic characteristics, economics, and legal constraints associated with the 1944 Mexico/U.S. Water Treaty. Few opportunities exist to increase the water supply yield of the Rio Grande. However, a number of strategies for augmenting municipal water supplies have been examined as part of this planning effort. These include advanced municipal water conservation, the Brownsville weir and reservoir, reuse of reclaimed water strategies for optimizing surface water supply from the Rio Grande, groundwater development, brackish and seawater desalination, and acquisition of additional Rio Grande supplies for domestic-municipal-industrial (DMI) uses.

Advanced water conservation is aimed at reducing the amount of water used per capita, thereby reducing overall municipal demand. Water rights purchase, water rights acquisition by long-term contract, and water rights acquisition through urbanization all involve transferring rights of Rio Grande water from irrigation usage to DMI usage.

Since municipal water has the highest priority in the Amistad/Falcon system, irrigation water is in a constant state of shortage. Accordingly, conveyance and on-farm improvements are needed to reduce the impact of irrigation shortages. Municipal water management strategies are not cost-effective when applied to irrigation use.

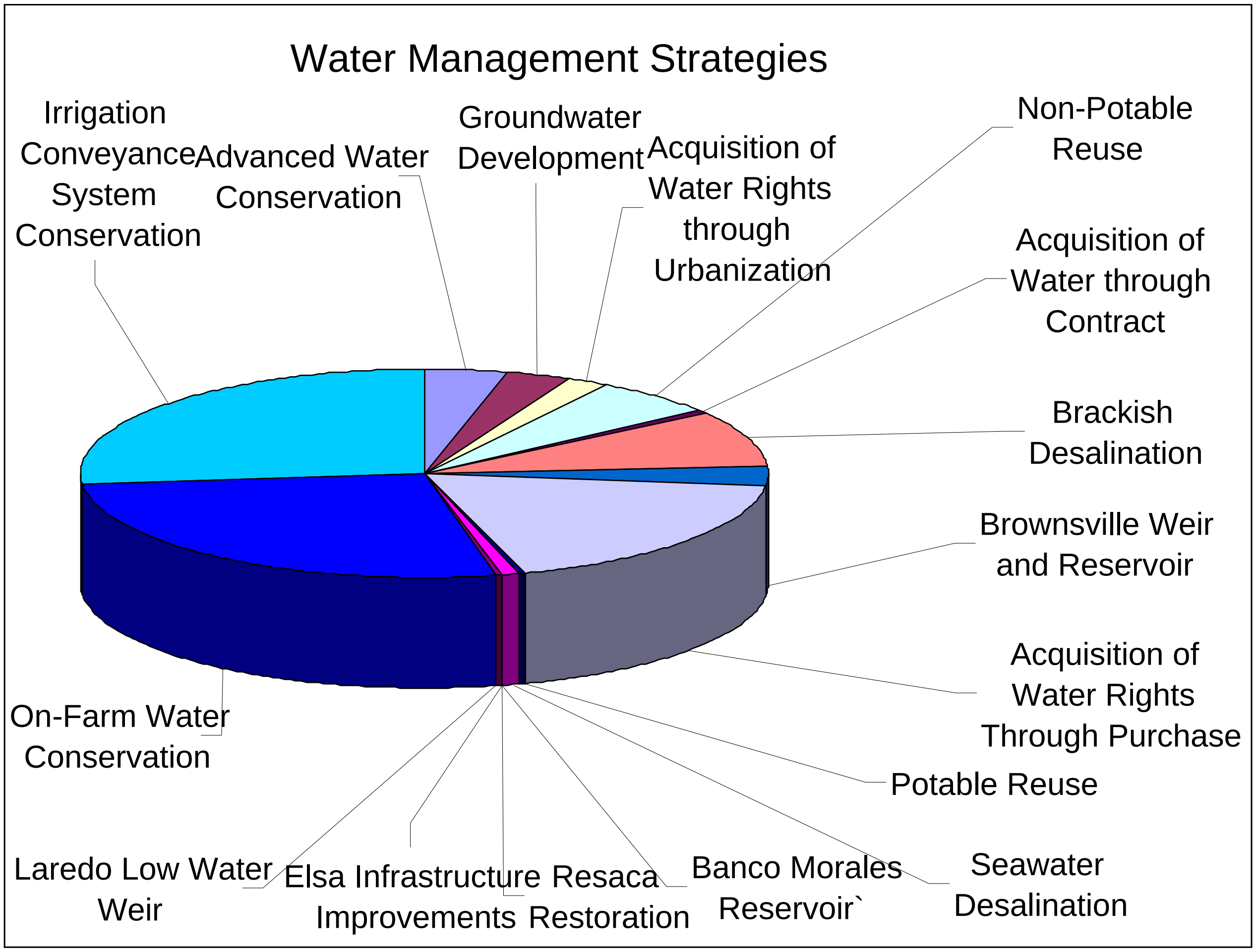
Two water management strategies were evaluated to conserve water and provide additional supply for irrigation use: on-farm improvements and conveyance system efficiency improvements. Technologies and methods currently available for on-farm water conservation include: plastic pipe (poly pipe), low energy precision application, irrigation scheduling using an evapotranspiration network, drip irrigation, metering, unit pricing of water, and growing water-efficient crops. The proposed conveyance efficiency program consists of six principal components: no-leak gates, additional water measurement devices, converting smaller concrete canals in poor condition to pipeline, lining smaller earthen canals, and implementing a verification program to monitor and measure the effectiveness of the efficiency improvements. However, there are few programs that provide financial assistance to irrigation districts for infrastructure improvements. Because agricultural water conservation is a central element of this regional water plan – and is essential to maintaining the viability of this sector of the regional economy – the Rio Grande RWPG recommends that new public funding sources be developed to assist irrigation districts with implementing conservation programs.

The proposed water supply yield and cost per acre-foot associated with each water management strategy (WMS) are shown below.

Exhibit 10: Water Management Strategy Summary

Strategy	**Total Capital Cost**	**Water Supplies Per Decade**					
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Advanced Water Conservation	$ 22,583,710	2917	6339	11986	16512	24867	32793
Groundwater Development	$ 27,474,302	3772	8572	17139	20492	22284	24520
Acquisition of Water Rights through Urbanization	$ 56,167,089	299	3,433	6,467	9,496	12,868	16,406
Non-Potable Reuse	$ 173,803,091	2,417	9,444	12,378	20,137	29,810	46,382
Acquisition of Water through Contract	$ 16,263,877	312	738	1,665	2,352	3,198	4,671
Brackish Desalination	$ 263,599,392	38,364	44,627	48,309	54,472	66,696	71,700
Brownsville Weir and Reservoir	$ 98,411,077	20,643	20,643	20,643	20,643	20,643	23,643
Acquisition of Water Rights Through Purchase	$ 631,081,709	9611	19461	41602	70944	110913	151237
Potable Reuse	$ 7,519,850	1,120	1,120	1,120	1,120	1,120	1,120
Seawater Desalination	$ 185,940,937	125	125	143	6,049	6,421	7,902
Banco Morales Reservoir	$ 25,790,900	238	238	238	238	238	238
Resaca Restoration	$ 52,000,000	877	877	877	877	877	877
Laredo Low Water Weir	$ 294,400,000	0	0	0	0	0	0
Elsa Improved Infratructure	$ 8,325,386	105	105	105	105	105	105
Irrigation							
On-Farm Water Conservation	$ 194,417,692	36,528	73,085	109,614	146,144	182,698	219,228
Irrigation Conveyance System Conservation	$ 130,757,978	91,160	182,313	191,435	200,551	209,667	218,783
TOTAL	**$ 2,188,536,991**	**208,488**	**371,120**	**463,721**	**570,132**	**692,405**	**819,605**

Exhibit 11: Water Management Strategies



Impacts of WMS on Key Parameters of Water Quality and Impacts of Moving Water from Rural and Agricultural Areas

The following table summarizes the impacts of WMS on water quality.

Exhibit 12: Water Quality Impacts by Water Management Strategy

Water Management Strategy	Positive Impacts	Negative Impacts
Additional Groundwater	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased urban runoff during storm event
Advanced Water Conservation	• Decreased wastewater flows	• Increased concentration of organic matter in wastewater
Non-potable Reuse	• Reduced wastewater flows • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive	• Increased urban runoff during storm event

	irrigation • Decreased wastewater flows, resulting in lower organic levels in receiving streams	
Potable Reuse	• Reduced wastewater flows • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation • Decreased wastewater flows result in lower organic levels in receiving streams	• Increased urban runoff during storm event
Dams, Weirs, and Storage • Brownsville Weir • Laredo Low Water Weir • Banco Morales Reservoir • Resaca Restoration	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows resulting in higher organic levels in receiving stream
Purchase of Water Rights	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Acquisition of Water Rights by Urbanization	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Acquisition of Water Rights by Long-term Contracts	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Brackish Desalination	• Improved water quality in wastewater effluent • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased levels of TDS in receiving streams due to concentrate discharge
Seawater Desalination	• Improved water quality in wastewater effluent • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased levels of TDS in receiving streams due to concentrate discharge

Improving Water Infrastructure and Distribution • Improvements to Elsa Infrastructure	• Increase distribution efficiency • Increase storage capacity	• None

Consolidated Water Conservation & Drought Management Recommendations

The Regional Water Plan provides guidance for selecting municipal water conservation strategies specific to the region, agricultural conservation plan for irrigation districts, and a model water conservation plan for a water user group.

The Rio Grande Regional Water Planning Group has incorporated into the 2010 Regional Water Plan strategies presented by the statewide Water Conservation Implementation Task Force in the *Water Conservation Best Management Practices Guide* (TWDB Report 362, Nov. 2004). Recommended strategies include:

- golf course conservation
- metering all new connections & retrofit on existing connections
- showerhead, aerator, and toilet flapper retrofit
- school education
- landscape irrigation conservation
- water wise landscape design
- athletic field conservation
- public information
- rainwater harvesting
- park conservation
- residential clothes washer incentive program

The Regional Water Plan also incorporates the following drought relief options offered by the U.S. Department of Agriculture through the Farm Service Agency: Conservation Reserve Program, Emergency Haying and Grazing Program, Farm Operating Loans, Farm Ownership Loans, Environmental Quality Incentive Program, Non-insured Crop Disaster Assistance Program, Farm Labor Housing Loans and Grants Program, and the Natural Resources Conservation Service.

The Regional Water Plan provides a template for agricultural conservation that follows TCEQ rules governing development of water conservation plans for public water suppliers. These rules define a water conservation plan as "a strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water."

The Regional Water Plan also provides a conservation plan for a water user group. According to TCEQ rules, water conservation plans for public water suppliers must have a utility profile, accurate metering, specification of goals, universal metering, and public education. Most have additional content for public water suppliers that are projected to supply 5,000 or more people in the next ten years and may have additional optional content.

Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

Because the Rio Grande is the main source for both DMI use and irrigation use, optimizing the supply of water available from the river is an important aspect of protecting the state's water, agricultural, and natural resources. A key strategy here is implementing on-farm practices and rehabilitating irrigation systems to conserve water.

There is tremendous potential for water savings in both areas: 219,000 ac-ft through on-farm improvements and 218,000 ac-ft through conveyance system improvements. In the long run, total water savings associated with both strategies would allow irrigators to offset water supply deficits. However, the implementation timeframe will not offer immediate relief.

Another factor impacting the area of resource protection is Mexico's compliance with the 1944 Treaty. Even though Mexico has repaid its water debt, there is little assurance of future compliance should the region be gripped by another severe drought. Texas A&M University studies have shown that the Lower Rio Grande Valley lost nearly $1 billion in decreased economic activity and 30,000 jobs as a direct result of Mexico's failure to comply with its treaty obligations over the period 1992 to 2002.

Environmental flow needs are in the forefront of all issues dealing with long-term protection of the Texas' natural resources. One possibility for maintaining and increasing environmental flows is the acquisition of Rio Grande water rights for environmental usage through the Texas Water Trust. These water rights could be managed to produce sufficient flows throughout the region. However, this option may not be viable because of the current water rights purchase and transfer structure.

Given the WUG format currently being implemented by the TWDB, no option exists to formally allocate projected water supplies for environmental use. Alternatively, environmental flows in the Rio Grande could be included as a separate WUG in the next round of regional planning to ensure minimums would be met in a manner consistent with all other WUGs.

International cooperation from Mexico is critically needed to maintain flow levels. If the United States were to implement an environmental flow program without Mexico's participation, the desired effect would be significantly reduced.

Another of the region's critical environmental issues is the growth of invasive plants such as the spread of salt cedar and other aquatic plants. Unfortunately, eradication methods are both costly and physically strenuous. The natural rise and fall of water elevation in rivers and streams somewhat curtails these plants by drowning out new seedlings.

However, in areas of minimal water flow, a perfect scenario exists for invasive plant growth.

Texas coastal estuaries, where freshwater from inland runoff mixes with the salty waters of the Gulf of Mexico, support an amazing abundance of wildlife. Young fish, shrimp, and crabs feed and hide in brackish estuary waters until they are mature enough to survive in the Gulf of Mexico. Resident and migratory birds by the thousands rest and feed in estuarine marshes. In fact, 95 percent of the Gulf's recreationally and commercially important fish and other marine species rely on estuaries during some part of their life cycle.

Approximately 323,000 AF/yr in new municipal water supplies are proposed in the 2010 Region M water plan. All of this except approximately 2,900 AF/yr of advanced water conservation can affect either freshwater inflows to the Lower Laguna Madre or streamflows in the Rio Grande. Alterations in flows on the Rio Grande are beyond the scope of the present evaluation. For Nueces-Rio Grande coastal basin streams draining to the Lower Laguna Madre there are no major dams, diversions, or other water management strategies proposed that can cause changes in streamflows. However, many of the proposed water management strategies can influence freshwater inflow through alteration of wastewater discharges based upon supplies imported from the Rio Grande basin or groundwater. Many of region's growing municipalities lie in the Nueces-Rio Grande coastal basin and will have greatly altered wastewater discharge into the streams that drain to the Laguna Madre.

The results of National Wildlife Federation analyses indicate no problems for freshwater inflows to the Lower Laguna Madre. The key spring and early summer inflow pulses needed to support strong productivity would not be impacted significantly. Nor would the ability of the Nueces-Rio Grande coastal basin to provide low flows during drought be altered very much. It should be kept in mind that much of the increase in wastewater discharge shown here is based on imports of water into the Nueces-Rio Grande coastal basin. These obviously come at the expense of the neighboring Rio Grande basin. An analogous effort to evaluate flow needs and effects of the Region M plan could be undertaken there in the next cycle of regional water planning.

Unique Stream Segments/Reservoir Sites/Legislative Recommendations

TWDB rules allow the RWPG to include in the regional water plan recommendations concerning legislative designation of ecologically unique streams, sites for future reservoir development, and policy issues. The Rio Grande RWPG elected to consider recommendations in each of these areas.

Ecologically Unique Stream Segments

State law prohibits state agencies and local units of government from developing a water supply project that would destroy the ecological value of a river or stream segment that has been designated by the Texas Legislature as ecologically unique. Furthermore, the

TWDB cannot finance water supply projects located on a stream segment that has been designated as ecologically unique.

TWDB rules specify the criteria that are to be applied in the evaluation of potential ecologically unique river or stream segments. These are: biological function, hydrologic function, riparian conservation areas, high water quality/exceptional aquatic life/high aesthetic value, and threatened or endangered species/unique communities.

To assist the Rio Grande RWPG, the Texas Parks and Wildlife Department (TPWD) developed a list of candidate stream segments in each region that appear to meet the criteria for designation as ecologically unique. The Rio Grande RWPG also received suggestions from the U.S. Fish & Wildlife Service, Zapata County, and the Texas Shrimp Association through two stakeholder “focus group” meetings during the first round of planning.

The Rio Grande RWPG reviewed the nominations submitted by TPWD and others with regard to legislative designation of river or stream segments as ecologically unique. The group elected not to include any recommendations.

Reservoir Sites

TWDB rules also provide that RWPGs “may recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation and the expected beneficiaries of the water supply to be developed at the site.”

Three reservoir sites have been considered by the Rio Grande RWPG: the proposed Brownsville Weir and Reservoir; the proposed Banco Morales Reservoir, and the proposed Laredo Low Water Weir. None are recommended for designation as a unique reservoir site at this time.

Legislative Recommendations

Under TWDB rules, regional water plans may include “regulatory, administrative, or legislative recommendations that the regional water planning group believes are needed and desirable to facilitate the orderly development, management, and conservation of water resources and preparation for and response to drought conditions.”

Many of the issues and needs of the region arise from the fact that the Rio Grande is an international river whose waters are shared by the U.S. and Mexico. No other regional water planning area faces this reality. Consequently, the recommendations made by the Rio Grande RWPG for action to address regional water needs are divided into two categories: some recommendations fall within the authority of the State of Texas; others must be addressed through the auspices of the International Boundary and Water Commission and/or other international and federal agencies.

Recommendations on State Issues

1 The Texas Legislature should appropriate funds to the Texas Water Development Board to implement and provide assistance to water user groups in developing and implementing appropriate Advanced Water Conservation measures, including a statewide public outreach and education program.

2 The State of Texas should consider factors other than merely population in funding the planning process in Region M because of the unique circumstances affecting water supply in the area.

3 The State should continue financing brackish groundwater projects and the demonstration seawater desalination project as means to increase water supply alternatives in the region.

4 The State should authorize the Rio Grande Watermaster to manage the Rio Grande WAM and should fully appropriate to the Texas Commission on Environmental Quality fees paid by Rio Grande water right holders as specified in Section 11.329 of the Texas Water Code for the purpose of fully funding Rio Grande Watermaster operations.

5 The State should assist in finding new technical and financial resources to help the region combat aquatic weeds and salt cedar and thus protect its water supplies. The Rio Grande RWPG joins with the Far West Texas and Plateau RWPGs to encourage funding for projects aimed at eradicating salt cedar and other invasive plant species in the Rio Grande watershed and for ongoing long-term brush management activities.

6 The State should continue providing technical and financial resources to fully develop the regional GAM.

7 The State should amend the planning process to allow for treating each irrigation district with the region as a WUG, rather than as part of "County-Other," in order to allow for development of individual water management strategies for the districts.

8 The Texas Commission on Environmental Quality should provide assistance to the Rio Grande RWPG as it reviews rules on converting water rights from one use to another and considers appropriate rule amendments, if necessary.

9 Entities within the region are encouraged to cooperate to resolve water issues through such means as regional water and wastewater utilities.

10 The formation of groundwater conservation districts is encouraged as a means to protect groundwater supplies, which are increasingly being tapped as a new water supply for municipal and industrial use.

11 The State should appropriate sufficient funds to the Texas Railroad Commission to allow for capping abandoned oil and gas wells that threaten groundwater supplies.

12 The Texas Legislature should provide technical and financial assistance to implement water management strategies identified in the regional water plans.

13 The Texas Legislature should appropriate funds to continue the regional water planning process.

Recommendations on National and International Issues

1 The International Boundary and Water Commission (IBWC) should renew efforts to ensure that Mexico complies with Minute 309 and set in place means to achieve full compliance with the 1944 Treaty, including enforcement of Minute 234, which addresses the actions required of Mexico to completely eliminate water delivery deficits within specified treaty cycles. Water saved in irrigation conservation projects in Mexico should be dedicated to ensure deliveries to the Rio Grande pursuant to the 1944 Treaty under Article 4B(c) and Minute No. 234.

2 The United States and Mexico should reinforce the powers and duties of both Sections of the IBWC pursuant to Article 24(c) which provides, among other things, for the enforcement of the Treaty and other Agreement provisions that "… *each Commissioner shall invoke when necessary the jurisdiction of the Courts or other appropriate agencies of his Country to aid in the execution and enforcement of these powers and duties.*"

3 The Minute 309 conservation projects funded by the North American Development Bank and other projects funded by national and international agencies to modernize and improve the facilities of irrigation districts in the Rio Grande Basin should be supported and given priority. In particular, both countries should support continued grant funding for conservation projects through the NADBank's Water Conservation Investment Fund.

4 The conservation irrigation projects currently underway through the Bureau of Reclamation for improvement to the irrigation systems of irrigation districts in the Rio Grande Basin in the United States should be supported and implemented.

5 For purposes of clarity, the IBWC should approve a Minute setting out the definition of "extraordinary drought" as that term is implicitly defined in the second subparagraph of Article 4B(d) as an event which makes it difficult for Mexico " … to make available the *run-off* of 350,000 acre feet (431,721,000 cubic meters) annually." A drought condition occurs when there is less than 1,050,000 acre feet annually of *run-off waters* in the watersheds of the named Mexican tributaries in the 1944 Treaty, measured as water enters the Rio Grande from the named tributaries.

6 Accounting of water between the United States and Mexico pursuant to the 1944 Treaty should be consistent with the 1906 Convention, which provides that all

waters measured at Fort Quitman, Texas, are 100 percent allocated to the United States.

7 For better water management in the Lower Reach of the Rio Grande, downstream of Anzalduas Dam, both countries should reaffirm operational policies that Mexico continue to take its share of waters through the Anzalduas canal diversion at the Anzalduas Dam or account for its water at that point, including any diversions by Mexico from the proposed Brownsville Weir Project storage, to the extent of its participation in the project.

8 IBWC should convene a binational meeting of water planners and water use stakeholders in both countries within six months following completion of the annual water accounting in which an annual deficit in flows from the named Mexican tributaries in the 1944 Treaty occurs. This meeting would be designed to share data and information useful in planning for water needs and contingencies in the intermediate future.

9 IBWC should restore the Rio Grande below Fort Quitman, Texas.

10 The IBWC should assume all local and regional financial responsibility for upkeep and maintenance of El Morillo Drain.

11 IBWC should coordinate bilateral efforts to review and evaluate existing sources of data regarding groundwater development in both countries in the Rio Grande Basin below Fort Quitman to the Gulf of Mexico. This effort should be focused on the potential impact on surface water supply in the Rio Grande watershed, with the goal of pursing such actions as may be necessary to evaluate present conditions and promote programs protecting the historical surface water supply in affected regions.

12 Regional watershed planning should be encouraged on both sides of the Rio Grande throughout the basin, including efforts to promote binational coordination of long-range water plans.

13 Interstate compacts between affected states in Mexico, similar to the Rio Grande Compact and Pecos River Compact between affected states in the United States, which deal with apportionment of available water supply from the Rio Grande and its tributaries to each state consistent with existing domestic and international law should be encouraged.

Water Infrastructure Funding Recommendations

The Infrastructure Financing Report (IFR) requirement was incorporated into the regional water planning process in response to Senate Bill 2 (77th Texas Legislature). For purposes of the IFR, each RWPG is required to determine proposed financing for all of the water management strategies that were proposed in this third round of regional planning. For each of these strategies, the RWPG must determine the funding needed to implement the strategy and the types of funding that are likely to be accessed.

According to TWDB guidelines, the primary objectives of the IFR are to determine:

- the number of political subdivisions with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without some form of outside financial assistance;
- how much of the infrastructure costs in the regional water plans cannot be paid for solely using local utility revenue sources;
- the financing options proposed by political subdivisions to meet future water infrastructure needs (including the identification of any state funding sources considered); and,
- what role(s) the RWPGs propose for the State in financing the recommended water supply projects.

In the majority of cases, municipal WUG strategies include urbanization, advanced water conservation measures and purchase of Rio Grande supplies. There are a total of eight counties, 52 cities, and 15 water supply corporations in this regional planning area. Surveys were sent to only those that had been listed in the plan with a need during the 50-year plan.

Public Participation, Facilitation, and Plan Implementation Issues

Public Participation

Public participation is the basis of the regional water planning process initiated by SB 1 in 1997. TWDB rules require RWPGs to have at least one meeting prior to preparation of the regional water plan, provide ongoing opportunities for public participation during the planning process, and hold at least one public hearing prior to adoption of the "initially prepared" regional water plan. RWPGs are also required to comply with TWDB rules specifying how and to whom notice of public meetings and public hearings is to be provided.

As in the first and second cycles of regional water planning, the Rio Grande RWPG has gone well beyond minimum requirements set by the state for public participation, providing multiple opportunities for public input and for direct participation in the planning process and development of the draft plan. The group also intensified efforts in the third round of planning to ensure public involvement and participation in the process.

The Rio Grande RWPG has held regular meetings throughout the planning process, generally on a monthly basis. Each meeting has provided opportunity for public comment. As planning progressed, the opportunity for comment was moved from the end of the agenda to the beginning in order to better accommodate the needs of the public.

A variety of mechanisms have been used to publicize Rio Grande RWPG meetings, including notices to the media and postings to the Rio Grande RWPG's website *www.RioGrandeWaterPlan.org*. The website was developed in late 2003 as a resource for the public on issues of concern to regional water planning and information on the planning process. According to web statistics, an average of 252 unique visitors made an average of 359 visits per month in 2009.

A simple, easy-to-read brochure about the region and the regional planning process was developed in April 2010 and was distributed at a variety of forums and through direct mail. The brochure also directs readers to the website for additional, in-depth information.

The Executive Summary of the plan is translated into Spanish, and is posted on the website.

The Rio Grande RWPG and its consultant team also actively solicited comment from local entities on the basic data used to develop the plan, including water infrastructure financing and draft population and water demand projections. In addition, presentations were made to a variety of groups with an interest in water planning, including water utility associations, citrus growers, and irrigation district boards of directors.

The Rio Grande RWPG provided extensive notice of and opportunity for public comment on the *Initially Prepared Plan*. A public hearing on the plan was held in Weslaco, Texas, on April 21, 2010. An additional public hearing was held in Laredo, Texas, on April 28, 2010.

Facilitation

Facilitation of the regional water planning process for the Rio Grande Region has been provided by the staff of the Lower Rio Grande Valley Development Council (LRGVDC), with assistance from the consultant team. In addition to performing administrative duties relating to the management of State funds, the LRGVDC also made all arrangements for meetings of the Rio Grande RWPG, which included posting required meeting notices, preparing meeting agendas, and distributing agenda back-up materials to members of the RWPG. The LRGVDC tape-recorded all Rio Grande RWPG meetings and prepared the official meeting minutes. A Spanish translator was provided if requested in advance of the meeting.

The consultant team also assisted in facilitating the planning process by providing presentations of technical information at RWPG meetings and assisting in identifying key water planning and policy issues.

Plan Implementation Issues

A number of key issues will affect whether this plan is successful in achieving its primary purpose of developing strategies for meeting the near and long-term water needs of the Rio Grande Region. Generally, the key issues relating to the implementation of this plan can be grouped into three categories:

- Issues and water management strategies that require additional in-depth evaluation. The recommendations presented in this regional water plan are based on a reconnaissance-level evaluation of projected water demands, water supply, needs, and various strategies for meeting future needs. Additional, more detailed feasibility-level planning will be necessary prior to implementing many of the recommended strategies. Also, in many cases, feasibility-level planning will need to be followed by engineering design and permitting activities. For the most part, the additional planning and project development activities required for strategy implementation will be the responsibility of local water suppliers (e.g., cities, water supply corporations, and irrigation districts). However, state and/or federal technical and financial assistance would greatly facilitate timely project development and implementation.

- Local buy-in and action to implement local water supply strategies. This regional water plan is best viewed as providing a framework for local action to implement strategies for meeting future water needs. The role of the Rio Grande RWPG is purely advisory. The RWPG has no authority to compel other entities to implement the actions recommended in this plan, nor does it have the authority or resources to undertake implementation activities on its own initiative. Rather, implementing strategies recommended for meeting future water needs is a primary responsibility of local water suppliers, which include cities, water supply corporations, other public water supply entities, and irrigation districts. With or without outside assistance, more detailed feasibility-level planning studies and engineering design is largely the responsibility of local water suppliers. Similarly, the costs of implementing water conservation and water supply strategies will be borne largely by the ratepayers served by local water suppliers. It is therefore essential that there be a strong commitment on the part of the governing bodies and management of local water suppliers to implement the strategies recommended in this plan.
- Funding for the implementation of plan recommendations. The availability of and access to funding for the implementation of recommended water management strategies is crucial. Most local water suppliers in the Rio Grande Region are governmental or quasi-governmental entities (e.g., water supply corporations) that have the authority to charge and collect taxes and/or fees for the services they provide. These entities also have the ability to borrow money to acquire additional water supplies and to develop and rehabilitate water-related infrastructure. For the most part, the direct costs for the services provided by these entities should be borne by the individual water users through taxes and/or fees for services. However, it should be recognized that there is also an appropriate role for the state and federal governments in financing water conservation, water supply development, and infrastructure projects. At present, there are a number of state and federal financial assistance programs for water-related infrastructure projects that are available to municipal water suppliers. However, there are few programs that provide financial assistance to irrigation districts for infrastructure improvements. Because agricultural water conservation is a central element of this regional water plan – and is essential to maintaining the viability of this sector of the regional economy – the Rio Grande RWPG recommends that new public funding sources be developed to assist irrigation districts with implementing conservation programs.

No interregional conflicts have been identified in the planning process or are contained in the plan.

RESUMEN EJECUTIVO

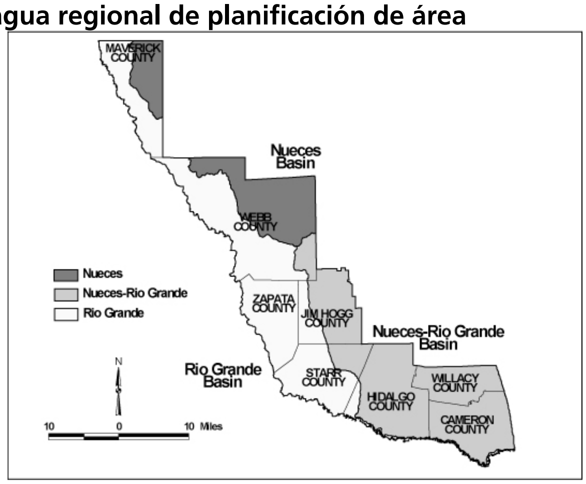
Introducción: Descripción del agua regional proceso de diseño

En 1997, la Setenta Cincoquisima legislatura de Texas promulgó el Senado Bill (SB 1 1), con frecuencia este Senado Bill se denomina el plan de manejo de agua de Brown-Lewis con el patrocinio del Senado y Cámara. Esta legislación surgió como consecuencia de la sequía que se experimentó en la región a mediados de los noventa y la creciente conciencia pública sobre las demandas de agua en estada región de rápido crecimiento. Las cuestiones y preocupaciones abordadas en SB1 incluyó agencias estatales, regionales y locales de planificación para la conservación del agua, el abastecimiento de agua y la gestión de la sequía, la administración de programas de derechos de agua del Estado, la política de transferencia de agua entre los vasos acuíferos, la gestión de aguas subterráneas, mercados de agua, asistencia financiera Estatal para proyectos relacionados con el agua y los programas estatales para la recopilación de datos del agua y su difusión.

El plan SB 1 altero radicalmente la manera en que el Estado prepara las planeación del agua, estableciendo un enfoque profundizado basado en los planes regionales de agua por los grupos regionales de agua designado (RWPGs) que representa a 11 diferentes grupos de interés. Hay 16 RWPGs; los miembros de estos grupos sirven sin compensación. El proceso de planificación es coordinado por la Texas Water Development Board (TWDB), que reúne los 16 planes regionales en un amplio plan Estatal de agua.

Texas Water Development Board Inicialmente designo el área de planificación del agua para el Rio Grande como "Region M" la cual abarca ocho condados adyacentes en la sección del Bajo y Medio de Rio Grande. Estos Condados son: Cameron, Hidalgo, Jim Hogg, Maverick, Starr, Webb, Willacy y Zapata (véase el anexo 1).

Exposición 1: Rio Grande agua regional de planificación de área



El grupo Regional de planificación del agua (RWPG) del Rio Grande consta actualmente de 19 miembros que representan a las once categorías de grupo de interés especificadas en SB 1 (véase el anexo 2 con fecha de actualización 1 de abril de 2010).

Todos los grupos de interes incluidos en este anexo tienen el derecho a votación además de su derecho a votar, la RWPG de Rio Grande incluye sin derecho a voto de los miembros que representan a las agencias del Estado y el Gobierno federal mexicano.

Exposición 2: Rio Grande agua Regional Planning Group

INTERÉS	NOMBRE	Residente Condado
Público	Mary Lou Campbell, Secretario * Mercedes	Hidalgo
Condados	John Wood Condado Señor Comisario, Brownsville	Cameron
Municipios	Roberto González * Obras de agua, Eagle Pass	Maverick
	John Bruciak, Gerente General Brownsville PUB, Brownsville	Cameron
	Tomás Rodríguez Ciudad de Laredo	Webb
Industrias	Donald K. McGhee Harlingen hidro Systems, Inc.,	Cameron
Agricultura	Robert E. Fulbright * Fulbright & Hinnant, Hebbronville	Jim Hogg
	Ray Prewett Texas Mutualidad de cítrico, misión de	Hidalgo
Medio ambiente	Sonia Nájera The Nature Conservancy	Cameron
Empresa pequeña	Carlos Garza AEC Engineering, LLC., Edinburg	Hidalgo
De energía eléctrica Utilidades	Ella de la Rosa Magia Valle Cooperativa eléctrica	Webb
Autoridades de río	James Darling, Vicepresidente * Rio Grande Autoridad regional del agua	Hidalgo
Distritos de agua	Sonny Hinojosa HCID n ° 2, San Juan	Hidalgo
	Sonia Lambert CCID n ° 2, San Benito	Cameron
Utilidades de agua	Charles Browning North Alamo Water Supply Corp., Edinburg	Hidalgo
Otros	Glenn Jarvis, Presidente * Abogado, McAllen	Hidalgo

La primera ronda de planificación regional del agua culminó con el plan del estado para el agua en el año de 2002. La segunda ronda de la planificación comenzó más tarde ese año y terminó en 2006 con la incorporación de planes regionales de agua revisados en el plan de agua de Texas en el año 2007 "Agua para Texas." La tercera ronda de la planeación del agua regional tuvo lugar del 2007 al 2010. Los resultados de estos esfuerzos se incluirán en el plan de agua de estado de 2011. La tercera ronda de planificación agua regional incluirá la actualización de las proyecciones de la demanda de agua y de la población y los análisis de nuevas estrategias de gestión de agua.

Resumen del capítulo

El resto de este resumen ejecutivo ofrece una sinopsis de cada capítulo.

- Capítulo 1 presenta una descripción del área de planeación del agua regional. Esto incluye información sobre los usos actuales de agua y centros de demanda de agua más importantes, las fuentes de abastecimiento de aguas superficiales y subterráneas, recursos agrícolas y naturales y las características demográficas y socioeconómicas de la región. También se incluyen un resumen de los planes del agua regional actuales, asi como también las recomendaciones en el plan actual de agua Estatal, y planes de agua locales, así como una evaluación de las amenazas a los recursos agrícolas y naturales.
- Capítulo 2 presenta la población actual proyectada y también la demanda de agua. Esta información es proporcionada por la ciudad y el condado y para la parte de cada cuenca hidrográfica dentro de la región del Río Grande. Se presentan las proyecciones de la demanda de agua para seis categorías de uso de agua: municipal, fabricación, riego, generación de energía eléctrica, minería y ganadería.
- Capítulo 3 proporciona un análisis total de abastecimiento de agua de la región
- Capítulo 4 identifica y evalúa las estrategias del manejo del agua seleccionadas en las necesidades.
- Capítulo 5 analiza los efectos de las estrategias de gestión de agua en los parámetros claves de la calidad del agua y los impactos del movimiento agua desde las zonas rurales y agrícolas.
- Capítulo 6 describe las recomendaciones consolidadas en el manejo de la conservación del agua y sequía en el plan de agua regional.
- Capítulo 7 describe cómo el plan regional es coherente con la protección a largo plazo de los recursos hidráulicos, recursos agrícolas y los recursos naturales del estado.
- Capítulo 8 presenta recomendaciones para segmentos de secuencia única, sitio de embalse y opciones legislativas.
- Capítulo 9 proporciona recomendaciones a la Asamblea legislativa sobre la financiación de infraestructura de agua.
- Capítulo 10 describe la participación pública, facilitación y planificar las cuestiones de aplicación.

Descripción física de la Región del Rio Grande

El clima de la región de Río Grande oscila entre un régimen subtropical húmedo en la porción oriental de la región y un régimen tropical y subtropical en la porción restante de la región. Vientos predominantes son sudeste durante todo el año y el aire cálido tropical desde el Golfo de México produce veranos cálidos y húmedos y relativamente inviernos templados y secos.

La Evaporación neta anual promedio del lago en la región de Río Grande varía entre 40 y 44 pulgadas en la costa y aproximadamente 60 a 64 pulgadas en la parte central de la región cerca de sur del Condado de Webb. La cantidad de precipitación varía a través de la región baja del Rio Grande desde un promedio de 28 pulgadas en la costa a 18 pulgadas en la parte noroeste de la región. La mayoría de las precipitaciones se produce durante la primavera desde abril a junio y durante finales del verano y principios del otoño, desde agosto hasta octubre.

La región de Río Grande se encuentra completamente dentro de las llanuras de costa occidental del Golfo de los Estados Unidos, un fondo de mar elevado con bajo relieve topográfico. La topografía de la región oscila entre sucesiva, relieve ondulante en la parte noroeste, convirtiéndose progresivamente más plana cerca de la costa del Golfo. El río Grande fluye del sureste a través de la región antes de girar al este en su desembocadura en el Golfo de México.

En general, los suelos en la región de Río Grande generalmente consisten de arcillas calcáreos a arcillas neutrales, mezcla de arena y arcilla y tierra arenosa.

La región baja del Valle del Rio Grande es el límite norte de gran parte de la biota semitropical de México. Un número de especies vegetales y animales de las zonas más xerofíticas y mésica al oeste y noroeste, respectivamente, converge en la zona.

La región baja de la Laguna Madre es una bahía muy salada, la mayoría de los cuales se encuentra en las partes orientales de los condados Cameron y Willacy. De Profundidad baja, praderas de algas marinas extensa y corrientes planas se caracterizan. La Laguna Madre inferior es compatible con una amplia variedad de organismos acuáticos marinos y la vida silvestre.

Organizaciones públicas y privadas han creado varios refugios y reservas en la región amenazadas y en peligro de extinción. Estos incluyen el Lower Rio Grande Valley National corredor/refugio de vida silvestre, Laguna Atascosa National Wildlife Refuge (NWR), Santa Ana NWR, Parque del Condado de Anzalduas, Falcon State Park (SP), Bentsen-Rio Grande Valley SP, Boca Chica SP, área de administración de vida silvestre (WMA) de Las Palomas, Arroyo Colorado WMA, Sabal Palm Audubon Center y santuario, Chihuahua Woods conservar la Nature Conservancy y la reserva costera de SouthBay.

Características demográficas y socioeconómicos de la región del Rio Grande.

La región de la frontera sur de Texas ha visto un crecimiento significativo en los últimos 40 años. Producto regional bruto en esta región se cuadruplico de 5,3 billones de dólares en 1970 a 20,3 billones de dólares en los años 2000. Durante el mismo período, el empleo en la región de la frontera sur de Texas fue 177.000, pero en 2008 había crecido hasta 537.000. En el año 2000, la región represento el 6,7% de la población y 4,4% del empleo del estado.

Condados de la región de exhibición 3: Rio Grande pueden elegir para la asistencia de EDAP

Counties	Average Unemployment Rate 2006-2008 (%)	Percent Above State Rate	Average Per Capita Income 2006-2008 ($)	Percent Below State Rate
Texas Average	4.7	n/a	36,940	n/a
Cameron	6.5	39.3	19,146	-48.2
Hidalgo	7.1	51.1	17,853	-51.7
Maverick	11.8	151.1	16,231	-56.1
Starr	11.4	142.6	13,464	-63.6
Webb	5.2	10.6	20,843	-43.6
Willacy	8.8	87.2	19,740	-46.6

El TWDB ha clasificado a siete de los ocho condados en la región de río grande como elegibles para la ayuda a través del programa de asistencia para personas en apuros económicos (EDAP). La elegibilidad está limitada a los condados con una tasa de desempleo superior al 25 por ciento de la media de Estado durante el período de los tres años más reciente y un ingreso por cápita promedio tasa de 25 porciento por debajo del promedio del Estado.

Demanda de agua y población actual y proyectada para la región del Rio Grande

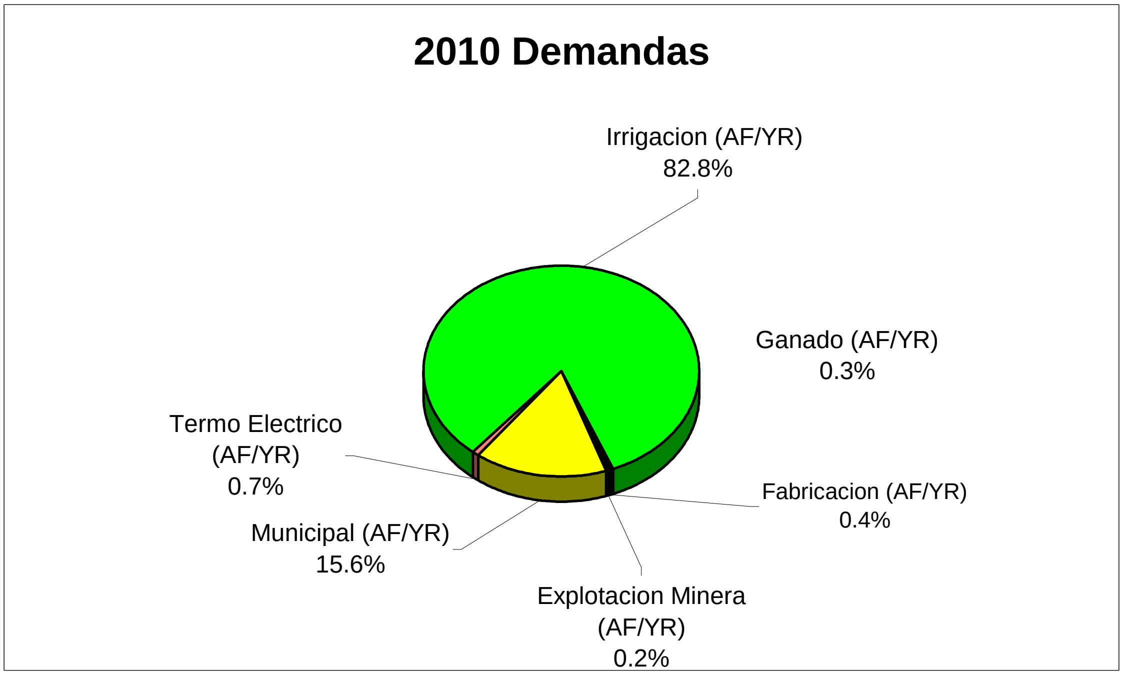
La TWDB proyecta que la población en los ocho condados que comprende el área de planificación de agua regional del Rio Grande será más del doble a partir de 2010 hasta el 2060.

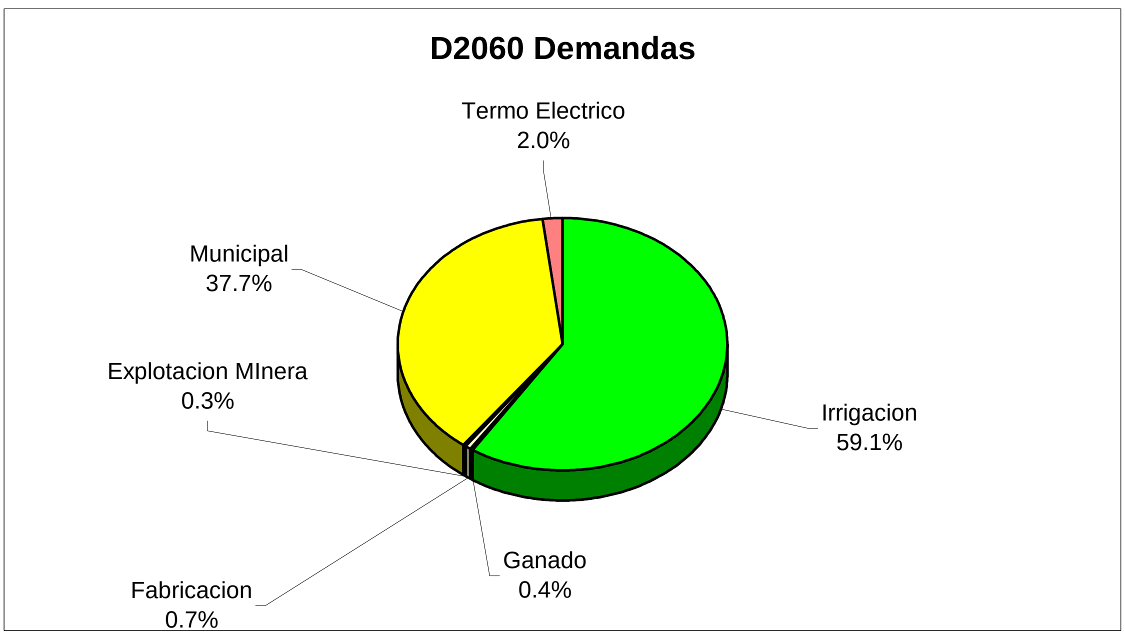
4 De exhibición: Projeccion de Población Para los condados

Condado Nombre	2010	2020	2030	2040	2050	2060
Cameron	424,762	510,697	599,672	688,532	777,607	862,511
Hidalgo	775,858	987,920	1,225,227	1,481,812	1,761,811	2,048,909
Jim Hogg	5,593	5,985	6,286	6,538	6,468	6,225
Maverick	58,252	67,929	77,165	85,292	92,831	99,091
Personal	69,379	83,583	98,262	113,102	127,802	141,961
Webb	257,647	333,451	418,332	511,710	613,774	721,586
Willacy	22,763	25,212	27,455	29,276	30,542	31,205
Zapata	14,025	16,217	18,415	20,486	22,354	23,733
Totales	**1,628,279**	**2,030,994**	**2,470,814**	**2,936,748**	**3,433,188**	**3,935,223**

La demanda total anual de agua para la región se proyecta que disminuirá a partir del año 2010 hasta el año 2030 y entonces tendrá un constante *aumento* hasta el año 2060. Esta tendencia es atribuible a la disminución de la superficie cultivada de regadío y aumento de las poblaciones urbanas, especialmente en el valle del Río Grande, debido a la urbanización se reducirán los terrenos para uso agrícola. La demanda de agua para riego en la región se proyecta que tendrá una reducción del 82,8% del uso total del agua a 59,1% para el año 2060. Durante el mismo período, las demandas de agua municipal se proyectan que aumentaran de un 16% a un 38%.

5 De exhibición: total de demandas de agua, por tipo de uso 2010 y 2060





Exhibición 6: Proyecciones de demanda de agua (acre-feet/año)

Water Demand Projections	2010	2020	2030	2040	2050	2060
Irrigation (AF/YR)	1,163,634	1,082,232	981,748	981,748	981,748	981,748
Livestock (AF/YR)	5,817	5,817	5,817	5,817	5,817	5,817
Manufacturing (AF/YR)	7,509	8,274	8,966	9,654	10,256	11,059
Mining (AF/YR)	4,186	4,341	4,433	4,523	4,612	4,692
Municipal (AF/YR)	288,323	349,410	416,396	487,858	565,475	646,006
Steam Electric (AF/YR)	13,463	16,864	19,716	23,192	27,430	32,598
Total Water Demand (AF/YR)	1,482,932	1,466,938	1,437,076	1,512,792	1,595,338	1,681,920

Evaluación de la adecuación actual de los suministros de agua

Suministros Actuales del Rio Grande

La región del Río Grande en Texas abarca porciones de tres cuencas: el río Grande, Nueces, y Nueces -Rio Grande costera. Sin embargo, prácticamente la totalidad de la del agua superficial disponible para y uso dentro de la región es desde el río grande. Casi todo el suministro confiable de agua superficial es el producto combinado de las presas Amistad y Falcón, que son las dos principales presas sobre el río grande. La mayoría de los influentes a este sistema de presas proviene del Río Conchos en el estado de Chihuahua, México y el Río Pecos en Texas. El volumen total estimado de las presas (es decir, la cantidad de agua disponible en la sequía de registro) para los Estados Unidos fue aproximadamente de 1,01 millones de acres-feet por año.

Esto representa más de un 94 por ciento de la cantidad total de agua disponible actualmente a la región de todas las fuentes (por ejemplo, las aguas subterráneas, reutilización, afluentes del río grande y otras fuentes locales). Con el tiempo, sin embargo, el suministro total fiable de agua del río Grande se proyecta que disminuirá significativamente, en gran medida como consecuencia de la capacidad de almacenamiento de conservación reducido debido a la sedimentación del sistema de las presas Amistad/Falcón. Entre los años 2010-2060, se proyecta el volumen total del sistema de depósito disminuirá por casi 32.500 acres (aproximadamente el 3 por ciento).

Debido a la manera en que los suministros disponibles en el sistema de reserva de Amistad/Falcón se administran y asignan, el impacto de la disminución de suministros será sufragado directamente por los usuarios de minería y agua de riego. Bajo el sistema de derechos de agua para la parte baja y media del Rio Grande, los derechos al agua domésticos-municipal-industrial (DMI) tienen un alto grado seguro. Una reserva DMI de 225.000 acres-pie continuamente se mantiene en el sistema de depósito. En comparación, riego y derechos de agua de la minería son los usuarios residuales de agua almacenada desde las presas.

Una preocupación adicional implica la operación de presas en la parte de México de la cuenca hidrográfica que contribuye a las corrientes hacia el sistema de reserva de Amistad/Falcón. México ha construido un amplio sistema de presa en los afluentes, especialmente en la cuenca Río Conchos. La capacidad de almacenamiento combinado de todas las grandes presas de México en afluentes del Río Grande es de aproximadamente 2,5 veces la conservación disponible del almacenamiento del país en las presas Amistad y Falcón. Esto tiene serias implicaciones a la luz de la declaración de México que opera sus presas no con el fin de cumplir sus obligaciones en virtud del Tratado de 1944 sino más bien exclusivamente para captar agua para satisfacer y ampliar sus propias demandas de agua interna.

México solamente recientemente ha reembolsado un déficit a largo plazo en exceso de un millón de acres-feet con respecto a las mínimas influentes que contribuyen al Rio Grande requerido por el tratado. Esta situación pone en entredicho la certeza de la cantidad de agua del río grande que estará disponible en el futuro a los titulares de derecho de agua de Texas.

Otras fuentes de abastecimiento de agua para la región incluyen:

- El Arroyo Colorado, el cual atraviesa los condados Cameron, Hidalgo y una pequeña parte de los condados de Willacy, representa una segunda fuente potencial de agua. El uso del agua en el Arroyo Colorado es para propósitos municipales, industrial, o con fines de riego es severamente limitado debido a las condiciones de mala calidad; sus flujos diarios incluyen principalmente de las corrientes de retorno de la agricultura y municipios y escurrimiento generado localmente. No obstante, el Arroyo Colorado es una fuente importante de las corrientes de agua dulce a la región baja de la Laguna Madre, que es ecológica y económicamente importante para la región.

- Las aguas subterráneas, principalmente desde el acuífero de la Costa del Golfo. La mayoría de las aguas subterráneas en la región son de mala calidad y no se puede utilizar para agricultura o uso municipal sin tratamiento. Los avances tecnológicos están disminuyendo los costos de la desalinización de las aguas subterráneas salobres, y este suministro se ha convertido en una opción para uso municipal, especialmente para satisfacer las demandas de pico
- Reutilización o "agua, de reciclaje" que proporciona aproximadamente 13.000 acres-feet por año (uno por ciento) para riego, fabricación y producción de eléctrica a partir de vapor.

Exposición 7 proporciona un resumen de los importes totales de los suministros de agua actuales disponibles para la región de Río Grande por categoría de uso de agua para cada década a través de 2060.

Exposición 7: Actual y proyectados los suministros de agua para la región de Río Grande (AF/año)

Categoría Del Uso Del Agua	2010	2020	2030	2040	2050	2060
Irrigacion	757,168	750,179	743,691	737,203	730,713	724,724
Municipal	323,884	327,654	330,487	331,411	331,247	331,118
Termoelectrico	16,216	16,216	16,216	16,216	16,216	16,216
Ganado	5,817	5,817	5,817	5,817	5,817	5,817
Fabricacion	6,550	6,553	6,556	6,559	6,561	6,564
Explocion Minera	4,941	5,088	5,169	5,249	5,329	5,396
Region M Total	**1,114,576**	**1,111,507**	**1,107,936**	**1,102,455**	**1,095,883**	**1,089,835**

Identificación, evaluación y selección de estrategias de administración del agua basada en las necesidades

La región del Río Grande se enfrenta a las necesidades importantes de abastecimiento de agua a pesar de que los excedentes de agua existente para algunas categorías de uso en algunos condados para algunos años. En general, el déficit en el uso municipal, industrial y la electricidad producida por el vapor aumentaran durante la vida del estudio de planificación mientras que el déficit de irrigación disminuirá debido a la urbanización. La "necesidad" de abastecimiento de agua significa que las demandas actuales o proyectadas son mayores que el suministro, produciendo un "déficit" de abastecimiento de agua o escasez. Suministro de "exceso" de la demanda, por otra parte, resulta en un “superávit” del abastecimiento de agua para el usuario particular.

8 De exhibición: necesidades de abastecimiento de agua para la Rio Grande Región por categoría de uso (AF/año)

Uso De La Categoría	2010	2020	2030	2040	2050	2060
Municipal	26,479	64,277	115,311	177,900	252,083	330,625
Fabricacion	1,921	2,355	2,748	3,137	3,729	4,524
Irrigacion	407,522	333,246	239,408	245,896	252,386	258,375
Termoelectrico	0	1,980	4,374	7,291	11,214	16,382
Explotacion Minera	0	0	0	0	0	0
Ganado	0	0	0	0	0	0
NECESIDADES TOTALES DEL AGUA (AF/yr)	**435,922**	**401,858**	**361,841**	**434,224**	**519,412**	**609,906**

Exposición 9: excedentes de abastecimiento de agua para la región de Río Grande por categoría de uso (AF/año)

Catergory Del Uso	2010	2020	2030	2040	2050	2060
Municipal	59,848	42,521	29,811	21,558	18,064	15,737
Fabricacion	962	634	338	42	34	29
Irrigacion	1,056	1,193	1,351	1,351	1,351	1,351
Termoelectrico	2,753	1,332	874	315	0	0
Explotacion Minera	755	747	736	726	717	704
Ganado	0	0	0	0	0	0
EXCESOS TOTALES DEL AGUA (AF/yr)	**65,374**	**46,427**	**33,110**	**23,992**	**20,166**	**17,821**

Oportunidades para el desarrollo de los suministros de agua adicionales para uso municipal están limitadas en la región del Río Grande, debido a las características hidrológicas, economícas y restricciones legales asociadas con el Tratado de agua de México/U.S. de 1944. Existen pocas oportunidades para aumentar el rendimiento de abastecimiento de agua del río grande. Sin embargo, una serie de estrategias para aumentar el abastecimiento municipal de agua ha sido examinada como parte de este esfuerzo de planificación. Estos incluyen la conservación de agua municipal avanzada, la presa de Brownsville, reutilización de agua reciclada estrategias para optimizar el abastecimiento de agua superficial desde el Rio Grande, desarrollo de aguas subterráneas, salobre y desalinización de agua salobre y agua del mar y adquisición adicional de abastecimientos del Rio Grande para usos domésticos-municipal-industrial (DMI).

Conservación del agua avanzada está encaminada a reducir la cantidad de agua utilizada por cápita, reduciendo la demanda general municipal. Compras de derechos sobre el agua, la adquisición de los derechos al agua por contrato a largo plazo y la adquisición de los derechos al agua a través de la urbanización todas implican la transferencia de derechos de agua del río grande para uso de riego así como también para uso de DMI.

Ya que las aguas municipales tengan la más alta prioridad en el sistema de Amistad/Falcón, agua de riego está en un constante estado de escasez. En consecuencia, se necesitan para reducir el impacto de la escasez de riego de transporte y mejoras en la finca. Estrategias de gestión de las aguas municipales no son rentables cuando se aplica al uso de riego.

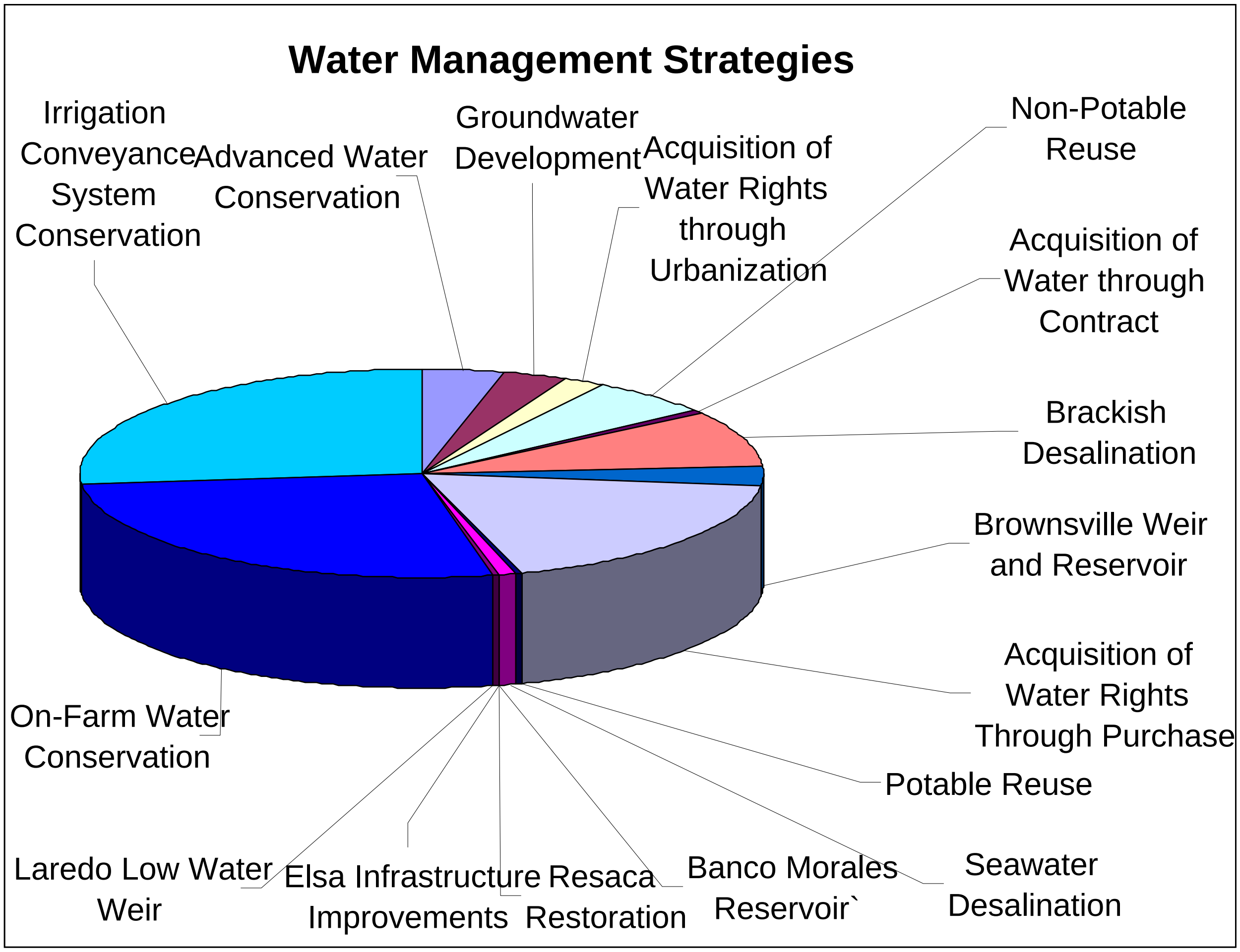
Dos estrategias de gestión de agua fueron evaluadas para conservar el agua y proporcionar suministros adicionales para uso de riego: mejoras y el sistema de mejoras de transporte de la eficiencia en la granja. Tecnologías y métodos actualmente disponibles para la conservación del agua en la granja incluyen: tubo plástico (polietileno pipe), aplicación de precisión de baja energía, programación utilizando una red de evapotranspiración, el riego por goteo, medición, precio por unidad de agua y cultivos eficiente del agua de riego. El programa de eficiencia de transporte propuesto consta de seis componentes principales: no fugas compuertas, dispositivos de medición de agua adicionales, convirtiendo los canales pequeños de concreto en malas condiciones usando tuberías, revestimiento de canales más pequeños de la tierra y aplicación de un programa de verificación para supervisar y medir la efectividad de las mejoras de eficiencia. Sin embargo, son pocos los programas que proporcionan asistencia financiera a los distritos de riego para mejoras en la infraestructura. Porque la conservación agrícola del agua es un elemento central de este plan regional de agua – y es fundamental para mantener la viabilidad de este sector de la economía regional – la RWPG de Rio Grande recomienda que se desarrolle nuevas fuentes de financiación públicas para ayudar a los distritos de riego con la implementación de programas de conservación.

A continuación se muestran el rendimiento del proyecto de abastecimiento de agua y el costo por acre-feet asociado con cada estrategia de administración de agua (WMS).

10 De la exposición: Resumen de estrategia de administración de agua

Strategy	Total Capital Cost	Water Supplies Per Decade					
		2010	2020	2030	2040	2050	2060
Advanced Water Conservation	$ 22,583,710	2917	6339	11986	16512	24867	32793
Groundwater Development	$ 27,474,302	3772	8572	17139	20492	22284	24520
Acquisition of Water Rights through Urbanization	$ 56,167,089	299	3,433	6,467	9,496	12,868	16,406
Non-Potable Reuse	$ 173,803,091	2,417	9,444	12,378	20,137	29,810	46,382
Acquisition of Water through Contract	$ 16,263,877	312	738	1,665	2,352	3,198	4,671
Brackish Desalination	$ 263,599,392	38,364	44,627	48,309	54,472	66,696	71,700
Brownsville Weir and Reservoir	$ 98,411,077	20,643	20,643	20,643	20,643	20,643	23,643
Acquisition of Water Rights Through Purchase	$ 631,081,709	9,611	19,461	41,602	70,944	110,913	151,237
Potable Reuse	$ 7,519,850	1,120	1,120	1,120	1,120	1,120	1,120
Seawater Desalination	$ 185,940,937	125	125	143	6,049	6,421	7,902
Banco Morales Reservoir	$ 25,790,900	238	238	238	238	238	238
Resaca Restoration	$ 52,000,000	877	877	877	877	877	877
Laredo Low Water Weir	$ 294,400,000	0	0	0	0	0	0
Elsa Improved Infratructure	$ 8,325,386	105	105	105	105	105	105
Irrigation							
On-Farm Water Conservation	$ 194,417,692	36,528	73,085	109,614	146,144	182,698	219,228
Irrigation Conveyance System Conservation	$ 130,757,978	91,160	182,313	191,435	200,551	209,667	218,783
TOTAL	**$ 2,188,536,991**	**208,488**	**371,120**	**463,721**	**570,132**	**692,405**	**819,605**

11 De la exposición: Estrategias de gestión del agua



Impactos de WMS en clave de parámetros de calidad del agua e impactos de agua en movimiento desde las áreas rurales y agrícolas

La siguiente tabla resume los impactos de WMS sobre la calidad del agua.

Exhibición 12: Impactos de calidad de agua por la estrategia de administración de agua

Estrategia de administración de agua	**Impactos positivos**	**Impactos negativos**
Adicion de las aguas subterráneas	• Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Aumento de las corrientes de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos • Mayor escurrimiento urbano durante el evento de tormenta
Conservación de agua avanzada	• disminución de los flujos de las aguas residuales	• Incremento de la concentración de materia orgánica en las aguas residuales

Reusó de agua no potable	• Fluye de la reducción de las aguas residuales • Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo • Corrientes de disminución de las aguas residuales, resultante en los niveles inferiores de orgánicos en la recepción de arroyos	• Mayor escurrimiento urbano durante el evento de tormenta
Reutilización de agua potable	• Fluye de la reducción de las aguas residuales • Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo • Como resultado las corrientes de aguas residuales de la disminución en los niveles inferiores de orgánicos en la recepción de flujos de	• Mayor escurrimiento urbano durante el evento de tormenta
Presas, presas y almacenamiento de información • Brownsville Weir • Laredo Bajo agua Weir • Embalse de morales de Banco • Restauración de resaca	• Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Mayor escurrimiento urbano durante el evento de tormenta • Flujos de aumento de las aguas residuales resultantes en los niveles más altos de orgánicos en la recepción de secuencia
Compra de derechos de agua	• Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Mayor escurrimiento urbano durante el evento de tormenta • Aumento de las corrientes de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos
Adquisición de derechos de agua por la urbanización	• Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Mayor escurrimiento urbano durante el evento de tormenta • Aumento de las corrientes de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos
Adquisición de derechos de agua por contratos a largo plazo	• Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o	• Mayor escurrimiento urbano durante el evento de tormenta • Aumento de las corrientes

	el riego excesivo	de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos
Desalinización salobre	• Calidad de agua mejoradas en el efluente de aguas residuales • Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Mayor escurrimiento urbano durante el evento de tormenta • Aumento de las corrientes de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos • Aumento de los niveles de TDS en la recepción de arroyos debido a la descarga de concentrado
Desalinización de agua de mar	• Calidad de agua mejoradas en el efluente de aguas residuales • Disminución de sedimentos o escorrentía química agrícola debido a la tormenta de eventos o el riego excesivo	• Mayor escurrimiento urbano durante el evento de tormenta • Aumento de las corrientes de aguas residuales a flujos de receptoras, es decir, mayores niveles de orgánicos • Aumento de los niveles de TDS en la recepción de arroyos debido a la descarga de concentrado
Mejora de la infraestructura de agua y distribución • Mejoras a la infraestructura de Elsa	• Aumentar la eficiencia de la distribución • Aumentar la capacidad de almacenamiento de información	• Ninguno

Recomendaciones de administración de sequía y de conservación de agua consolidado

El Plan Regional de agua proporciona orientación para la selección de estrategias de conservación de las aguas municipales específicas para la región, plan de conservación agrícola para distritos de riego y un plan de conservación de agua de modelo para un grupo de usuarios de agua.

El grupo de planificación de agua de Rio Grande Regional ha incorporado a las estrategias de Plan Regional de agua de 2010 presentadas por la implementación de la conservación de aguas estatales equipo especial en la *Guía de prácticas de mejor gestión para la conservación de agua* (TWDB informe 362, noviembre de 2004). Estrategias recomendadas incluyen:

- conservación de agua en los campos golf
- medición de todas las conexiones y reactualización en las conexiones existentes
- regadera de seguridad, aeración y reactualización de aseo de golpeo

- educación escolar
- conservación de agua de irrigación para la jardinería
- diseño de mejor uso de agua de jardinería
- conservación de agua en los campos deportivo
- información pública
- lluvia
- conservación de agua en los Parques
- programa de incentivo en el lavado de ropa residencial

El Plan Regional de agua también incorpora las siguientes opciones de alivio de la sequía, ofrecidas por el departamento de agricultura de los Estados Unidos a través de la Agencia de servicio agrícola: programa de conservación de la reserva, la Haying de emergencia y el programa de pastoreo, programa de incentivos de calidad ambiental Farm operativo préstamos, préstamos de propiedad de la granja, programa de asistencia de desastres de recortar de no asegurados, Farm Labor Housing préstamos y el programa de subvenciones y el servicio de conservación de los recursos naturales.

El Plan Regional de agua, proporciona una plantilla para la conservación agrícola que sigue las reglas de TCEQ que rigen el desarrollo de planes de conservación de agua para los proveedores de agua pública. Estas reglas se definen como un plan de conservación de agua como "una estrategia o la combinación de estrategias para reducir el volumen de agua retirado de una fuente de abastecimiento de agua, para reducir la pérdida o el desperdicio de agua, para mantener o mejorar la eficiencia en el uso del agua, para aumentar el reciclado y la reutilización del agua y para la prevención de la contaminación del agua".

El Plan Regional de agua también proporciona un plan de conservación para un grupo de usuarios de agua. De acuerdo con las reglas de la TCEQ, planes de conservación de agua para los proveedores de agua pública deben tener un perfil de utilidad, la medición precisa, la especificación de objetivos, la medición universal y la educación pública. La mayoría tienen contenido adicional para los proveedores de agua pública que se proyectan para suministrar 5.000 o más personas en los próximos diez años y pueden tener contenido opcional adicional.

Protección a largo plazo de los recursos hídricos del Estado, recursos agrícolas y recursos naturales

Debido a que el río Grande es la principal fuente para el uso DMI y uso de riego, optimizar el suministro de agua disponible desde el río es un aspecto importante de la protección del Estado para los recursos del agua, agricultura, y naturales. Una estrategia clave aquí es implementar las prácticas en la finca y rehabilitar los sistemas de riego para conservar el agua.

Existe un enorme potencial para el ahorro de agua en ambas esferas: 219.000 CA-pies a través de mejoras en la granja y 218.000 CA-ft a través de mejoras del sistema de transporte. A largo plazo, ahorro de agua total asociado con ambas estrategias permitiría regantes compensar el déficit de abastecimiento de agua. Sin embargo, el plazo de aplicación no ofrecerá un remedio inmediato.

Otro factor que afecta la zona de protección de los recursos es de conformidad de México con el Tratado de 1944. A pesar de que México ha reembolsado su deuda de agua, hay poca garantía de cumplimiento de normas futura si la región fuera azotada por otra grave sequía. Estudios de la Universidad de Texas A & M han demostrado que la región baja del Valle del Rio Grande perdió cerca de 1.000 millones de dólares en la disminución de la actividad económica y 30.000 puestos de trabajo como consecuencia directa de la falla de México para cumplir con sus obligaciones contractuales durante el período de 1992 a 2002.

Necesidades de flujo ambientales están en la vanguardia de todas las cuestiones relacionadas con la protección a largo plazo de los recursos naturales de Texas. Una posibilidad para mantener y aumentar los caudales ambientales es la adquisición de derechos de agua del río grande para el uso de medio ambiente a través de la Fundación del agua de Texas. Estos derechos de agua podrían gestionarse para producir suficientes corrientes en toda la región. Sin embargo, esta opción puede no ser viable debido a la compra de derechos de agua corriente y estructura de transferencia.

Teniendo en cuenta el formato WUG que se están llevando a cabo por el TWDB, no existen opciones formalmente asignadas para la protección de abastecimiento de agua para uso ambiental. De forma alternativa, flujos medioambientales en el río Grande podrían ser incluidos como un WUG independiente en la próxima ronda de planificación regional para garantizar los mínimos requeridos de manera consistente con los otros WUGs.

Críticamente es necesaria la cooperación internacional de México para mantener los niveles de flujo. Si los Estados Unidos implementar un programa de medio ambiente de flujo sin la participación de México, se reducirá considerablemente el efecto deseado.

Otro de los problemas ambientales críticos de la región es el crecimiento de las plantas invasoras tales como la propagación de cedro de sal y otras plantas acuáticas. Desafortunadamente, los métodos de erradicación son costosos y físicamente agotadores. El auge natural y caída de elevación de agua en ríos y arroyos restringe un poco estas plantas por ahogamiento en nuevas plantas de semillero. Sin embargo, en las zonas del flujo de agua mínima, un escenario perfecto existe para el crecimiento de las plantas invasoras.

Los estuarios costeros de Texas, donde el agua dulce de escurrimiento interior se mescla con las aguas saladas del Golfo de México, estas apoyan una increíble abundancia de flora y fauna. Crías de peces, camarones y jaibas se alimentan y se protegen en las aguas en los estuarios de aguas salobres hasta que estén lo suficientemente maduros como para sobrevivir en el Golfo de México. Miles de aves locales y migratorias descansan y se alimentan en zonas de estuarios pantanosos. De hecho, el 95 por ciento de la pesca recreacional como comercialmente del Golfo y otras especies marinas dependen de los estuarios alguna parte del ciclo de su vida.

Aproximadamente 323,000 AF/año en nuevos suministros de agua municipales son propuestas en el plan de agua de la región M de 2010. Todo esto excepto aproximadamente 2.900 AF/año de conservación del agua avanzados pueden afectar tanto a las corrientes de agua dulce de la región baja de la Laguna Madre o las corrientes de agua en el río grande. Alteraciones en las corrientes en el río grande están fuera del alcance de la presente evaluación. Para la cuenca costera de Nueces-Rio Grande desagua en la región baja de la Laguna Madre no ay presas, sistemas de desvíos, u otras propuestas de estrategia de manejo de agua que pueden causar cambios en la corriente del agua. Sin embargo, muchas de las propuestas de las estrategias de agua pueden influir en la afluencia de agua dulce a través de la alteración de los vertidos de aguas residuales basadas en suministros importados procedentes de la cuenca del río grande o las aguas subterráneas. Mucho del crecimiento de los municipios de la región se encuentran en la cuenca costera de Nueces-Rio Grande y enormemente alterara el vertido de aguas residuales en los arroyos que desembocan en la Laguna Madre.

Los resultados de los análisis de la Federación Nacional de vida silvestre indican que no hay problemas para las corrientes de agua dulce a la región baja de la Laguna Madre. La afluencia de primavera y el verano son la clave y para dar el impulso necesario para que la productividad no se vean afectadas significativamente. La cuenca costera de Nueces-Rio Grande no tendrá la capacidad para proporcionar flujos bajos durante la sequía no se modificaría mucho. Debe tenerse en cuenta que gran parte del aumento de vertido de aguas residuales que se muestra a continuación se basa en las contribución de agua proveniente de la cuenca costera de Nueces-Rio Grande. Obviamente estos provienen a expensas de la vecina cuenca del Rio Grande. Un esfuerzo análogo para evaluar las necesidades de flujo y los efectos del plan de la región M podría llevarse a cabo en el próximo ciclo de planificación agua regional.

Recomendaciones de segmentos de corriente única/presas/legislación

Las reglas de TWDB permiten a la RWPG incluir en las recomendaciones del plan de agua regional la designación legislativa relativa a los arroyos ecológicamente únicos, los sitios para el desarrollo futuro de presas y cuestiones de política. La RWPG de Rio Grande fue elegida para considerar las recomendaciones en cada una de estas áreas.

Segmentos de arroyos ecológicamente únicos

La ley estatal prohíbe que agencias del Estado y las unidades locales de Gobierno a el desarrollo de un proyecto de abastecimiento de agua que destruiría el valor ecológico de un río o un segmento de un arroyo secuencia que ha sido designado por la legislatura de Texas como ecológicamente único. Además, el TWDB no puede financiar proyectos de abastecimiento de agua, ubicados en un segmento de secuencia que ha sido designado como ecológicamente único.

Las reglas de TWDB especifican los criterios que se aplican en la evaluación del río o secuencia de un arroyo que tenga el potencial de ser ecológicamente único o secuencia de segmentos. Estos son: función biológica, función hidrológica, áreas de conservación ribereñas, un agua de alta calidad/acuáticos estético de vida/alto valor excepcional y comunidades amenazadas o especies en peligro de extinción /comunidades únicas.

Para ayudar a la RWPG de Rio Grande, los parques de Texas y el departamento de vida silvestre (TPWD) desarrollaron una lista de candidatos segmentos de cuerpo de agua en cada región que parecen cumplir los criterios para su designación como ecológicamente único. La RWPG de Rio Grande también había recibido sugerencias del servicio de vida silvestre y pesca de Estados Unidos, el condado de Zapata y la Asociación de camarón de Texas a través de dos reuniones de "enfoque de grupo" de las partes interesadas durante la primera ronda de la planificación.

La RWPG de Rio Grande examinó las candidaturas presentadas por TPWD y otros con respecto a la designación legislativa de río o secuencia de segmentos como ecológicamente únicos. El grupo eligió no incluir a todas las recomendaciones.

Embalse de sitios

Las reglas de TWDB proporcionan también que la RWPGs "podrá recomendar sitios de valor único para la construcción de embalses, incluyendo las descripciones de los sitios, razones para la designación única y los beneficiarios previstos del abastecimiento de agua para ser desarrollado en el sitio."

Tres sitios de embalse han sido consideradas por la RWPG de Rio Grande: la propuesta de Brownsville Weir y embalse; la propuesta de el embalse de morales de Banco y la propuesta Laredo bajo agua Weir. Ninguno se recomienda para su designación como un sitio único de lagos para almacenar agua en este momento.

Recomendaciones legislativas

Bajo las reglas de TWDB, los planes regionales de agua podrán incluir "recomendaciones reguladoras, administrativas o legislativas, que el grupo de planificación regionales de agua considera son necesarias y convenientes para facilitar el desarrollo ordenado, administración y conservación de los recursos hídricos y la preparación y la respuesta a las condiciones de sequía."

Muchos de los problemas y necesidades de la región surgen del hecho de que el río Grande es un río internacional, cuyas aguas son compartidas por los Estados Unidos y México. Ningún otro grupo de planificación regional de agua en el área enfrenta esta realidad. En consecuencia, las recomendaciones formuladas por la RWPG de Rio Grande para tomar acción para enfrentar necesidades regionales de agua se dividen en dos categorías: algunas recomendaciones caen dentro de la autoridad del Estado de Texas; otros deben abordarse a través de los auspicios de la frontera internacional y de la Comisión de agua o de otros organismos internacionales y federales.

Recomendaciones sobre cuestiones de Estado

1 La legislatura de Texas proveerá los fondos adecuados a la Junta de desarrollo hidráulico de Texas para implementar y prestar asistencia al agua a grupos de

usuarios en el desarrollo y aplicación de las medidas avanzadas de conservación de agua, incluyendo una divulgación pública estatal y un programa de educación.

2 El estado de Texas tomara en cuenta otros factores además de los de población en la financiación del proceso de planificación en la región M debido a las circunstancias únicas que afectan el suministro de agua en el área.

3 El Estado debe seguir financiando proyectos de agua subterránea salobre y el proyecto de plantas pilotos de desalinización de agua de mar como medio para aumentar las alternativas de abastecimiento de agua en la región.

4 El Estado debería autorizar el plan maestro del agua de Río Grande para administrar la WAM del Río Grande y debe totalmente proveer los fondos adecuados a la Comisión de Texas sobre calidad ambiental provenientes de los pagos por los titulares de derecho de agua de río grande como esta especificado en la sección 11.329 del código de agua de Texas con el fin de financiar plenamente las operaciones de el plan maestro del agua de Río Grande.

5 El Estado debe ayudar a encontrar nuevos recursos técnicos y financieros para ayudar a combatir plantas acuáticas y Atarfe (especies de plantas invasivas) de la región y proteger así sus suministros de agua. La RWPG de Rio Grande se une con el Far West Texas y RWPGs de la meseta para alentar a la financiación para proyectos encaminados a la erradicación de Atarfe y otras especies de plantas invasoras en la cuenca del río grande y continuara a corto y largo plazo manejo de actividades.

6 El Estado debe continuar proporcionando recursos técnicos y financieros para desarrollar plenamente la GAM regionales.

7 El Estado debería modificar el proceso de planificación para permitir el trato de cada distrito de riego como parte de la WUG, en lugar de hacerlo como parte de "el condado-otros," a fin de permitir la elaboración de estrategias de gestión de agua individuales para los distritos.

8 La Comisión de Texas sobre calidad ambiental debería prestar asistencia a la RWPG de Rio Grande al revisar las reglas sobre la conversión de derechos sobre el agua de un uso a otro y considerar los cambios necesarios de la regla correspondiente, si es necesario.

9 Se alienta a las entidades dentro de la región a cooperar para resolver los problemas de agua a través de medios tales como las entidades que manejan los servicios de agua potable y agua residuales de la región.

10 Se alienta a la formación de los distritos de conservación de las aguas subterráneas como un medio para proteger el abastecimiento de las aguas subterráneas, que es cada vez más aprovechado como un nuevo abastecimiento de agua para uso industrial y municipal.

11 El estado debería proveer los fondos necesarios a la Comisión de ferrocarriles de Texas para tapar los pozos de gas y petróleo abandonados que amenazan a los suministros de agua subterránea.

12 La legislatura de Texas debería proporcionar asistencia técnica y financiera para implementar estrategias de administración de agua identificadas en los planes regionales de agua.

13 La legislatura de Texas debería proveer fondos para continuar el proceso de planificación de agua de la región.

Recomendaciones sobre los problemas nacionales e internacionales

1 La frontera internacional y la Comisión de agua (IBWC) deben renovar los esfuerzos para garantizar que México cumpla con el acuerdo 309 y sentar los medios para lograr el pleno cumplimiento con el Tratado de 1944, incluida la aplicación del acuerdo 234, que aborda las acciones requeridas de México para eliminar completamente el déficit de entrega de agua dentro de ciclos de Tratado especificado. Agua almacenada en proyectos de conservación de riego en México debe dedicarse a garantizar las entregas hacia el Río Grande de acuerdo con arreglo al Tratado de 1944 en virtud del artículo 4B(c) y minuto no. 234.

2 Los Estados Unidos y México deben reforzar las atribuciones y obligaciones de ambas secciones de la IBWC con arreglo al artículo 24, que prevé, entre otras cosas, para la aplicación del Tratado y otro acuerdo disposiciones "… *cada Comisario deberá invocar cuando sea necesario la jurisdicción de los tribunales o de otros organismos pertinentes de su país para ayudar en la ejecución y aplicación de estos poderes y deberes.* "

3 El minuto 309 proyectos de conservación financiados por el Banco de desarrollo de América del Norte y otros proyectos financiados por organismos nacionales e internacionales para modernizar y mejorar las instalaciones de los distritos de riego en la cuenca de Río Grande deben ser apoyados y darles prioridad. En particular, ambos países deberían apoyar continua invertir fondos para proyectos de conservación a través del Fondo de inversiones de conservación de agua (NADBank's).

4 Los proyectos de conservación de riego actualmente en marcha a través de la Oficina de reclamación para mejora de los sistemas de riego de los distritos de riego en la cuenca de Río Grande en los Estados Unidos debe ser compatibles y implementado.

5 Con fines de clarificación, el IBWC debe aprobar un notas que fije la definición de "sequía extraordinaria" como ese término se define implícitamente en el segundo párrafo del artículo 4B(d) como un evento que hace difícil para México "… para que esté disponible el flujo de agua debido a fuertes lluvias de 350.000 acres pies (431,721,000 metros cúbicos) cada año." se produce una condición de sequía. Cuando hay menos de 1.050.000 acres pies anualmente de el flujo de agua debido a fuertes lluvias en las cuencas hidrográficas que descargan en los cuerpos de agua

mexicanos de acuerdo al tratado de 1944, este se medirá al entrar en el río grande cuando procedan de los afluentes mexicanos.

6 La contabilidad de agua entre los Estados Unidos y México de acuerdo con el Tratado de 1944 debe ser coherente con la Convención de 1906, que establece que todas las aguas que se mide en Fort Quitman, Texas, son 100 por ciento asignados a los Estados Unidos.

7 Para una mejor gestión del agua en el segmento del agua en la región baja del río Grande, río abajo de la presa de Anzalduas, de ambos países deberían reafirmar políticas operacionales que México seguirá tomando de agua que le corresponde a través de la desviación de canal de Anzalduas en la presa de Anzalduas o la cuenta de su agua en ese momento, incluyendo cualquier desviación por México desde el almacenamiento de Brownsville Weir proyecto propuesto, en la medida de su participación en el proyecto.

8 IBWC debería convocar una reunión binacional de planificadores de agua y uso del agua de las partes interesadas en ambos países dentro de seis meses siguientes a la finalización anual del agua contable en el que se produzca un déficit anual en las corrientes de los afluentes mexicanos de acuerdo con el Tratado de 1944. Esta reunión tendría por objeto compartir datos e información útil en la planificación de las necesidades de agua y contingencias en el futuro intermedios.

9 IBWC debería restaurar el río Grande a bajo de Fort Quitman, Texas.

10 El IBWC debe asumir toda la responsabilidad financiera local y regional para la conservación y mantenimiento de El Morillo drenaje.

11 IBWC deberían coordinar los esfuerzos bilaterales para revisar y evaluar las fuentes existentes de datos con respecto al desarrollo de las aguas subterráneas en ambos países de la cuenca del río grande por debajo de Fort Quitman hasta el Golfo de México. Este esfuerzo debe centrarse en el impacto potencial sobre abastecimiento de agua superficial en la cuenca del río Grande, con el objetivo de embolsar tales acciones como sean necesarias para evaluar las condiciones actuales y promover programas de protección en el suministro de agua de superficie en regiones que tengan un historial afectado.

12 Planificación de cuencas hidrográficas regionales debería alentarse en ambos lados del río grande através de toda la cuenca, incluidos los esfuerzos para promover la coordinación binacional de planes de agua a largo plazo.

13 Pactos Interestatales entre los Estados afectados en México, similar a la del Pacto de Río Grande y río Pecos entre los Estados afectados en los Estados Unidos, que se ocupan de distribuir el abastecimiento disponible de agua de manera proporcional del río grande y sus afluentes a cada estado consistente con sus derechos locales e internacionales actuales deberían alentarse.

Recomendaciones de financiamiento de infraestructura de agua

El requisito de informe de financiamiento de infraestructura (IFR) fue incorporado en el proceso de planificación del agua regional en respuesta al estatuto preliminar 2 (SB2) del proyecto de ley de Senado de planificación regionales de agua (77 th legislatura de Texas). A efectos de la IFR, cada RWPG es necesario para determinar la financiación propuesta para todas las estrategias de gestión de agua que fueron propuestas en esta tercera ronda de planificación regional. Para cada una de estas estrategias, el RWPG debe determinar la financiación necesaria para implementar la estrategia y los tipos de financiación que tienen probabilidades de ser accedido.

De acuerdo con las directrices de TWDB, los objetivos principales de la IFR son determinar:

- el número de subdivisiones políticas con las necesidades detectadas para suministros de agua adicionales que será incapaz de pagar sus necesidades de infraestructura de agua sin algún tipo de asistencia financiera exterior;
- ¿Cuánto de los costos de infraestructura en los planes de agua regional no pueden ser pagados por uso exclusivamente de fuentes de ingresos de los servicios de agua potable y aguas residuales locales;
- las opciones de financiación propuestas por subdivisiones políticas para satisfacer las necesidades futuras de infraestructura de agua (incluyendo la identificación de cualquier recurso financiero considerado del Estado); y,
- qué acciones proponen la RWPGs al el estado en la recomendación de financiación de los proyectos de abastecimiento de agua.

En la mayoría de los casos, las estrategias WUG municipales incluyen urbanización, medidas avanzadas de conservación de agua y la compra de suministros del Río Grande. Hay un total de ocho condados, 52 ciudades y 15 empresas de abastecimiento de agua en esta área de planificación regional. Las encuestas fueron enviadas sólo aquellos que habían sido incluidas en el plan con la necesidad del plan de 50 años.

Participación pública, facilitación de la actividad y las cuestiones de aplicación de plan

Participación pública

La participación del público es la base del proceso de planificación del agua regional iniciado por SB 1 en 1997. Las reglas de TWDB requieren que el RWPGs tenga al menos una reunión antes de la elaboración del plan regional de agua, proporcionar un curso de oportunidades para la participación del público durante el proceso de planificación y celebrar al menos una audiencia pública previo a la adopción "inicialmente preparada" del plan de agua regional. El RWPGs también debe cumplir con las reglas de TWDB específicamente en cómo y a quién el aviso de reuniones públicas y audiencias públicas deban facilitarse.

Tanto en el primer y segundo ciclos de planificación agua regional, la RWPG de Rio Grande ha ido mucho más allá de los requisitos mínimos establecidos por el Estado para la participación del público, proporcionando múltiples oportunidades para la entrada de público y para la participación directa en el proceso de planificación y desarrollo del proyecto de plan. El grupo también intensifico sus esfuerzos en la tercera ronda de la planificación para garantizar la participación pública y la implicacion en el proceso.

La RWPG de Rio Grande ha celebrado reuniones regulares en todo el proceso de planificación, generalmente en una base mensual. Cada reunión ha brindado la oportunidad para escuchar los comentarios del público. Conforme las reuniones de la planificación progresaron, el orden de la agenda cambio para que la oportunidad de comentario se trasladara del final de la agenda del programa al principio del programa a fin de acomodar mejor las necesidades del público.

Se han utilizado una variedad de mecanismos para dar a conocer las reuniones de la RWPG de Rio Grande, incluyendo avisos a los medios de comunicación y mensajes através del Sitio Web www.RioGrandeWaterPlan.org. Del RWPG de Rio Grande El sitio Web fue desarrollada a finales de 2003 como un recurso para la opinión pública sobre cuestiones de interés para la planificación agua regional y la información sobre el proceso de planificación. Según las estadísticas de la web, un promedio de 252visitantes únicos hizo un promedio de 359 visitas al mes en 2009.

Un folleto sencillo, fácil de leer sobre la región M y el proceso de planificación regional se desarrolló en abril de 2010 y fue distribuido en una variedad de foros y a través de correo directo. El folleto también dirige a los lectores a la página Web para obtener información adicional y en profundidad.

El resumen ejecutivo del plan es traducido al español y se registra en el sitio Web.

La RWPG de Rio Grande y su equipo consultor también solicita activamente comentarios de entidades locales sobre los datos básicos que se utilizan para desarrollar el plan, incluiyendo la financiación de infraestructura de agua y el proyecto de las proyecciones de la demanda de agua y de la población. Además, se hicieron presentaciones a una variedad de grupos con un interés en la planificación de agua, incluyendo las asociaciones de utilidad de agua, los cultivadores de cítricos y juntas de directores de distrito de riego.

La RWPG de Rio Grande proporciono extensa aviso y oportunidad para comentarios del público sobre el *Plan Inicial de elaboración*. Una audiencia pública sobre el plan se celebró en Weslaco, Texas, el 21 de abril de 2010. Una audiencia pública adicional se celebró en Laredo, Texas, el 28 de abril de 2010.

Facilitación

La Facilitación del proceso de planificación del agua para la región de Río Grande ha proporcionado por el personal del consejo de desarrollo de la región baja del valle del Río Grande (LRGVDC), con la asistencia del equipo consultor. Además de realizar las tareas administrativas relacionadas con la gestión de los fondos del Estado, la LRGVDC también hizo todos los arreglos para las reuniones de la RWPG de Rio Grande, que incluye un registro requerido de avisos de reunión, preparar programas de reunión y distribuir materiales de respaldo de orden del día a los miembros de la RWPG. La LRGVDC grabo todas las reuniones de la RWPG de Rio Grande y preparo el Acta de la reunión oficial. Si así lo solicita antes de la reunión, se proporcionó un traductor de español.

El equipo consultor también ayudó a facilitar el proceso de planificación al proporcionar presentaciones de información técnica en las reuniones de RWPG y ayudar en la identificación de los problemas claves de planificación y política de agua.

Problemas de implementación de plan

Un número clave de cuestiones afectará si este plan tiene éxito en el logro de su objetivo principal de desarrollar estrategias para hacer frente a las necesidades de agua de la región de Río Grande a corto y largo plazo. Por lo general, las cuestiones claves relativas a la aplicación de este plan pueden agruparse en tres categorías:

- Cuestiones y estrategias de gestión de agua que requieren evaluación a fondo adicional. Las recomendaciones presentadas en este plan regional de agua se basan en una evaluación del nivel de reconocimiento de las demandas de agua proyectada, abastecimiento de agua, las necesidades y diversas estrategias para satisfacer las necesidades futuras. Adicional, y más detallada planificación de nivel de viabilidad será necesaria antes a la aplicación de muchas de las estrategias recomendadas. También, en muchos casos, planificación de viabilidad-nivel deberá ser seguida de diseño de ingeniería y el proceso de los permisos. En su mayor parte, las actividades de desarrollo adicionales de un proyecto de planificación y necesarias para la aplicación de la estrategia será la responsabilidad de los proveedores de agua local (por ejemplo, las ciudades, las empresas de abastecimiento de agua y distritos de riego). Sin embargo, asistencia técnica y financiera del estado y/o federal facilitaría enormemente la oportuna desarrollo e implementación de proyectos.

- Inversionistas locales y acciones pueden implementar estragias de sumistro de agua y las medidas para aplicar local del agua. Este plan regional de agua se aprecia mejor cuando proporciona un marco de la acción local para aplicar estrategias para satisfacer las necesidades futuras de agua. El papel de la RWPG de Río Grande es puramente consultivo. El RWPG no tiene autoridad para obligar a otras entidades para aplicar las medidas recomendadas en este plan, ni tiene la autoridad o los recursos para llevar a cabo actividades de aplicación por su propia iniciativa. Más bien, la aplicación de las estrategias recomendadas para satisfacer las necesidades futuras de agua es una responsabilidad primordial de proveedores de agua local, que incluyen las ciudades, las empresas de abastecimiento de agua, otras entidades de abastecimiento público de agua y los distritos de riego. Con o sin ayuda externa, estudios de planificación mas detallados a nivel de factibilidad y diseño de ingeniería es en gran medida la responsabilidad de los proveedores de agua local. Del mismo modo, se sufragarán los gastos de la aplicación de estrategias de abastecimiento de agua y la conservación de agua en gran parte por los contribuyentes servidos por los proveedores de agua local. Por lo tanto, es esencial que exista un fuerte compromiso por parte de los órganos directivos y la gestión de los proveedores de agua locales para implementar las estrategias recomendadas en este plan.

- Fondos para la aplicación de las recomendaciones del plan. La disponibilidad de y el acceso a la financiación para la aplicación de las estrategias de gestión de agua recomendada es crucial. La mayoría de los proveedores locales de agua en la región de Río Grande son entidades gubernamentales o semipúblicos (por ejemplo, las empresas de abastecimiento de agua) que tienen la autoridad para cobrar y recaudar los impuestos y las tarifas de los servicios que ofrecen. Estas entidades tienen también la posibilidad de pedir prestado dinero para adquirir suministros de agua adicionales y para desarrollar y rehabilitar la infraestructura relacionadas con el agua. En su mayor parte, los costos directos de los servicios prestados por estas entidades deben proveerse por los usuarios de agua individuales a través de los impuestos y tarifas por servicios. Sin embargo, debe reconocerse que existe también un papel adecuado para los gobiernos estatal y federal en la financiación de la conservación del agua, el desarrollo de abastecimiento de agua y proyectos de infraestructura. En la actualidad, hay un número de programas estatales y federales de asistencia financiera para proyectos de infraestructura relacionados con el agua que están disponibles para los proveedores de agua municipal. Sin embargo, son pocos los programas que proporcionan asistencia financiera a los distritos de riego para mejoras en la infraestructura. Porque la conservación agrícola del agua es un elemento central de este plan regional de agua – y es fundamental para mantener la viabilidad de este sector de la economía regional – la RWPG de Rio Grande recomienda que se desarrolle nuevas fuentes de financiación públicas para ayudar a los distritos de riego con la implementación de programas de conservación.

Ningún conflicto interregional ha sido identificada en el proceso de planificación o está contenida en el plan.

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CHAPTER 1.0 : INTRODUCTION – GENERAL OVERVIEW OF REGIONAL WATER PLANNING & SENATE BILL ONE

The Texas Water Development Board (TWDB) was established in 1957 through a state constitutional amendment. A six-member board was appointed by the governor to serve as a policy-making body. Membership consisted of overlapping six-year terms, and each board member had to be from a different section of the state. The agency's original function was to provide loan assistance to political subdivisions for the development of surface water supply projects that could not be financed through commercial channels. During the 1960s the board's responsibilities grew to include the authority to obtain and develop water conservation storage facilities, prepare a state water plan, and assume operations of the Texas Water Commission not related to the question of water rights.

In the 1990s the Texas Water Development Board had a number of broad responsibilities. One primary function was still the granting of loans to local governments in order to implement flood and pollution control, wastewater treatment, and municipal solid waste management. In addition, the board provided grants and loans to economically distressed areas of the state to implement water and sewage projects, including low-interest loans to colonia residents for plumbing improvements.

The agency is responsible for collecting data and conducting studies regarding agricultural water conservation, fresh water needs of Texas estuaries and bays, and surface and ground water resources. It also maintained the Texas Natural Resources Information System, a central database of information concerning the state's resources. The executive administrator's office implements the agency's policies. An administrative division provides support through services such as accounting, budget monitoring, and inventory record keeping. The board funds its assistance programs with state-backed bonds and federal grants to provide for a State Revolving Fund for borrowers, overseen by the office of the Development Fund manager.

Loan recipients also receive engineering and technical advice from the board's engineers and archeologists. As the agency responsible for developing a state water plan, the Texas Water Development Board employs a number of research sections to assess and project water availability, environmental impact, and water uses for both agricultural and municipal areas. The board continually collects surface and underground water information through hydrologic monitoring. It provides technical evaluation of water resource problems and promotes programs on conservation education. In 1991 the board had a budget of almost $11 million. By the early 1990s the agency had sold over $1 billion in bonds for the financing of water-related projects since its inception. It is the TWDB's responsibility to see that there is an adopted State Water Plan, as established through Senate Bill 1.

During 1997 the 75th Texas Legislature enacted Senate Bill 1 (SB 1), often referred to as the Brown-Lewis Water Plan after its Senate and House sponsors. Due to the drought of 1996 and increasing public awareness of the state's rapidly increasing water demands, this major legislation provided for a major overhaul of many longstanding state water laws and policies. SB 1 addressed a wide range of issues and concerns including state, regional, and local planning for water conservation, water supply and drought management; administration of state water rights programs; interbasin transfer policy; groundwater management; water marketing; state financial assistance for water-related projects; and state programs for water data collection and dissemination.

SB 1 radically altered the manner in which future state water plans are to be prepared. Historically, the state water plan had been prepared by the TWDB with input from other state and local agencies and the public. With SB 1, the Legislature established a "bottom up" approach whereby future state water plans are based on regional water plans prepared and adopted by appointed regional water planning groups (RWPGs). The RWPGs serve without compensation and are responsible for overseeing the preparation of the regional water plans.

The regional water plans are to be based on an assessment of future water demands and currently available water supply, and are to include specific recommendations for meeting identified water needs through 2060. The plans may also include recommendations regarding strategies for meeting long-term (2040-2060) needs, as well as recommendations regarding legislative designation of ecologically unique rivers and streams, reservoir sites, and policy issues. By law, the regional water plans are to be completed by September 1, 2010, at which time the TWDB will have one year to compile a new state water plan. The rough draft of this regional water plan is due March 1, 2010. The regional water plans and the state water plan are to be updated every five years. This is the third round of regional water planning.

In February 1998, the TWDB adopted administrative rules, which included the delineation of 16 regional water planning areas (see Figure 1.1) and the definition of the procedures and requirements for the development of the regional water plans. The TWDB also appointed the initial members of 16 RWPGs. Subsequently, the RWPGs adopted by-laws, selected a political subdivision to act as its administrative agent, and developed a scope of work and budget for preparation of the regional water plans. Funding for the preparation of the regional water plans was provided in the form of grants from the TWDB.

Initially designated by TWDB as "Region M," the Rio Grande Regional Water Planning Area (herein referred to as the Rio Grande Region) consists of the eight counties adjacent to or in proximity to the middle and lower Rio Grande (see Figure 1.2). These are:

Cameron	Starr
Maverick	Zapata
Hidalgo	Webb
Jim Hogg	Willacy

The Rio Grande Regional Water Planning Group, at the time of the adoption of this plan, consists of various members representing 10 of the 11 interest group categories specified in SB1. One category, river authorities, is not represented on the Rio Grande RWPG, as there are no river authorities in existence within the boundaries of the Rio Grande Region. In addition to its voting membership, the Rio Grande RWPG includes non-voting members representing state agencies and the Mexican federal government.

This is the third round of planning for the regional water plan. There are updates on the guidelines for the water planning itself, which are stated in Exhibit B. Exhibit B is used as a reference to the guidelines that will help in having accurate data for the population and water demand projections. The population projections were updated with the help of the guidelines set forth by Exhibit B. Cities were allowed to make corrections in their population count reported in 2000 by the United States Census. Several changes were made by the cities to have a better representation of the water demand needs. Exhibit B added several relevant chapters, so instead of seven chapters, there are now ten. All ten chapters will be described briefly in this chapter.

By rule, the TWDB has set forth specific requirements and guidelines for the preparation of the regional water plans (31 Texas Administrative Code, Chapter 357, Regional Water Planning Guidelines Rules). Accordingly, there are several key tasks that are common to the development of the water plans in all regions:

- Development of population and water demand projections by decade for the period 2010-2060;
- Evaluation of the adequacy of currently available water supplies under drought of record hydrologic conditions;
- Comparison of currently available water supplies with projected demands to identify where and when there is a surplus of supply or a need for additional supplies;
- Evaluation of the social and economic impacts of not meeting the identified water needs; and,
- Development of recommendations regarding strategies for meeting near-term water needs (2010 to 2040) and strategies or scenarios to meet long-term future needs (2040 to 2060).

In addition, each RWPG may, at their discretion, include recommendations in their regional water plans with regard to:

- Legislative designation of ecologically unique river and stream segments;
- Identification of sites uniquely suited for reservoir construction;
- Regulatory, administrative, or legislative actions to improve water resource management in the region or in the state; and,
- Coordinated planning with neighboring regions concerning mutual interests and shared resources.

This document presents the approved water supply plan for the Rio Grande Region. Pursuant to TWDB requirements, the plan is organized into ten chapters.

Figure 1.1: TWDB Designated Regional Water Planning Areas

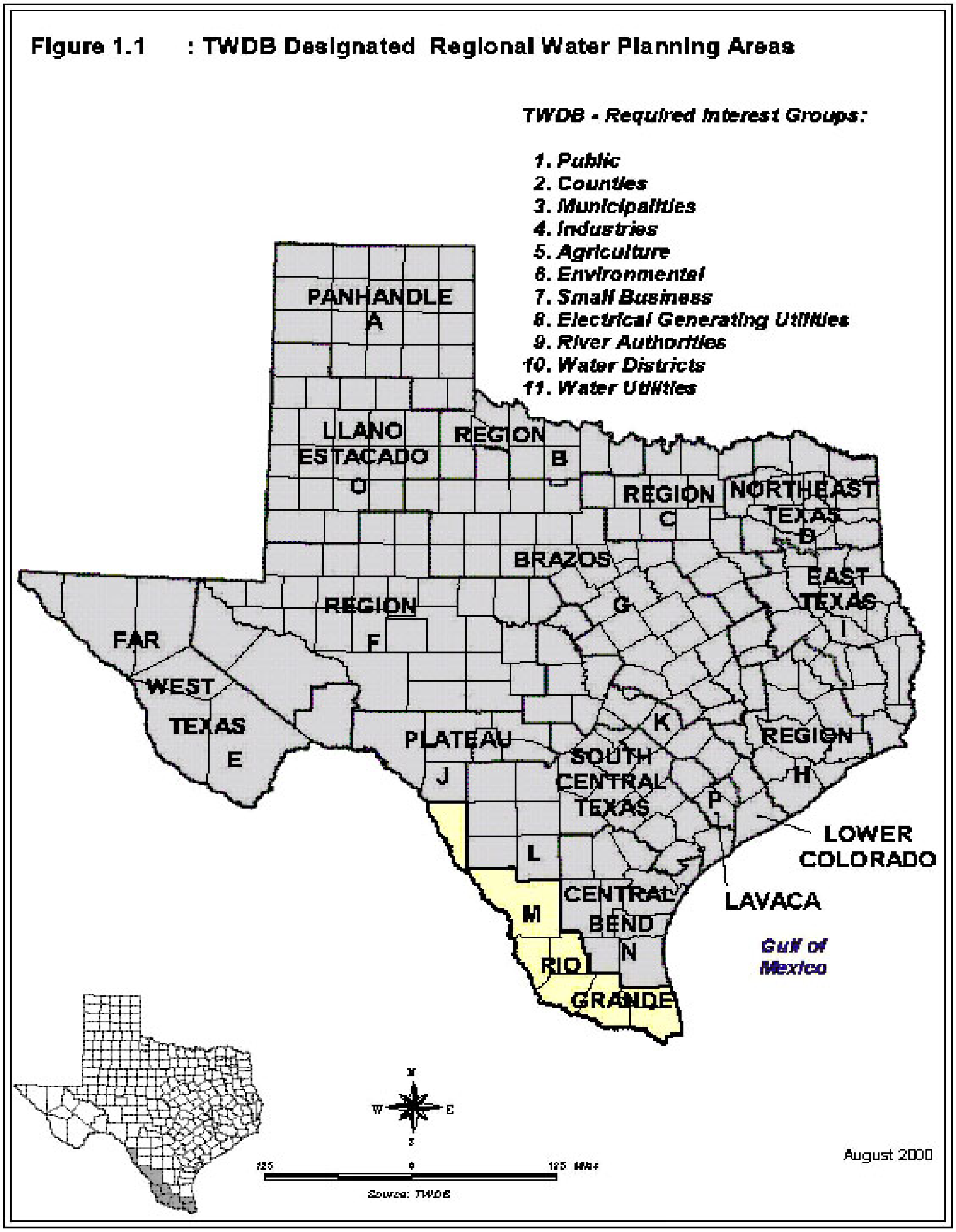
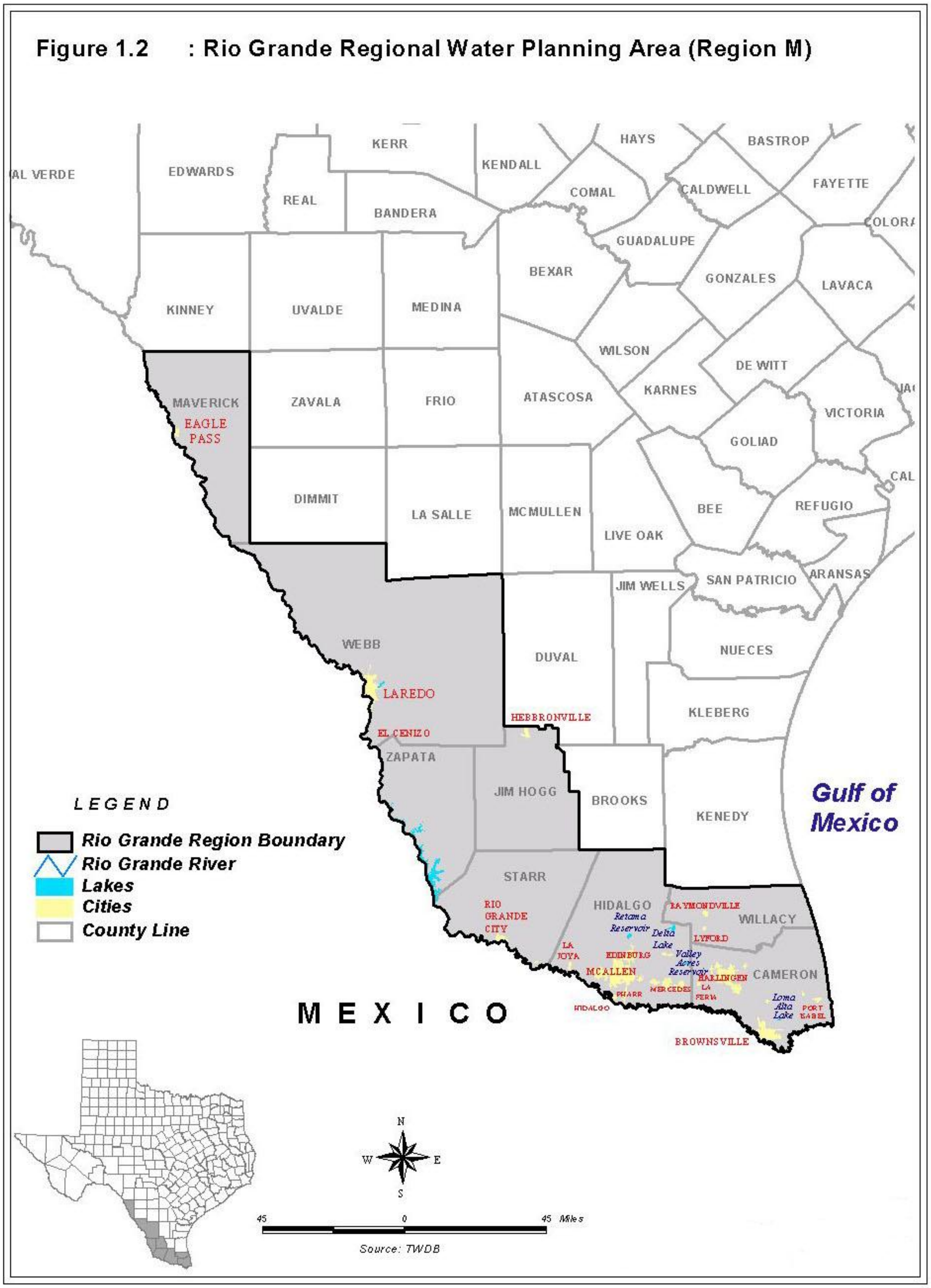


Figure 1.2: Rio Grande Water Planning Area (Region M)



Voting and non-voting members of the Rio Grande RWPG are shown in Table 1.1. The Lower Rio Grande Valley Development Council (LRGVDC) serves as the administrative agency on behalf of the Rio Grande RWPG.

Table 1.1: Voting Members of the Rio Grande Regional Water Planning Group

INTEREST	NAME	RESIDENT COUNTY
PUBLIC	**MARY LOU CAMBELL SECRETARY, MERCEDES**	**HIDALGO**
COUNTIES	**JOHN WOOD COUNTY COMMISSIONER, BROWNSVILLE**	**CAMERON**
MUNICIPALITIES	**ROBERTO GONZALEZ WATER WORKS, EAGLE PASS**	**MAVERICK**
	JOHN BRUCIAK, GENERAL MANAGER BROWNSVILLE PUB, BROWNSVILLE	**CAMERON**
	TOMAS RODRIGUEZ CITY OF LAREDO	**WEBB**
INDUSTRIES	**GARY WHITTINGTON UNIFIRST LINEN SERVICE, HARLINGEN**	**CAMERON**
AGRICULTURE	**ROBERT E. FULBRIGHT HINNANT & FULBRIGHT, HEBBRONVILLE**	**JIM HOGG**
	RAY PREWETT TEXAS CITRUS MUTUAL, MISSION	**HIDALGO**
ENVIRONMENTAL	**SONIA NAJERA THE NATURE CONSERVANCY**	**CAMERON**
SMALL BUSINESS	**DONALD K. MCGHEE HYDRO SYSTEMS, INC., HARLINGEN**	**CAMERON**
	CARLOS GARZA AEC ENGINEERING, LLC., EDINBURG	**HIDALGO**
ELECTRIC GENERATING UTILITIES	**ELLA DE LA ROSA MAGIC VALLEY ELECTRIC COOPERATIVE**	**HIDALGO**
RIVER AUTHORITIES	**JAMES DARLING RIO GRANDE REGIONAL WATER AUTHORITY**	**HIDALGO**
WATER DISTRICTS	**SONNY HINOJOSA HCID NO. 2, SAN JUAN**	**HIDALGO**
	SONIA LAMBERT CCID NO. 2, SAN BENITO	**CAMERON**
WATER UTILITIES	**CHARLES BROWNING[1] NORTH ALAMO WATER SUPPLY CORP., EDINBURG**	**HIDALGO**
OTHER	**GLENN JAVIS, CHAIR ATTORNEY, McALLEN**	**HIDALGO**

Special thanks go out to all board members who helped develop the Regional Water Plan, including these former members:

- Jose Aranda, County Judge, Maverick County
- Joe Guerra, Plant Manager, Webb County
- James R. Matz, Cameron County[2]

[1] See attachment 1-3 for memorial resolution honoring Mr. Charles Browning Jr.
[2] See attachment 1-2 for memorial resolution honoring Mr. James R. Matz

Chapter 1 presents a description of the regional water planning area. This includes information regarding current water uses and major water demand centers, sources of surface and groundwater supply, agricultural and natural resources, and the demographic and socioeconomic characteristics of the region. Also included is a summary of existing regional water plans, a summary of recommendations in the current state water plan, a summary of local water plans, and an assessment of threats to agricultural and natural resources.

Chapter 2 of this plan presents current and projected population and water demands. This information is reported by city and county and for the portion of each river basin within the Rio Grande Region. Water demand projections are presented for six water use categories: municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock.

Chapter 3 describes a total analysis of the region's water supply.

Chapter 4 presents how to identify, evaluate, and select water management strategies based on needs.
Chapter 5 describes the impacts of water management strategies on key parameters of water quality and the impacts of moving water from rural and agricultural areas.

Chapter 6 describes consolidated water conservation and drought management recommendations of the regional water plan.

Chapter 7 presents a description of how the regional plan is consistent with long-term protection of the state's water resources, agricultural resources, and natural resources.

Chapter 8 describes unique stream segments/reservoir site/legislative recommendations.

Chapter 9 is a report to legislature on water infrastructure funding recommendations. The 77th Texas Legislature required the Planning Groups to report to the TWDB how affected entities proposed to pay for Water Management Strategies in the approved Regional Water Plans.

Chapter 10 is to help in budgeting purposes for the actual adoption of the Regional Water Plan.

1.1 PHYSICAL DESCRIPTION OF THE RIO GRANDE REGION

The following sub-sections provide a general description of the region's physical characteristics including climate, topography, geology, soils, and natural resources.

1.1.1 Climate

The climate of the Rio Grande Region ranges from a humid subtropical regime in the eastern portion of the region to a tropical and subtropical regime in the remaining portion of the region. Prevailing winds are southeasterly throughout the year and the warm tropical air from the Gulf of Mexico produces hot and humid summers and relatively mild and dry winters. The July maximum temperature in the region ranges from about 96°F to 98°F. The January minimum temperature in the region ranges from about 40°F to 49°F (TWDB, 1977). The number of frost-free days (growing season) varies from 320 days at the coast to 230 days in the northwestern portion of the region near Maverick County. Average annual net lake evaporation in the Rio Grande Region varies from 40 to 44 inches at the coast to approximately 60 to 64 inches at the central portion of the region near southern Webb County (Figure 1.3). Lake-surface evaporation rates are highest in the summer months.

The amount of rainfall varies across the Lower Rio Grande Region from an average of 28 inches at the coast to 18 inches in the northwestern portion of the region (Figure 1.4). Most precipitation occurs during the spring from April through June, and during the late summer and early fall, from August through October. Spring precipitation is the result of seasonal transition as inflowing warm, moist air from the Gulf of Mexico and the Pacific Ocean generates thunderstorms. The period from late summer to early fall is the hurricane season, during which Atlantic and Gulf storms may move ashore along the Texas or Upper Mexican Gulf Coast.
These storms can generate tremendous amounts of rainfall over a short period of time causing extensive flooding due to the relatively flat nature of the region's terrain. It is these fall storms, which provide a large portion of the surface water runoff captured in water supply reservoirs within the Rio Grande Basin.

1.1.2 Topography, Geology, and Soils

The Rio Grande Region is located entirely within the Western Gulf Coastal Plains of the United States, an elevated sea bottom with low topographic relief. Topography in the region ranges from a rolling, undulating relief in the northwestern portion becoming progressively flatter near the Gulf Coast. The lower portion of the region consists of a broad, flat plain which rises gently from sea level at the Gulf of Mexico in the east to an elevation of approximately 960 feet in the northern part of Maverick County at the upper end of the region. The western edge of this plain culminates in a westward-facing escarpment known as the Bordas Escarpment. Drainage in the region is by the aforementioned river basins and their tributaries. The Rio Grande River flows southeasterly through the region before turning east to its confluence with the Gulf of Mexico.

Geologic formations exposed in the region include Cretaceous, Tertiary, and Quaternary-aged deposits. In general, the geologic strata of the Rio Grande Region decrease in age from west to east across the area. The oldest strata, which are of Cretaceous age, outcrop in northwestern Maverick County and consist of chalky limestone and marl. The youngest or most recent sediments are located in Cameron County.

Figure 1.3: Rio Grande RWPA Average Annual Net Evaporation

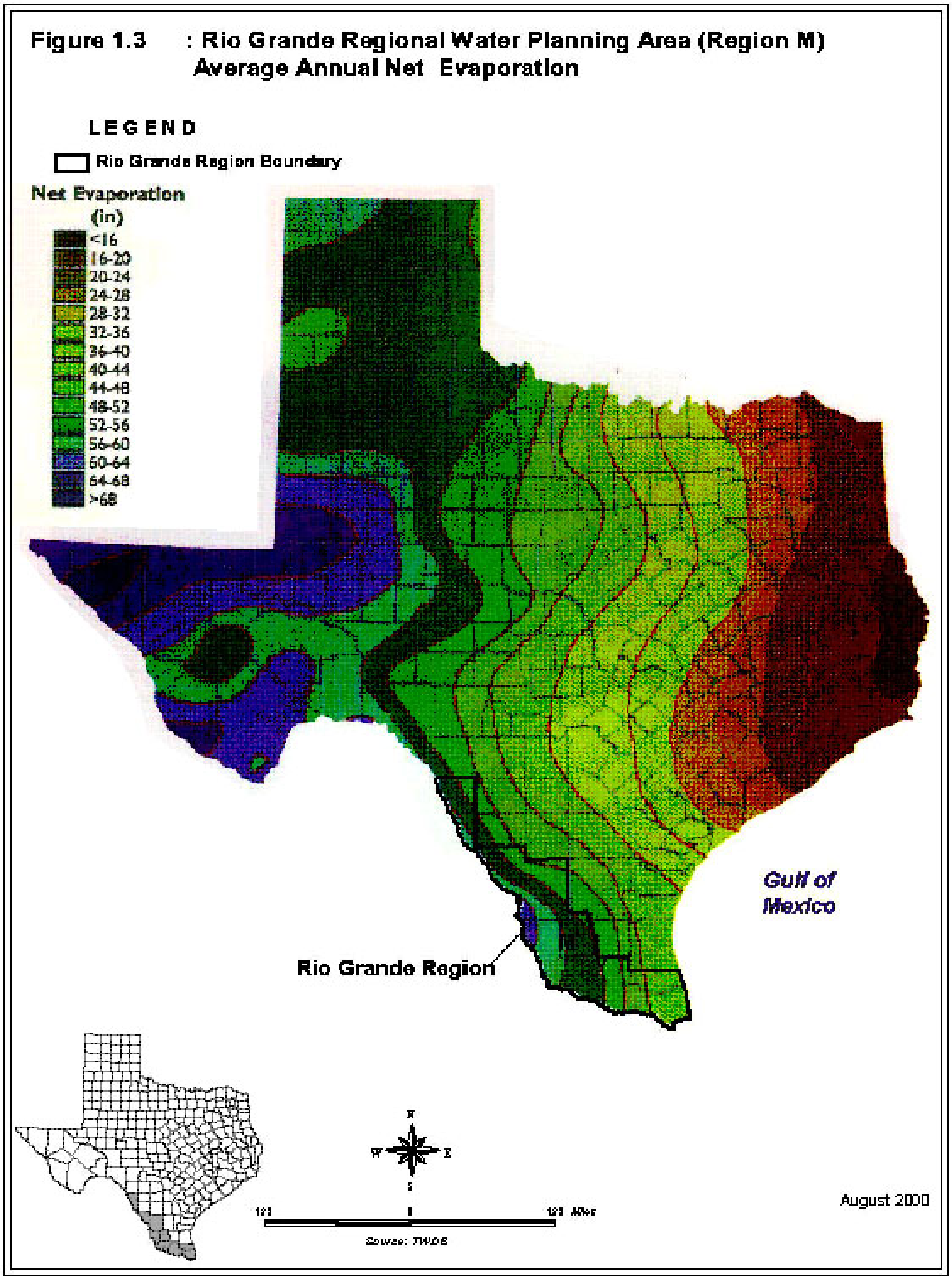
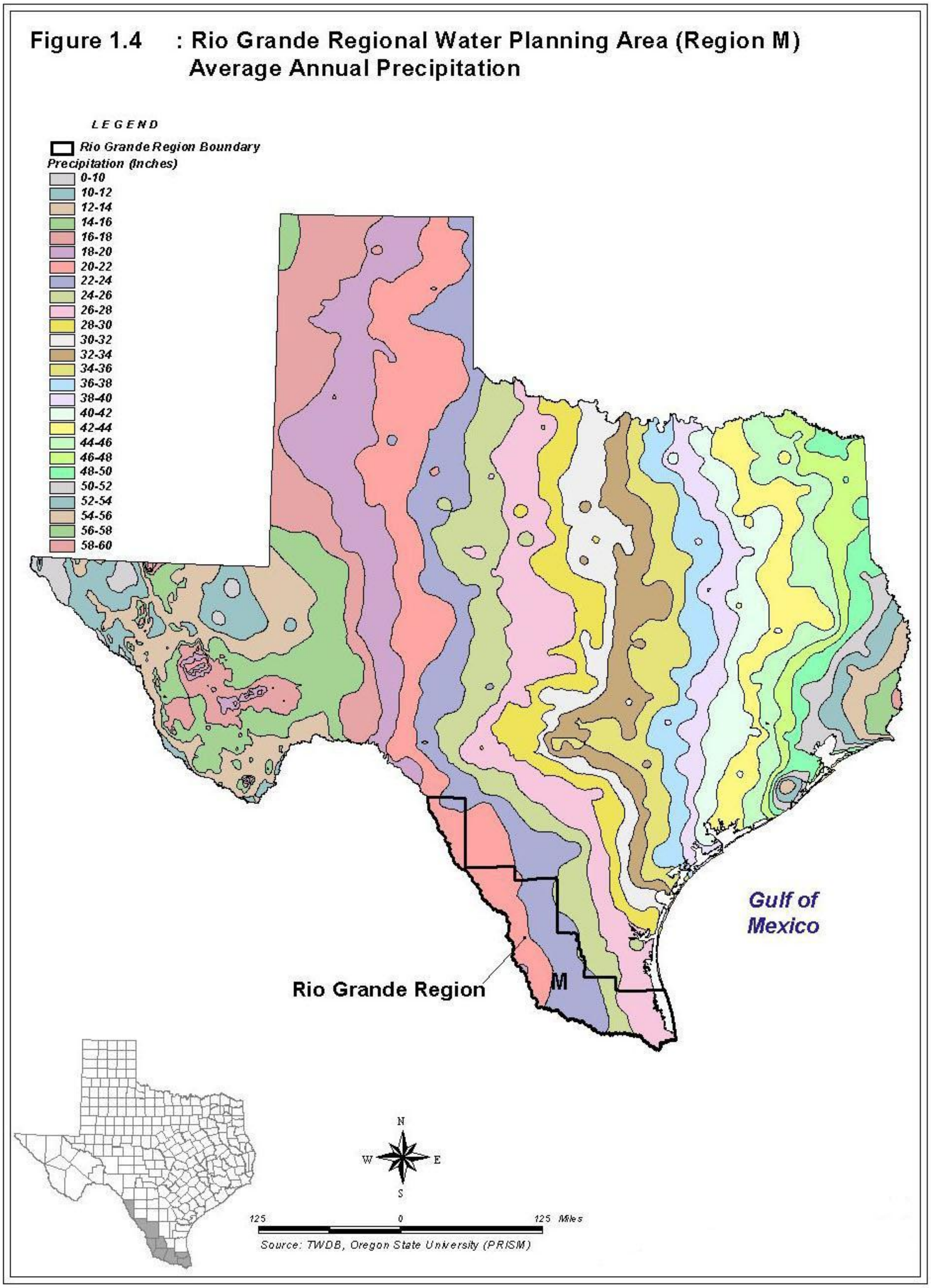


Figure 1.4: Rio Grande RWPA Average Annual Precipitation



In general, soils in the Rio Grande Region generally consist of calcareous to neutral clays, clay loams and sandy loams. A general soils map is presented in Figure 1.5.

A general description of the topography, geology, and soils for each county in the region is presented in the following sections.

1.1.2.1 Cameron County

Cameron County is located at the extreme southern tip of Texas. The geologic formations in the county are not cemented (unlithified) and dip gently toward the Gulf of Mexico. They are of Pleistocene age or younger and only two geologic formations are exposed in the county; the Beaumont Formation and the overlying sediments of recent age (Holocene).

Cameron County consists of a flat plain that slopes gently to the northeast with an elevation that varies from sea level to 70 feet[3]. The county's average elevation is 45 feet. The greater part of the area is an alluvial plain or delta of the Rio Grande River.

The county is located in an area of highly intensified and specialized farming. A narrow band of saline coastal soils parallels the Gulf of Mexico and is used as range. Portions of the northern and eastern parts of the county are used for dryland farming. Soil associations mapped in Cameron County include: Sejita-Lomalta - Barrada, Laredo - Lomalta, Willamar, Laredo - Olmito, Rio Grande - Matamoras, Willacy - Racombes, Lyford - Raymondville - Lozano, Hidalgo - Raymondville, Willacy - Raymondville, Raymondville, Harlingen-Benito, Harlingen, Mercedes, and Mustang-Coastal dunes associations (Soil Survey of Cameron County, 1977).

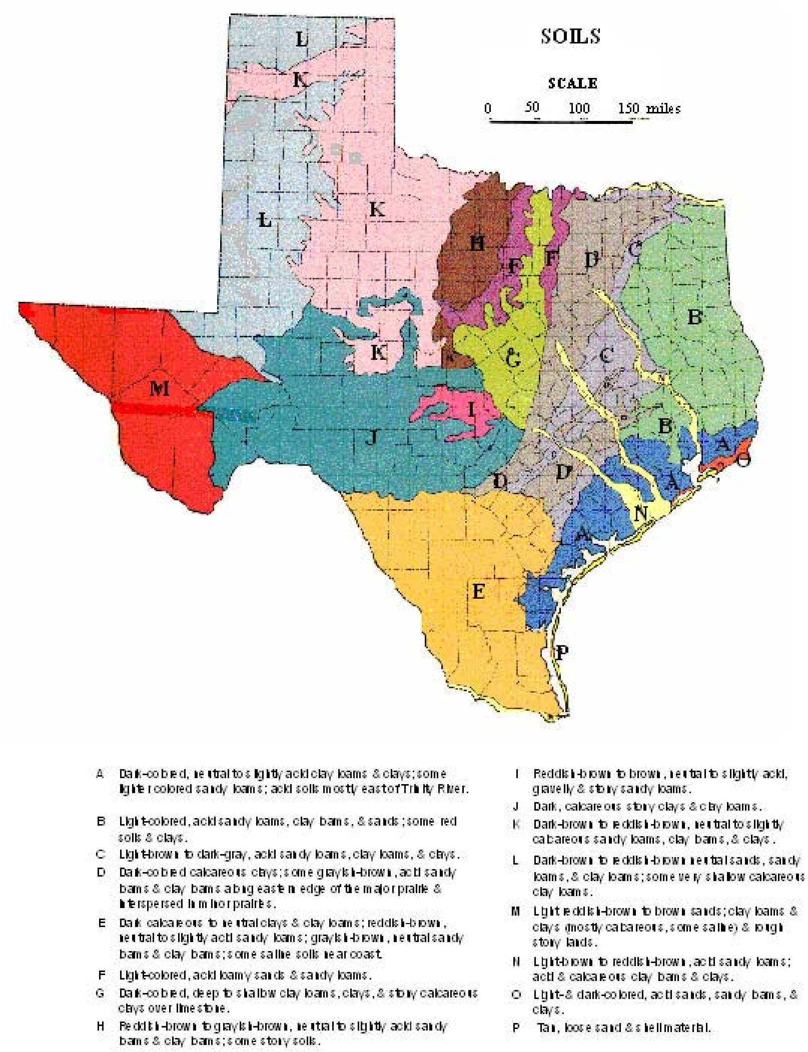
1.1.2.2 Hidalgo County

The land surface in Hidalgo County is nearly level to gently sloping. The elevation ranges from about 40 feet above mean sea level (msl) on the eastern side of the county to 375 feet above msl on the western side[4]. The surface sedimentary rocks, mostly unlithified, dip gently toward the gulf.

The major soils in Hidalgo County, used primarily for non-irrigated and irrigated crops, are generally deep, well drained, moderately permeable, and loamy throughout. They are on a nearly level to gently sloping upland plain. Soil associations in Hidalgo County include: Hidalgo, McAllen-Brennan, Brennan-Hidalgo, Willacy-Delfina-Hargill, Delmita-Randado, Willacy-Racombes, Nueces-Sarita, Delfina-Hebbronville-Comitas, Harlingen, Runn-Reynosa, Raymondville-Mercedes, Raymondville-Hidalgo, Rio Grande-Matamoras, and Pits-Jimenez-Quemado associations (Soil Survey for Hidalgo County, 1981).

[3] Soil Survey of Cameron County, 1977
[4] Soil Survey for Hidalgo County, 1981

Figure 1.5: Soils of Texas



(Source:University of Texas Bureau of Economic Geology, 1977)

1.1.2.3 Jim Hogg County

The topography in Jim Hogg County is mostly level to gently sloping and gently undulating. Wind-blown sand deposits are located across much of the south-central portion of the county. About 98 percent of the county is used for range[5]. Raising cattle is the main agricultural enterprise, but some cultivated crops are also produced. Seven soil associations are mapped for the county and consist of mostly sandy loams and fine sands. The soil associations in the county include: Delmita, Nueces-Sarita, Falfurrias-Sarita, Brennan-Hebbronville, Copita-Brennan,

[5] Soil Survey of Jim Hogg County, 1974

Cuevitas-Randado-Zapata, and Comitas associations (Soil Survey of Jim Hogg County, 1974).

1.1.2.4 Maverick County

The topography of Maverick County ranges from nearly level to rolling. Elevation, in the county, ranges from about 540 above mean sea level in the southern part to 960 feet in the northern part[6]. The drainage pattern is distinctly expressed in most of the county, except in the north-central part, which is a nearly level and featureless plain. On the rolling hills, geological erosion occurs almost as fast as the soils form due to these soils being underlain at a shallow depth by strongly cemented caliche. Soil associations in Maverick County include: Copita-Pryor-Dant, Elindio-Montell, Jimenez-Olmos-Zapata, Catarina-Maverick, Brundage-Dant, Lagloria-Laredo, and Brustal associations (Soil Survey of Maverick County, 1977).

Approximately 92 percent of Maverick County is native rangeland used primarily for raising cattle. Significant irrigated cropland occurs in the county in an area generally paralleling the Rio Grande. The soils in the northern portion of the county consist of clays that produce mainly short grasses. Mesquite has invaded areas of these soils. Ridges and drainage-ways in these areas characterize the central and southern parts of the county. These soils are sandy loams and clay loams that produce a number of grasses and many shrubs. Shallow and gravelly soils on ridges, and hills along the Rio Grande produce good browse such as that provided by cuajillo, grasses, and forbs (Soil Survey of Maverick County, 1977).

1.1.2.5 Starr County

Starr County has a nearly level to undulating topography in most areas, but is rolling or hilly in a few locations. The most prominent landscape feature is the line of low hills that forms the boundary between the flood plain of the Rio Grande and the plain to the north. These gravelly, highly dissected ridges form an escarpment 50 to 100 feet above the flood plain[7]. At the southern extension of the west-facing Bordas Escarpment is a gently rolling plain with rounded hills and broad valleys. The hills are drained by a number of arroyos that flow into the Rio Grande. A minor but prominent landscape feature of Starr County is the sand sheet that covers the extreme northeastern part of the county. This area is the southwestern extension of an area of windblown sand that covers about 2,800 square miles of area in South Texas.

A majority of the county consists of deep, clayey and loamy soils on uplands. The parent material of most soils in the county consists of alkaline and calcareous, unconsolidated material deposited mainly in a fluvial (river)

[6] Soil Survey of Maverick County, 1977
[7] Soil Survey of Starr County, 1972

environment, as well as the windblown sand deposits discussed above. Eight different soil associations are mapped in Starr County and include the McAllen-Brennan, Catarina-Copita, McAllen-Zapata, Copita, Delmita, Rio Grande-Reynosa, Sarita, and Jimenez-Quemado associations (Soil Survey of Starr County, 1972).

1.1.2.6 Webb County

The land surface of Webb County is nearly level to rolling, with elevations ranging from 400 feet to about 900 feet above sea level[8]. The surface geology consists of consolidated and unconsolidated sedimentary and eolian (wind-blown) deposits that dip gently toward the Gulf of Mexico. Soils in Webb County consist of mostly deep, nearly level to gently sloping, clayey and loamy soils that vary widely in their potential for major land uses. Soil associations in Webb County include: Montell-Moglia-Viboras, Catarina-Maverick-Palafox, Catarina-Maverick-Moglia, Duval-Brystal, Aguilares-Montell, Hebbronville-Brundage-Copita, Copita-Verick, Delmita-Randado-Cuevitas, Maverick-Jimenez-Quemado, Laglori-rio Grande, and Nueces-Delfina (Soil Survey of Webb County, 1985).

1.1.2.7 Willacy County

Geologic formations in Willacy County crop out in bands that parallel the Gulf and dip gently gulfward[9]. The oldest surface geologic unit in the county is the Pleistocene-age Lissie Formation. Willacy County is on nearly level stream and coastal terraces where slopes are generally less than one percent; however, there is enough relief in the higher areas that well drained soils with well developed profiles have formed. Most of the soils in the county consist of loamy and clayey soils on nearly level flats and gently sloping ridges on stream and coastal terraces. Soil associations in Willacy County include: Raymondville-Mercedes, Lyford-Lozano, Hidalgo Racombes, Willacy-Racombes, Delfina-Hargill-Willacy, Willacy-Raymondville, Nueces-Sarita, Galveston-Mustang-Dune land, Sauz, Falfurrias, Satatton-Tatton, Willamar-Porfirio, Barrada-Lalinda-Arrada, and Saucel-Latina associations (Soil Survey of Willacy County, 1982).

1.1.2.8 Zapata County

Geologic units mapped in the county consist of mostly Eocene-aged deposits. The relief of the county is nearly level. Along the present stream channel of the Rio Grande, there are recent sediments derived from the wide variety of parent rocks within the vast watershed of the river. These sediments are mainly silty and alkaline or calcareous and they contain a high proportion of weatherable minerals.

[8] Soil Survey of Webb County, 1985
[9] Soil Survey of Willacy County, 1982

A soil survey publication and map has not been prepared by the USDA Natural Resources Conservation Service (formerly the Soil Conservation Service) for Zapata County. Review of general soil map prepared by the Bureau of Economic Geology (Figure 1.5, above) indicates that the soils in the county consist of dark calcareous to neutral clays and clay loams and reddish-brown, neutral to slightly acid sandy loams.

1.1.3 Vegetation Areas (Biotic Communities)

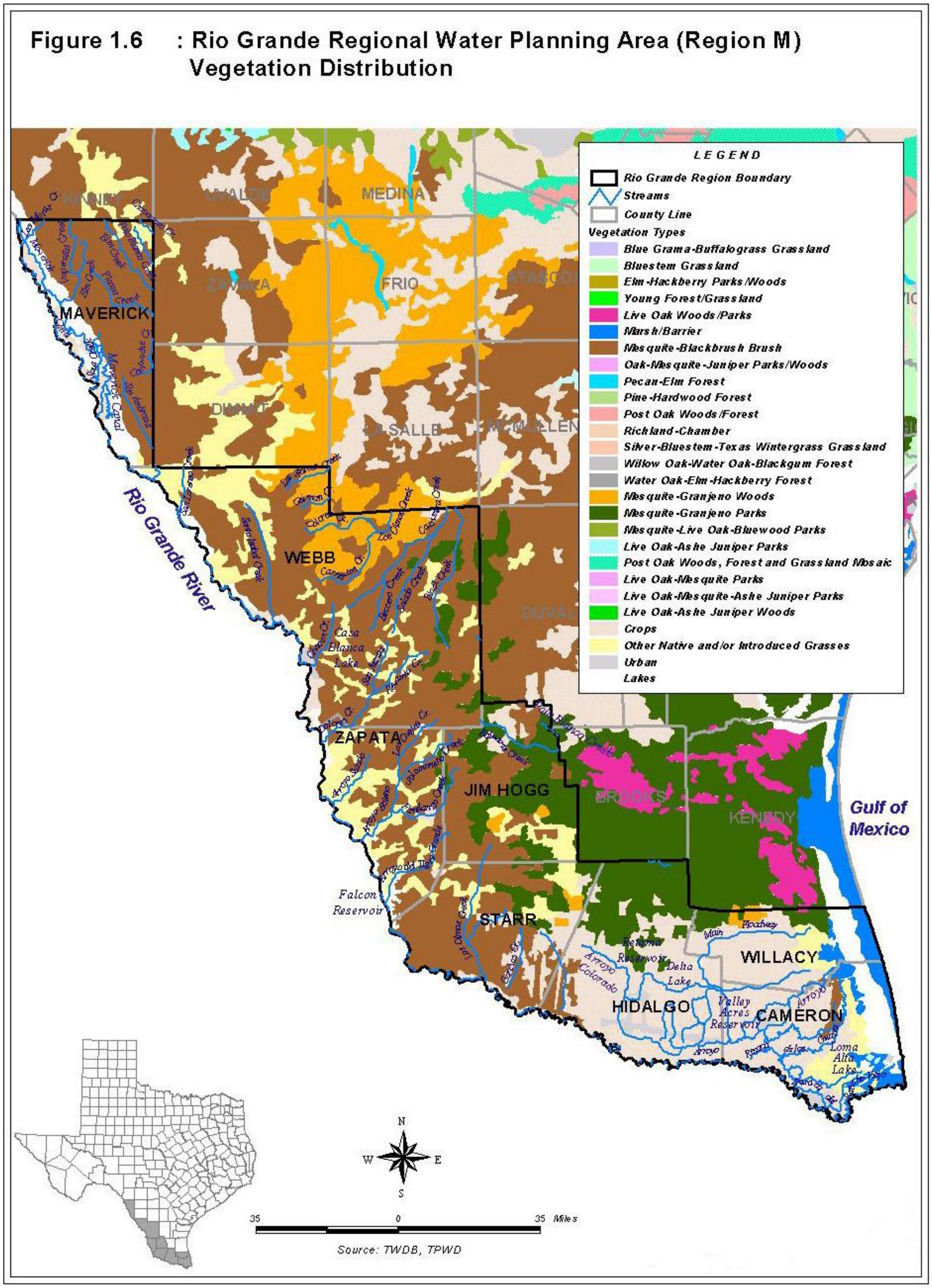
Located within the Matamoran district of the Tamaulipan Biotic Province (Blair, 1950), the Lower Rio Grande Valley is the northern boundary of much of the semitropical biota of Mexico. A number of plant and animal species from the more xeric and mesic areas to the west and northeast respectively, converge in the Lower Rio Grande area.

1.1.3.1 Terrestrial Vegetative Types

The predominant vegetation type in this area is thorny brush, but there is overlap with the vegetative communities of the Chihuahuan desert to the west, the Balconian province to the north (Texas Hill Country), and the tropical plant communities of Mexico to the south. The result is unique and varied flora and fauna. Xeric plants such as mesquite (*Prosopis glandulosa*), leatherstem (*Jatropha dioica*), lotebrush (*Ziziphus obtusifolia*), and brasil (*Condalia hookeri*) are found in this area. Sugar hackberry (*Celtis laevigata*) and Texas persimmon (*Diospyra texana*), more prevalent to the north, are also located in the Lower Rio Grande Valley. Other common species such as lantana (*Lantana horrida*), Mexican olive (*Cordia boisierri*), and Texas ebony (*Pithecellobium ebano*) are typically more tropical in location. Montezuma bald cypress (*Taxodium mucronatum*), Gregg wild buckwheat (*Eriogonum greggi*), Texas ebony and anacahuita (Mexican olive) have their northernmost extension in the Lower Rio Grande Valley. More than 90 percent of total riparian vegetation and 95 percent of Tamaulipan Thornscrub have been cleared since the 1900s. Surface water remains only briefly in arroyos following substantial rainfall. Because of this scarcity of water the resulting vegetation types are closely correlated to topographic characteristics (LBJSPA, 1976).

Eleven distinct biotic communities compose the Lower Rio Grande Valley, stretching from Falcon Reservoir to the Gulf of Mexico (USFWS, 1997). The communities to the northwest are arid, semi-desert, thorny brush. Vegetation communities toward the coast are comprised of more wetlands, marshes and saline environments (see Figure 1.6).

Figure 1.6: Rio Grande RWPA Vegetation Distribution



1.1.3.1.1 Ramaderos

This region, which occupies west-central Starr County, consists of arroyos that provide wildlife habitat.

1.1.3.1.2 Chihuahuan Thorn Forest

Located below Falcon Dam along the Rio Grande, the Chihuahuan Thorn Forest includes a narrow riparian zone and an upland desert shrub community. Rare plants such as the Montezuma bald cypress and the federally endangered Johnston's frankenia (*Frankenia johnstonii*) are found here, as well as such uncommon birds as the brown jay (*Cyanocorax morio*), ringed kingfisher (*Ceryle torquata*) and red-billed pigeon (*Columba flavirostris*).

1.1.3.1.3 Upper Valley Flood Forest

This community is located along the Rio Grande from south-central Starr County to the western border of Hidalgo County. The floodplain narrows in this region, with typical riverbank trees including Rio Grande ash (*Fraxinus berlandieriana*), sugar hackberry, black willow (*Salix nigra*), cedar elm (*Ulmus crassifolia*). Only a short distance from the river the dominant species shift to honey mesquite, granjeno (*Celtis pallida*), and prickly pear (*Opuntia lindheimeri*).

1.1.3.1.4 Barretal

The Barretal community occurs in southeastern Starr County, just north of the Upper Valley Flood Forest. Barreta (*Helietta parvifolia*), a small tree located on gravelly caliche hilltops, and paloverde (*Parkinsonia texana*), guajillo (*Acacia berlandieri*), blackbrush (*Acacia rigidula*), anacahuita, yucca (*Yucca treculeana*) and many species of cacti are typical of this community.

1.1.3.1.5 Upland Thorn Scrub

Upland Thorn Scrub, the most common community in the Tamaulipan Biotic Province, occurs in southwestern Hidalgo County. Typical woody plants include anacahuita, cenizo (*Leucophyllum frutescens*), and paloverde.

1.1.3.1.6 Mid-Valley Riparian Woodland

This community is located along the Rio Grande from western Hidalgo County eastward to the Sabal Palm Forest. This tall, dense, closed-canopy bottomland hardwood forest is favored by chachalacas (*Ortalis vetula*) and green jays (*Cyanocorax yncas*), birds more typical of Mexico. Trees of this community include Rio Grande ash, sugar hackberry, black willow, cedar elm, Texas ebony, and anaqua (*Ehretia anacua*).

1.1.3.1.7 Woodland Potholes and Basins

Central Hidalgo County and western Willacy County contain this community of seasonal wetlands and playa lakes. Additionally, three hypersaline lakes are present, attracting migrating shorebirds. The federally endangered ocelot (*Leopardus pardalis*) occupies dense thickets in this area. Wetlands are located in low woodlands of honey mesquite, granjeno, prickly pear, lotebush, elbow bush (*Forestiera angustifolia*) and brasil.

1.1.3.1.8 Mid-Delta Thorn Forest

The Mid-Delta Thorn Forest originally covered eastern Hidalgo County, the western two-thirds of Cameron County, and southwest Willacy County. Conversion of land for agricultural and urban uses has left only isolated pockets of native vegetation remaining. Typical plants include honey mesquite, Texas ebony, coma (*Bumelia lanuginosa*), anacua, granjeno, colima (*Zanthoxylum fagara*), and other thicket-forming species. This region provides excellent wildlife habitat and is a preferred area for white-winged dove (*Zenaida asiatica*).

1.1.3.1.9 Sabal Palms Forest

This area of riparian forest contains the last remaining acreage of original Sabal Palm Forest in south Texas. It is located on the Rio Grande at the southernmost tip of Texas. Vegetation in this region includes Texas sabal palm (*Sabal texana*), Texas ebony, tepeguaje (*Leucaena pulverulenta*), anacua, brasil, and granjeno. The National Audubon Society's Sabal Palm Grove Sanctuary is located in this area.

1.1.3.1.10 Loma Tidal Flats

Located at the mouth of the Rio Grande, this community consists of clay dunes, saline flats, marshes, and shallow bays along the Gulf of Mexico. Sea ox-eye (*Borrichia frutescens*), saltwort (*Batis maritima*), glasswort (*Salicornia sp.*), gulf cordgrass (*Spartina spartinae*), Berlandier's fiddlewood (*Citharexylum berlandieri*), Texas ebony and yucca are typical plants of this region.

1.1.3.1.11 Coastal Brushland Potholes

This community is comprised of dense brushy woodland around freshwater ponds, changing to low brush and grasslands around brackish ponds, and saline estuaries nearer the Gulf of Mexico. Typical plants include honey mesquite, granjeno, barbed-wire cactus (*Acanthocereus pentagonus*), and gulf cordgrass. Area wetlands provide important habitat for migratory wildlife.

1.1.3.2 Lower Laguna Madre

The lower Laguna Madre is a hypersaline bay, most of which lies in the eastern portions of Cameron and Willacy counties. Shallow depth, extensive seagrass meadows, and tidal flats characterize it. Small portions of the lower Laguna Madre are estuarine in nature with more moderate to brackish salinities. The Arroyo Colorado and Rio Grande provides most of the freshwater inflow to the bay with other drainage canals and floodways having smaller contributions. Freshwater from these sources aid in moderating salinities in the bay and are vital to the success of estuarine dependant aquatic species. The lower Laguna Madre supports a wide variety of marine aquatic organisms and wildlife. It also supports considerable water-related recreational activities (i.e. boating, sport fishing, bird watching, etc.) and commercial fisheries.

1.1.4 Protected Areas

Public and private interests have created several refuges and preserves in the Lower Rio Grande Valley to protect remaining vegetation and the habitats of endangered and threatened species. These include the Lower Rio Grande Valley National Wildlife Corridor/Refuge, Laguna Atascosa National Wildlife Refuge (NWR), Santa Ana NWR, Anzalduas County Park, Falcon State Park (SP), Bentsen-Rio Grande Valley SP, Boca Chica SP, Las Palomas Wildlife Management Area (WMA), Arroyo Colorado WMA, Sabal Palm Audubon Center and Sanctuary, the Nature Conservancy's Chihuahua Woods Preserve, the South Bay Coastal Preserve, Estero Llano Grande, and Resaca de la Palma.

Nine local communities, USFWS, and the Texas Parks and Wildlife Department (TPWD) have recently developed and completed the final stages of the World Birding Center committing $20-25 million to the project. These nine sites are "world class" birding destinations attracting thousands of visitors to "bird" and learn about conservation of natural resources.

1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor

The U.S. Fish and Wildlife Service (USFWS), with the support and assistance of the TPWD and several private organizations and individuals, is creating a wildlife corridor along the Rio Grande from Falcon Dam to the Gulf of Mexico. The wildlife refuge serves as the largest component of the Lower Rio Grande Wildlife Corridor. It currently includes 115 individual tracts totaling 91,000 acres. The completed refuge is projected to total 132,500 acres in fee and conservation easements. The wildlife refuges described below are part of this system. Additional acreage is purchased from willing sellers at fair market value or obtained through conservation easements.

1.1.4.2 Laguna Atascosa National Wildlife Refuge

Laguna Atascosa NWR contains more than 88,378 acres of land, providing essential habitat for a variety of south Texas wildlife. It is located north of the Rio Grande and south of the Arroyo Colorado along the Laguna Madre.

1.1.4.3 Santa Ana National Wildlife Refuge

This 2,088-acre refuge receives extensive bird watching attention because it is located at the convergence of two major migratory waterfowl flyways, the Central and the Mississippi. More than half of all butterfly species in the U.S. are found in this refuge.

1.1.4.4 Falcon State Park

This park, managed by the TPWD, contains over 500 acres above Falcon Dam. It is popular with bird watchers because of its diversity of bird species.

1.1.4.5 Sabal Palm Audubon Center and Sanctuary

This sanctuary, owned by the National Audubon Society, is located in the southernmost point of Texas on the Rio Grande. It is a 527-acre forested area that includes a substantial portion of the remaining sabal palm forest. The sanctuary is popular with bird watchers and other nature enthusiasts for its wildlife. The state threatened southern yellow bat (*Lasiurus ega*) is a year-round resident. The ocelot and jaguarundi (*Herpailurus yagouaroundi*) are believed to inhabit parts of the sanctuary.

1.1.4.6 Bentsen-Rio Grande Valley State Park

This park, managed by the TPWD, is located west of Mission in Hidalgo County. It consists of almost 600 acres of subtropical resaca woodlands and brushland, and is a popular bird-watching area. Boca Chica State Park, administered by Bentsen-Rio Grande Valley SP, is located in Southeastern Cameron County. Endangered and rare birds, such as Brown Pelicans, Reddish Egrets, Osprey, Peregrine Falcons, and several others, are commonly found in the park area.

1.1.5 Rare, Threatened, or Endangered Plant Species

The federal Endangered Species Act (ESA) of 1973, with amendments, provides a means to conserve endangered and threatened species and the ecosystems on which these species depend. The ESA provides for conservation programs for endangered and threatened species, and to take steps as may be appropriate for achieving the purposes of conserving species of fish and wildlife protected by international treaty. Federal agencies are required to ensure that no actions that an agency would undertake will jeopardize the continued existence of any endangered or threatened species, except as provided by the ESA. Any federal permits required to implement components of this water plan would be subject to the terms of the ESA. Specifically, Section 7 of the ESA requires that: "Each Federal agency shall, in consultation with and with the assistance of the Secretary (of the Interior), insure that any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical….In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available."

Within the Rio Grande Region, twenty-six (26) plant species occur which have been designated by the USFWS and/or the TPWD as rare, threatened, or endangered. Seven out of the twenty-six species are federally listed species. Species designated as threatened or endangered receive full protection under the ESA. Species of Concern (SOC) are those species for which there is some information showing evidence of vulnerability, but lacking sufficient data to support listing at the present time.[10]

1.1.6 Rare, Threatened, or Endangered Animal Species

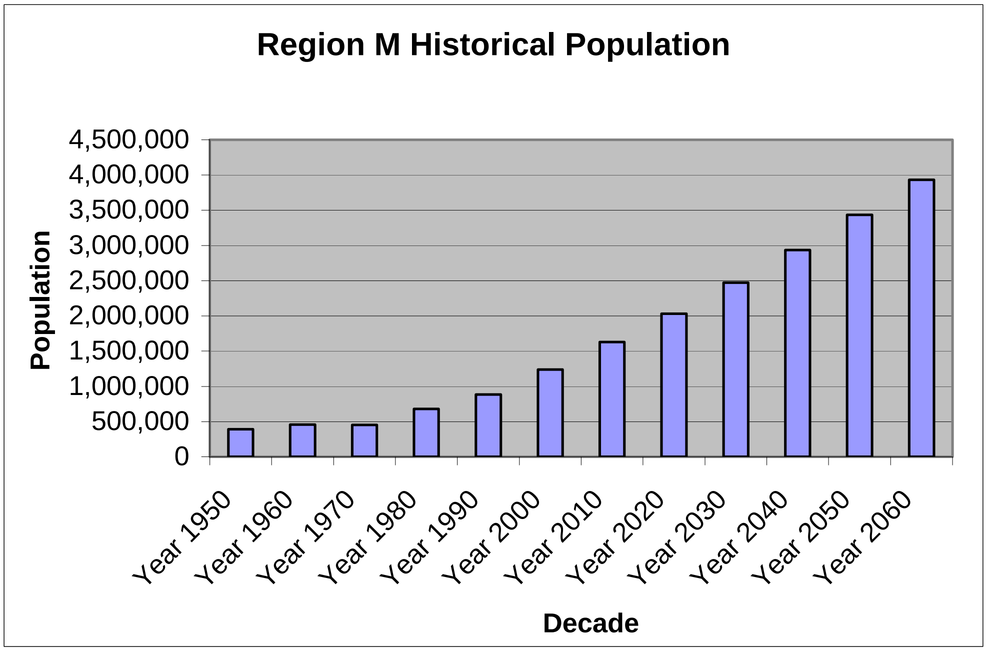
There are sixty-nine rare, threatened, or endangered animal species with habitat found within the Rio Grande Region that are listed by the USFWS and/or the TPWD. These include seven species of amphibians, 29 birds, nine fishes, eight mammals, 14 reptiles, and two insects. Thirteen out of the sixty-nine species are federally listed species.[11]

1.2 DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS OF THE RIO GRANDE REGION

The following sub-sections provide an overview of the demographic and economic characteristics of the Rio Grande Region.

[10] Attachment 1-1 in appendix shows a list of rare, threatened and endangered species
[11] Attachment 1-1 in appendix shows a list of rare, threatened and endangered species

Figure 1.7: Historical Populations from US Census Bureau



Population in the Rio Grande Region increased from approximately 398,700 in 1950 to more than 1.6 million in 2010. As shown in Figure 1.7, most of this increase has occurred since 1970. During the period from 1970 to 1990, six of the 31 fastest growing counties in Texas were within the Rio Grande Region. Hidalgo, Maverick, Starr, and Zapata counties more than doubled their populations during this 20-year period.

Population distribution in the Rio Grande Region is concentrated in Cameron, Hidalgo, and Webb counties. In 2010, the combined population of these three counties accounted for nearly 89 percent of the region's total population.

Recent population changes have been made from years 2010 to 2060.

Figures 1.8 and 1.9 show the population distribution for the region in 1950 and in 2010.

Figure 1.8: 1950 Region Population

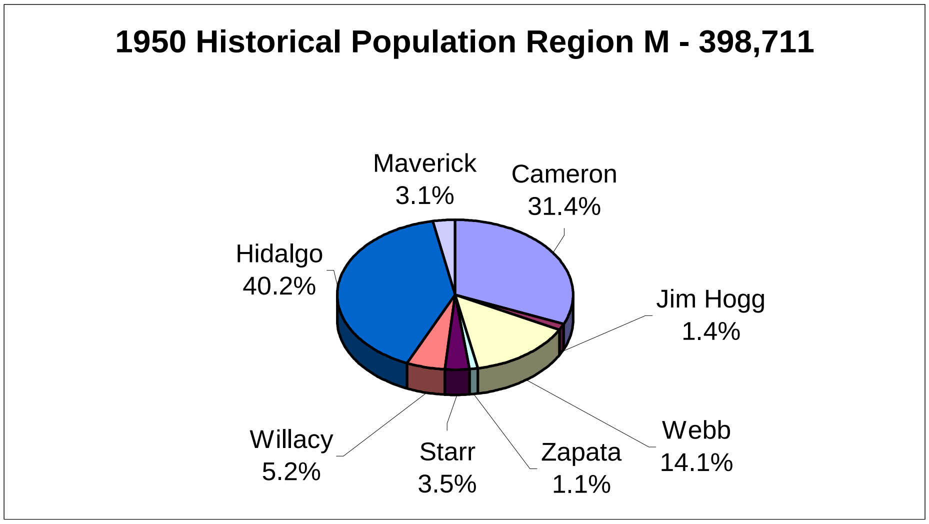


Figure 1.9: 2010 Region Population

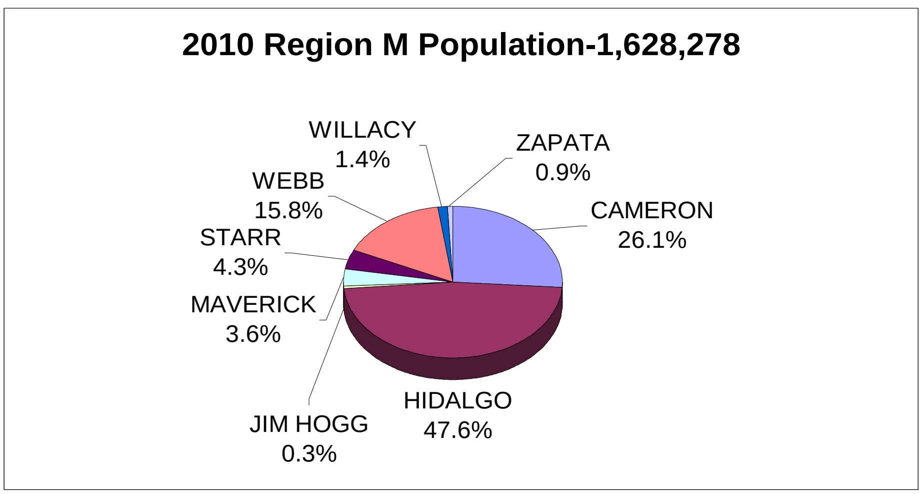
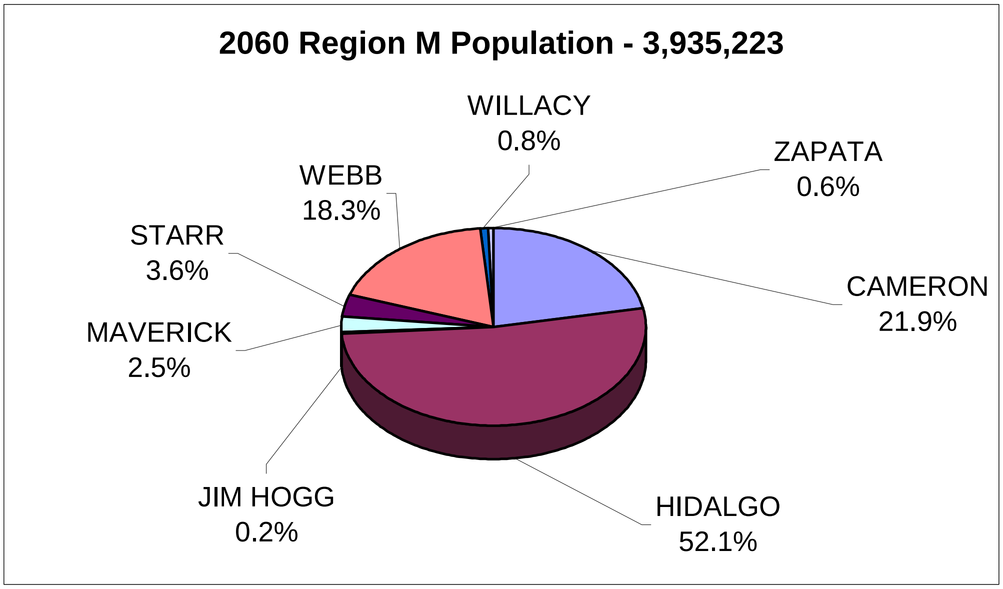


Figure 1.10: 2060 Region Population



1.2.1 Historical and Current Population

As indicated in Figures 1.8 and 1.9, the percentage of the region's population living in Cameron, Willacy and Jim Hogg counties has decreased slightly since 1950, while the portion of the population in the other five counties has either remained the same or increased. Chapter 2 of this report presents population growth projections for the Rio Grande Region for the 50-year planning period (2010 - 2060).

An important factor driving rapid population growth in the Rio Grande Region is its proximity to and its cultural, social, economic relationship with Mexico. Over the past 50 years, Mexico's population growth rate has been approximately three times greater than that of the United States. Much of that growth has occurred in the northern border states of Mexico. It is estimated that nearly seven million people currently live in the portion of the Rio Grande Basin that lies within Mexico. These population growth trends along both sides of the border are expected to continue for the foreseeable future.

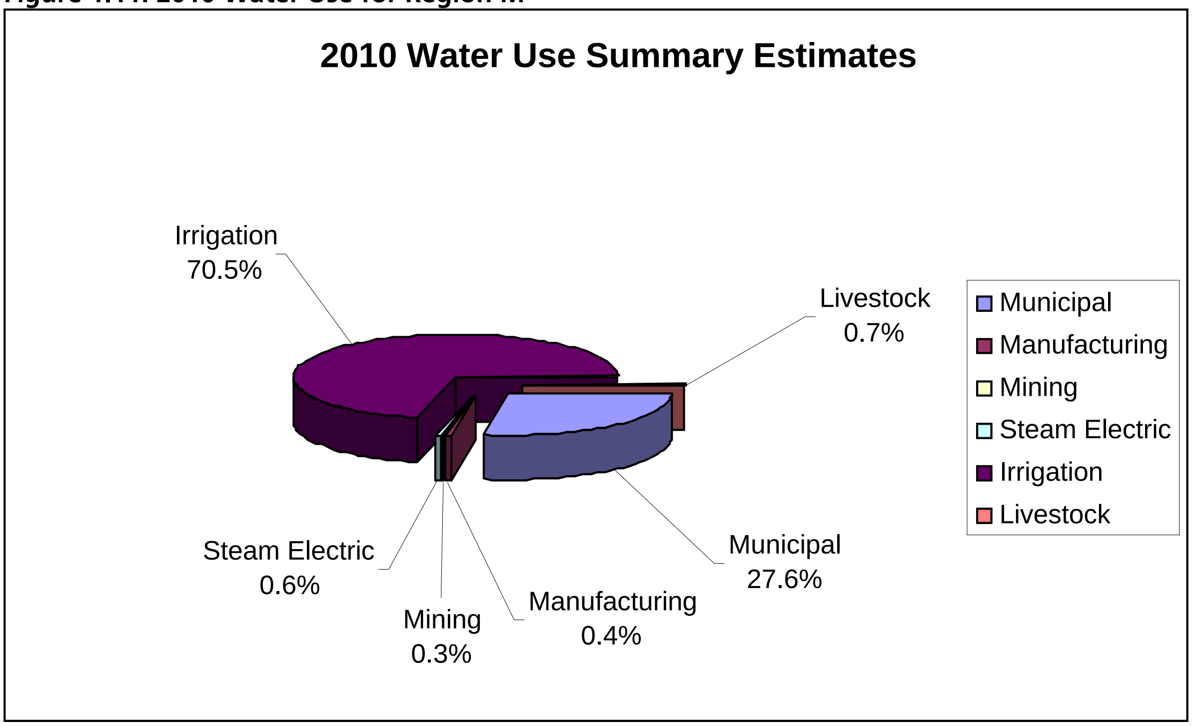
1.2.2 Current Water Use

Water use estimates for Region M were created based on population projections for the region. Hidalgo is projected to use the most water compared to the other counties in the region. Jim Hogg County is projected to use the least amount of water of the eight counties in the region. The irrigation category used the most water for the region at 518,938 acre-ft.

Table 1.2: 2010 Water Use Estimates

2010 Water Use Estimates for Region M in acft								
Region	**County Name**	**Population Estimates**	**Municipal**	**Manufacturing**	**Mining**	**Steam Electric**	**Irrigation**	**Livestock**
M	CAMERON	424,762	56,587	1,085	8	2,090	128,066	351
M	HIDALGO	775,858	87,151	1,724	670	2,267	290,971	604
M	JIM HOGG	5,593	914	0	27	0	0	579
M	MAVERICK	58,252	7,624	65	140	0	50,164	402
M	STARR	69,379	6,516	9	0	0	7,686	1,140
M	WEBB	257,647	38,402	17	1,207	48	3,339	1,134
M	WILLACY	22,763	3,578	126	6	0	37,042	242
M	ZAPATA	14,025	2,240	0	0	0	1,670	481
Region M Total		**1,628,279**	**203,012**	**3,026**	**2,058**	**4,405**	**518,938**	**4,933**

Figure 1.11: 2010 Water Use for Region M



1.2.3 Economic Activities

Historically, agriculture has been the predominant component of the economy of the Rio Grande Region. While the region is becoming more urbanized and its economy is becoming more diversified, agriculture still plays a major role in the regional economy.

The Texas Comptroller of Public Accounts (CPA) website shows that agricultural income during the last five years has averaged over $500 million per year for Cameron, Hidalgo, Willacy, and Starr counties, of which, more than 80 percent was from crop production. The primary crops produced in the region are fruits, vegetables, cotton, and sorghum. Agriculture receipts in the other counties within the region come primarily from livestock, with some vegetable crop production.

Due in part to its proximity to Mexico, the trade, services and manufacturing sectors are becoming increasingly important to the region's economy. The trade and service sectors of the economy have been responsible for much of the economic growth in the Rio Grande Region over the past decade in terms of both revenue and employment. Growth in these sectors of the economy is largely attributable to the significant expansion of trade between the U.S. and Mexico under the North American Free Trade Agreement (NAFTA). Under NAFTA, the region is becoming increasingly important as a transportation hub for trade with Mexico.

Manufacturing is an important sector of the economy, primarily in the region's three U.S. Census Bureau-designated Metropolitan Statistical Areas of Brownsville-Harlingen-San Benito, McAllen-Edinburg-Mission, and Laredo. The most important factor in the expansion of the region's manufacturing sector has been the growth of the maquiladora industry in Mexico. At the end of the millennium, approximately 81 percent of the more than 2,000 maquila plants in Mexico were located in the six northern Border States. The maquila industry was originally designed to take advantage of certain U.S. tariff code provisions that allowed U.S. firms to export unassembled products to Mexico for assembly. The assembled products are then imported in the U.S. Duties were only paid on the value added during the assembly process rather than on the full value of the product. Even more favorable tariff conditions are now in place under NAFTA and the maquiladora industry has been shifting toward full transformation of raw materials for finished products.

In Jim Hogg, Webb, Starr, and Zapata counties, oil and gas production and trade are also important sources of income, averaging over $1 billion per year in taxable value in the past decade.

The Texas Department of Tourism website illustrates that in 2008 the total destination spending for tourism for Cameron, Hidalgo, Willacy, Webb, and Starr counties was over $2,000 million. Tourism in Falcon State Park has significant economic impact in Zapata and Starr Counties. In addition, water-related recreational activities (boating, sport fishing, bird watching, etc.) and commercial fishing in the lower Laguna Madre and adjacent waters also influence the regional economy.

In 1995, the direct impact of water-related recreational activities in the Laguna Madre to South Texas and the state was $221 million. The direct impact of commercial fishing in South Texas was $63.1 million.

Wildlife viewing in and around areas with aquatic habitat contributes considerably to the Rio Grande Valley economy. The economic impact by bird watchers in the Rio Grande Valley is estimated to be approximately $125 million dollars per year (Source: McAllen Chamber of Commerce). Santa Ana NWR attracts an estimated 99,000 bird watchers per year, most of who have traveled from outside of the four county area, and most from other states. These visitors inject $36 million dollars into the local economy, with a total gross input of almost $89 million dollars. Also, within the last two years, two new businesses have been added, which have begun taking tourists on canoeing and river exploration trips on the Rio Grande's new birding lodging facilities. Additionally, existing outfitters on the Arroyo Colorado continue to do business. The four Valley nature festivals generate significant income to the local economics. The quality of the river and its adjacent wildlife habitat will affect the number of ecotourists visiting the Valley in the future.

Although the Rio Grande Region has seen a large increase in the number of jobs during the decade of the 2000s, unemployment remains significantly above the state and national averages, and median household income is significantly lower. High unemployment is attributed largely to the constant influx of immigrants from Mexico and the area's abundance of migrant workers. Table 1.3 presents median household income and unemployment rate by county.

Table 1.3: Median Household Income and Unemployment Rate, by County

County	Median Household Income ($)	Percent of Labor Force that is Unemployed (%)
Cameron	29,589	6.8
Hidalgo	30,153	7.3
Jim Hogg	32,350	3.9
Maverick	27,652	11
Starr	23,070	11.9
Webb	33,696	5.4
Willacy	24,961	9
Zapata	24,635	4.9

Source: United States Department of Agriculture 2008

According to the Texas Comptroller of Public Accounts (CPA), Region M is part of the CPA's thirteen-region economic model for Texas. Region M is included in the South Texas Region of their model. During this first part of the millennium, employment growth in this region should reach 2.8 percent annually. This is nearly a full percentage point above the expected average of 1.9 percent for the state of Texas as a whole.

This trend shows the region will prosper despite the economic slowdown being set by the state of Texas as a whole. Gross regional product in this region has quadrupled from $5.3 billion in 1970 to over $20.3 billion in the 2000s. This is an annual growth rate of 4.6 percent. In 1970, employment in South Texas Border region was 177,000 but by 2008 had grown to 537,000. This is an average annual growth of 3.2 percent. The statewide rate was 2 percent. The per capita spendable income rose from $7,400 in 1970 to $13,000 in 2000. This is a gain of 76 percent. In the year 2000, this region accounted for 6.7 percent of the population and 4.4 percent of the state's employment base.

Table 1.4: EDAP Counties

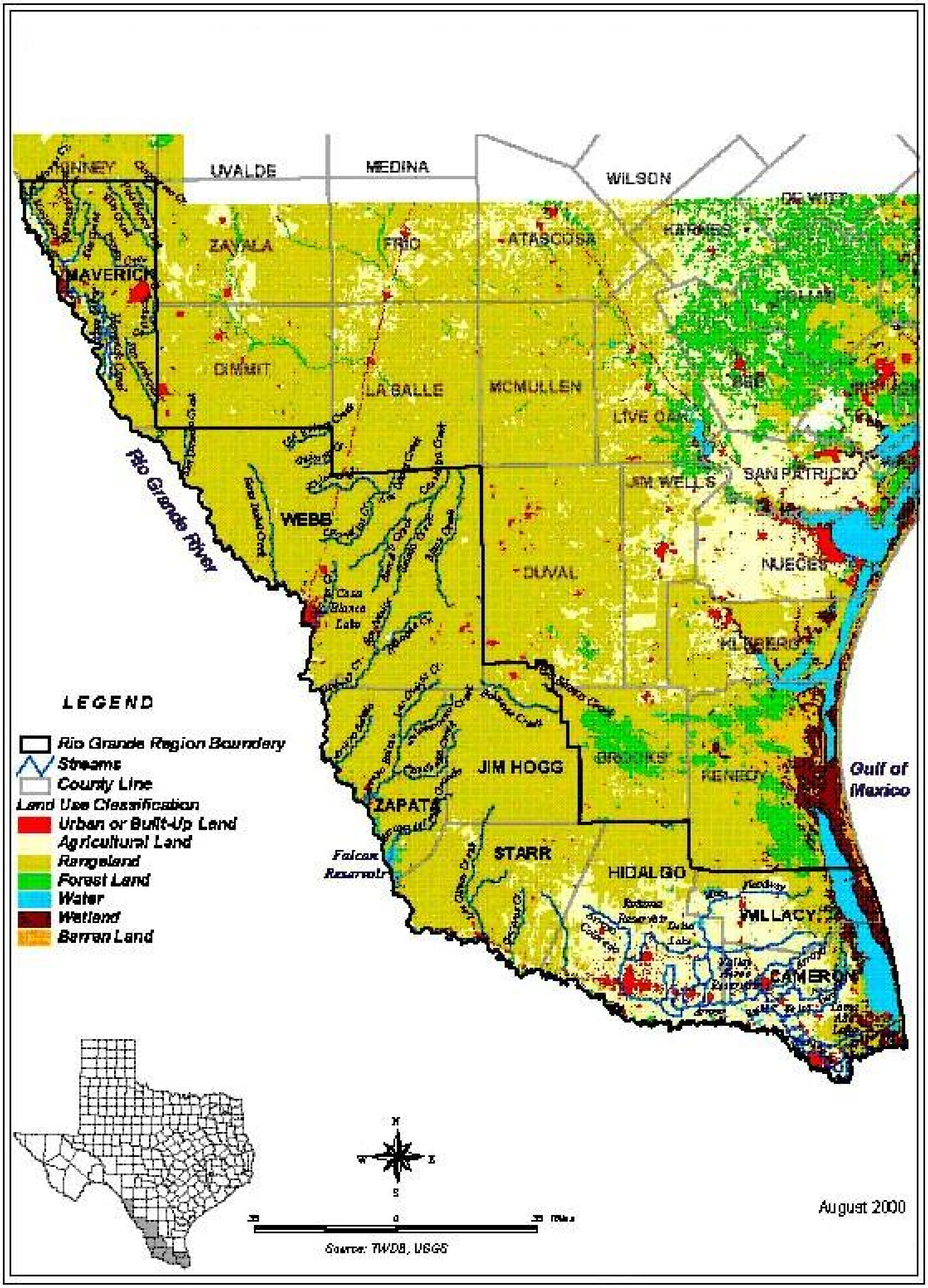
Under Section 17.923 of the Water Code
Texas Water Development Board

Counties	Average Unemployment Rate 2006-2008 (%)	Percent Above State Rate	Average Per Capita Income 2006-2008 ($)	Percent Below State Rate
Texas Average	4.7	n/a	36,940	n/a
Cameron	6.5	39.3	19,146	-48.2
Hidalgo	7.1	51.1	17,853	-51.7
Maverick	11.8	151.1	16,231	-56.1
Starr	11.4	142.6	13,464	-63.6
Webb	5.2	10.6	20,843	-43.6
Willacy	8.8	87.2	19,740	-46.6
Zapata	5.7	21.3	16,978	-54.0

United States Bureau of Labor Statistics 2008

According to the TWDB, seven out of the eight counties in Region M are labeled as EDAP Counties. Even though the urbanization of the region, it still has a long way to go before becoming as prosperous as other regions in Texas.

Figure 1.12: Rio Grande RWPA Surface Water Hydrology I



1.3 SURFACE WATER RESOURCES

The Rio Grande Region encompasses portions of three river basins: the Rio Grande, the Nueces and the Nueces-Rio Grande (see Figure 1.11). An overview of the characteristics and surface water resources of each of basin is provided in the sections that follow and more detailed descriptions are provided in Chapter 3. The adoption of this plan has no major impacts to navigation regarding the water resources of the region.

1.3.1 Rio Grande Basin

As depicted in Figure 1.12, the Rio Grande Basin extends southward from the Continental Divide in southern Colorado through New Mexico, and Texas to the Gulf of Mexico. From El Paso, Texas to the Gulf of Mexico, the Rio Grande forms the international boundary between the United States and Mexico, a straight-line distance of 700 miles and a river mile distance of nearly 1,250 miles. Approximately 176,000 square miles of the 355,500 square miles in the entire Rio Grande Basin contributes to the Rio Grande. The remainder of the Basin consists of internal closed sub-basins. The Texas portion of the contributing watershed encompasses approximately 54,000 square miles. Approximately 8,100 square miles within the Texas portion of the basin are in closed sub-basins that do not contribute flows to the Rio Grande. The Pecos and Devils Rivers are the principal tributaries of the Rio Grande in Texas. Both of these rivers flow into Amistad Reservoir on the Rio Grande, which is located upstream of the City of Del Rio, Texas, about 600 river miles from the mouth of the Rio Grande. Springs from other regions feed into our region and are eventually contributed to our water supply.

In Mexico, the Rio Conchos, Rio Salado, and the Rio San Juan are the largest tributaries of the Rio Grande. The Rio Conchos drains over 26,000 square miles and flows into the Rio Grande near the town of Presidio, Texas, about 350 river miles upstream of Amistad Reservoir. The Rio Salado has a drainage area of about 23,000 square miles and discharges directly into Falcon Reservoir on the Rio Grande. Falcon Reservoir is located between the cities of Laredo, Texas and Rio Grande City, Texas, about 275 river miles upstream from the Gulf of Mexico. The Rio San Juan has a drainage area of approximately 13,000 square miles and enters the Rio Grande about 36 river miles below Falcon Dam near Rio Grande City, Texas. Amistad-Falcon Reservoir system is designated as a special water resource by the TWDB (31 TAC 357.5(g)).

In addition to the two international reservoirs on the Rio Grande (Amistad and Falcon), Mexico has constructed an extensive system of reservoirs on tributaries of the Rio Grande. Figure 1.13 shows the location of these reservoirs. The impacts of the development of the tributary reservoirs in Mexico on the supply of water available to the Rio Grande Region has been evaluated as part of the regional planning effort and is discussed in Chapter 3.

The vast majority of the Rio Grande Basin is comprised of rural, undeveloped land that is used principally for farming and ranching operations. In Texas, the major urban centers include El Paso in the far western portion of the state; the cities of Del Rio, Eagle Pass, and Laredo on the river in the central portion of the basin; and Mission, McAllen, Harlingen, and Brownsville in the Lower Rio Grande Valley. In Mexico, there are several major urban areas along the Rio Grande including Juarez, Nuevo Laredo, Reynosa, Monterrey, and Matamoras.

Practically all of the surface water available to and used in the Rio Grande Region is from the Rio Grande. Nearly all of the dependable surface water supply that is available to the Rio Grande Region is from the yield of the Amistad and Falcon International Reservoirs. These reservoirs are operated as a system by the International Boundary and Water Commission (IBWC) for flood control and water supply purposes. These impoundments provide controlled storage for over eight million acre-feet of water owned by the United States and Mexico, of which 2.25 million acre-feet are allocated for flood control purposes and 6.05 million acre-feet are reserved for sedimentation and conservation storage (water supply).

Some very limited supplies are available from tributaries of the Rio Grande in Maverick, Webb, Zapata, and Starr counties; from the Arroyo Colorado which flows through southern Hidalgo County and northern Cameron County to the Laguna Madre; from the pilot channels within the floodways that convey local runoff and floodwaters from the Rio Grande throughout the Lower Rio Grande Valley to the Laguna Madre; and from isolated lakes and resacas in Hidalgo and Cameron counties. Under drought of record conditions, surface water supplies from sources other than the Rio Grande are of little significance.

According to available publications and literature, existing springs within the Rio Grande Basin of the Region M planning area (primarily Maverick, Webb, Zapata, Jim Hogg, and Starr Counties) are not numerous and small in terms of their discharge quantities. There are no major springs that are extensively relied upon for water supply purposes. Many of the small springs do provide water for livestock and wildlife when they are flowing. Typically, the flow rate of the existing springs is less than 20 gallons per minute, with most springs in the region flowing at a rate of only a few gallons per minute. Therefore, there are no major springs that are extensively relied upon for water supply purposes. Much of the area is underlain by shales and marls, which cannot store or transmit much water.

Figure 1.13: Rio Grande RWPA Surface Water Hydrology II

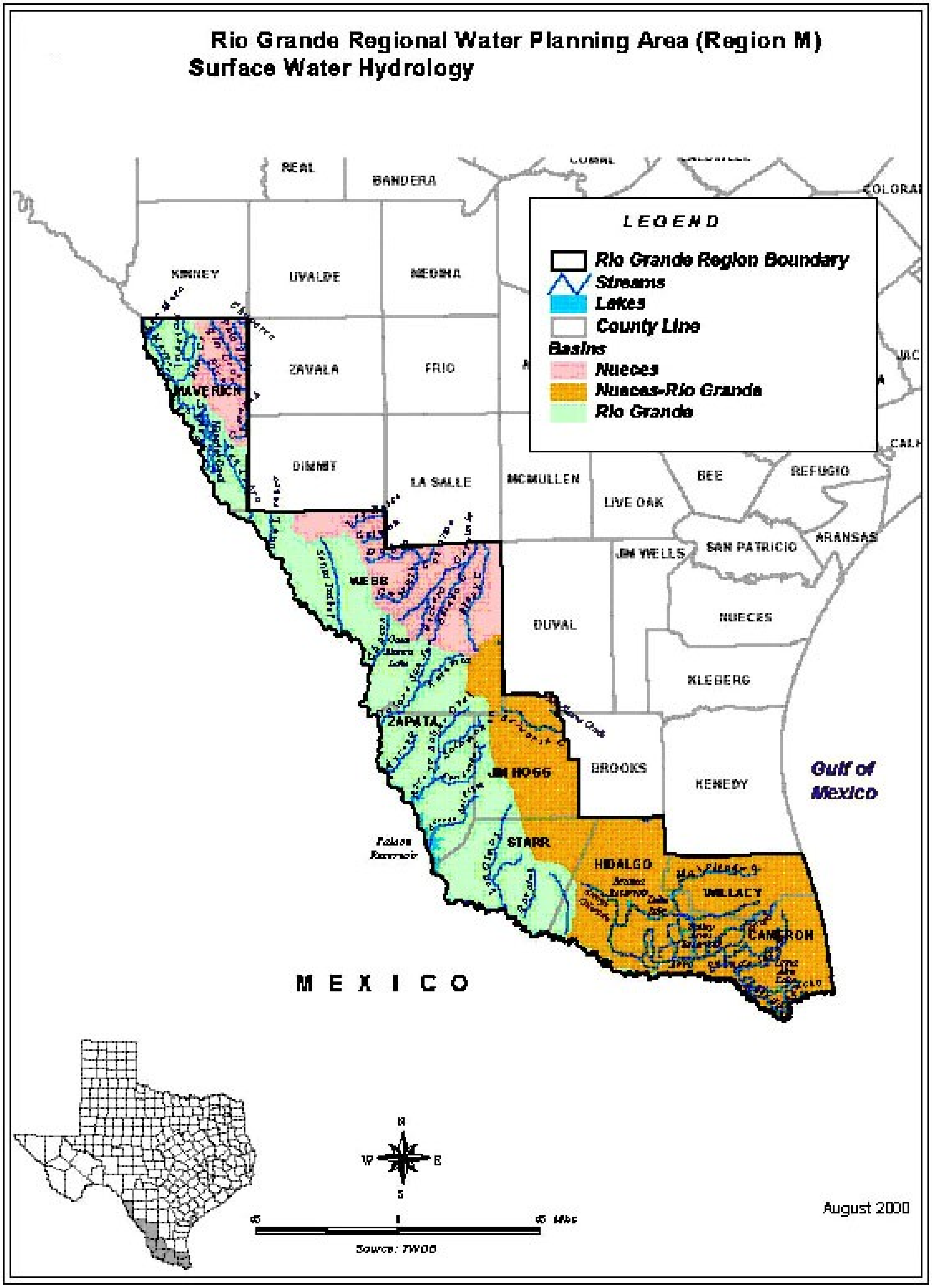


Figure 1.14: Rio Grande RWPA Watershed

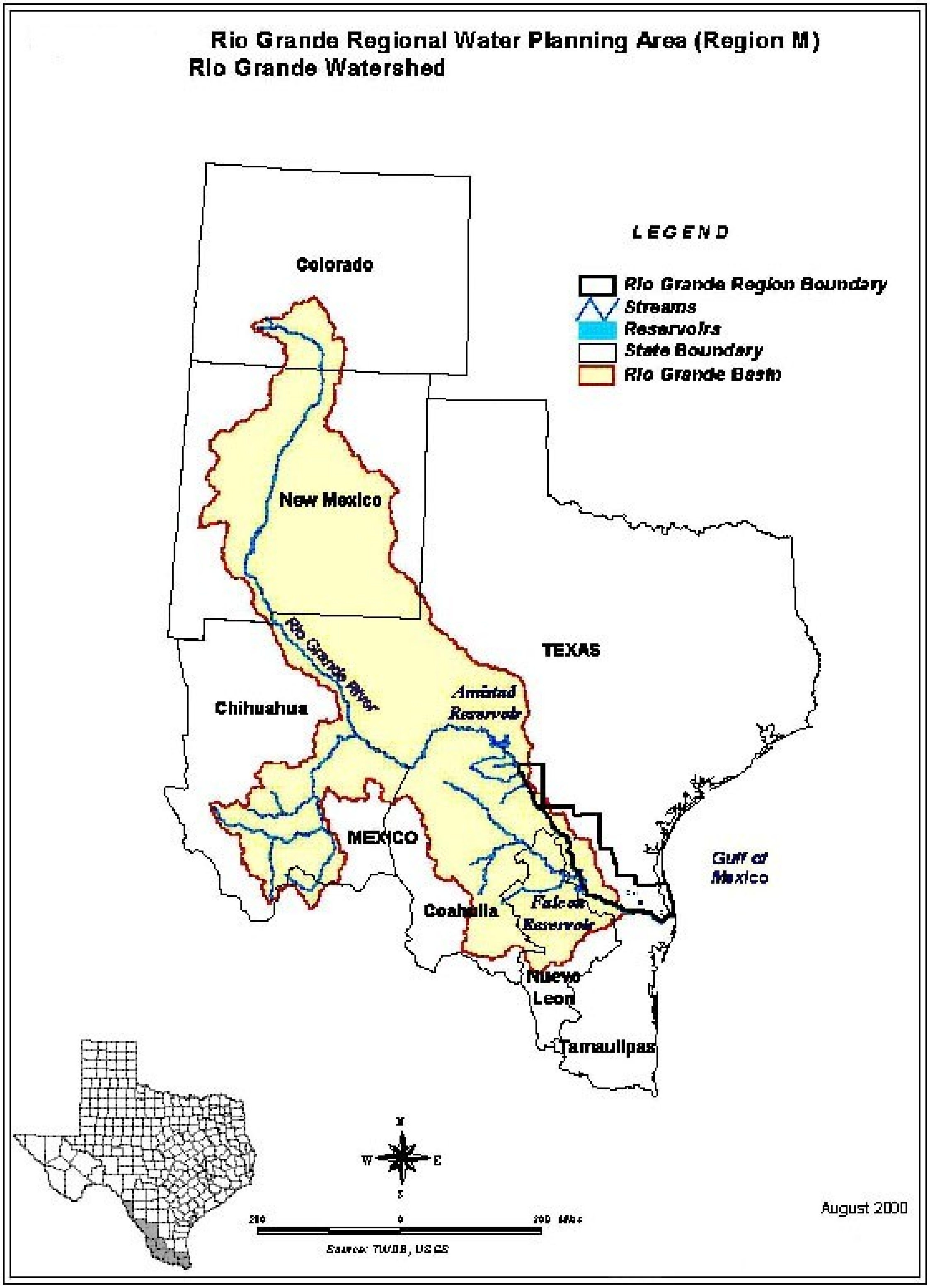
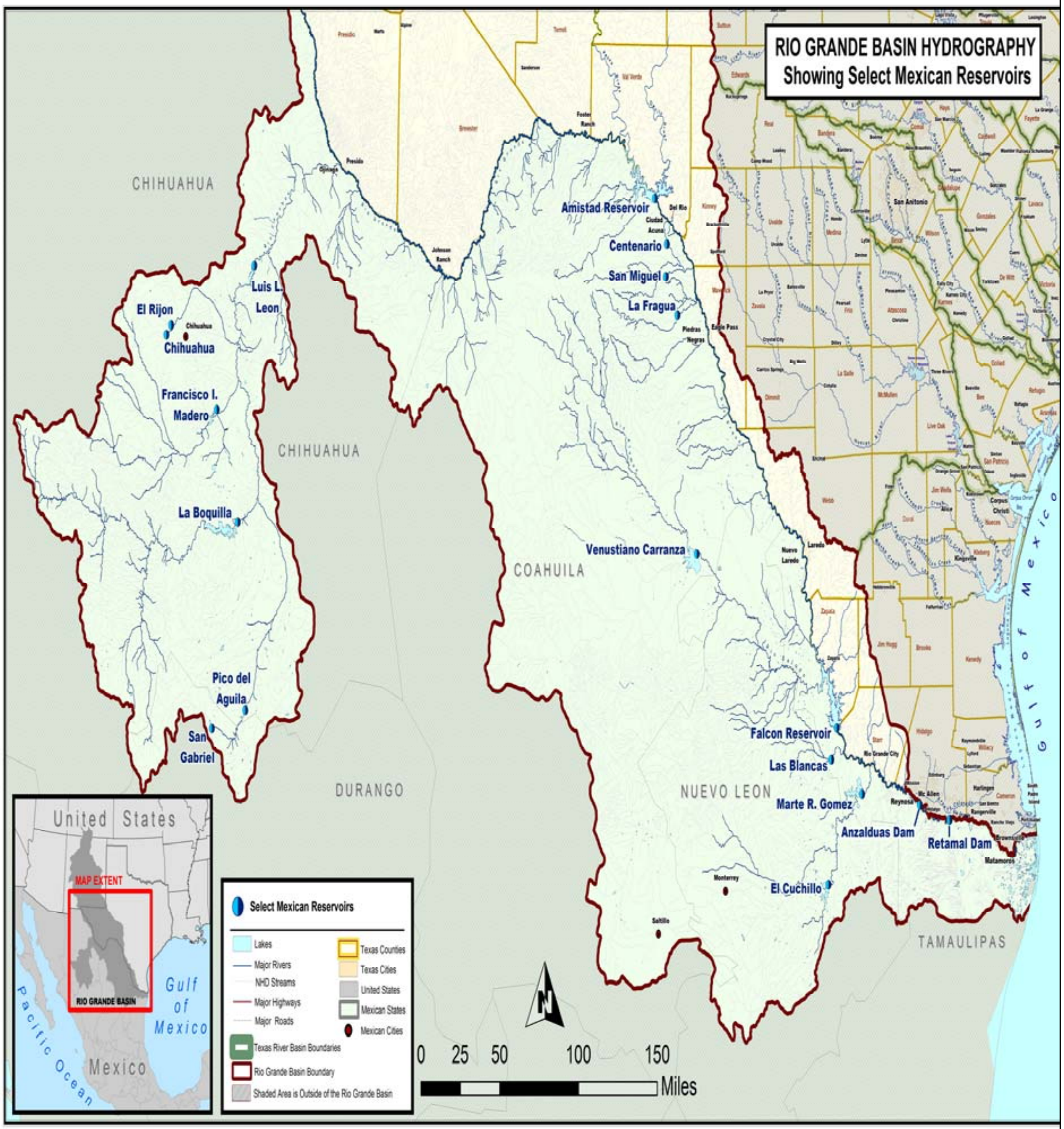


Figure 1.15: Major Reservoirs Located on Tributaries of the Rio Grande in Mexico



Source: IBWC

1.3.2 Nueces River Basin

The Nueces River Basin is bounded by the Rio Grande and Nueces-Rio Grande Basins on its southern boundary and by the Colorado, San Antonio, and San Antonio-Nueces Basins on its northern boundary. The basin extends from Edwards County in Texas to its discharge point in Nueces Bay, which flows into Corpus Christi Bay and ultimately to the Gulf of Mexico. As shown in Figure 1.11 (above), only a small portion of the Nueces Basin in Webb and Maverick counties is located within the Rio Grande Region. No part of the Nueces River passes through the Rio Grande Region and the Nueces Basin is of little consequence in terms of the surface water supply available to the region.

1.3.3 Nueces-Rio Grande Coastal Basin

The Nueces-Rio Grande Coastal Basin is bounded on the north by the Nueces River Basin, on the west and south by the Rio Grande Basin. The drainage area of the Nueces-Rio Grande Coastal Basin is 10,442 square miles. The area drains to the Laguna Madre Estuary. Within the Rio Grande Region the basin encompasses the southeastern portion of Webb County, nearly two-thirds of Jim Hogg County, the majority of Hidalgo and Cameron counties, and all of Willacy County (Figure 1.11, above). There are two major drainage courses in the basin: the main floodway and the Arroyo Colorado. The Arroyo Colorado is of special importance because it flows directly into the hyper-saline lower Laguna Madre. Freshwater inflows from the Arroyo Colorado are critical to the ecological health of the Laguna Madre estuary and the commercial and sport fishing industries that are dependent upon it. In addition to natural drainage, most of the surface water diverted from the lower Rio Grande, as well as water discharges and irrigation tailwater, flows to the Arroyo Colorado. However, there are no natural perennial streams within the drainage area and the basin is of little consequence in terms of water supply.

According to available publications and literature, existing springs within the Nueces-Rio Grande Coastal Basin of the Region M planning area (Cameron, Hidalgo and Willacy Counties) are not numerous and small in terms of their discharge quantities. There are no major springs that are extensively relied upon for water supply purposes. Many of the small springs do provide water for livestock and wildlife when they are flowing.

1.3.4 Surface Water Quality

Surface water quality is addressed in this section for portions of two basins - the Rio Grande, which flows directly into the Gulf of Mexico; and the Arroyo Colorado, which discharges into the Laguna Madre and then into the Gulf of Mexico.

Surface and sub-surface discharges that arise from both natural processes and the activities of man affect the quality of these water resources. In general, the presence of minerals, which contribute to the total dissolved solids concentration in surface water, arise from natural sources, but can be concentrated as flows travel downstream. Return flows from both irrigation and municipal uses can concentrate dissolved solids, but can also add other elements such as nutrients, sediments, chemicals, and pathogenic organisms.

Water in the Rio Grande normally is of suitable quality for irrigation, treated municipal supplies, livestock, and industrial uses; however, salinity, nutrients, and fecal coliform bacteria are of concerns throughout the basin. Salinity concentrations in the Rio Grande are the result of both human activities and natural conditions: the naturally salty waters of the Pecos River are a major source of the salts that flow into Amistad Reservoir and continue downstream. Untreated or poorly treated discharges from inadequate wastewater treatment facilities, primarily in Mexico, are the principal source for fecal coliform bacteria contamination. A secondary source is nonpoint source pollution on both sides of the river, including poorly constructed or malfunctioning septic and sewage collection systems and improperly managed animal wastes. Nutrient levels are a concern in the Rio Grande, but current levels do not represent a severe threat to human health, nor have they supported excessive aquatic plant growth. In the Rio Grande, below Amistad Reservoir, contact recreation use is not supported due to the elevated levels of fecal coliform bacteria that have been observed.

The Arroyo Colorado traverses Willacy, Cameron, and Hidalgo counties and is the major drainageway for approximately two dozen cities in this area, with the notable exception of Brownsville. Almost 500,000 acres in these three counties are irrigated for cotton, citrus, vegetables, grain sorghum, corn, and sugar cane production, and much of the runoff and return flows from these areas are discharged into the Arroyo Colorado. The Arroyo Colorado and the Brownsville Ship Channel both discharge into the Laguna Madre near the northern border of Willacy County. The Arroyo Colorado includes the TCEQ Classified Stream Segment 2201 and 2202. Use of the water in the Arroyo Colorado for municipal, industrial, and/or irrigation purposes is severely limited because of the poor water quality conditions that exist there. A more thorough discussion of the Arroyo Colorado is discussed later in this chapter as well as a more detailed discussion of surface water quality in Chapter 3.

1.4 GROUNDWATER RESOURCES

Throughout the Rio Grande Region, groundwater provides water supply that ranges from sustainable municipal supplies to quantities of water suited for irrigation, livestock, and industrial supply. The major aquifers within the region include the Gulf Coast aquifer, which underlies the entire coastal region of Texas, and the Carrizo aquifer that exists in a broad band that sweeps across the state beginning at the Rio Grande north of Laredo and continuing northeast to Louisiana. Figure 1.14 illustrates the location of these aquifers.

The minor aquifers that exist within the region have not been identified in prior water plans developed by the TWDB as "minor aquifers," but they may produce significant quantities of water that supply relatively small areas. These minor aquifers in the region include the Rio Grande Alluvium, which is also called the Rio Grande aquifer, the Laredo Formation, and the Yegua-Jackson aquifer. A more detailed discussion of each of these groundwater sources is presented in Chapter 3.

1.4.1 Groundwater Quality

In general, groundwater from the various aquifers in the region has total dissolved solids concentrations exceeding 1,000 mg/L (slightly saline) and often exceeds 3,000 mg/L (moderately saline). The salinity hazard for groundwater ranges from high to very high[12]. Localized areas of high boron content occur throughout the study area. Chapter 3 presents a detailed description of groundwater quality in the Gulf Coast aquifer, Carrizo Wilcox aquifer, Laredo Formation, Rio Grande Alluvium and in other aquifers in the Rio Grande Region.

1.5 EXISTING WATER PLANNING IN THE RIO GRANDE REGION

1.5.1 Local Water Planning

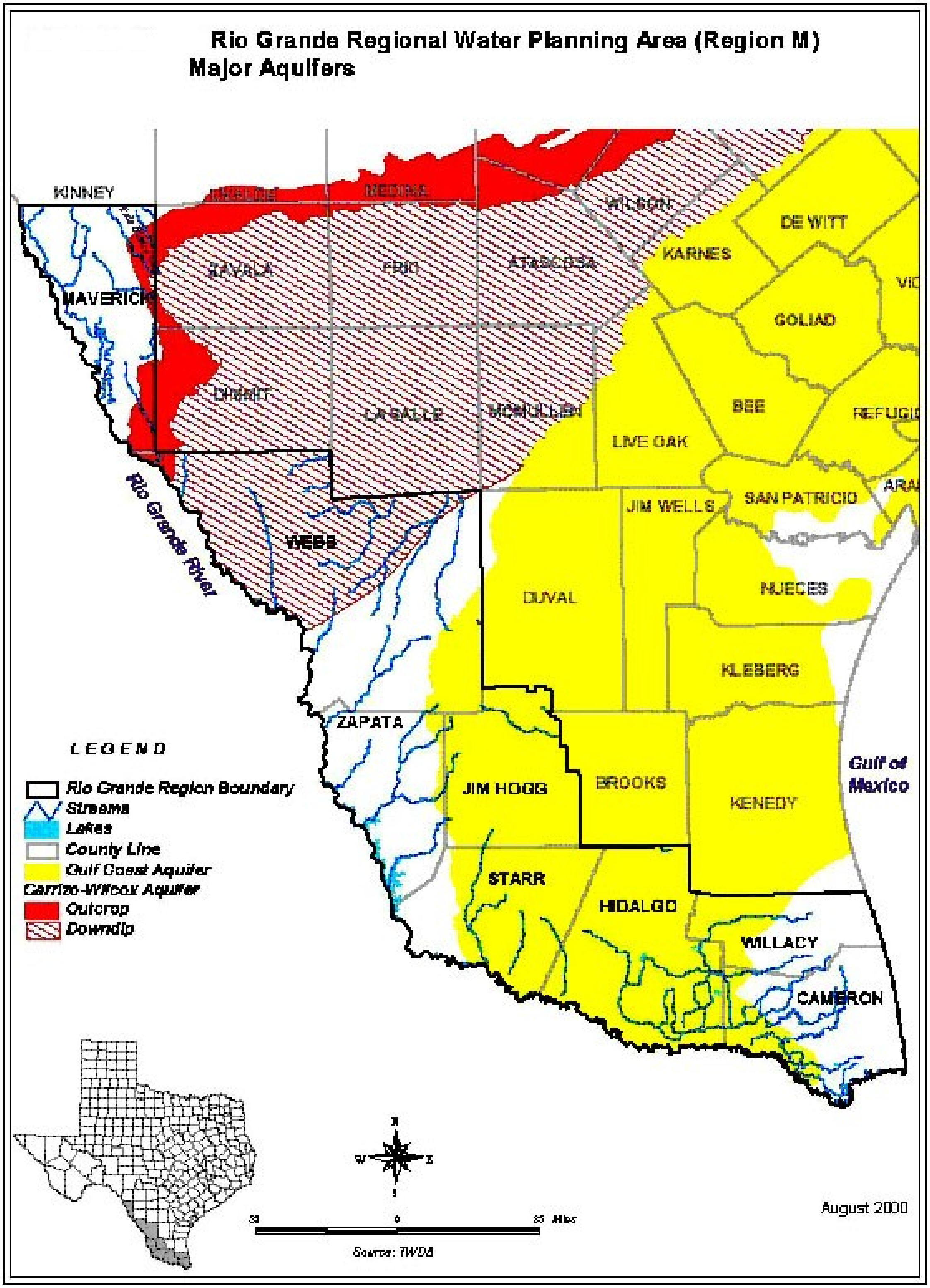
In addition to its impacts on state and regional water planning, Senate Bill 1 has also had a significant impact on local water planning in the Rio Grande Region and throughout the state. Under SB 1 and associated rules of the Texas Commission of Environmental Quality (TCEQ), the Texas Water Code now requires each retail public utility that provides potable water service to 3,300 or more connections to submit a Water Conservation Plan to the TWDB. They are required to prepare and submit a Water Conservation Plan by May 1, 2009.

Because of these requirements and recent drought conditions, many communities in the Rio Grande Region have addressed drought preparedness and water conservation planning. A review of TCEQ records shows that many communities and irrigation districts in the region have water conservation and drought contingency plans.

Table 1.5 lists the entities that have prepared and filed Water Conservation and Drought Contingency Plans as of January 2010. It should be noted that smaller public water systems (i.e., those with fewer than 3,300 connections) were required to prepare drought plans by May 2009, but these small systems do not have to file their drought plans with the TCEQ.

[12] Salinity hazard is a measure of the potential for salts to be concentrated in the soil from high salinity groundwater. Accumulation or buildup of salts in the soil can affect the ability of plants to take in water and nutrients from the soil. Salinity hazard is usually expressed in terms of specific conductance in micromhos per centimeter at 25° C.

Figure 1.16: Region M Major Aquifers



In addition to drought preparedness at a local level, the on-going drought in the Rio Grande watershed has shown that the water rights system for the middle and lower Rio Grande functions effectively as a regional drought contingency plan. Under this system, domestic, municipal, and industrial (DMI) water rights have a very high degree of reliability and are provided with further assurance through a DMI reserve of 225,000 acre-feet that is maintained in the reservoir system. By comparison, irrigation and mining water rights are treated as residual users of stored water from the reservoirs and therefore bear the brunt of water supply shortages. In essence, irrigation and mining water demand must adjust to the available water supply. Furthermore, many irrigation districts allow transfers of water between individual irrigators. Such transfers have the effect of reallocating limited irrigation supplies from lower to higher value uses, thereby minimizing the economic impact of water shortages.

Table 1.5: Existing Local Water Plans Filed with the TCEQ

Water Supplier		Water Conservation Plan	Drought Contingency Plan
1.	Brownsville PUB	X	X
2.	Brownsville ID	X	
3.	Cameron County ID No 2	X	
4.	Cameron County WID No. 16	X	
5.	City of Eagle Pass Water Works System	X	
6.	City of Edinburg	X	
7.	City of Laredo	X	
8.	City of Los Fresnos	X	
9.	City of Mercedes	X	X
10.	City of Mission	X	
11.	City of La Feria		X
12.	City of La Villa		X
13.	City of Pharr	X	
14.	City of Rio Grande City	X	X
15.	City of San Juan		X
16.	City of Weslaco		X
17.	City of San Benito	X	
18.	County of Webb	X	
19.	Delta Lake Irrigation District	X	
20.	East Rio Hondo WSC	X	X
21.	Engleman Irrigation District	X	
22.	Harlingen Irrigation District	X	
23.	Harlingen Waterworks System	X	X
24.	Hidalgo & Cameron County WCID No 9	X	
25.	Hidalgo County Irrigation District No 1	X	
26.	Hidalgo County Irrigation District No 2	X	

Water Supplier		Water Conservation Plan	Drought Contingency Plan
27.	Hidalgo County Irrigation District No 6	X	
28.	Hidalgo County WCID No 19	X	
29.	Hidalgo County WID 3	X	
30.	Hidalgo County Irrigation District No 16	X	
31.	La Feria Irrigation District Cameron County No 3	X	
32.	Maverick County WCID No 1	X	X
33.	North Alamo WSC	X	X
34.	Sharyland WSC	X	
35.	Zapata County Water Works	X	X
36.	City of Donna		X

1.5.2 Existing Regional Water Plans

Immediately prior to the initiation of the SB 1 regional water planning program, two regional water supply planning projects were conducted within the Rio Grande Region. In February 1998, Phase I of the South Texas Regional Water Supply Plan (STRWSP) was completed under the sponsorship of the South Texas Development Council, with funding assistance from the TWDB. This plan addressed water supply needs in Jim Hogg, Starr, Webb, and Zapata counties. The report for this initial planning phase provided background data and identified key issues that need to be addressed in future water planning. Specific recommendations regarding water supply strategies were not developed.

In February 1999, the Integrated Water Resources Plan (IWRP) for the Lower Rio Grande Valley was completed. This planning effort was sponsored by the Lower Rio Grande Valley Development Council with funding from the TWDB, the U.S. Economic Development Administration, the U.S. Bureau of Reclamation, and local sources. This plan addressed water planning issues in Cameron, Hidalgo, and Willacy counties. In addition to comparing projected water supplies and demand, the IWRP makes specific recommendations regarding water supply for the three counties it addressed. One of the key conclusions of the plan is that:

"The dramatic population growth will result in an increase in municipal water demands to supply domestic, manufacturing, and steam electric needs. However, these increasing municipal demands, and the remaining agricultural water requirements after the impacts of urbanization are considered, can be met through:

- improvements to the irrigation canal delivery system;
- aggressive water conservation efforts in all areas of consumption; and

- implementation of wastewater reuse, desalination of brackish groundwater and desalination of seawater where cost effective."

Both the IWRP and the STRWSP were carefully reviewed as a part of this water planning process and serve as valuable references for this regional water plan.

1.5.3 Summary of Recommendations from the Current State Water Plan

The 2007 State Water Plan is defined by the Texas Water Development Board as a "bottom-up" consensus-driven approach to water planning that involves 16 regional water planning groups. Within TWDB guidelines, each regional planning group reviews water use projections and water availability volumes in dry or drought-of-record conditions. When a water need is identified, the planning groups recommend water management strategies to meet the need. Once the planning group adopts the regional water plan, the plan is sent to the TWDB for approval. The TWDB then compiles information from the regional water plans and other sources to develop the state water plan."

Some of the main conclusions from the State Water Plan include:

- Population in Texas is expected to double between the years 2000 and 2060
- The water demand is expected to increase by 27 percent from 2000 to 2060
- Existing water supplies are expected to decrease 18 percent from 2010 to 2060. This depletion is predominantly due to sedimentation in reservoirs and the depletion of aquifers
- Texas is going to need an additional 8.8 million acre-feet of water by 2060 if new supplies are not developed
- All of the planning groups identified about 4,500 water management strategies to supply an additional 9 million acre-feet of water
- The capital costs needed to implement those water management strategies would cost about $30.7 billion
- If Texas does not implement the State Water Plan, water shortages during drought could cost businesses and workers in the state about $9.1 billion per year by 2010 and $98.4 billion by 2060
- If Texas does not implement the State Water Plan, about 85 percent of the state's population will not have enough water in drought conditions in 2060

In terms of Region M in the State Water Plan, the following are highlights of the plan as defined by the Texas Water Development Board:

- Total capital costs to implement all water management strategies is approximately $1.1 billion
- One new major reservoir is proposed, the Brownsville Weir
- The Rio Grande will remain the main source of raw water for the region
- Municipal demand will increase and will be met primarily through the conversion of irrigation water rights to municipal rights

Select recommendations from the Region M plan, as included in the State Water Plan, include the need to develop new technical and financial resources to combat invasive aquatic weeds in the Rio Grande, to fund brackish groundwater desalination projects, and develop new management strategies on the irrigation district level.

1.5.4 Studies Performed

The analysis and exploration of viable solutions to meet projected water demands in RGRWPA has been accomplished through three studies. They are classified as Study No.'s 1, 2, and 3. Study No. 1 explored the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependant on Amistad and Falcon Reservoirs for their supply. These implications relate primarily to any changes in the available water supply from the two respective reservoirs for the different types of water users and uses that might occur as a result of implementing different water management strategies. Study No. 2 was intended to add a sense of transparency to actual need for water conservation efforts specific to Region M. It did so by analyzing individual Irrigation Districts which make up nearly 85% of the total regional demand. Study No. 3 analyzed two demonstration projects in order to add substantial value and information to the regional water plan. These two studies consisted of an evaluation of on-farm water conservation and a seawater reverse osmosis pilot study. These three studies are outlined in the following sections.

1.5.4.1 Study No. 1: Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing Water Rights on the Lower and Middle Rio Grande

This study was undertaken by TRC/Brandes as a subcontractor to NRS Consulting Engineers, the primary consultant to the Rio Grande Regional Planning Group for development and preparation of the Rio Grande Regional Water Plan. This work was part of the first phase of the third round of Regional Water Planning that is administered and conducted by the Texas Water Development Board pursuant to authorization in Senate Bill 1 as passed by the 77th Texas Legislature.

The primary purpose of this study was to investigate the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependant on Amistad and Falcon Reservoirs for their supply. These implications relate primarily to any changes in the available water supply from Amistad and Falcon Reservoirs for the different types of water users and uses that might occur as a result of implementing different water management strategies as may be considered by the Rio Grande Regional Planning Group (RPG).

The Rio Grande Water Availability Model (WAM), developed by the Texas Commission on Environmental Quality (TCEQ), was used extensively in this study to evaluate the effects of potential changes in various aspects of the existing Rio Grande Operating Rules. The Texas Commission on Environmental Quality (TCEQ) regulates the operation of the Lower and Middle Rio Grande System and the allocation of water stored in Amistad and Falcon Reservoirs among all users. The Rio Grande WAM simulates the allocation of prescribed amounts of water within the basin to individual Texas water rights. Simulations and analyses have been undertaken to investigate the impacts on water availability and the reliability of Amistad-Falcon water supplies if different assumptions regarding changes in future demands from irrigation to all municipal use, modifications to storage allocations in Amistad and Falcon Reservoirs for irrigation and mining water rights and for the domestic-municipal-industrial reserve, classifying all municipal water rights the same as Class A irrigation and mining rights with similar water allocation procedures, and modification to the accounting procedures used by the International Boundary and Water Commission for allotting flows in the Rio Grande at Fort Quitman between the United States and Mexico.

There were several findings and recommendations as a result of this study. The 2010 firm annual yield of the Amistad-Falcon reservoir system with all water used for DMI purposes is about 12% more compared to the yield of the reservoir system with the current mix of municipal, industrial, irrigation and mining uses. Based on the estimated firm yield of the Amistad-Falcon reservoir system, the projected DMI demands over the next 50 years along the Lower and Middle Rio Grande can be fully satisfied if irrigation/mining water rights were converted to DMI use. Results from these and additional WAM simulations and analyses were presented to the Rio Grande RPG. Members discussed the general findings and determined that further evaluations to investigate the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system with respect to Amistad and Falcon Reservoirs were not warranted at that time and should not be undertaken.

1.5.4.2 Study No. 2: Classify Irrigation Districts as Water User Groups

The purpose of this study was to better clarify actual need for water conservation efforts specific to Region M. In the previous rounds of regional planning, water supply and demand analyses were performed for a multitude of Water User Groups (WUGs) in the region, including the classification of irrigation water users as a county-wide group (i.e. Irrigation – Cameron County). Using this classification system creates a difficult set of circumstances for accurately evaluating irrigation water users, including the development of accurate water supply and demand figures and developing water management strategies for implementation.

Irrigation Districts deliver the majority of raw water to municipal users; irrigation Districts make up nearly 85% of the total regional demand for water. Therefore, the in-depth analysis of individual Irrigation Districts allowed for a better understanding of the Region's water supply and demand. The analysis included the study of conveyance systems which are in place for the conveyance of both irrigation and raw water. The efficiencies of the respective systems were also examined. Additionally, Irrigation Districts have irrigation water demands that vary significantly as a result of various states of urbanization which they face. In other words, urbanization plays a vital role in water demand and, thus, must be taken into account. Most importantly, a breakdown of the different types of crops which are being planted was performed, with respect to their planting and harvesting schedules and the different amounts of water needed to produce such crops. The types of crops planted could be modified to better utilize rainfall and optimize the use of delivered irrigation water. With this information, the Region gained valuable insight and was better able to evaluate specific water management strategies needed to meet future water deficits. Because of this study, funding recommendations for the implementation of specific projects by specific entities can be better made.

A thorough analysis of irrigation water supply and demand data is critical. In Region M, irrigation demand is primarily based on the available supply from the Amistad-Falcon reservoir system. During droughts, supply is limited and allowable irrigation water is allocated accordingly, resulting in a perceived reduction in demand. Ultimately, the demand on any given Irrigation District would be such that all land in the District that is included as flat-rate acreage would have the option to receive irrigation water. In turn, Irrigation Districts typically own enough irrigation water rights (class A, class B, or a combination of both) to serve irrigation water users within their boundaries should the water be available in the reservoir.

External factors come into play when attempting to predict future water demands; that is to say, external factors which influence future irrigation water demands must be taken into consideration. However, these factors cannot be accurately quantified and are therefore not included in the demand projections. This specifically pertains to agriculture and the future planting schedule. The aforementioned impact of urbanization is substantial and plays a major role in predicting future demand. Also, climate change could drastically change the amount of irrigation water needed to sustain an equivalent crop yield; the amount of rainfall is a huge factor in irrigation. Improvements to irrigation systems can have a tremendous impact on crop schedules and, in turn, can alter water demand figures; improving distribution efficiency can skew predicted figures by two-fold. A potential increase in energy and fossil fuels would increase chemical costs, fertilizer costs, and tractor operation costs. Additionally, changes to crop subsidies, crop prices, and overall changes to the type of crop being planted would have a direct impact on water requirements. Although these factors cannot be specifically analyzed, the potential impacts deserve notice and discussion.

1.5.4.3 Study No. 3: Results of Demonstration Projects

Since the last round of regional planning was complete, a number of demonstration projects have been undertaken. Included in these demonstration projects are two studies that will add substantial information to the regional water plan. Both of these demonstrations are designed to gain some sort of insight on different methods which can be implemented in order to achieve a common goal; ultimately, these studies will be used to solve future water necessities that pertain to Region M and serve as a foundation for new innovative ways which must be explored and exploited because of their potential impact. These studies surfaced via previously recommended water management strategies for the respective region.

The Harlingen Irrigation District undertook a comprehensive analysis aimed at evaluating on-farm water conservation. The analysis specifically targeted irrigation technologies and methods to be implemented over a ten-year period. The analysis was funded by a grant from the Texas Water Development Board and was initiated in 2005. The aforementioned project is actually composed of five different parts or projects. Namely, drip and furrow flood irrigation in annual crops and multi-year crops; surge, automated surface and precision surface irrigation; low elevation spray application, low pressure in canopy, and low energy precision application center pivot sprinkler demonstration sites; automated and manual on-farm measurement systems; and, variable speed pump control and optimized delivery of on-farm demands. Implementation of the respective on-farm water conservation measures would require individual agricultural producers to adopt new irrigation technologies and management practices. These practices have proven to be successful in regards to water reduction. However, to achieve recommended rates of implementation, it is vital to expand state and federal technical assistance programs, provide initiatives, and/or financial assistance to irrigators. Feasibility and viability of these on-farm solutions depend on this expansion as well as the analysis of optimal irrigation strategies for alternative crops in the region; different crops use different amounts of water and, specifically, high-value crops tend to use larger volumes of water. These two factors, among others, create obstacles to the adoption of on-farm water conservation solutions.

A seawater reverse osmosis (RO) pilot study was performed by the Public Utility Board of the City of Brownsville. The notion stemmed from a Feasibility Study, which took place in 2004, that determined that the Lower Rio Grande Valley region would be confronted with a water supply deficit by 2050 and that seawater desalination was a viable alternative. The pilot study commenced in 2007 and its primary purpose was to provide an opportunity to evaluate the actual performance of proposed water treatment systems under site-specific conditions. The final study scope developed by BPUB and TWDB called for the comparison of four types of pretreatment technologies by means of protocol tests: Eimco Conventional System, GE Zenon Ultrafiltration, Norit Ultrafiltration, and Pall Microfiltation. In addition, three RO membranes were tested during the pilot study and added value to the pilot study as a whole.

Both demonstrations provided valuable knowledge and have successfully accomplished their objectives; they demonstrated that there are viable solutions to our future water necessities and have done so by implementing water management strategies. The demonstration project carried out by the Harlingen Irrigation District indicates that on-farm conservation is a viable water management strategy for the region and has proven that water consumption can be reduced by implementing on-farm conservation while maintaining crop yields similar to more water intensive methods. Moreover, the Brownsville PUB pilot study was also successful; the study proved that seawater desalination is a feasible and recommended water management strategy for the region.

1.6 THREATS TO AGRICULTURAL AND NATURAL RESOURCES

1.6.1 Quantity

As described in section 1.3.3 and in detail in Chapter 3, under the existing water rights system, irrigation water use is a "residual" claimant to available water supplies from the Rio Grande. During periods of low inflows to the reservoir system, when there are little or no allocations made to irrigation and mining storage accounts, these users deplete their storage accounts and may suffer shortages. Under "drought of record" conditions, hydrologic simulations of reservoir operations indicate that only 60-80 percent of the potential irrigation demand can be satisfied. In essence, the system for the administration of Rio Grande water rights functions as a regional drought management plan in that DMI uses are given a priority over irrigation and mining uses and, during drought conditions, irrigation and mining demands must be reduced to levels that match the available supply. Consequently, irrigated agriculture bears the brunt of drought in terms of supply shortages and the associated economic costs of such shortages. Chapter 7 discusses the effects of environmental flows provided by a study done by the National Wildlife Federation.

An additional threat to the availability of water from the Rio Grande for irrigation use is the development and operation of reservoirs on Mexican tributaries. An evaluation of the operation of existing reservoirs during the current drought indicates that significant quantities of water are owed to the United States by Mexico under the terms of the 1944 Treaty. Because of the manner in which available supplies are managed by the State of Texas, any decrease in water availability due to the operation of reservoirs in Mexico will result in further decreases in the available water supply for irrigation and mining use.

Another threat to agricultural and natural resources of the region is the impact of ongoing and projected urbanization on currently undeveloped areas, and the loss of water availability for wildlife. Urbanization plays a major role in determining future demand. The impact can be quantified based on previous rates of urbanization (loss of flat-rate acres and loss of irrigated acres). Particularly in Cameron and Hidalgo counties, projected urbanization is expected to significantly reduce the area of irrigable farmland. Within the Lower Rio Grande Valley, urbanization is expected to be concentrated in corridors along State Highways 77 and 83, as well as other places not along the 77/83 corridor, which run through agricultural areas. In addition to the direct reduction of irrigable farmland acreage due to change in land use, urbanization also impacts adjacent farmland by increasing property values and restricting some types of agricultural activities (e.g. use of pesticides).

Increased pumping of groundwater from the Gulf Coast Aquifer and the Rio Grande Alluvium may threaten riparian habitats fringing resacas and potholes. This would have a negative impact on ecotourism. The lowering of Falcon Lake level due to reduced inflow could negatively impact the diversity of bird species that currently exists.

1.6.2 Water Quality

According to The State of Texas Water Quality Inventory, the size and wide range of geologic and climatic conditions in the Rio Grande Basin are responsible for a wide range of water quality in the river system. Most of the flow of the Rio Grande is diverted for irrigation and municipal uses at the American Canal in Texas and the Acequia-Madre Canal in Mexico before it reaches El Paso.

Downstream of El Paso, most of the flow consists of treated municipal wastewater from El Paso and irrigation return flow. The Rio Grande flow is intermittent to Presidio, where inflow from Mexico’s Rio Conchos enters the river. The presence of metals and pesticides has been identified sporadically throughout the Rio Grande Basin. Elevated fecal coliform levels occur in the river downstream of major U.S./Mexico border cities due to municipal wastewater discharges in Texas and untreated wastewater discharges in Mexico. Levels of chloride and total dissolved solids are increasing in the Rio Grande downstream of Falcon Reservoir due to repeated use of water for irrigation. Elevated nutrient levels are also common in the Rio Grande.

Major tributaries to the Rio Grande are the Devils River and Pecos River in Texas, and the Rio Conchos, Rio Salado, Rio San Juan, Rio Alamo, and Rio San Rodrigo in Mexico. The Devils River has no known water quality problems. The Pecos River drains a substantial part of New Mexico and far West Texas. The saline waters of the Pecos River entering Texas are stored in Red Bluff Reservoir. Downstream of the reservoir, the salinity in the Pecos River continues to increase.

The TCEQ’s 1996 Clean Rivers Program also has summarized water quality concerns and possible water quality concerns on a river basin basis (TWDB, 1997).

The water quality of the Rio Grande Basin has been studied extensively in recent years to assess concentrations of salts, conventional pollutants, and toxics. Data indicate increasing levels of fecal coliform as an indicator of declining water quality. However, through the construction of new wastewater treatment facilities in Nuevo Laredo, as well as active programs for wastewater treatment improvements administered by the Border Environmental Cooperation Commission, these influences are not considered to be of long-term significance (STDC, 1998). Wastewater treatment plant expansions should be encouraged in the colonias to improve the quality of water that is discharged into the river.

Water quality can also be improved by increasing the width of riparian vegetation along rivers (like the Rio Grande and Arroyo Colorado) and streams to minimize urban and agriculture runoff impacts from contaminated water especially agriculture fields next to rivers of drainages with little to no vegetative buffer along the riparian area.

The Texas Water Commission (now the TCEQ) in cooperation with IBWC and CAN completed intensive salt balance studies in 1988 and in 1993. These studies were incorporated into analyses by Miramoto, Fenn, and Swietlik (Flow, Salts, and Trace Elements in the Rio Grande, TR-169, July 1995). This report found that the salt load to the Amistad Reservoir was approximately 1.84 million tons per year. The contributing flow from Fort Quitman and the Pecos River was found to contribute 48 percent of the salt load while delivering only 21 percent of the flow. Salinity levels were observed to be increasing due to the specific influences of the Pecos River, Rio Salado, and tailwater from Fort Quitman. These three water sources were found to contribute 50 percent of the salt load and only 26 percent of the Texas/Mexico flow in the Rio Grande River.

The report observed that due to these salinity loads, concentrating effects of evaporation, and low flow contributions from non-point sources, the salinity levels of the Rio Grande were increasing. Furthermore, the salinity levels in Amistad Reservoir are projected to double from their 1969 levels by the year 2004 (increasing at a rate of 15 mg/L per year). Meanwhile, salinity concentration in Falcon Reservoir is projected to reach levels as high as 885 mg/L by the year 2000.

This report relied on data observed after the drought of record in the 1950s and before the existing drought. Implicitly, it can be assumed that the salt load has only increased with continued low flows to this reservoir system. Also, evidence of a non-equilibrium state for salinity concentrations suggests increasing costs for water treatment and counterpart lowered yields for certain types of crops.

The TCEQ has participated in a Bi-national Toxic Substances Study of the Rio Grande River and is currently authoring a technical report addressing the study's results. This study, conducted with the IBWC and CAN, used regulatory screening levels for protection of aquatic life, human health, toxic concentrations considered for federal criteria and other criteria to screen water samples collected from the Rio Grande. Results suggest that the public water supply could be threatened if detected constituents were found in sufficiently high concentrations. The data may have more relevance to aquatic life than drinking water supply.

In the State of Texas Water Quality Inventory, the TCEQ noted that the Arroyo Colorado, the major drainageway in the Lower Rio Grande Valley, receives much of its flow from municipal, industrial, and agricultural wastewater generated in the area. In the above-tidal segment, which is wastewater effluent dominated, fecal coliform bacteria levels are elevated, preventing attainment of the standard for contact recreation use. In the tidal segment, the aquatic life use is not supported because of depressed dissolved oxygen concentrations. Nutrient and chlorophyll concentrations exceed screening levels in both segments (TWDB).
In the above-tidal portion of Petronila Creek, ortho-phosphorus concentrations are elevated. In addition, chloride, sulfate, and total dissolved solids concentrations exceed segment criteria, as a result of leaching from deposits left by past oil field activity (TWDB).

Elevated concentrations of various metals and/or pesticides occur in sediment in the Arroyo Colorado above tidal and Petronila Creek above Tidal. Pesticide residues derived from agricultural runoff have been a long-standing problem in the Arroyo Colorado (TWDB). The Texas Department of Health has issued a restricted-consumption advisory for the Arroyo Colorado in the above-tidal portion. The advisory recommends that fish consumption be limited to one meal per month due to elevated levels of chlordane, toxaphene, and DDT in fish tissue. The advisory covers portions of Willacy, Cameron, and Hidalgo counties. An aquatic life closure has been issued for Donna Reservoir due to elevated levels of PCBs in fish tissue (TWDB).

1.7 WATER PROVIDERS & DEMAND CENTERS

Table 1.6: Water User Groups[13] and Wholesale Water Providers

Water User Groups	
WUGs	**County Name**
Adams Garden Irrigation District No. 19	Cameron County
Bayview Irrigation District No. 11	Cameron County
Brownsville Irrigation District	Cameron County
Cameron County Irrigation District Cameron County No. 3	Cameron County
Cameron County Irrigation District Cameron County No. 4	Cameron County
Cameron County Irrigation District No. 16	Cameron County
Cameron County Irrigation District No. 2	Cameron County
Cameron County Irrigation District No. 6	Cameron County
Harlingen Irrigation District No. 1	Cameron County
Hidalgo and Cameron Counties Irrigation District No. 9	Cameron County Hidalgo County
Valley Acres Irrigation District	Cameron County Hidalgo County
Donna Irrigation District No. 2	Hidalgo County
Engleman Irrigation District	Hidalgo County
Hidalgo County Improvement District No. 19	Hidalgo County
Hidalgo County Irrigation District No. 1	Hidalgo County
Hidalgo County Irrigation District No. 13	Hidalgo County
Hidalgo County Irrigation District No. 16	Hidalgo County
Hidalgo County Irrigation District No. 2	Hidalgo County
Hidalgo County Irrigation District No. 5	Hidalgo County
Hidalgo County Irrigation District No. 6	Hidalgo County
Hidalgo County Water Control and Improvement District No. 18	Hidalgo County
Hidalgo County Water Irrigation District No. 3	Hidalgo County
Santa Cruz Irrigation District No.6	Hidalgo County
United Irrigation District	Hidalgo County
Delta Lake Irrigation District	Hidalgo County Willacy County

Wholesale Water Providers	
WWPs	**County Name**
Harlingen Waterworks System	Cameron County
Laguna Madre WD	Cameron County
Southmost Regional Water Authority	Cameron County
Valley MUD #2	Cameron County
Military Highway WSC	Cameron & Hidalgo County
City of McAllen	Hidalgo County
Sharyland WSC	Hidalgo County
La Joya WSC	Hidalgo County
North Alamo Water Supply Corporation	Hidalgo County
City of Eagle Pass	Maverick County
Webb County Water Utility	Webb County

TWDB guidelines in Exhibit B state that a wholesale water provider is any person or entity, including river authorities and irrigation districts, that has contracts to sell

[13] Individual irrigation districts are not classified as water user groups but rather are addressed as subset of the associated county irrigation water user group (per Amendment no. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010).

more than 1,000 acre-ft of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. A water user group is any city with a population over 500; or utilities providing more than 280 acre-feet per year of water for municipal counties having four or less of the utilities; or collective reporting units consisting of grouped utilities having common association; or rural and unincorporated with municipal water use (referred as "county other" and aggregated on a county basin); or manufacturing (aggregated on county basis); or mining (aggregated on county basis); or steam electric power generation (aggregated on county basis); or mining (aggregated on county basis); irrigation (aggregated on county basis); and livestock (aggregated on county basis) areas. Water user groups are represented at county and basin unit levels, and if a water user group exists in one or more regions, counties, or basins, then that group will be reported in a divided fashion for each individual divided combination. Table 1.6 above indicates the water providers that follow the TWDB guidelines to designate them as water user groups for this region.

TWDB guidelines state that each regional water planning group may identify and designate "major water providers." These guidelines define a major water provider as an entity "…which delivers and sells a significant amount of raw or treated water for municipal and/or manufacturing use on a wholesale and/or retail basis." The intent of TWDB 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.

Table 1.7: Major Municipal Water Demand Centers in the Rio Grande Region

Major Municipal Water Demand Centers	
County	***Demand Center***
Cameron	Brownsville-Harlingen-San Benito
Hidalgo	McAllen-Edinburg-Mission
Webb	Laredo

For the 2nd round of regional planning, the Rio Grande RWPG elected to not designate any water suppliers in the region as "major water providers." This decision was made primarily based on the unique nature of water rights and water marketing in the Rio Grande Region. Although there are numerous entities, including irrigation districts and municipalities that currently supply or deliver water to other entities, these relationships are not fixed and can change with the changing water needs of a water user group. Designation of major water providers will be re-considered in future updates of the regional water plan.

Table 1.8: Irrigation Major Water Demand Centers

Irrigation Major Water Demand Centers						
Irrigation District	***Irrigable Acres***	***Authorized Water Right (ac-ft)***		***Irrigation District***	***Irrigable Acres***	***Authorized Water Right (ac-ft)***
Adams Gardens Irrigation District No. 19	7,400	18,738		Hidalgo County Water Improvement District No. 3	3,200	9,753
Bayview Irrigation District No. 11	6,000	16,978		Hidalgo County Water Improvement District No. 5	5,700	14,234
Brownsville Irrigation District	17,000	33,949		Hidalgo County Irrigation District No. 5	16,531	34,913
Cameron County Irrigation District No. 2	75,000	147,824		Hidalgo and Cameron County Irrigation District No. 9	65,000	177,151
Cameron County Irrigation District No. 6	15,000	52,142		Hidalgo County Irrigation District No. 13	1,200	4,857
Cameron County Water Improvement District No. 10	3,453	8,488		Hidalgo County Irrigation District No. 16	4,948	30,749
Cameron County Water Improvement District No. 16	1,753	3,713		Hidalgo County Water Control and Improvement District No. 18	2,100	5,318
Cameron County Water Improvement District No. 17	1,399	625		Hidalgo County Irrigation District No. 19	5,000	9,048
Delta Lake Irrigation District	70,000	174,776		La Feria Irrigation District No. 3	27,500	75,626
Donna Irrigation District-Hidalgo County No. 1	32,000	94,064		Santa Cruz Irrigation District No. 15	32,800	75,080
Engleman Irrigation District	7,761	20,044		Santa Maria Irrigation District-Cameron County No. 4	3,700	10,183

Harlingen Irrigation District-Cameron County No. 1	39,000	98,233		United Irrigation District of Hidalgo County	26,836	57,374
Hidalgo County Irrigation District No. 1	30,000	85,615		Maverick Co. ID	-	134,900
Hidalgo County Irrigation District No. 2	46,709	137,675		Valley Acres	7,948	16,124
Hidalgo County Municipal Irrigation District No. 1	0	1,120				

1.8 IMPACTS OF PROPOSED BORDER FENCE

1.8.1 Goals and Objectives of the Proposed Border Fence

The goal of the proposed border fence is to increase border security within the Rio Grande Valley Sector and Region M counties. The ultimate objective is to decrease the number of illegal border crossings.

The description of the project is to construct, operate, and maintain tactical infrastructure consisting of primary pedestrian fencing, concrete flood protection structures/concrete fencing, patrol roads, and access roads along the US/Mexico border in the Rio Grande Valley Sector and Region M counties. Fences vary in length, from approximately 1 mile long to 13 miles long.

There are standard minimum design criteria that must be met and have been established by the United States Border Patrol and Environmental Stewardship Plan/Biological Resources Plan:

- The fence must be built at least 15 to 18 feet high and extend below grade;
- Capable of withstanding a crash of a 10,000-pound (gross weight) vehicle traveling at 40 miles per hour;
- Capable of withstanding vandalism, cutting, or various types of penetration;
- Semi-transparent, as dictated by operational need;
- Designed to survive extreme climate changes;
- Designed to reduce or minimize impacts on small animal movements;
- Engineered not to impede the natural flow of surface water; and
- Aesthetically pleasing to the extent possible.

1.8.2 Water Resources

1.8.2.1 Hydrology and Groundwater

Moderate impacts on hydrology and ground water will occur from the construction of tactical infrastructure when combined with other past, present, and reasonably foreseeable future actions due to increased erosion and stream sedimentation.

1.8.2.2 Surface Water and Waters of the United States

Moderate impacts on surface water and waters on the United States could occur from increased erosion and stream sedimentation. Residential and commercial areas have the potential to create additional erosion and stream sedimentation and adverse cumulative effects, along with disturbance from construction and operation of the tactical infrastructure. Many factors have degraded the quality of water in the Region M section and have resulted in long-term impacts on water quality. Past actions that have impacted the region are sewage and urban runoff, agricultural runoff, international bridges, agriculture clearing along the river, and industrial discharges.

Wetland losses in the United States have resulted from draining, dredging, filling, leveling and flooding for urban, agricultural, and residential development. Along the Texas coast in the mid-1950s, there was an estimated 4.1 million acres of wetlands. Wetlands decreased to 3.9 million by the 1990s, including 3.3 million acres of freshwater wetlands and 567,000 acres of saltwater wetlands. Even less acreage of wetlands exist today. Due to the construction of tactical infrastructure, wetlands will be avoided to the maximum extent possible. Approximately 8 acres of wetlands will be impacted by construction of the tactical infrastructure. The cumulative impacts on wetlands will be long-term.

1.8.2.3 Floodplains

Floodplain resources can be adversely impacted by development, increases in impervious areas, loss of vegetation, changes in hydrology, and soil compaction. Construction, operation, and maintenance of tactical infrastructure has the potential for moderate impacts on floodplains from further loss of soil on access roads and patrol roads, and the placement of structures in the floodplains. The construction of the levee system that controls the flow of water over low-lying areas previously affected the floodplains. The impacts of the new tactical infrastructure will be moderate due to the cumulative impacts from previous actions including 11 international bridges and its infrastructure within the floodplains.

1.8.3 Vegetation

Moderate impacts on native species vegetation and habitat are expected from construction of tactical infrastructure. The border fence has directly reduced habitat for sensitive flora species and wildlife use. Indirect impacts from the border fence include introduction of nonnative species, funneling wildlife to unsuitable habitat, and funneling of illegal traffic to other sensitive habitats.

Development of land for urban use will continue at a steady pace, resulting in loss of farmland and of wildlife habitat. Construction of border fencing and facilities will contribute to his developmental issue, and cause fragmentation of habitat. Purchase of land for management as wildlife habitat and for conservation will continue, but will have an adverse impact on completing and connecting a wildlife corridor along the Rio Grande. Lands already purchased are undergoing restoration at various levels and some of these are being affected by fence construction due to loss of connectivity. Water rights issues could become important and affect agricultural, wildlife, and urban acreages during planning efforts.

1.8.4 Wildlife and Aquatic Resources

Moderate to adverse impacts on wildlife and species are expected from the construction of tactical infrastructure on the US Border Fence. The border fence has slightly adversely impacted wildlife due to loss of habitat connectivity, genetic isolation, and water access for wildlife. Displaced wildlife will move to adjacent habitat if sufficient habitat exists and the funneling of illegal traffic could also disrupt nesting, foraging, and movements of individual species. Due to the border fence and the growth of commercial development and residential development, the amount of potentially suitable habitat could continue to decrease, that could produce a long-term, adverse cumulative effect especially for the recovery of the endangered ocelot and jaguarondi. Wildlife could also be impacted by noise during construction, operational lighting, and loss of potential prey species. Species will also impacted by equipment spill and leaks.

1.8.4.1 Rare Species That Could Be Affected By Border Fence

Rare species that are of concern in Texas

Fish: river goby, Rio Grande silvery minnow

Amphibians: sheep frog, white-lipped frog, black-spotted newt, Mexican burrowing toad, south Texas siren (large form), Mexican tree frog

Reptiles: black-striped snake, reticulate collared lizard, indigo snake, speckled racer, Texas tortoise, Texas horned lizard, northern cat-eyed snake

Birds: gray hawk, white-tailed hawk, piping plover, northern aplomado falcon, peregrine falcon, rose-throated becard, rookery

Mammals: Mexican long-tongued bat, jaguarondi, southern yellow bat, ocelot, white-nosed coati, jaguar

Plants: Vasey's adelia, south Texas ambrosia, prostrate milkweed, star cactus, Kleberg saltbush, Texas ayenia, Chihuahua balloon-vine, Runyon's cory cactus, lila de los llanos, Green Island echeandia, Gregg's will buckwheat, Johnston's frankenia, plains gumweed, Mexican mudplantain, Runyon's water-willow, St. Joseph's staff, Walker's manioc, Falfurras milkvine, Zapata bladderpod, ashy dogweed, Bailey's ballmoss

Vegetation Types: Blackbrush Series, Texas Ebony – Anacua Series, Texas Ebony – Snake-eyes Series, Texas Ebony – Snake-eyes – Berlandier fiddlewood Series, Mesquite – Huisache Series, Texas Palmetto Series, American Elm – Hackberry Series, Cedar Elm – Sugarberry Series, Sea Oats – Bitter Panicum Series

1.8.5 Socioeconomics

Construction of tactical infrastructure associated with the project will have minor beneficial direct and indirect impacts on socioeconomics through increased employment and the purchase of goods and services. There will be minor project impacts on employment, temporary housing, public services, and material supplies.

1.8.5.1 Water Supply Systems

As a result of the tactical infrastructure there are short-term impacts on irrigation and municipal water supply systems. Irrigation districts have water rights, enforced through TCEQ, and they provide water not only to farmers, but to municipal customers as well. All water supply infrastructures will be identified prior to construction, and impacts on these systems will be avoided to the maximum extent practical.

Canals will be avoided to the utmost extent practicable. Pipelines that can not be avoided will be moved. All changes to water supply system and irrigation district infrastructure will be in accordance with TCEQ requirements to make certain that these entities can provide water to their clientele.

1.8.5.2 Drainage Systems

As a result of the tactical infrastructure there will be anticipated short-term impacts on irrigation and storm drainage systems. All drainages will be identified prior to construction and impacts on these systems will be avoided to the highest level practical. Proper engineering practices and applicable codes and ordinances will reduce storm water runoff-related impacts to a level of irrelevance. Erosion and sedimentation controls will be in place during construction to reduce and control siltation or erosion impacts on areas outside of the construction site. All storm water drainages will be identified prior to construction and impacts on these systems will be minimal.

1.8.5.3 Municipal Sanitary Sewer Systems

Short-term minor adverse impacts on municipal sanitary systems are expected. All sanitary sewer infrastructures will be recognized prior to construction and impacts on these systems will be avoided to the maximum extent practical. Any outfall pipes that will be affected by the construction will be moved. No long-term impacts are expected.

1.9 WATER RIGHT CONVERSION BILL

There have been many disputes in the past 20 years between irrigation water districts and municipal suppliers in the Rio Grande Valley. The dispute has been that water supply corporations were organized initially to serve rural residents, but because of growth in previously rural areas, now serve a large population. It also centered on how irrigation rights previously used on farm land that is now urbanized would be changed to municipal use.

The Texas Legislature in 2007 passed a law on the conversion of irrigation rights to municipal use rights. It only applies to the Lower Rio Grande, but impacts the Middle Rio Grande as well. The statute establishes a method by which agricultural water rights are converted to municipal use and the terms of the conversion transaction. (Acts 2007, 8^{th} Leg., Ch. 1430, Vernon's Texas Civil Statutes, Water Code, Subchapter O, Sections 49.501, *et seq*.)

The statute only covers water districts and municipal water suppliers in counties that border the Gulf of Mexico and Mexico or is adjacent to such a county. This basically means the four-county area in the Lower Rio Grande Valley.

When subdivisions are platted and recorded, the municipal water supplier, who will serve the subdivision with potable water, has two years in which to petition the water district to convey the water rights associated with the previous farm land in the subdivision or contract over a 40-year period for the delivery of the equivalent amount of water.

If the municipal supplier fails to file such a petition within this two year period, then after notice to other water suppliers in these counties, other water suppliers in the four-county area may opt to purchase the rights at the same terms and conditions as a purchaser from outside the county areas. If one opts to purchase the rights within 90 days, then the sale may be made to the purchaser located outside the four-county area. The effect on the Middle Rio Grande and one county in the Lower Rio Grande is that municipal suppliers in the four county area have first right to purchase the water rights.

The amount of water rights which are associated with a subdivision is based upon the number of previously irrigated acres within the subdivision and its prorated share of the district's water rights.

The law provides that a district can provide for the water rights out of its existing municipal use water rights or convert the previous irrigation rights of the district to municipal use through an amendment to its water rights as provided by TCEQ rules.

The statute provides that if the water rights are conveyed to the municipal water supplier, that the amount paid to the water district is equivalent to 68% of the prevailing market value of water rights sold in the Lower and Middle Rio Grande, which are determined by the Rio Grande Regional Water Authority (RGRWA), based upon the price paid in the last three sales transactions of 100 acre feet or more from the previous year. If the water is to be delivered on a contractual basis, the law provides for a formula to determine the delivery charge to be paid by the municipal supplier to the water district on an annual basis.

The water district must agree to designate at least 75% of the proceeds from the sale of water rights for capital improvements of the district.

As of January 2010, no petitions have been filed under this statute, but the RGRWA has established the market value according to the statute as $2,218 per acre foot of municipal use rights after conversion from irrigation rights for the year 2009.

1.10 ARROYO COLORADO WATERSHED PROTECTION PLAN

The Arroyo Colorado (Segment 2201 and 2202), an ancient distributary channel of the Rio Grande, extends about 90 miles from Mission, Texas through southern Hidalgo County to the city of Harlingen in Cameron County, eventually discharging into the Laguna Madre near the Cameron-Willacy county line. The watershed of the Arroyo Colorado is approximately 1,828 square kilometers (706 square miles). It serves as the major drainageway for approximately two dozen cities in the area. Flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff, and base flows from shallow groundwater.

Use of the water in the Arroyo Colorado for municipal, industrial or irrigation purposes is severely limited because of poor water quality conditions. Salinity concentrations in the Arroyo typically exceed the limits considered desirable for human consumption as well as those acceptable for irrigation of crops. The 2008 Texas Water Quality Inventory and 303(d) List include both segments of the Arroyo Colorado for failing to meet the state's water quality standards designed to protect aquatic life use. The Arroyo Colorado Tidal, Segment 2201, is listed for bacteria, depressed dissolved oxygen (DO), and mercury and PCBs in edible fish tissue. Segment 2202, Arroyo Colorado Above Tidal, is also listed for elevated bacteria and mercury and PCBs in edible fish tissue.

The TCEQ initiated an effort in 1998 to develop a Total Maximum Daily Load (TMDL) for pollutants causing low DO in the tidal segment of the Arroyo Colorado. The TMDL was completed in 2002, but was not adopted. Rather, the TCEQ initiated the development of a comprehensive watershed protection plan to address low DO in the tidal segment of the Arroyo Colorado and identify ways to reduce pollutant loadings, improve aquatic habitat, and conduct additional monitoring and modeling for refinement of the existing TMDL analysis.

The consensus-based, local effort began in July 2003 with the formation of the Arroyo Colorado Watershed Partnership. The Arroyo Colorado Watershed Partnership Steering Committee, consisting of local stakeholders and agency representatives, and workgroups provided direction for the Arroyo Colorado Watershed Partnership in development of the Watershed Protection Plan (WPP). The Texas Sea Grant College Program and the Texas AgriLife Extension Service facilitated and coordinated the development of the WPP through funding provided by TCEQ. The WPP included five major components: Wastewater Infrastructure; Agricultural Issues; Habitat Restoration; Further Study and Monitoring/ Refinement of TMDL Analysis; and Outreach and Education. The five workgroups developed recommendations for each of their components, including action items that will improve water quality. Recommendations were integrated into the Arroyo Colorado WPP and in January 2006, "A Watershed Protection Plan for the Arroyo Colorado-Phase I" was released to the public. The workgroups and steering committee continue to meet regularly today.

Following the release of the WPP in 2006, the TCEQ funded an effort to implement the WPP through the Texas Water Resources Institute, part of Texas AgriLife Research, the Texas AgriLife Extension Service, and the College of Agriculture and Life Sciences at Texas A&M University. The funding began putting the strategies and objectives listed within the plan into action. The Arroyo Colorado Watershed Partnership has grown to over 700 members. The Partnership has brought in more than $3.1 million in federal funding and matched more than $1.7 million in local funds to sustain the program.

These dollars fund priority action items listed within the WPP. The top priority of the plan is the construction of individual wetlands and ponds for removal of nutrients from treated wastewater and the construction of regional wetland systems for removal of nutrients from multiple sources. Other priority items include habitat restoration including wetland development, wastewater infrastructure improvements, implementation of best management practices (BMPs) on farms and in cities, outreach and education for adults and youth, and water quality monitoring to assess the impacts of the WPP.

1.10.1 Habitat Restoration and Wastewater Infrastructure

To enhance wastewater infrastructure and water quality treatment, TCEQ provided financial assistance to the Cities of San Juan, San Benito, and La Feria to enhance water quality through the design, construction, maintenance, operation, and monitoring of wetlands that will receive treated effluent from municipal wastewater treatment facilities and storm water runoff. Recreational appurtenances such as boardwalks, all-weather paths, signage, and kiosks are also being developed as part of the wetland systems. San Juan and La Feria wetlands are complete and San

Benito will begin construction later this year. Additional constructed wetlands in both cities and rural areas are needed, including a regional wetland system near the Port of Harlingen.

1.10.2 Agricultural BMPs

In a watershed where agriculture is the primary land use, best management practices (BMPs) to protect water quality and voluntary action by agricultural producers are a high priority of the WPP. Agricultural producers receive guidance and support from the Extension Service, the Texas State Soil and Water Conservation Board (TSSWCB), the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), and local Soil and Water Conservation Districts (SWCDs) in the from of education, cost-sharing and technical assistance to install BMPs. Educational events have reached more than 3,500 producers to expand their knowledge of new technologies for more efficient and safe production, BMPs that protect water quality, and cost share program participation. Over 130 producers have developed and implemented a water quality management plan (WQMP) on more than 65,000 acres in the watershed. The WPP sets a goal to establish WQMPs and install BMPs on 33 percent (100,000 acres) of the irrigated cropland by 2010 and 50 percent (150,000 acres) by 2015. Additional funds are needed to reach all of the agricultural producers and target BMP installation along the Arroyo Colorado.

1.10.3 Urban BMPs

The Lower Rio Grande Valley is one of the fastest growing metropolitan areas in the U.S. and thus, urban BMPs to protect water quality are also a top priority. Storm water management plans developed by each city in a joint effort through the Lower Rio Grande Valley TPDES Stormwater Task Force, a coalition of 15 valley cities formed in 2002 and facilitated by the Texas A&M University-Kingsville, outline specific BMPs to be installed by each city. The task force has partnered with the City of McAllen to develop and assess a system of storm water regional detention facilities (RDFs) that can manage and direct storm water flows within the city to mitigate flooding concerns and drainage issues and serve to improve water quality. The study will provide guidance for other cities to follow. Additional BMPs, such as constructed wetlands, low impact development (smart growth), and green development, such as porous pavement or vegetated corridors, etc., are still needed and the task force and the Arroyo Colorado Watershed Partnership continue to seek funds for these types of projects. Many of these additional BMPs, such as low impact development, provide a water conservation benefit as well, which could enhance or supplement potable water supplies leading to a reduction in demand on current water supply.

1.10.4 Outreach and Education

A physical watershed model, provided in part by the Nueces River Authority (NRA), serves as an excellent hands-on educational tool for youth and adults. Over 21,000 individuals in the watershed have viewed the model to learn about their local watershed, their impact on water quality and how they can be better stewards. The Arroyo Colorado Watershed Coordinator and the storm water task force liaison presented the model to thousands of students at 24 local schools. The storm water task force and the Partnership also partnered on other outreach efforts. More than 1,000 storm drain markers, reading "No Dumping, Drains to Laguna Madre," were installed and the task force hopes to fund an additional 20,000 markers in the future. The partnership installed ten road signs marking the watershed boundary on major entry points to the watershed and again, the storm water task force has plans to fund and facilitate the installation of at least 35 more signs.

1.10.5 Water Quality Monitoring

To assess the impacts of these efforts, the NRA and the International Boundary and Water Commission (IBWC) and U.S. Geological Survey conduct routine water quality monitoring in the Arroyo Colorado at twelve sites. The TSSWCB is providing funds to conduct edge-of-field monitoring to assess agricultural BMP effectiveness. In addition, the TSSWCB funded the development of a new Land Use-Land Cover (LULC) map to reflect the many land use changes in the rapidly growing watershed. The map is being used to more accurately characterize and model the watershed and assess loadings as researchers are using the Soil and Water Assessment Tool (SWAT) model and GIS to simulate the current sediment and nutrient loadings in the Arroyo Colorado watershed. Data was collected for input into the SWAT model and following model calibration and validation, the model should be released in early 2010.

1.10.6 Additional Needs

Many activities are underway; the WPP outlines additional goals and measures that need to be implemented to improve the Arroyo Colorado Watershed.

1.10.6.1 Wastewater Infrastructure

(2006-2010)

- Conversion of a 14-acre wastewater treatment lagoon system into a wetland cell system for effluent polishing pond for the city of Hidalgo.
- 1-acre effluent polishing pond for the City of Hidalgo.

(2011-2015)

- 10-acre wetland system for effluent polishing for the City of Alamo,
- 6-acre wetland system and 2-acre pond system as part of the expansion of the City of La Feria's nature park
- 20-acre effluent polishing pond (e.g., oxbow lake) for the City of Pharr and the City of McAllen.

1.10.6.2 Habitat Restoration

- Small projects include installation of stream bank stabilization structures, creation of wetland swales in drainage channels and installation of vegetated filter strips.
- Larger projects include construction of wetlands for tertiary treatment of waste streams from individual wastewater treatment plants and/or for polishing flows from multiple wastewater treatment facilities in close proximity, and construction of large regional wetlands that treat flows from multiple sources including wastewater treatment facilities and nonpoint discharges from urban and agricultural areas or water pumped directly from the Arroyo Colorado.

1.10.6.3 Agricultural BMPs

(2006-2010)
- Local producers design and implement WQMPs on 50,000 acres of agricultural land.

(2011-2015)
- Local producers design and implement WQMPs on additional 50,000 acres of agricultural land.

1.10.6.4 Urban BMPs

- Implement measures listed within individual storm water management plans
- Promote low-impact urban development
- Promote new urban or Smart Growth principles
- Promote green development and preservation of native landscape/green corridors

1.10.6.5 Outreach and Education

- Deliver basic facts about the Arroyo Colorado
- Raise awareness and increase community involvement in the Arroyo Colorado Watershed Partnership
- Develop Partnership agreements for message distribution
- Create micro-campaigns for specific target audiences
- Institutionalize a practice of ongoing campaign evaluation
- Establish volunteer monitoring programs on the Arroyo Colorado and associated drainages
- Collaborate with government agencies offering environmental E&O
- Collaborate with NGOs supporting environmental educations and conservation programs

1.11 FALCON-MATAMOROS AQUEDUCT

1.11.1 Background

Currently the border population between Nueva Ciudad Guerroero and Matamoros in the state of Tamaulipas is supplied with water from the Rio Grande basin that is stored in Falcon Dam and conveyed through the Rio Grande channel over 274 miles, suffering considerable losses as a result of evaporation, seepage into subsoil and clandestine pumping.

According to the available information, the flow rate necessary to supply 1.2 million residents living in the border towns between Nueva Ciudad Guerrrero and Matamoros is 183 cfs, which means that a flow of 352 cfs must be conveyed through the river.

The economic dynamic in Tamaulipas is that over 50% of the formal employment is concentrated there in that region of the state, with an accumulated growth of 22.6% in the last 7 years.

1.11.2 Objective

The objective of the project is to ensure the supply of water needed for urban growth over the next 20 years for the people of Tamaulipas living the low Rio Grande basin, by increasing the conveyance efficiency of the water concessioned for urban use in the 9 cities and their rural areas. It also will help strengthen the compliance with Mexico's commitment under the 1944 Water Treaty.

1.11.3 Solution

The construction of a 142 mile aqueduct from Falcon Dam to Matamoras with bulk delivery of water along the way to border cities in Tamaulipas and the rural areas of Rio Bravo, Valle Hermoso and Matamoros. The aqueduct will also include pump stations, intake, submergence controls, regulation tanks, and/or standpipes, as well as the structures needed for special crossings, such as canals, gas lines, rivers, railroads, etc. Due to the population growth over the next 20 years, the aqueduct would be used to meet the demand for the future. Cost of this project is estimated at $400 million.

1.12 1944 TREATY

The Treaty of 1944 Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande governed the allotment of waters from Fort Quitman, Texas to the Gulf of Mexico. The treaty has withstood a series of international disagreements and continues to dictate water distribution practices despite economic, demographic, and climatic changes. Many disputes between the two countries, United States and Mexico, have been going on throughout the existence of the treaty due to the treaties' ambiguous language and the legal interpretation by the stakeholders from both nations. The International Boundary and Water Commission (IBWC) is involved in the most recent incident, which involves the historical water accounting practices at the Fort Quitman water gauge.

The Lower Rio Grande Valley Water Planning District has become increasingly concerned about surface water shortages and proper water accounting procedures at Fort Quitman, Texas, due to major financial losses incurred during Mexico's water debt, Hurricane Dolly and the current two-year drought. The IBWC has historically allocated 50 percent of all waters accumulated at Fort Quitman water gauge to the United States and 50 percent to Mexico. Surface waters at Fort Quitman gauge belong entirely to the United States in accordance with the Convention of 1906, claim the Texas Commission on Environmental Quality (TCEQ) and the Rio Grande Regional Planning Group (Region M). The 1944 Treaty cites that the 50-50 division is related to the unnamed flows "between Fort Quitman and the lowest major international storage dam." Region M funded an independent study to determine the quantity of water at the gauge and if it fluctuates over time.

The conclusion of the study indicates that during years of sufficient rainfall, if the 50/50 split was eliminated, Texas water rights owners could access approximately 16,550 acre-feet of additional water.

1.13 Water Accounting at Fort Quitman[14]

The issue of how flows of the Rio Grande at Fort Quitman are divided between the United States and Mexico has been a concern to Rio Grande water users because of the apparent inconsistencies and discrepancies regarding this distribution in two historical agreements between the United States and Mexico; namely, the 1906 Convention and the 1944 Treaty. Article I of the 1906 convention states that "…the United States shall deliver to Mexico a total of 60,000 acre-feet of water annually in the bed of the Rio Grande at the point where the head works of the Acquit Madre, known as the Old Mexican Canal, now exist above the city of Juarez, Mexico." Article IV states that "the delivery of water as herein provided is not to be construed as a recognition by the United States of any claim on the part of Mexico to the said waters; and it is agreed that in consideration of such delivery of water, Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican canal and Fort Quitman, Texas….". the 1944 Treaty between the United States and Mexico, which, among other things, establishes ownership of waters flowing in the Rio Grande between the two countries from Fort Quitman downstream to the Gulf of Mexico, states in article IV of Section II that inflows to the Rio Grande below Fort Quitman from certain named tributaries are allotted to each of the two countries in specified proportions and that each country is allotted "one-half of all flows not otherwise allotted by this article occurring in the main channel of the Rio

[14] Information on Water Accounting at Fort Quitman came from "Special Study No. 1: Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing Water Rights on the Lower and Middle Rio Grande."

Grande (Rio Bravo), including the contributions from all unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam."

Historically, in its accounting for ownership of waters of the Rio Grande, the IBWC has imposed the 50/50 language in the 1944 treaty to divide the flows in the Rio Grande at Fort Quitman equally between the United States and Mexico, when, clearly, the 1906 Convention specifically states that "….Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican canal and Fort Quitman, Texas …..". First of all, it is important to understand the significance and the implications of the fact that the quantity of flow in the Rio Grande at Fort Quitman has varied considerably throughout history. Half of the time the flow is greater than about 88,000 acre-feet/year. For purposes of evaluating the effect of the different flow allocations at Fort Quitman, the Rio Grande Water Availability Module first was operated as it is currently structured in accordance with IBWC's current accounting practice, i.e., the 50/50 split of Fort Quitman flows. The United States' share of the firm yield of the Amsted-Falcon Reservoir system was determined to be 1,012,081 acre-feet/year. The structure of the WAM then was modified to allot all of the flow in the Rio Grande at Fort Quitman to the United States, and this simulation produced a firm yield from the Amistad-Falcon Reservoir system for the United States of 1,028,631 acre-feet/year, an increase of 16,550 acre-feet/year over the 50/50 allocation. Clearly, these results demonstrate that changing IBWC's accounting practices with regard to the allotment of flows in the Rio Grande at Fort Quitman to be consistent with what appears to be the proper interpretation of language in the 1906 Convention would be a benefit to the Texas water rights which are dependent on the Amistad-Falcon reservoir system for their supplies.

ATTACHMENT 1-1

RARE, THREATENED, AND ENDANGERED SPECIES LISTS

Texas Parks & Wildlife
Annotated County Lists of Rare Species
Updated: July 2009

CAMERON COUNTY

Species	Federal Status	State Status
***** AMPHIBIANS *****		
Black Spotted Newt (*Notophthalmus meridionalis*) - can be found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River		T
Mexican Treefrog (*Smilisca baudinii*) – subtropical region of extreme southern Texas; breeds May-October coinciding with rainfall, eggs laid in temporary rain pools		T
Sheep Frog (*Hypopachus variolosus*) – predominantly grassland and savanna; moist sites in arid areas		T
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
White-lipped Frog (*Leptodactylus labialis*) - grasslands, cultivated fields, roadside ditches, and a wide variety of other habitats; often hides under rocks or in burrows under clumps of grass; species requirements incompatible with widespread habitat alteration and pesticide use in south Texas		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) – year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) – migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentration along coast and barrier islands; low-altitude migrant, stopovers and leading landscape edges such as lake shores, coastlines, and barrier islands	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks.	LE	E
Brownsville Common Yellowthroat (*Geothlypis trichas insperata*) - tall grasses and bushes near ponds, marshes, and swamps; breeding April to July		
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) - riparian trees, brush, palm, and mesquite thickets; during day also roosts in small caves and recesses on slopes of low hills; breeding April to June		T

Common Black Hawk (*buteogallus anthracinus*) – cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain, formerly bred in south Texas		T
Eskimo Curlew (*Numenius borealis*) – historic; nonbreeding: grasslands, pastures, plowed fileds, and less frequently, marshes and mudflats	LE	E
Gray Hawk (*Asturina nitida*) – locally and irregularly along U.S.-Mexico border; mature riparian woodlands and nearby semiarid mesquite and scrub grasslands; breeding range formerly extended north to southernmost Rio Grande floodplain of Texas		T
Interior Least Tern (*Sterna antillarum athalassos*) – subspecies is listed only when inland (more than 50 miles from coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Northern Aplomado Falcon (*Falco femoralis septentrionalis*) - open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species	LE	E
Northern Beardless-tyrannulet (*Camptostoma imberbe*) - mesquite woodlands; near Rio Grande frequents cottonwood, willow, elm, and great leadtree; breeding April to July		T
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p, tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Piping Plover (*Charadrius melodus*) – wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) – resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Rose-throated Becard (*Pachyramphus aglaiae*) - riparian trees, woodlands, open forest, scrub, and mangroves; breeding April to July		T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (Tillandsia unioides); feeds on invertebrates, fruit, and nectar; breeds March-August		
Snowy Plover (*Charadrius alexandrinus*) - wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (Sterna fuscata) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Southeastern Snowy Plover (*Charadrius alexandrinus tenuirostris*) – wintering migrant along the Texas Gulf Coast beaches and bayside mude or salt flats		

Texas Botteri's Sparrow (*Aimophila botterii texana*) - grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses T

Tropical Parula (*Parula pitiayuma*) – dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July T

Western Burrowing Owl (*Athene cunicularia hypugaea*) – open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

Western Snowy Plover (*Charadrius alexandrinus nivosus*) – uncommon breeder in the Panhandle; potential migrant; winter along coast

White-faced Ibis (*Plegadis chihi*) – prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats T

White-tailed Hawk (*Buteo albicaudatus*) - near coast it is found on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March to May T

Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960 T

Zone-tailed Hawk (*Buteo albonotatus*) - rough, deep, rocky canyons and streamsides in semiarid mesa, hill, and mountain terrain; breeding March to July T

*** BIRDS-RELATED ***

Colonial waterbird nesting areas - many rookeries active annually

Migratory songbird fallout areas - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds

*** FISHES ***

American Eel (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries

Mexican goby (*Microphis claytonia*) – Southern coastal area; brackish and freshwater coastal streams T

Opossum Pipefish (*Microphis brachyurus*) - brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth T

Rio Grande Silvery Minnow (*Hybognathus amarus*) (extirpated) - historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves LE E

River goby (*Awaous banana*) – Southern coastal waters; clear water with slow to moderate current, sandy or hard bottom, and little or no vegetation; also enters brackish and ocean waters T

Smalltooth sawfish (Pristis pectinata) – different life history stages have different patterns of habitat use; young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, sea grass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on a variety of fish species and crustaceans LE E

*** INSECTS***

A Royal moth (*Sphingicampa blanchardi*) – woodland–hardwood; Tamaulipan thornscrub with caterpillar's host plant, Texas Ebony (Pitheocellobium flexicaule) an important element

Manfreda giant-skipper (*Stallingsia maculosus*) – most skippers are small and stout-bodied; name dervies from fast, erratic flight; at rest most skippers hold front and hind wings at different angles; skipper larvae are smooth, with the head and neck constricted; skipper larvae usually feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk

Smyth's Tiger Beetle (*Cicindela chlorocephala smythi*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches

Subtropical blue-black tiger beetle (*Cicindela nigrocoerulea subtropica*) – most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches

Tamaulipan agapema (*Agapema galbina*) – Tamaulipan thornscrub with adequate densities of the caterpillar food plant Condalia hookeri hookeri (=obovata); adults occur Sep-Oct; eggs hatch with in two weeks and larvae mature 'rapidly'

*** MAMMALS ***

Coues' Rice Rat (*Oryzomys couesi*) – cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees around the shoreline are important features; prefers salt and freshwater, as well as grassy areas near water; breeds April-August T

Ghost-face bat (*Mormoops megalohylla*) – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year

Jaguar (*Panthera onca*) (extirpated) – dense chaparral; no reliable Texas sightings since 1952 LE E

Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Mexican Long-tongued Bat (*Choeronycteris mexicana*) - deep canyons where uses caves & mine tunnels as day roosts; also found in buildings & often associated with big-eared bats (*Plecotus* spp.); single Texas record from Santa Ana NWR		
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Southern Yellow Bat (*Lasiurus ega*) – associated with trees, such as palm trees (*Sabal mexicana*) in Brownsville, which provide them with daytime roosts; insectivorous; breeding in late winter		T
West Indian Manatee (*Trichechus manatus*) - Gulf and bay system; opportunistic, aquatic herbivore	LE	E
White-nosed Coati (*Nasua narica*) – woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground & in trees; omnivorous; may be susceptible to hunting, trapping, & pet trade		T
Yuma Myotis Bat (*Myotis yumanensis*) - desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; single offspring born May-early July		

MOLLUSKS

False Spike Mussel *(Quincuncina mitchelli*) - substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		
Mexican Fawnsfoot *(Truncilla cognata*) - largely unknown; possibly intolerant of impoundment; possibly needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin		
Salina Mucket *(Potamilus metnecktayi*) - lotic waters; other habitat requirements are poorly understood; Rio Grande Basin		
Texas Hornshell *(Popenaias popeii*) - both ends of narrow shallow runs over bedrock, in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders; not known from impoundments; Rio Grande Basin and several rivers in Mexico	C	

*** REPTILES ***

Atlantic Hawksbill Sea Turtle *(Eretmochelys imbricata*) - Gulf and bay system	LE	E
Black-striped Snake (*Coniophanes imperialis*) - extreme south Texas; semi-arid coastal plain, warm, moist micro-habitats and sandy soils; proficient burrower; eggs laid April-June		T
Green Sea Turtle *(Chelonia mydas*) – Gulf and bay system	LT	T

Indigo Snake (*Drymarchon corais*) – thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Keeled Earless Lizard (*Holbrookia propinqua*) - coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates; lays clutches of 2-7 eggs March-September (most May-August) in soil/underground		
Kemp's Ridley Sea Turtle *(Lepidochelys kempii*) - Gulf and bay system	LE	E
Leatherback Sea Turtle *(Dermochelys coriacea*) - Gulf and bay system	LE	E
Loggerhead Sea Turtle *(Caretta caretta*) - Gulf and bay system	LT	T
Northern Cat-eyed Snake (*Leptodeira septentrionalis septentrionalis*) - Gulf Coastal Plain south of the Nueces River; thorn brush woodland; dense thickets bordering ponds and streams; semi-arboreal; nocturnal		T
Speckled Racer (*Drymobius margaritiferus*) - extreme south Texas; dense thickets near water, Texas palm groves, riparian woodlands; often in areas with much vegetation litter on ground; breeds April-August		T
Texas Horned Lizard (*Phrynosoma cornutum*) - open arid or semi-arid regions with sparse vegetation; grass, cactus, scattered brush or scrubby trees; burrows into soil, uses rodent burrows, or hides under surface cover		T
Texas scarlet snake (*Cemophora coccinea lineri*) – mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-Sept		T
Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover		T

*** VASCULAR PLANTS ***

Bailey's ballmoss (*Tillandsia baileyi*) – epiphytic on various trees and shrubs; flowering February-May

Green Island echeandia (*Echeandia texensis*) - associated with shrubs or in grassy openings in subtropical thornscrub plant communities on somewhat saline clay on lomas along the Gulf Coast near the mouth of the Rio Grande; known to flower in April, June, and November, and may also flower in other months

Lila de los llanos (*Echeandia chandleri*) - grasslands and openings in subtropical woodlands and brush on clay soils; common in windblown saline clay on lomas near mouth of Rio Grande; flowering (May?) September-December; fruiting October-December

Mexican mud-plantain (*Heteranthera mexicana*) - aquatic; ditches and ponds; flowering June-August

Plains gumweed (*Grindelia oolepis*) – endemic; prairies and grasslands on black clay soils of the Gulf Coastal Bend; may occur along railroad rights-of-way and in urban areas; flowering May-December

Runyon's cory cactus (*Coryphantha macromeris* var. *runyonii*) - endemic; low hills and flats on gravelly soils in Tamaulipan shrub communities along the Rio Grande

Runyon's water willow (*Justicia runyonii*) - calcareous silt loam, silty clay, or clay in openings in subtropical woodlands on active or former floodplains; flowering (July-) September-November		
Shinner's rocket (*Thelypodiopsis shinnersii*) - mostly found along margins of Tamaulipan thornscrub on clay soils of the Rio Grande Delta, including lomas near the mouths of rivers; flowers mostly March and April		
South Texas ambrosia (*Ambrosia cheiranthifolia*) - open prairies and various shrublands on deep clay soils; flowering July-November	LE	E
Star cactus (*Astrophytum asterias*) – gravelly saline clays or loams over the Catahoula and Frio formations, on gentle slopes and flats in grasslands or shrublands; flowering in May	LE	E
Texas ayenia (*Ayenia limitaris*) – woodlands on alluvial deposits on floodplains and terraces along the Rio Grande; flowering throughout the year with sufficient rainfall	LE	E
Vasey's adelia (*Adelia vaseyi*) – subtropical woodlands in Lower Rio Grande Valley; flowering January-June		

Status Key:	
LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	- Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
NL	- Not Federally Listed
E, T	- State Listed Endangered/Threatened
"blank"	- Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

Texas Parks & Wildlife
Annotated County Lists of Rare Special
Updated: July 2009

HIDALGO COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
Black Spotted Newt (*Notophthalmus meridionalis*) - can be found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River		T
Mexican Treefrog (*Smilisca baudinii*) - subtropical region of extreme southern Texas; breeds May-October coinciding with rainfall, eggs laid in temporary rain pools		T
Sheep Frog (*Hypopachus variolosus*) - predominantly grassland and savanna; moist sites in arid areas		T
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
White-lipped Frog (*Leptodactylus labialis*) – grasslands, cultivated fields, roadside ditches, and a wide variety of other habitats; often hides under rocks or in burrows under clumps of grass; species requirements incompatible with widespread habitat alteration and pesticide use in south Texas		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Brownsville Common Yellowthroat (*Geothlypis trichas insperata*) - tall grasses and bushes near ponds, marshes, and swamps; breeding April to July		
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) - riparian trees, brush, palm, and mesquite thickets; during day also roosts in small caves and recesses on slopes of low hills; breeding April to June		T
Common Black Hawk (*Buteogallus anthracinus*) – cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas		T
Gray Hawk (*Asturina nitidus*) - mature woodlands of river valleys and nearby semiarid mesquite and scrub grasslands		T
Hook-billed Kite (*Chondrohierax uncinatus*) – dense tropical and subtropical forests, but does occur in open woodlands; uncommon to rare in most of range; accidental in south Texas		
Interior Least Tern (*Sterna antillarum athalassos*) – nests along sand and gravel bars within braided streams, rivers & some inland lakes	LE	E

Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Northern Beardless-tyrannulet (*Camptostoma imberbe*) - mesquite woodlands; near Rio Grande frequents cottonwood, willow, elm, and great leadtree; breeding April to July		T
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Reddish Egret (*Egretta rufescens*) - resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Rose-throated Becard (*Pachyramphus aglaiae*) – riparian trees, woodlands, open forest, scrub, and mangroves; breeding April to July		T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Southeastern Snowy Plover (*Charadrius alexandrinus tenuirositris*) – wintering migrant along the Texas Gulf coast beaches and bayside mud or salt flats		
Texas Botteri's Sparrow (*Aimophila botterii texana*) - grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses		T
Tropical Parula (*Parula pitiayuma*) - dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July		T
Western Burrowing Owl (*Athene cunicularia hypugaea*) – open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Western Snowy Plover (*Charadrius alexandrinus nivosus*) – uncommon breeder in the Panhandle; potential migrant; winter along coast		
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
Zone-tailed Hawk (*Buteo albonotatus*) - rough, deep, rocky canyons and streamsides in semiarid mesa, hill, and mountain terrain; breeding March to July		T

*** FISHES ***

American Eel (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries

Rio Grande silvery minnow (*Hybognathus amarus*) – extirpated; historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves LE E

River Goby (*Awaous banana*) - clear water with slow to moderate current, sandy or hard bottom, and little or no vegetation; also enters brackish and ocean waters T

*** INSECTS***

A Mayfly (*Campsurus decoloratus*) – Texas and Mexico; possibly clay substrates; mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation

A Royal moth (*Sphingicampa blanchardi*) – woodland–hardwood; Tamaulipan thornscrub with caterpillar's host plant, Texas Ebony (Pitheocellobium flexicaule) an important element

A Tiger beetle (*Tetracha affinis angustata*) – most tiger bettles diurnal, open sandy areas, beaches, open paths or lanes, or on mudflats; larvae in hardpakced ground in vertical burrows

Arroyo darner (*Aeshna dugesi*) – creek, high-moderate gradient; eggs laid in aquatic plants, larvae cling to bottome of pools of streams, adults forage widely in pools in streams, from desert up to pine-oak zone; inverivore, diurnal; larvae overwinter, flight season late June to early Sept.

Los Olmos tiger beetle (*Cicindela nevadica olmosa*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches

Manfreda Giant-skipper (*Stallingsia maculosus*) - most skippers are small and stout-bodied; name derives from fast, erratic flight; at rest most skippers hold front and hind wings at different angles; skipper larvae are smooth, with the head and neck constricted; skipper larvae usually feed inside a leaf shelter and pupate in a cocoon made of leaves fastened together with silk-

Neojuvenile tiger beetle (*Cicindela obsolete neojuvenilis*) – bare or sparsely vegetated, dry, hard-packed soil; typically in previously disturbed areas; peak adult activity in July

Rawson's metalmark Calephelis rawsoni) – most areas in shaded limestone outcrops in central Texas, desert scrub or oak woodland in foothills, or along rivers elsewhere; larval hosts are Eupatorium havanense, E, greggi.

Subtropical blue-black tiger beetle (*Cicindela nigrocoerulea subtropica*) – most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches		
Tamaulipan agapema (*Agapema galbina*) – Tamaulipan thornscrub with adequate densities of the caterpillar foodplant Condalia hookeri hookeri =obovata); adults occur Sep – Oct; eggs hatch with in two weeks of larvae mature 'rapidly'		

*** MAMMALS ***

Cave Myotis Bat (*Myotis velifer*) - roosts colonially in caves, rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Petrochelidon pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore		
Coues' Rice Rat (*Oryzomys couesi*) - cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees around the shoreline are important features; prefers salt and freshwater, as well as grassy areas near water; breeds April-August		T
Ghost-face bat (*Mormoops megalohylla*) – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		
Jaguar (*Panthera onca*) – extirpated; dense chaparral; no reliable Texas sightings since 1952	LE	E
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Mexican Long-tongued Bat (*Choeronycteris mexicana*) - deep canyons where uses caves & mine tunnels as day roosts; also found in buildings & often associated with big-eared bats (*Plecotus* spp.); single Texas record from Santa Ana NWR		
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains spotted skunk (Spilogale putorius interrupta) – catholic, open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tall grass praires		
Southern Yellow Bat (*Lasiurus ega*) - associated with trees, such as palm trees (*Sabal mexicana*) in Brownsville, which provide them with daytime roosts; insectivorous; breeding in late winter		T
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade		T

MOLLUSKS

False Spike Mussel *(Quincuncina mitchelli*) - substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins

Mexican Fawnsfoot *(Truncilla cognata*) - largely unknown; possibly intolerant of impoundment; possibly needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin

Salina Mucket *(Potamilus metnecktayi*) - lotic waters; other habitat requirements are poorly understood; Rio Grande Basin

Texas Hornshell *(Popenaias popeii*) - both ends of narrow shallow runs over bedrock, in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders; not known from impoundments; Rio Grande Basin and several rivers in Mexico C1

*** REPTILES ***

Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite T

Black Striped Snake (*Coniophanes imperialis*) – extreme south Texas; semi-arid coastal plain, warm, moist micro-habitats and sandy soils; proficient burrower; eggs laid April-June T

Indigo Snake (*Drymarchon corais*) - thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter T

Keeled Earless Lizard (*Holbrookia propinqua*) – coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates; lays clutches of 2-7 eggs March-September (most May-August) in soil/underground

Northern Cat-eyed Snake (*Leptodeira septentrionalis septentrionalis*) - Gulf Coastal Plain south of the Nueces River; thorn brush woodland; dense thickets bordering ponds and streams; semi-arboreal; nocturnal T

Speckled Racer (*Drymobius margaritiferus*) - extreme south Texas; dense thickets near water, Texas palm groves, riparian woodlands; often in areas with much vegetation litter on ground; breeds April-August T

Spot-tailed earless lizard (*Holbrookia lacerate*) – central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid undergound

Texas Horned Lizard (*Phrynosoma cornutum*) – open arid or semi-arid regions with sparse vegetation; grass, cactus, scattered brush or scrubby trees; burrows into soil, uses rodent burrows, or hides under surface cover T

Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; shallow depressions at base of bush or cactus or underground burrow or hides under surface cover		T

*** VASCULAR PLANTS ***

Bailey's ballmoss (*Tillandsia baileyi*) - epiphytic on various trees and shrubs; flowering February-May		
Chihuahua balloon-vine (*Cardiospermum dissectum*) - shrublands on gravelly soils along Lower Rio Grande Valley; flowering July-September		
Falfurrias milkvine (*Matelea radiata*) - endemic; known only from one collection from Falfurrias; habitat unknown; flowering (May?) June		
Gregg's wild-buckwheat (*Eriogonum greggii*) – grasslands and brushlands on gypsum-capped hills; flowering in summer?		
Mexican mud-plantain (*Heteranthera mexicana*) – aquatic; ditches and ponds; flowering June-August		
Runyon's cory cactus (*Coryphantha macromeris* var. *runyonii*) - endemic; low hills and flats on gravelly soils in Tamaulipan shrub communities along the Rio Grande		
Runyon's water-willow (*Justicia runyonii*) - calcareous silt loam, silty clay, or clay in openings in subtropical woodlands on active or former floodplains; flowering (July-) September-November		
St. Joseph's staff (*Manfreda longiflora*) - endemic; various soils (clays and loams with various concentrations of salt, caliche, sand, and gravel) in openings or amongst shrubs in thorny shrublands; on Catahoula and Frio formations, and also on Rio Grande floodplain alluvial deposits; flowering in September		
Star cactus (*Astrophytum asterias*) - gravelly saline clays or loams over Catahoula & Frio formations, on gentle slopes & flats in grasslands or shrublands; flowering in May	LE	E
Texas ayenia (*Ayenia limitaris*) - woodlands on alluvial deposits on floodplains and terraces along the Rio Grande; flowering throughout the year with sufficient rainfall	LE	E
Vasey's adelia (*Adelia vaseyi*) - subtropical woodlands in Lower Rio Grande Valley; flowering January-June		
Walker's manioc (*Manihot walkerae*) - periphery of native brush in sandy loam; also on caliche cuestas?; flowering April-September (following rains?)	LE	E

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	- Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
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E, T	- State Listed Endangered/Threatened
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Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

Texas Parks & Wildlife
Annotated County Lists of Rare Species
Updated: July 2009

STARR COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
Black Spotted Newt (*Notophthalmus meridionalis*) - can be found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River		T
Mexican Burrowing Toad (*Rhinophrynus dorsalis*) - roadside ditches, temporary ponds, arroyos, or wherever loose friable soils are present in which to burrow; generally underground emerging only to breed or during rainy periods		T
Mexican Treefrog (*Smilisca baudinii*) – subtropical region of extreme southern Texas; breeds May-October coinciding with rainfall, eggs laid in temporary rain pools		T
Sheep Frog (*Hypopachus variolosus*) – predominantly grassland and savanna; moist sites in arid areas		T
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
White-lipped Frog (*Leptodactylus labialis*) - grasslands, cultivated fields, roadside ditches, and a wide variety of other habitats; often hides under rocks or in burrows under clumps of grass; species requirements incompatible with widespread habitat alteration and pesticide use in south Texas		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Brown Jay (*Cyanocorax morio*) – woodlands and mesquite along the Rio Grande; dense brushy woods, open woods, forest edge, second-growth woodland, clearings, plantation; nests in tree or shrub often far out on limb, usually 7-21 meters about ground		
Brownsville Common Yellowthroat (*Geothlypis trichas insperata*) - tall grasses and bushes near ponds, marshes, and swamps; breeding April to July		
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) - riparian trees, brush, palm, and mesquite thickets; during day also roosts in small caves and recesses on slopes of low hills; breeding April to June		T
Common Black Hawk (*Buteogallus anthracinus*) – cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas		T

Gray Hawk (*Asturina nitidus*) - mature woodlands of river valleys and nearby semiarid mesquite and scrub grasslands		T
Hook-billed Kite (*Chondrohierax uncinatus*) - dense tropical and subtropical forests, but does occur in open woodlands; uncommon to rare in most of range; accidental in south Texas		
Interior Least Tern (*Sterna antillarum athalassos*) – nests along sand and gravel bars within braided streams, rivers & some inland lakes	LE	E
Mexican hooded oriole (*Icterus cucullatus cucullatus*) – scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Northern Beardless-tyrannulet (*Camptostoma imberbe*) - mesquite woodlands; near Rio Grande frequents cottonwood, willow, elm, and great leadtree; breeding April to July		T
Peregrine Falcon (*Falco peregrinus*) - both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (f.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Rose-throated Becard (*Pachyramphus aglaiae*) – riparian trees, woodlands, open forest, scrub, and mangroves; breeding April to July		T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Tropical Parula (*Parula pitiayuma*) – dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July		T
Western Burrowing Owl (*Athene cunicularia hyppugaea*) – open grasslands, especially praire, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
White-tailed Hawk (*Buteo albicaudatus*) - near coast it is found on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March to May		T
Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
Zone-tailed Hawk (*Buteo albonotatus*) - rough, deep, rocky canyons and streamsides in semiarid mesa, hill, and mountain terrain; breeding March to July		T

FISHES

Rio Grande Silvery Minnow (*Hybognathus amarus*) (extirpated) - historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves.	LE	E

*** INSECTS***

A Tiger beetle (*Tetracha affinis angustata*) – most tiger beetles diurnal, open sandy areas, beaches, open paths or lanes, or on mudflats; larvae in hardpacked ground in vertical burrows		
Cazier's Tiger Beetle (*Cicindela cazieri*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches		
Neojuvenile tiger beetle (*Cicindela obsolete neojuvenilis*) – bare or sparsely vegetated, dry, hard-packed soil; typically in previously disturbed areas; peak adult activity in July		

*** MAMMALS ***

Cave myotis bat (*Myotis velifer*) – colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter		
Coues' Rice Rat (*Oryzomys couesi*) – cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees around the shoreline are important features; prefers salt and freshwater, as well as grassy areas near water; breeds April-August		T
Ghost-faced bat (*Mormoops megalophylla*) – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring' single offspring born per year		
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Mexican long-tounged bat (*Choeronycteris Mexicana*) – deep canyons where uses caves and mine tunnels as day roosts; also found in building and often associated with big-eared bats (Plecotus spp.) single Texas record from Santa Ana NWR		
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
White-nosed Coati (*Nasua narica*) – woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground & in trees; omnivorous; may be susceptible to hunting, trapping, & pet trade		T
Yuma Myotis Bat (*Myotis yumanensis*) - desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; single offspring born May-early July		

***** MOLLUSKS *****		
False spike mussel (IQuincuncina mitchelli) – substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe river basins		
Mexican fawnsfoot mussel (*Truncilla cognate*) – largely unknown; possible intolerant of impoundment; possible needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin		
Salina mucket (*Popenaias popeii*) – lotic waters; submerged soft sediment (clay and silt) along river bank; other habitat requirements are poorly understood; Rio Grande basin		
Texas Hornshell (*Popenaias popeii*) – Rio Grande drainage from the Pecos River to the Falcon Breaks	C	
***** REPTILES *****		
Indigo Snake (*Drymarchon corais*) – thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Northern cay-eyed snake (*Leptodeira septentrionalis septentrionalis*) – Gulf Coastal Plain south of the Nueces River; thorn brush woodland; dense thickets bordering ponds and streams; semi-arboreal; nocturnal		T
Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite		T
Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates		
Texas Horned Lizard (*Phrynosoma cornutum*) - open arid or semi-arid regions with sparse vegetation; grass, cactus, scattered brush or scrubby trees; burrows into soil, uses rodent burrows, or hides under surface cover		T
Texas Tortoise (*Gopherus berlandieri*) – open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover		T
***** VASCULAR PLANTS *****		
Ashy dogweed (*Thymophylla tephroleuca*) - endemic; grassland or blackbrush or cenizo shrublands on fine sandy loam soils; flowering February-November	LE	E
Chihuahua balloon-vine (*Cardiospermum dissectum*) - shrublands on gravelly soils along Lower Rio Grande Valley; flowering July-September		
Gregg's wild-buckwheat (*Eriogonum greggii*) - grasslands and brushlands on gypsum-capped hills; flowering in summer?		

Johnston's frankenia (*Frankenia johnstonii*) - shrublands on flats on saline sandy to clayey soils and on rocky gypseous slopes; flowering throughout year depending on rainfall	LE-PDL	E
Kleberg saltbush (*Atriplex klebergorum*) - endemic; sandy to clayey loams, usually saline; often with other halophytes; maturation usually occurs in fall but may vary with rainfall		
Prostrate milkweed (*Asclepias prostrata*) - open bare ground on loose sandy loam, including disturbed areas; flowering March-October		
Runyon's cory cactus (*Coryphantha macromeris* var. *runyonii*) - endemic; low hills and flats on gravelly soils in Tamaulipan shrub communities along the Rio Grande		
Shinner's rocket (*Thelypodiopsis shinnersii*) – most found along margins of Tamaulipan thornscrub on clay soils of the Rio Grande Delta, including lomas near the mouths of rivers: flowers mostly March and April		
St. Joseph's staff (*Manfreda longiflora*) – endemic; various soils (clays and loams with various concentrations of salt, caliche, sand, and gravel) in openings or amongst shrubs in thorny shrublands; on Catahoula and Frio formations, and also on Rio Grande floodplain alluvial deposits; flowering in September		
Star cactus (*Astrophytum asterias*) – gravelly saline clays or loams over the Catahoula and Frio formations, on gentle slopes and flats in grasslands or shrublands; flowering in May	LE	E
Vasey's adelia (*Adelia vaseyi*) – subtropical woodlands in Lower Rio Grande Valley; flowering January-June		
Walker's manioc (*Manihot walkerae*) – periphery of native brush in sandy loam; also on caliche cuestas?; flowering April-September (following rains?)	LE	E
Zapata bladderpod (*Lesquerella thamnophila*) - endemic; blackbrush and/or cenizo shrublands on gravelly to sandy loams derived from Eocene formations; flowering March-April	LE	E

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Texas Parks & Wildlife
Annotated County Lists of Rare Species
Updated: July 2009

WEBB COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Baird's Sparrow (*Ammodramus bairdii*) – shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of state, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties		T
Common Black Hawk (*Buteogallus anthracinus*) - cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas		T
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mexican Hooded Oriole (*Icterus cucullatus cucullatus*) – scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		

Western Burrowing Owl (*Athene cunicularia hypugaea*) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures, such as culverts		
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** FISHES *****		
Blue Sucker (*Cycleptus elongatus*) - usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Headwater catfish (*Ictalurus lupus*) – originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
Rio Grande Darter (*Etheostoma grahami*) – gravel and rubble riffles of creeks and small rivers		T
Rio Grande Shiner (*Notropis jemezanus*) – large, open, weedless rivers or large creeks with bottom of rubble, gravel and sand, often overlain with silt		
Rio Grande Silvery Minnow (*Hybognathus amarus*) (extirpated) - historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves.	LE	E
***** INSECTS *****		
Neojuvenile tiger beetle (*Cicindela obsolete neojuvenilis*) – bare or sparsely vegetated, dry, hard-packed soil; typically in previously disturbed areas; peak adult activity		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T

Cave Myotis Bat (*Myotis velifer*) - roosts colonially in caves, rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Petrochelidon pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore		
Davis Pocket Gopher (*Geomys personatus davisi*) - burrows in sandy soils in southern Texas		
Ghost-faced Bat (*Mormoops megalophylla*) - colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		
Gray Wolf (*Canis lupus*) (extirpated) – formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains spotted skunk (*Spilogale putorius interrupta*) – catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade		T
Yuma Myotis Bat (*Myotis yumanensis*) - desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; single offspring born May-early July		

MOLLUSKS

False Spike Mussel *(Quincuncina mitchelli*) - substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		
Mexican Fawnsfoot *(Truncilla cognata*) - largely unknown; possibly intolerant of impoundment; possibly needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin		
Salina Mucket *(Potamilus metnecktayi*) - lotic waters; other habitat requirements are poorly understood; Rio Grande Basin		
Texas Hornshell *(Popenaias popeii*) - both ends of narrow shallow runs over bedrock, in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders; not known from impoundments; Rio Grande Basin and several rivers in Mexico	C1	

*** REPTILES ***

Indigo Snake (*Drymarchon corais*) - thornbrush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T

Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite		T
Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates		
Texas Horned Lizard (*Phrynosoma cornutum*) - open arid or semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; burrows into soil, uses rodent burrows, or hides under surface cover		T
Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover		T

*** VASCULAR PLANTS ***

Ashy dogweed (*Thymophylla tephroleuca*) - endemic; grassland or blackbrush or cenizo shrublands on fine sandy loam soils; flowering February-November	LE	E
Johnston's frankenia (*Frankenia johnstonii*) - shrublands on flats on saline sandy to clayey soils and on rocky gypseous slopes; flowering throughout year depending on rainfall	LE-PDL	E
Kleberg saltbush (*Atriplex klebergorum*) - endemic; sandy to clayey loams, usually saline; often with other halophytes; maturation usually occurs in fall but may vary with rainfall		
McCart's whitlow-wort (*Paronychia maccartii*) – known only from one type specimen collected in Webb County, March 1962; type location is located three miles south of Mirando City, where substrate is hardpacked red sand, probably of the Cuevitas-Randado association derived from the Goliad formation; flowering in spring		
Nickel's cory cactus (*Coryphantha nickelsiae*) – alluvial gravels (?) or low hills along the Rio Grande; Webb County included in distribution based on 1906 specimen record with "Laredo" as location		

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Texas Parks & Wildlife

Annotated County Lists of Rare Species
Updated: July 2009

MAVERICK COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) – potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Baird's Sparrow (*Ammodramus bairdii*) - shortgrass prairie with scattered low bushes and matted vegetation		
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mexican Hooded Oriole (*Icterus cucullatus cucullatus*) – scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level		
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Western Burrowing Owl (*Athene cunicularia hypugaea*) - open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows and man-made structures, such as culverts		

*** FISHES ***

Blue Sucker (*Cycleptus elongatus*) - usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Headwater catfish (*Ictalurus lupus*) – originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
Proserpine Shiner (*Cyprinella proserpina*) – rocky runs and pools of creeks and small rivers		T
Rio Grande Darter (*Etheostoma grahami*) – gravel and rubble riffles of creeks and small rivers		T
Rio Grande Shiner (*Notropis jemezanus*) – large, open, weedless rivers or large creeks with bottom of rubble, gravel and sand, often overlain with silt		
Rio Grande Silvery Minnow (*Hybognathus amarus*) (extirpated) - historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves.	LE	E

*** INSECTS ***

Neojuvenile tiger beetle (*Cicindela obsolete neojuvenilis*) – bare of sparsely vegetated, dry, hard-packed soil; typically in previously disturbed areas; peak adult activity in July

*** MAMMALS ***

Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Carrizo Springs pocket gopher (*Geomys personatus streckeri*) – underground burrows of deep, sandy soils; feed mostly on vegetation; reproductive data not well known, but likely breed year round, with no more than two litters per year		
Cave Myotis Bat (*Myotis velifer*) - roosts colonially in caves, rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Petrochelidon pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum caves of Panhandle during winter; opportunistic insectivore		
Ghost-faced Bat (*Mormoops megalophylla*) - colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		

Gray Wolf (*Canis lupus*) (extirpated) – formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Margay (*Leopardus weidii*) - neotropical forested areas; rests during the day in trees; forages both in trees and on the ground		T
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade		T
Yuma Myotis Bat (*Myotis yumanensis*) - desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; single offspring born May-early July		
*****MOLLUSKS*****		
False Spike Mussel *(Quincuncina mitchelli)* - substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		
Mexican Fawnsfoot *(Truncilla cognata)* - largely unknown; possibly intolerant of impoundment; possibly needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin		
Salina Mucket *(Potamilus metnecktayi)* - lotic waters; other habitat requirements are poorly understood; Rio Grande Basin		
Texas Hornshell *(Popenaias popeii)* - both ends of narrow shallow runs over bedrock, in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders; not known from impoundments; Rio Grande Basin and several rivers in Mexico	C	
***** REPTILES *****		
Indigo Snake (*Drymarchon corais*) - thornbrush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite		T
Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and Adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates		

Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September T

Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover T

*** VASCULAR PLANTS ***

Silvery wild-mercury (*Argythamnia argyraea*) – among shortgrass on whitish clay soils in shrub-invaded grasslands, particularly over the Yegua Formation; flowering April-June; fruiting until fall

Texas trumpets (*Acleisanthes crassifolia*) – shallow, well-drained, calcareous, gravelly loams over caliche on gentle to moderate slopes, often in sparsely vegetated openings in cenizo (*Leucophyllum frutescens*) shrublands

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Texas Parks & Wildlife
Annotated County Lists of Rare Species
Updated: July 2009

JIM HOGG COUNTY

Species	Federal Status	State Status
***** AMPHIBIANS *****		
Sheep Frog (*Hypopachus variolosus*) – predominantly grassland and savanna; moist sites in arid areas		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more norther breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is alo a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Western Burrowing Owl (*Athene cunicularia hypugaea*) – open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nest and roosts in abandoned burrows		
Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** INSECTS *****		
Cazier's tiger beetle (*Cicindela cazieri*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches		
Leonora's dance damselfly (*Argia leonorae*) - south central and western Texas; small streams and seepages		

Los Olmos Tiger Beetle (*Cicindela nevadica olmosa*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches		
Superb Grasshopper (*Eximacris superbum*) - collected in south Texas, but repeated efforts to collect not successful; may over-winter in adult stage		

*** MAMMALS ***

Cave myotis bat (*Myotis velifer*) – colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Ghost-faced bat (*Mormoops megalophylla*) – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade		T

*** REPTILES ***

Indigo Snake (*Drymarchon corais*) – thornbrush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite		T
Texas Scarlet Snake (*Cemophora coccinea lineri*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates		

Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September T

Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association.; open brush w/grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover T

*** VASCULAR PLANTS ***

Bushy whitlow-wort (*Paronychia congesta*) - endemic; full sun in openings in blackbrush shrublands in shallow soils on xeric caliche or calcareous outcrops on the Bordas Escarpment; flowering April-June and probably sporadically after rains later in season

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Updated: July 2009

ZAPATA COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
Mexican Burrowing Toad (*Rhinophrynus dorsalis*) - roadside ditches, temporary ponds, arroyos, or wherever loose friable soils are present in which to burrow; generally underground emerging only to breed or during rainy periods		T
White-lipped Frog (*Leptodactylus labialis*) - grasslands, cultivated fields, roadside ditches, and a wide variety of other habitats; often hides under rocks or in burrows under clumps of grass; species requirements incompatible with widespread habitat alteration and pesticide use in south Texas		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) – scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Bair's Sparrow (*Ammodramus bairdii*) – shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of state, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties		
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) - riparian trees, brush, palm, and mesquite thickets; during day also roosts in small caves and recesses on slopes of low hills; breeding April to June		T
Common Black Hawk (*Buteogallus anthracinus*) – cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas		T
Gray Hawk (*Asturina nitidus*) - mature woodlands of river valleys and nearby semiarid mesquite and scrub grasslands		T
Hook-billed Kite (*Chondrohierax uncinatus*) - dense tropical and subtropical forests, but does occur in open woodlands; uncommon to rare in most of range; accidental in south Texas		
Interior Least Tern (*Sterna antillarum athalassos*) – nests along sand and gravel bars within braided streams, rivers & some inland lakes	LE	E
Mexican Hooded Oriole (*Icterus cucullatus cucullatus*) – scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Northern Beardless-tyrannulet (*Camptostoma imberbe*) - mesquite woodlands; near Rio Grande frequents cottonwood, willow, elm, and great leadtree; breeding April to July		T

Peregrine Falcon (*Falco peregrinus*) - both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.;. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Western Burrowing Owl (*Athene cunicularia hypugaea*) – open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nest and roosts in abandoned burrows		
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** FISHES *****		
Rio Grande Silvery Minnow (*Hybognathus amarus*) (extirpated) - historically Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradient in mud, sand, or gravel bottom; ingests mud and bottom ooze for algae and other organic matter; probably spawns on silt substrates of quiet coves.	LE	E
***** INSECTS *****		
Neojuvenile tiger beetle (*Cicindela obsolete neojuvenilis*) – bare or sparsely vegetated, dry, hard-packed soil; typically in previously disturbed areas; peak adult activity		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Cave myotis bat (*Myotis velifer*) – colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		

Davis Pocket Gopher (*Geomys personatus davisi*) - burrows in sandy soils in southern Texas		
Ghost-faced bat (*Mormoops megalophylla)* – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		
Jaguarundi (*Herpailurus yaguarondi*) – thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains spotted skunk (*Spilogale putorius interrupta*) – catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground & in trees; omnivorous; may be susceptible to hunting, trapping, & pet trade		T
Yuma myotis bat (*Myotis yumanensis*) – desert regions; most commonly found in lowland habitats near open water, where forages; roosts in caves, abandoned mine tunnels, and buildings; single offspring born May-early July		
*****MOLLUSKS*****		
False Spike Mussel *(Quincuncina mitchelli*) - substrates of cobble and mud, with water lilies present; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		
Mexican Fawnsfoot *(Truncilla cognata*) - largely unknown; possibly intolerant of impoundment; possibly needs flowing streams and rivers with sand or gravel bottoms based on related species needs; Rio Grande basin		
Salina Mucket *(Potamilus metnecktayi*) - lotic waters; other habitat requirements are poorly understood; Rio Grande Basin		
Texas Hornshell *(Popenaias popeii*) - both ends of narrow shallow runs over bedrock, in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders; not known from impoundments; Rio Grande Basin and several rivers in Mexico	C	
***** REPTILES *****		
Indigo Snake (*Drymarchon corais*) - thornbush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Reticulate Collared Lizard (*Crotaphytus reticulatus*) - requires open brush-grasslands; thorn-scrub vegetation, usually on well-drained rolling terrain of shallow gravel, caliche, or sandy soils; often on scattered flat rocks below escarpments or isolated rock outcrops among scattered clumps of prickly pear and mesquite		T

Spot-tailed earless lizard (*Holbrookia lacerate*) – central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas Horned Lizard (*Phrynosoma cornutum*) - open arid or semi-arid regions with sparse vegetation; grass, cactus, scattered brush or scrubby trees; burrows into soil, uses rodent burrows, or hides under surface cover		T
Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association; open brush with grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover		T
***** VASCULAR PLANTS *****		
Ashy dogweed (*Thymophylla tephroleuca*) - endemic; grassland or blackbrush or cenizo shrublands on fine sandy loam soils; flowering February-November	LE	E
Chihuahua balloon-vine (*Cardiospermum dissectum*) - shrublands on gravelly soils along Lower Rio Grande Valley; flowering July-September		
Correll's bluet (*Houstonia correllii*) - sandy soils in openings in mesquite woodlands or thorn shrublands		
Correll's false dragon-head (*Physostegia correllii*) - wet soils including roadside ditches and irrigation channels; flowering June-July		
Johnston's frankenia (*Frankenia johnstonii*) - shrublands on flats on saline sandy to clayey soils and on rocky gypseous slopes; flowering throughout year depending on rainfall	LE-PDL	E
Kleberg saltbush – (*Atriplex klebergorum*) - Texas endemic; usually occurs in sparsely vegetated saline areas, including flats and draws; in light sandy or clayey loam soils with other halophytes; occasionally observed on scraped oil pad sites; observed flowering in late August-early September, but may vary with rainfall, fruits are usually present in fall; because of its annual nature, populations fluctuate widely from year to year		
Prostrate milkweed (*Asclepias prostrata*) - open bare ground on loose sandy loam, including disturbed areas; flowering March-October		
St. Joseph's staff (*Manfreda longiflora*) – thorn shublands on clays and loams with various concentrations of salt, caliche, sand, and gravel; rosettes are often obscured by low shrubs; flowering September-October		
Star cactus (*Astrophytum asterias*) – gravelly saline clays or loams over the Catahoula and Frio formations, on gentle slopes and flats in grasslands or shrublands; flowering in May	LE	E
Zapata bladderpod (*Lesquerella thamnophila*) - endemic; blackbrush and/or cenizo shrublands on gravelly to sandy loams derived from Eocene formations; flowering March-April	LE	E

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WILLACY COUNTY

	Federal Status	State Status
***** AMPHIBIANS *****		
Black Spotted Newt (*Notophthalmus meridionalis*) - can be found in wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods; Gulf Coastal Plain south of the San Antonio River		T
Mexican treefrog (*Smilisca baudinii*) – subtropical region of extreme southern Texas; breeds May-October coinciding with rainfall, eggs laid in temporary rain pools		T
Sheep Frog (*Hypopachus variolosus*) – predominantly grassland and savanna; moist sites in arid areas		T
South Texas Siren - large form (*Siren* sp. 1) - wet or sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods, but does require some moisture to remain; southern Texas south of Balcones Escarpment; breeds February-June		T
***** BIRDS *****		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	T
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	
Audubon's Oriole (*Icterus graduacauda audubonii*) - scrub, mesquite; nests in dense trees, or thickets, usually along water courses		
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks	LE-PDL	E
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) - riparian trees, brush, palm, and mesquite thickets; during day also roosts in small caves and recesses on slopes of low hills; breeding April to June		T
Common Black Hawk (*Buteogallus anthracinus*) - cottonwood-lined rivers and streams; willow tree groves on the lower Rio Grande floodplain; formerly bred in south Texas		T
Eskimo Curlew (*Numenius borealis*) – historic; nonbreeding: grasslands, pastures, plowed fields, and less frequently, marshes and mudflats	LE	E
Mountain Plover (*Charadrius montanus*) – breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Northern Aplomado Falcon (*Falco femoralis septentrionalis*) - open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species	LE	E
Northern Beardless-Tyrannulet (*Camptostoma imberbe*) - mesquite woodlands; near Rio Grande frequents cottonwood, willow, elm, and great		T

leadtree; breeding April to July		
Peregrine Falcon (*Falco peregrinus*) – both subspecies migrate across the state from more northern breeding areas in U.S. and Canada to winter along coast and farther south; subspecies (F.p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level	DL	T
Piping Plover (*Charadrius melodus*) – wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) – resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Rose-throated Becard (*Pachyramphus aglaiae*) – riparian trees, woodlands, open forest, scrub, and mangroves; breeding April to July		T
Sennett's Hooded Oriole (*Icterus cucullatus sennetti*) - often builds nests in and of Spanish moss (*Tillandsia unioides*); feeds on invertebrates, fruit, and nectar; breeds March-August		
Snowy Plover (*Charadrius alexandrinus*) - wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Southeastern Snowy Plover (*Charadrius alexandrinus tenuirostris*) - wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Texas Botteri's Sparrow (*Aimophila botterii texana*) - coastal lowlands & prairies; brush or open grassy land; nests on or near ground, in tall grass or at base of tuft of grass		T
Tropical Parula (*Parula pitiayuma*) - dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July		T
Western Burrowing Owl (*Athene cunicularia hypugaea*) – open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Western Snowy Plover (*Charadrius alexandrinus nivosus*) – uncommon breeder in the Panhandle; potential migrant; winter along coast		
White-faced Ibis (*Plegadis chihi*) – prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk (*Buteo albicaudatus*) - near coast it is found on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March to May		T
Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas;		T

formerly nested in Texas, but no breeding records since 1960

Zone-tailed Hawk (*Buteo albonotatus*) – arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small tress in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions — T

*** BIRDS-RELATED ***

Colonial waterbird nesting areas - many rookeries active annually

*** FISHES ***

American Eel (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries

Opossum Pipefish (*Microphis brachyurus*) - brooding adults found in fresh or low salinity waters and young move or are carried into more saline waters after birth — T

Smalltooth sawfish (*Pristis pectinata*) – different life history stages have different patterns of habitat use; young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, seagrass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on variety of fish species and crustaceans — LE E

*** INSECTS ***

A tiger beetle (*Tetracha affinis angustata*) – most tiger beetles diurnal, open sandy areas, beaches, open paths or lanes, or on mudflats; larvae in hard-packed ground in vertical burrows

Los Olmos Tiger Beetle (*Cicindela nevadica olmosa*) - most tiger beetles are active, usually brightly colored, and found in open, sunny areas; adult tiger beetles are predaceous and feed on a variety of small insects; larvae of tiger beetles are also predaceous and live in vertical burrows in soil of dry paths, fields, or sandy beaches

Rawson's metalmark (*Calephelis rawsoni*) – moist areas in shaded limestone outcrops in central Texas, desert scrub or oak woodland in foothills, or along rivers elsewhere; larval hosts are Eupatorum havanense, E. greggi.

Superb Grasshopper (*Eximacris superbum*) - collected in south Texas, but repeated efforts to collect not successful; may over-winter in adult stage

*** MAMMALS ***

Coues' Rice Rat (*Oryzomys couesi*) - cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees around the shoreline are — T

important features; prefers salt and freshwater, as well as grassy areas near water; breeds April-August		
Ghost-faced bat (*Mormoops megalophylla*) – colonially roosts in caves, crevices, abandoned mines, and buildings; insectivorous; breeds late winter-early spring; single offspring born per year		
Jaguar (*Panthera onca*) (extirpated) – dense chaparral; no reliable sightings in Texas since 1952	LE	E
Jaguarundi (*Herpailurus yaguarondi*) - thick brushlands, near water favored; six month gestation, young born twice per year in March and August	LE	E
Maritime Pocket Gopher (*Geomys personatus maritimus*) - fossorial, in deep sandy soils; feeds mostly from within burrow on roots & other plant parts, especially grasses; ecologically important as prey species & in influencing soils, microtopography, habitat heterogeneity, and plant diversity		
Ocelot (*Leopardus pardalis*) - dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Southern Yellow Bat (*Lasiurus ega*) – associated with trees, such as palm trees (*Sabal mexicana*) in Brownsville, which provide them with daytime roosts; insectivorous; breeding in late winter		T
West Indian Manatee (*Trichechus manatus*) – Gulf and bay system; opportunistic, aquatic herbivore	LE	E
White-nosed Coati (*Nasua narica*) - woodlands, riparian corridors and canyons; most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade		T

*** REPTILES ***

Atlantic Hawksbill Sea Turtle (*Eretmochelys imbricata*) - Gulf and bay system	LE	E
Black-striped Snake (*Coniophanes imperialis*) - extreme south Texas; semi-arid coastal plain, warm, moist micro-habitats and sandy soils; proficient burrower; eggs laid April-June		T
Green Sea Turtle (*Chelonia mydas*) – Gulf and bay system	LT	T
Indigo Snake (*Drymarchon corais*) – thornbrush-chaparral woodlands of south Texas, in particular dense riparian corridors; can do well in suburban and irrigated croplands if not molested or indirectly poisoned; requires moist microhabitats, such as rodent burrows, for shelter		T
Keeled Earless Lizard (*Holbrookia propinqua*) - coastal dunes, barrier islands, and other sandy areas; eats insects and likely other small invertebrates; lays clutches of 2-7 eggs March-September (most May-August) in soil/underground		
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) - Gulf and bay system	LE	E
Leatherback Sea Turtle (*Dermochelys coriacea*) - Gulf and bay system	LE	E
Loggerhead Sea Turtle (*Caretta caretta*) - Gulf and bay system	LT	T

Northern Cat-eyed Snake (*Leptodeira septentrionalis septentrionalis*) - Gulf Coastal Plain south of the Nueces River; thorn brush woodland; dense thickets bordering ponds and streams; semi-arboreal; nocturnal; active, alert, rear-fanged, mildly venomous, but harmless to humans — T

Speckled racer (*Drymobius margaritiferus*) – extreme south Texas; dense thickets near water, Texas palm groves, riparian woodlands; often in areas with much vegetation litter on ground; breeds April-August

Spot-tailed Earless Lizard (*Holbrookia lacerata*) - central & southern Texas and Adjacent Mexico; oak-juniper woodlands & mesquite-prickly pear associations; eggs laid underground; eats small invertebrates

Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September — T

Texas scarlet snake (*Cemophora coccinea lineri*) – mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September

Texas Tortoise (*Gopherus berlandieri*) - open scrub woods, arid brush, lomas, grass-cactus association.; open brush w/grass understory preferred; uses shallow depressions at base of bush or cactus or underground burrow or hides under surface cover — T

*** VASCULAR PLANTS ***

Bailey's ballmoss (*Tillandsia baileyi*) - epiphytic on various trees and shrubs; flowering February-May

Runyon's water willow (*Justicia runyonii*) - calcareous silt loam, silty clay, or clay in openings in subtropical woodlands on active or former floodplains; flowering (July-) September-November

Short-fruited spikesedge (*Eleocharis brachycarpa*) – south coastal Texas (exact collection locality unknown); preferred habitat unknown, but presumably wet; collected (with mature achenes ?) in April

Texas ayenia (*Ayenia limitaris*) - woodlands on alluvial deposits on floodplains and terraces along the Rio Grande; flowering throughout the year with sufficient rainfall — LE — E

Vasey's adelia (*Adelia vaseyi*) - subtropical woodlands in Lower Rio Grande Valley; flowering January-June

Status Key:	
LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	-Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
NL	- Not Federally Listed
E, T	- State Listed Endangered/Threatened
"blank"	- Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

ATTACHMENT 1-2

RESOLUTION TO JAMES MATZ

RESOLUTION IN MEMORY OF JAMES R. MATZ

2010-01

WHEREAS, James R. Matz was a charter voting member of the Rio Grande Regional Water Planning Group (RGRWPG); and,

WHEREAS, James R. Matz loyally dedicated himself to the betterment of the Rio Grande Valley; and,

WHEREAS, at the time of his death James R. Matz was Chair of the Valley Proud Environmental Council, was a member of: the RGRWPG; Friends of the Wildlife Corridor; Arroyo Colorado Audubon Society; National Wildlife Federation; National Audubon Society; Native Plant Project; Ocean Conservancy; Nature Conservancy; Valley Land Fund; World Wildlife Fund; Keep Texas Beautiful; National Arbor Day Foundation; and the Wildlife Trust; and,

WHEREAS, James R. Matz also served two terms on the Harlingen City Commission, was a two term Cameron County Commissioner and a two term Mayor of the City of Palm Valley; and,

WHEREAS, during his tenure as a voting member of the RGRWPG he fully dedicated himself to the RGRWPG's efforts to meet the challenges of ensuring an adequate water supply for the Rio Grande Valley and the entire RGRWPG eight (8) County Region; and,

WHEREAS, the RGRWPG is indebted to James R. Matz for his outstanding service which has resulted in substantial benefits and contributions to the constituents of the RGRWPG Region; and,

NOW, THEREFORE, BE IT RESOLVED by the Rio Grande Regional Water Planning Group that the RGRWPG endorses and ratifies the presentation of this resolution celebrating the life and recognizing the myriad contributions of James R. Matz.

CONSIDERED, PASSED and APPROVED this 14th day of January, 2010 at a regular meeting of the Rio Grande Regional Water Planning Group.

Glenn Jarvis, Chairman

ATTACHMENT 1-3

RESOLUTION TO CHARLES BROWNING, JR.

RESOLUTION

IN MEMORY OF CHARLES BROWNING, JR.

2010-02

WHEREAS, Charles W. "Chuck" Browning, Jr. was a charter voting member of the Rio Grande Regional Water Planning Group (RGRWPG); and,

WHEREAS, "Chuck" Browning continually dedicated himself to the betterment of the Rio Grande Valley as well as the eight (8) counties comprising the RGRWPG; and,

WHEREAS, at the time of his death "Chuck" Browning was Manager of North Alamo Water Supply Corporation, Committee Member of the Rio Grande Regional Water Authority (RGRWA), the Rio Grande Valley Partnership, the Lower Rio Grande Valley Water Committee, The Rio Grande Regional Water Planning Group (Region M) as voting member and Vice Chair, and member on the South Texas Water Utilities Manager Association; and,

WHEREAS, during his tenure as a voting member of the Rio Grande Regional Water Planning Group, dedicated himself to the RGRWPG's efforts in meeting the challenge that an adequate water supply was available for the entire RGRWPG eight (8) County Region; and,

WHEREAS, the RGRWPG is truly indebted to Charles William "Chuck" Browning, Jr. for his outstanding service which resulted in substantial benefits and contributions to the constituents of the RGRWPG Region.

NOW, THEREFORE, BE IT RESOLVED by the Rio Grande Regional Water Planning Group that the RGRWPG endorses and ratifies the presentation of this resolution celebrating the life and recognizing the countless contributions of Charles William "Chuck" Browning, Jr.

CONSIDERED, PASSED and APPROVED this 2nd day of June, 2010 at a regular meeting of the Rio Grande Regional Water Planning Group.

Glenn Jarvis, Chairman

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CHAPTER 2.0 : CURRENT AND PROJECTED POPULATION & WATER DEMAND FOR THE RIO GRANDE REGION

The primary goal in preparing the Rio Grande Regional Water Plan is to estimate current and future water demands within the region. In the following chapters, water demand projections are compared with estimates of currently available water supplies to identify the location, extent, and timing of any future water shortages or surpluses. Texas Water Development Board (TWDB) rules (§357.7, Texas Administrative Code) require that the results of the analyses of current and projected population and water demands be reported by city, by county, by river basin, and by categories such as irrigation, mining, manufacturing, municipal, livestock, and steam electric. Exhibit B (1.1.2) provides updated guidelines:

> *"The development of new population and water demand projections will be the most relevant feature of the first phase of this next round of planning. TWDB staff will prepare draft population and water demand projections for all the regions and their water user groups."*

TWDB staff projections were approved by the board for use in regional water plans. These projections are the main reference tools for this chapter dealing specifically with population growth and associated water demands.

Table 2.1 summarizes the Rio Grande Regional Water Planning Area's projected population and expected water demand through the year 2060, delineated by category of use. All tables and graphs are based on data provided by TWDB.

As specified in Section 357.7 (d)(2), Title 31 of the TAC, entities wishing to revise population or demand projections address their requests through their respective regional water planning group. If a planning group concurs, they submit requests to the Executive Administrator of the TWDB. TWDB staff coordinates reviews of each request with the TCEQ, Texas Parks and Wildlife Department, and the Texas Department of Agriculture. Designated representatives from each agency must approve each revision. The TWDB's governing board (Board) is responsible for approving and adopting final population and water demand projections.

Requests to the Board should be submitted to the Executive Administrator in the form of memorandums from planning groups describing: 1) what they wish to revise and how revisions compare to Board-adopted 2006 projections for each decade of the planning horizon, and 2) language clearly describing the justification and methodology for developing revised projections. Memorandums should be accompanied by spreadsheets comparing requested revisions to Board-adopted 2006 estimates. Spreadsheets should be forwarded electronically to Connie Townsend.

Table 2.1: Population and Water Demand Projections Summary for the Rio Grande Regional Water Planning Area (RGRWPA)

Regional Total Projection	D2010	D2020	D2030	D2040	D2050	D2060
Population	1,628,278	2,030,994	2,470,814	2,936,748	3,433,188	3,935,223
Irrigation (AF/YR)	1,163,634	1,082,232	981,748	981,748	981,748	981,748
Livestock (AF/YR)	5,817	5,817	5,817	5,817	5,817	5,817
Manufacturing (AF/YR)	7,509	8,274	8,966	9,654	10,256	11,059
Mining (AF/YR)	4,186	4,341	4,433	4,523	4,612	4,692
Municipal (AF/YR)	288,323	349,410	416,396	487,858	565,475	646,006
Steam Electric (AF/YR)	13,463	16,864	19,716	23,192	27,430	32,598
Total Water Demand (AF/YR)	1,482,932	1,466,938	1,437,076	1,512,792	1,595,338	1,681,920

The regional water plan projects the Rio Grande Region's population to more than triple over the next 50 years, increasing from approximately 1.62 million people at present to 3.94 million by 2060. This dramatic growth is the principal factor underlying projected increases in municipal, manufacturing, and steam electric water demands. However, in terms of total demand within this region, projected increases in urban water demands are slightly offset by projected *decreases* in irrigation water demand. The result is a projected approximate *increase* of 14 percent in total water demand over the 50-year planning period.

The following sections of this chapter describe the methodology used to develop these projections. This chapter also presents projections of population and water demand for cities, for major providers of municipal and manufacturing water, and for categories of water use including municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock. Projected demands are also provided for each of the two river basins and the one coastal basin partially located within this region.

2.1 TWDB GUIDELINES FOR REVISIONS TO POPULATION AND WATER DEMAND PROJECTIONS

To have a better standard of guidelines for calculating accurate population and water demand projections, a second round of planning was conducted, resulting in development of Exhibit B – a new set of guidelines adopted by the TWDB in accordance with all provisions of 31 Texas Administrative Code (TAC) Chapter 357. Provisions set forth in the TAC or TWDB agency rules take precedence over guidelines set forth in Exhibit B. Exhibit B Section 4.2 explains the process:

"Population and water demand projections for 2010 through 2060 for the state, counties, cities, and county-other (including utility sub-components) will be reviewed through a process coordinated by the Executive Administrator of the TWDB with the Planning Groups, TNRCC [now TCEQ], TDA, and the TPWD.

New population projections, using a standard cohort-component procedure, will be developed using the 2000 Census and other pertinent sources.

Projections will be developed first at the county level; then the projections will be allocated to municipal and county-other water user groups."

TWDB met regularly with representatives of the various parties involved to achieve consensus. The projections were extensively evaluated before reaching final draft stage. Then, after lengthy analysis of population and water demand projections, TWDB approved these projections.

2.2 POPULATION PROJECTIONS

Population and water demand revisions incorporated up-to-date information. This section contains information on the planning group's methodology – a four-step process based on TWDB guidelines.

The first step was to project the living population at the beginning of the year who are expected to survive to the target year. The second step was to determine approximate net migration of this population; net migration rates were multiplied by adjusted population figures in the launch year. The third step was to project the number of births and net impact of mortality and migration on the youngest age group. The fourth step was to combine results from the mortality, migration, and fertility modules. This methodology is further explained in SB1 and Exhibit B. Race and gender were considered in calculating these projections.

Population is the main factor in calculating total municipal water demand, including residential and commercial uses, and these data were then used to calculate each city's base per capita water use. Overall, municipal water demand projections are the product of three variables: current and projected population, per capita water use, and assumptions about the effects of certain water conservation measures. Therefore, future water savings resulting from installation of more water-efficient fixtures (according to the 1991 State Water-Efficient Plumbing Act) were also a consideration.

Population of the eight counties comprising the Rio Grande Regional Water Planning Area is projected to grow at an average rate of nearly 2 percent annually over the 50-year planning period. This suggests an increase from approximately 1.62 million residents in 2010 to over 3.93 million in 2060. Table 2.2 presents these projections, by county, for each decade of the planning period. Cameron and Hidalgo Counties lead with the highest total populations, while Webb County is forecast to experience the greatest proportionate annual increase for the region.

2.2.1 Revisions to Population Projections

The revisions that Region M made to their originally-requested population projections used the TWDB's recommended regional totals as guidance. The State Data Center (SDC) identified 23 cities within Region M that were growing faster than their anticipated growth rate from the 2006 State Water Plan (SWP).

The TWDB recommended using a 3% population increase above the 2006 SWP through each decade. Therefore, SDC projections could not be used for the 23 cities due to an overall regional increase of 5%. However, the SDC projections could be used if the expected population growth for the 23 cities was offset with a reduction in population in County-other. This option was deemed unacceptable by the Region M Board.

Using a maximum regional population increase of 3% above the 2006 SWP, the population growth for each city identified by the SDC as having grown faster than projected was reduced by 38%. For instance, the SDC indicated that the City of Brownsville's anticipated population in 2010 was 6% greater than identified in the 2006 SWP. In order to meet the maximum increase as identified by the TWDB (3% of the regional total) while at the same time not decreasing the County-other population, the City of Brownsville was projected to have a 3.7% population increase over the 2006 SWP. This same methodology was recreated for each of the 23 cities identified by the SDC.

The five counties that were then affected by the increases were Cameron, Hidalgo, Willacy, Starr, and Maverick.

Figure 2.1: RGRWPA Population Projections (by decade)

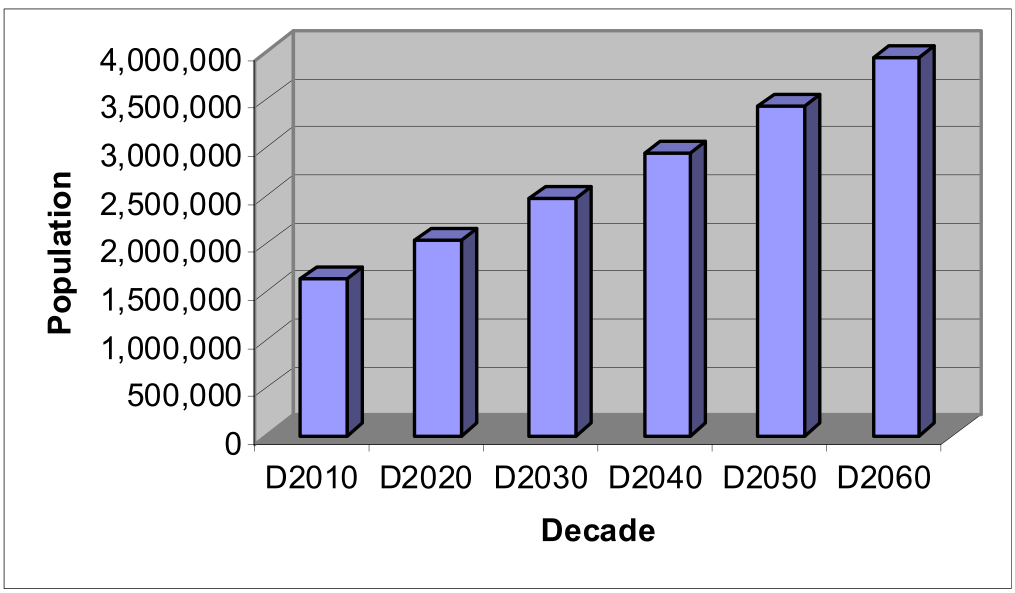
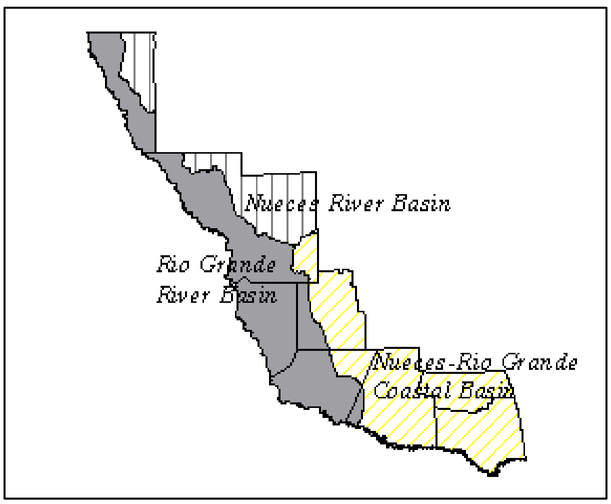


Table 2.2: RGRWPA Population - Projections by County

County Name	2010	2020	2030	2040	2050	2060
CAMERON	424,762	510,697	599,672	688,532	777,607	862,511
HIDALGO	775,858	987,920	1,225,227	1,481,812	1,761,811	2,048,909
JIM HOGG	5,593	5,985	6,286	6,538	6,468	6,225
MAVERICK	58,252	67,929	77,165	85,292	92,831	99,091
STARR	69,379	83,583	98,262	113,102	127,802	141,961
WEBB	257,647	333,451	418,332	511,710	613,774	721,586
WILLACY	22,763	25,212	27,455	29,276	30,542	31,205
ZAPATA	14,025	16,217	18,415	20,486	22,354	23,733
Totals	**1,628,279**	**2,030,994**	**2,470,814**	**2,936,748**	**3,433,188**	**3,935,223**

Figure 2.2: River Basins in the RGRWPA[1]



[1] As discussed in Chapter 1, the Rio Grande Regional Water Planning Area covers a portion of the Nueces and Rio Grande River Basins, as well as a portion of the Nueces Rio Grande Coastal Basin.

Table 2.3: Population Projections for Cameron County by River Basin

POPULATIONS PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
CAMERON	NUECES-RIO GRANDE	BROWNSVILLE	179,054	216,587	255,477	294,353	333,360	370,578
CAMERON	NUECES-RIO GRANDE	COMBES	3,089	3,655	4,240	4,823	5,407	5,962
CAMERON	NUECES-RIO GRANDE	COUNTY-OTHER	45,008	51,569	58,351	65,113	71,876	78,307
CAMERON	NUECES-RIO GRANDE	EAST RIO HONDO WSC	19,904	26,420	33,155	39,869	46,585	52,973
CAMERON	NUECES-RIO GRANDE	EL JARDIN	10,798	13,445	16,182	18,910	21,639	24,234
CAMERON	NUECES-RIO GRANDE	HARLINGEN	69,214	79,581	90,333	101,090	111,896	122,218
CAMERON	NUECES-RIO GRANDE	INDIAN LAKE	699	866	1,039	1,211	1,383	1,547
CAMERON	NUECES-RIO GRANDE	LA FERIA	7,954	9,898	11,908	13,912	15,916	17,822
CAMERON	NUECES-RIO GRANDE	LAGUNA MADRE WD	7,725	11,408	15,215	19,010	22,806	26,416
CAMERON	NUECES-RIO GRANDE	LAGUNA VISTA	2,651	3,314	4,008	4,705	5,413	6,094
CAMERON	NUECES-RIO GRANDE	LOS FRESNOS	6,649	8,908	11,243	13,571	15,899	18,114
CAMERON	NUECES-RIO GRANDE	LOS INDIOS	1,418	1,703	1,997	2,290	2,583	2,862
CAMERON	NUECES-RIO GRANDE	MILITARY HIGHWAY WSC	11,278	13,862	16,533	19,196	21,860	24,393
CAMERON	NUECES-RIO GRANDE	OLMITO WSC	7,261	10,203	13,244	16,275	19,307	22,191
CAMERON	NUECES-RIO GRANDE	PALM VALLEY	1,400	1,400	1,400	1,400	1,400	1,400
CAMERON	NUECES-RIO GRANDE	PALM VALLEY ESTATES UD	344	444	547	650	753	851
CAMERON	NUECES-RIO GRANDE	PORT ISABEL	5,282	5,723	6,179	6,633	7,088	7,520
CAMERON	NUECES-RIO GRANDE	PRIMERA	3,973	4,871	5,806	6,748	7,699	8,613
CAMERON	NUECES-RIO GRANDE	RANCHO VIEJO	2,300	2,350	2,400	2,450	2,500	2,550
CAMERON	NUECES-RIO GRANDE	RIO HONDO	2,223	2,419	2,623	2,829	3,037	3,238
CAMERON	NUECES-RIO GRANDE	SAN BENITO	26,922	30,599	34,400	38,189	41,979	45,584
CAMERON	NUECES-RIO GRANDE	SANTA ROSA	3,472	4,148	4,847	5,543	6,240	6,903
CAMERON	NUECES-RIO GRANDE	SOUTH PADRE ISLAND	3,203	4,028	4,881	5,732	6,583	7,392
CAMERON	NUECES-RIO GRANDE	VALLEY MUD #2	1,066	1,066	1,066	1,066	1,066	1,066
CAMERON	**NUECES-RIO GRANDE**	**TOTAL**	**422,887**	**508,467**	**597,074**	**685,568**	**774,275**	**858,828**
CAMERON	RIO GRANDE	BROWNSVILLE	1,390	1,681	1,983	2,284	2,587	2,875
CAMERON	RIO GRANDE	COUNTY-OTHER	82	94	106	118	130	142
CAMERON	RIO GRANDE	EL JARDIN	61	76	92	107	122	137
CAMERON	RIO GRANDE	MILITARY HIGHWAY WSC	162	199	237	275	313	349
CAMERON	RIO GRANDE	VALLEY MUD #2	180	180	180	180	180	180
CAMERON	**RIO GRANDE**	**TOTAL**	**1,875**	**2,230**	**2,598**	**2,964**	**3,332**	**3,683**
CAMERON	**BASIN TOTALS**		**424,762**	**510,697**	**599,672**	**688,532**	**777,607**	**862,511**

Table 2.4: Population Projections for Hidalgo County by River Basin

POPULATION PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
HIDALGO	NUECES-RIO GRANDE	ALAMO	20,915	28,107	36,163	44,880	54,400	64,166
HIDALGO	NUECES-RIO GRANDE	ALTON	12,342	15,513	19,064	22,907	27,104	31,411
HIDALGO	NUECES-RIO GRANDE	COUNTY-OTHER	75,813	102,960	133,363	166,259	202,193	239,056
HIDALGO	NUECES-RIO GRANDE	DONNA	17,830	20,419	23,311	26,435	29,839	33,325
HIDALGO	NUECES-RIO GRANDE	EDCOUCH	4,076	4,659	5,311	6,013	6,778	7,562
HIDALGO	NUECES-RIO GRANDE	EDINBURG	71,940	92,789	116,092	141,263	168,699	196,813
HIDALGO	NUECES-RIO GRANDE	ELSA	6,267	6,710	7,204	7,736	8,313	8,904
HIDALGO	NUECES-RIO GRANDE	HIDALGO	11,215	15,599	20,507	25,814	31,606	37,546
HIDALGO	NUECES-RIO GRANDE	HIDALGO COUNTY MUD #1	5,280	7,476	9,936	12,598	15,505	18,487
HIDALGO	NUECES-RIO GRANDE	LA JOYA	3,030	3,631	4,302	5,027	5,817	6,625
HIDALGO	NUECES-RIO GRANDE	LA VILLA	1,361	1,374	1,389	1,405	1,422	1,439
HIDALGO	NUECES-RIO GRANDE	MCALLEN	132,249	158,025	186,864	218,039	252,051	286,921
HIDALGO	NUECES-RIO GRANDE	MERCEDES	15,775	17,129	18,636	20,260	22,023	23,827
HIDALGO	NUECES-RIO GRANDE	MILITARY HIGHWAY WSC	10,261	12,048	14,050	16,216	18,582	21,009
HIDALGO	NUECES-RIO GRANDE	MISSION	68,351	88,532	111,086	135,447	161,998	189,204
HIDALGO	NUECES-RIO GRANDE	NORTH ALAMO WSC	114,538	153,770	197,713	245,263	297,197	350,473
HIDALGO	NUECES-RIO GRANDE	PALMHURST	9,144	14,136	19,727	25,777	32,384	39,162
HIDALGO	NUECES-RIO GRANDE	PALMVIEW	6,258	8,771	11,586	14,632	17,959	21,372
HIDALGO	NUECES-RIO GRANDE	PENITAS	1,261	1,316	1,376	1,441	1,511	1,584
HIDALGO	NUECES-RIO GRANDE	PHARR	65,969	82,640	101,269	121,386	143,309	165,772
HIDALGO	NUECES-RIO GRANDE	PROGRESO	6,348	8,097	10,056	12,176	14,491	16,866
HIDALGO	NUECES-RIO GRANDE	SAN JUAN	39,074	54,082	70,892	89,081	108,947	129,327
HIDALGO	NUECES-RIO GRANDE	SHARYLAND WSC	31,885	36,438	41,538	47,057	53,085	59,268
HIDALGO	NUECES-RIO GRANDE	WESLACO	32,862	37,961	43,658	49,811	56,516	63,385
HIDALGO	**NUECES-RIO GRANDE**	**TOTAL**	**764,044**	**972,182**	**1,205,093**	**1,456,923**	**1,731,729**	**2,013,504**
HIDALGO	RIO GRANDE	COUNTY-OTHER	4,422	6,104	7,988	10,026	12,252	14,536
HIDALGO	RIO GRANDE	HIDALGO	460	641	843	1,061	1,299	1,543
HIDALGO	RIO GRANDE	LA JOYA	1,282	1,536	1,820	2,127	2,461	2,803
HIDALGO	RIO GRANDE	MCALLEN	18	21	25	29	33	38
HIDALGO	RIO GRANDE	MILITARY HIGHWAY WSC	103	121	141	163	187	211
HIDALGO	RIO GRANDE	SULLIVAN CITY	5,528	7,315	9,317	11,483	13,849	16,276
HIDALGO	**RIO GRANDE**	**TOTAL**	**11,813**	**15,738**	**20,134**	**24,889**	**30,081**	**35,407**
HIDALGO	**BASIN TOTALS**		**769,572**	**979,497**	**1,214,410**	**1,468,406**	**1,745,578**	**2,029,780**

Table 2.5 Population Projections for Jim Hogg County by River Basin

POPULATION PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
JIM HOGG	NUECES-RIO GRANDE	COUNTY-OTHER	744	796	837	870	861	829
JIM HOGG	NUECES-RIO GRANDE	HEBBRONVILLE	4764	5098	5354	5569	5509	5302
JIM HOGG	**NUECES-RIO GRANDE**	**TOTAL**	**5,508**	**5,894**	**6,191**	**6,439**	**6,370**	**6,131**
JIM HOGG	RIO GRANDE	COUNTY-OTHER	85	91	95	99	98	94
JIM HOGG	**RIO GRANDE**	**TOTAL**	**85**	**91**	**95**	**99**	**98**	**94**
JIM HOGG	**BASIN TOTALS**		**5,593**	**5,985**	**6,286**	**6,538**	**6,468**	**6,225**

Table 2.6 Population Projections for Maverick County by River Basin

POPULATION PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
MAVERICK	NUECES	COUNTY-OTHER	48	59	69	78	86	92
MAVERICK	**NUECES**	**TOTAL**	**48**	**59**	**69**	**78**	**86**	**92**
MAVERICK	RIO GRANDE	COUNTY-OTHER	25,050	30,803	36,243	40,958	45,272	48,772
MAVERICK	RIO GRANDE	EAGLE PASS	26,160	28,212	30,238	32,116	33,937	35,559
MAVERICK	RIO GRANDE	EL INDIO WSC	6,994	8,855	10,615	12,140	13,536	14,668
MAVERICK	**RIO GRANDE**	**TOTAL**	**58,204**	**67,870**	**77,096**	**85,214**	**92,745**	**98,999**
MAVERICK	**BASIN TOTAL**		**58,252**	**67,929**	**77,165**	**85,292**	**92,831**	**99,091**

Table 2.7 Population Projections for Starr County By River Basin

POPULATION PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
STARR	NUECES-RIO GRANDE	COUNTY-OTHER	1,470	1,846	2,234	2,624	3,009	3,378
STARR	**NUECES-RIO GRANDE**	**TOTAL**	**1,470**	**1,846**	**2,234**	**2,624**	**3,009**	**3,378**
STARR	RIO GRANDE	COUNTY-OTHER	36,356	45,658	55,237	64,893	74,409	83,541
STARR	RIO GRANDE	LA GRULLA	1,640	1,746	1,862	1,985	2,116	2,249
STARR	RIO GRANDE	RIO GRANDE CITY	14,982	16,674	18,447	20,259	22,090	23,878
STARR	RIO GRANDE	RIO WSC	2,942	3,868	4,821	5,782	6,729	7,638
STARR	RIO GRANDE	ROMA CITY	11,989	13,791	15,661	17,559	19,449	21,277
STARR	**RIO GRANDE**	**TOTAL**	**67,909**	**81,737**	**96,028**	**110,478**	**124,793**	**138,583**
STARR	**BASIN TOTAL**		**69,379**	**83,583**	**98,262**	**113,102**	**127,802**	**141,961**

Table 2.8 Population Projections for Webb County by River Basin

POPULATION PROJECTIONS								
COUNTY	RIVER BASIN	WATER USER GROUP	2010	2020	2030	2040	2050	2060
WEBB	NUECES	COUNTY-OTHER	751	873	1,010	1,159	1,323	1,496
WEBB	**NUECES**	**TOTAL**	**751**	**873**	**1,010**	**1,159**	**1,323**	**1,496**
WEBB	NUECES-RIO GRANDE	COUNTY-OTHER	1,123	1,306	1,510	1,735	1,981	2,241
WEBB	**NUECES-RIO GRANDE**	**TOTAL**	**1,123**	**1,306**	**1,510**	**1,735**	**1,981**	**2,241**
WEBB	RIO GRANDE	COUNTY-OTHER	5,777	6,716	7,767	8,923	10,187	11,522
WEBB	RIO GRANDE	EL CENIZO	5,929	8,729	11,865	15,315	19,085	23,068
WEBB	RIO GRANDE	LAREDO	234,423	302,377	378,468	462,176	553,670	650,317
WEBB	RIO GRANDE	RIO BRAVO	8,318	11,566	15,203	19,205	23,579	28,199
WEBB	RIO GRANDE	WEBB COUNTY WATER U	1,326	1,884	2,509	3,197	3,949	4,743
WEBB	**RIO GRANDE**	**TOTAL**	**255,773**	**331,272**	**415,812**	**508,816**	**610,470**	**717,849**
WEBB	**BASIN TOTAL**		**257,647**	**333,451**	**418,332**	**511,710**	**613,774**	**721,586**

Table 2.9 Population Projections for Willacy County by River Basin

POPULATION PROJECTIONS								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
WILLACY	NUECES-RIO GRANDE	COUNTY-OTHER	385	385	385	385	385	384
WILLACY	NUECES-RIO GRANDE	LYFORD	2,335	2,512	2,684	2,839	2,972	3,076
WILLACY	NUECES-RIO GRANDE	NORTH ALAMO WSC	7,187	8,649	9,981	11,052	11,781	12,141
WILLACY	NUECES-RIO GRANDE	RAYMONDVILLE	10,071	10,402	10,704	10,947	11,112	11,194
WILLACY	NUECES-RIO GRANDE	SAN PERLITA	747	812	871	919	952	968
WILLACY	NUECES-RIO GRANDE	SEBASTIAN MUD	2,038	2,452	2,830	3,134	3,340	3,442
WILLACY	**BASIN TOTAL**		**22,763**	**25,212**	**27,455**	**29,276**	**30,542**	**31,205**

Table 2.10 Population Projections for Zapata County by River Basin

POPULATION PROJECTIONS								
COUNTY	RIVER BASIN	WATER USER GROUP	2010	2020	2030	2040	2050	2060
ZAPATA	NUECES-RIO GRANDE	COUNTY-OTHER	9,169	11,361	13,559	15,630	17,498	18,877
ZAPATA	NUECES-RIO GRANDE	ZAPATA	4,856	4,856	4,856	4,856	4,856	4,856
ZAPATA	**BASIN TOTAL**		**14,025**	**16,217**	**18,415**	**20,486**	**22,354**	**23,733**

2.3 WATER DEMAND PROJECTIONS

Total annual water demand for the Rio Grande Regional Water Planning Area is projected to *increase* until 2010, then *decrease* until 2030, and then steadily *increase* until 2060. This trend is attributable to diminishing irrigated acreage and rising urban populations, especially in the Rio Grande Valley, as land use changes from agriculture to urbanization (see Figure 2.3).

Consequently, over time, total water demand for irrigation in the region is projected to fall from the current 82.9 percent to 59.1 percent by 2060. During the same period, municipal water demands are projected to increase from 15.5 percent at present to 37.7 percent in 2060. Figures 2.4 and 2.5 show the relative projected water demand, by type of use, for the years 2000 and 2060.

Figure 2.3: RGRWPA Total Water Demand Projections

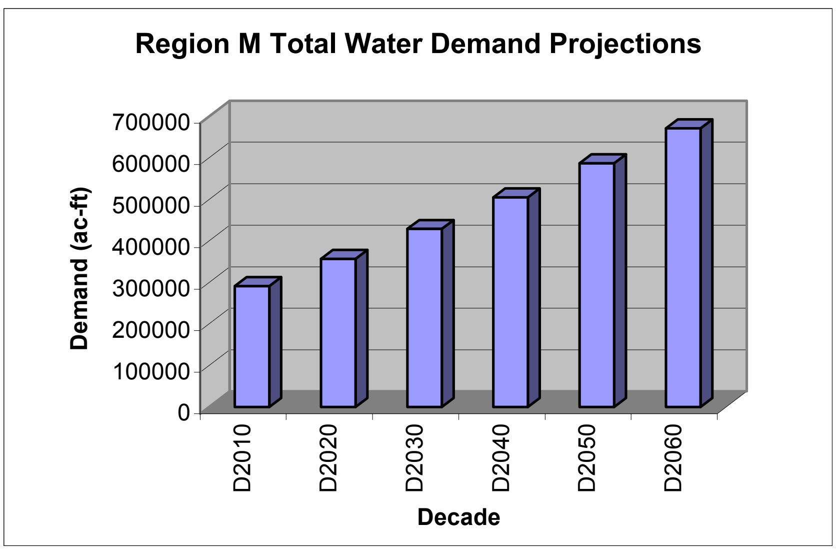


Figure 2.4: Year 2010 Total Water Demand by Type of Use

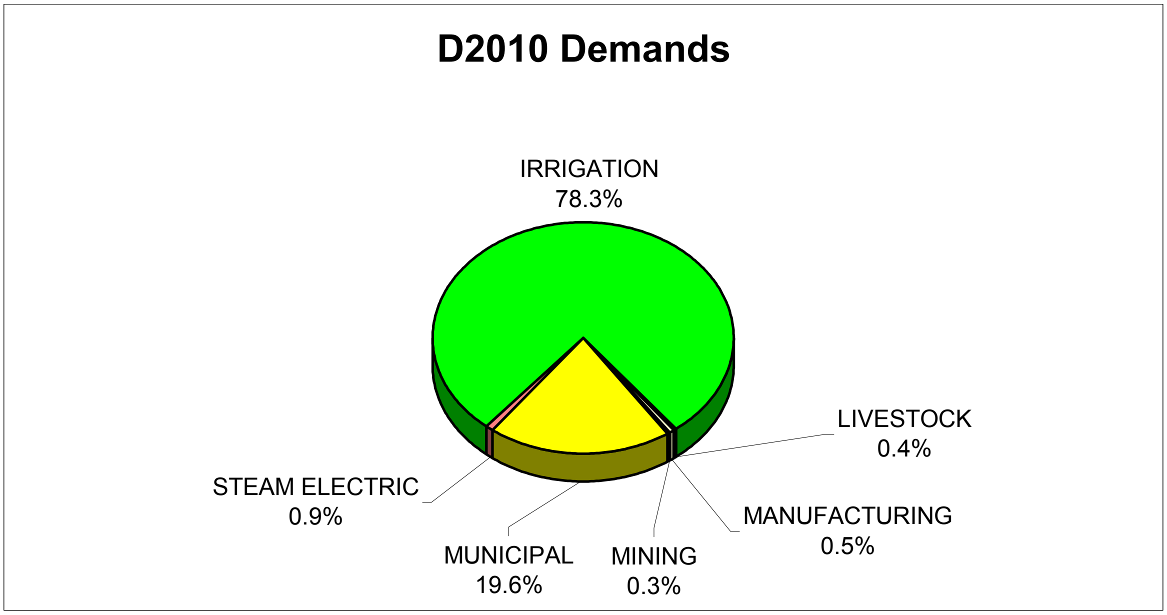
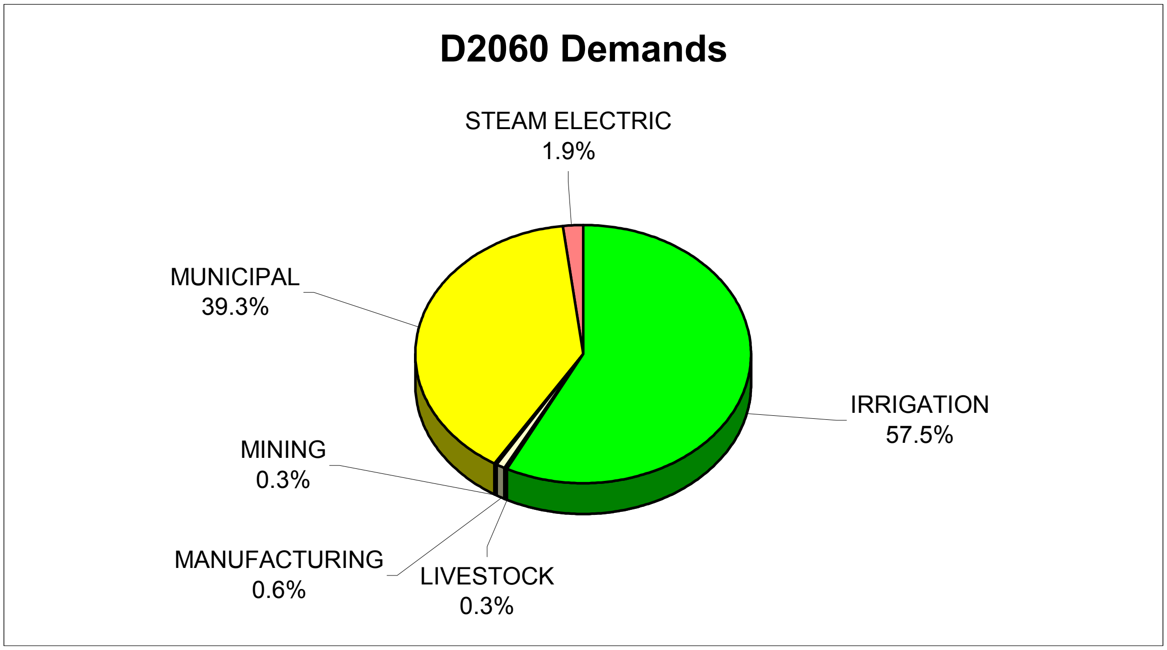


Figure 2.5: Year 2060 Total Water Demand by Type of Use

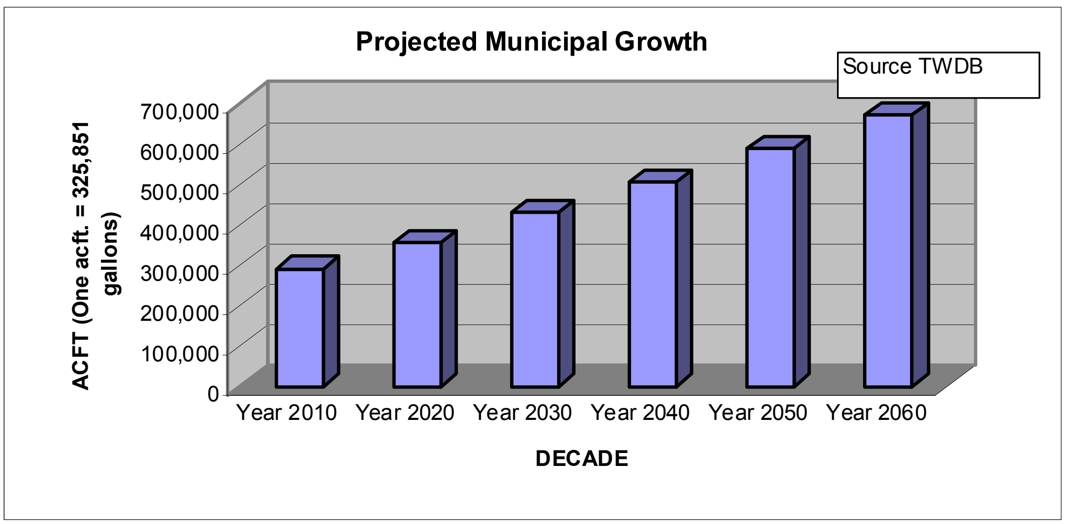


2.3.1 Projections for Municipal Water Demand

Municipal water consumption is calculated from data about residential, institutional, and commercial users. Factors affecting future municipal water use are population growth, climatic conditions, and water conservation practices. Because the region's population is projected to at least triple over the next 50 years, growth in municipal water use is inevitable.

Overall, annual municipal water demand within the region is projected to almost double from 2010 to 2060 (see Figure 2.6). While this represents a major increase over the planning period, growth in water usage is significantly slower than rate of population growth. These projections are attributable to anticipated improvements in municipal water use efficiency and in water savings associated with the adoption of various conservation measures such as those proposed in the 1991 State Water Efficient Plumbing Act.

Figure 2.6: Projected RGRWPA Municipal Demand



PROJECTIONS

Table 2.11: Municipal Water Demand Projections by County and River Basin (in acre-feet per year)

County	River Basin	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060
Cameron	Nueces-Rio Grande	88,172	104,258	120,673	137,443	154,464	171,307
	Rio Grande	518	592	669	747	826	904
Cameron Total		**88,690**	**104,850**	**121,342**	**138,190**	**155,290**	**172,211**
Hidalgo	Nueces-Rio Grande	114,145	140,213	169,712	201,562	237,698	275,393
	Rio Grande	1,265	1,638	2,061	2,508	3,032	3,571
Hidalgo Total		**115,410**	**141,851**	**171,773**	**204,070**	**240,730**	**278,964**
Jim Hogg	Nueces-Rio Grande	868	902	927	942	926	890
	Rio Grande	16	16	17	17	17	16
Jim Hogg Total		**884**	**918**	**944**	**959**	**943**	**906**
Maverick	Nueces	5	6	7	8	9	9
	Rio Grande	9,404	10,553	11,659	12,641	13,592	14,467
Maverick Total		**9,409**	**10,559**	**11,666**	**12,649**	**13,601**	**14,476**
Starr	Nueces-Rio Grande	242	298	355	414	472	530
	Rio Grande	13,245	15,475	17,816	20,196	22,592	25,012
Starr Total		**13,487**	**15,773**	**18,171**	**20,610**	**23,064**	**25,542**
Webb	Nueces	136	155	175	199	225	255
	Nueces-Rio Grande	204	231	262	297	337	382
	Rio Grande	54,515	69,015	85,564	104,007	124,052	145,783
Webb Total		**54,855**	**69,401**	**86,001**	**104,503**	**124,614**	**146,420**
Willacy	Nueces-Rio Grande	3,323	3,527	3,706	3,844	3,966	4,039
Willacy Total		**3,323**	**3,527**	**3,706**	**3,844**	**3,966**	**4,039**
Zapata	Rio Grande	2,265	2,531	2,793	3,033	3,267	3,448
Zapata Total		**2,265**	**2,531**	**2,793**	**3,033**	**3,267**	**3,448**
Nueces Total		141	161	182	207	234	264
Nueces-Rio Grande Total		206,954	249,429	295,635	344,502	397,863	452,541
Rio Grande Total		81,228	99,820	120,579	143,149	167,378	193,201
Total		**288,323**	**349,410**	**416,396**	**487,858**	**565,475**	**646,006**

The region's municipal water demand is projected to triple in the next 50 years, increasing from 288,323 acre-feet per year in 2010 to 646,006 acre-feet per year in 2060. Table 2. presents this projected growth, by county and river basin. As indicated, demand is concentrated in Cameron, Hidalgo, and Webb counties, which together account for nearly 89 percent of municipal water consumption in the region. Cameron County alone accounts for 38 percent, Hidalgo County accounts for 39 percent, and Webb County accounts for 19 percent of the region's municipal water use.

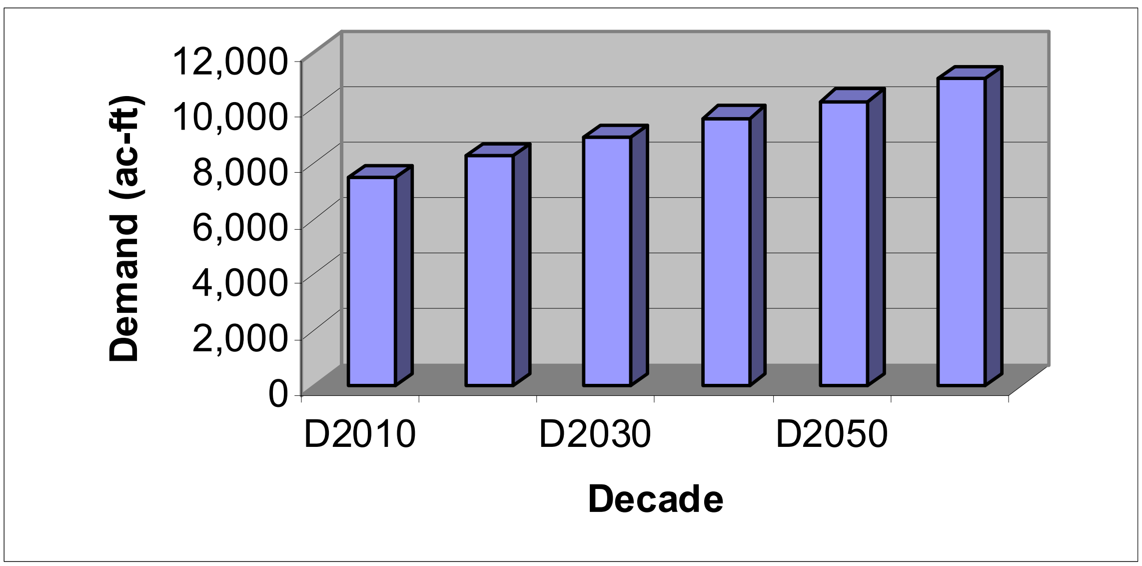
2.3.2 Projections for Manufacturing Water Demand

For SB 1 planning purposes, manufacturing water use is defined as the cumulative water demand on county and river basins for all industries within specified industrial classifications (SIC) determined by the TWDB. Projections of manufacturing water use, developed by the TWDB and employed in the 1997 State Water Plan, were used as default projections in this report, except where better information warranted a revision. Exhibit B (4.2.4) states the following plan of research for calculating estimates of manufacturing water demand:

- *"Complete industry surveys to update water use efficiency estimates developed for the 2002 State Water Plan.*
- *Analyze the impact of technology adoption, and input substitution on the relationship of water used to output.*
- *Develop projections of industry output and associated water use by county."*

The region's demand for manufacturing water is projected to increase from approximately 7,509 acre-feet per year in 2010 to 11,059 acre-feet per year by 2060 (see Figure 2.7), primarily due to projected population growth in Cameron and Hidalgo Counties. The TWDB has no data to enable similar projections for Jim Hogg, Starr, and Zapata Counties. Table 2.12 illustrates projected demand for manufacturing water in each of the counties and shows that Cameron and Hidalgo Counties will account for 98 percent of the total manufacturing need.

Figure 2.7: Projected RGRWPA Manufacturing Demand



PROJECTIONS

Table 2.12: Manufacturing Water Demand by County (in acre-feet per year)

Manufacturing Water Demands Projections by County (acft/year)

MANUFACTURING

COUNTY	2010	2020	2030	2040	2050	2060
CAMERON	4,156	4,590	4,983	5,372	5,709	6,165
HIDALGO	3,236	3,559	3,851	4,143	4,403	4,742
JIM HOGG	0	0	0	0	0	0
MAVERICK	64	69	73	77	80	85
STARR	0	0	0	0	0	0
WEBB	28	31	34	37	39	42
WILLACY	25	25	25	25	25	25

2.3.3 Projections for Irrigation Water Demand

Irrigation Districts make up nearly 85% of the total regional demand for water. In the previous rounds of regional planning, demand analyses were performed for a multitude of Water User Groups (WUGs) in the region, including the classification of irrigation water users as a county-wide group (i.e. Irrigation-Cameron County). Utilizing this classification system creates a difficult set of circumstances in which to accurately evaluate irrigation water users, including the development of accurate water supply and demand figures, and developing water management strategies for implementation.

In terms of regional water planning, the analysis of individual Irrigation Districts will allow for a better understanding of the Region's water demand. The region will be better able to evaluate specific water management strategies needed to meet future water deficits.

A thorough analysis of irrigation water demand data is critical. In Region M, irrigation demand is primarily based on the available supply from the Amistad/Falcon reservoir system. During droughts, supply is limited and allowable irrigation water is allocated accordingly, resulting in a perceived reduction in demand. Ultimately, the demand on any given Irrigation District would be such that all land in the District that is included as flat-rate acreage would have the option to receive irrigation water. In turn, Irrigation Districts typically own enough irrigation water rights to serve irrigation water users within their boundaries should the water be available in the reservoir.

In order to break down the irrigation demand from the Amistad/Falcon system (1,180,278 ac-ft) into by-county use, water rights associated with the Amistad/Falcon system were compiled and compared. For instance, irrigators in Cameron County hold 31.7 percent of all Region M irrigation water rights. This percentage was multiplied by the base year demand to arrive at the Cameron County base year demand for Amistad/Falcon water (374,585 ac-ft). The same methodology was used for each county in the region. As described earlier, additional water sources exist to provide irrigation water. They were treated as "supply equals demand" and were simply added to the Amistad/Falcon demands.

The region's annual demand for irrigation water is projected to decrease from 1,163,633 acre-feet per year in 2010 to 981,749 acre-feet per year in 2060 (see Figure 2.8). This lower demand estimate arises from spreading urbanization which reduces irrigable acreage, primarily in Cameron and Hidalgo Counties.

In the last round of regional planning (2005), irrigation water demand projections were determined by the Rio Grande RWPG with assistance from TCEQ. The numbers used differ from those recommended by the TWDB, which used a base year irrigation demand of 909,590 acre-feet. In researching the subject, the regional planning group realized that the base year value originally used by the TWDB is not accurate for actual irrigation demands. Data regarding annual rainfall, Amistad/Falcon reservoir levels, yearly allocations, and actual irrigation water usage were compiled from 1989 to 2004. The most accurate depiction of irrigation demand would take place in a year with normal rainfall and normal reservoir levels; based on these parameters, 1994 most accurately represented normal conditions. In 1994, rainfall totaled 20 inches, 2.5 inches below the average rainfall from 1989 to 2004. Also, the Amistad/Falcon reservoir system sat at 86.5% of total capacity. Total irrigation usage as reported by TCEQ was 1,180,278 acre-feet. This number is a combination of charged and no-charge water in the middle and lower Rio Grande River.

Figure 2.8: Projected RGRWPA Irrigation Water Demand

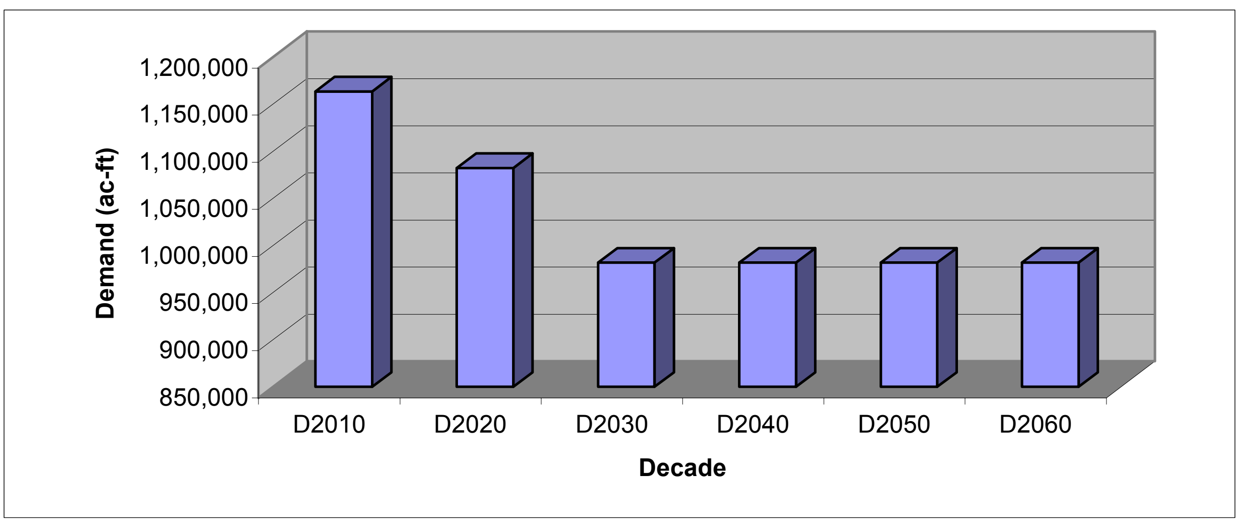


Table 2.13: Irrigation Water Demand per County and River Basin

County	River Basin	2010	2020	2030	2040	2050	2060
Cameron	Nueces-Rio Grande	352,707	333,861	312,137	312,137	312,137	312,137
Cameron	Rio Grande	14,697	13,910	13,007	13,007	13,007	13,007
Cameron	**Total**	**367,404**	**347,771**	**325,144**	**325,144**	**325,144**	**325,144**
Hidalgo	Nueces-Rio Grande	560,291	505,458	436,074	436,074	436,074	436,074
Hidalgo	Rio Grande	22,739	20,513	17,698	17,698	17,698	17,698
Hidalgo	**Total**	**583,030**	**525,971**	**453,772**	**453,772**	**453,772**	**453,772**
Jim Hogg	Nueces-Rio Grande	817	817	817	817	817	817
Jim Hogg	**Total**	**817**	**817**	**817**	**817**	**817**	**817**
Maverick	Nueces	3,897	3,760	3,602	3,602	3,602	3,602
Maverick	Rio Grande	91,143	87,933	84,261	84,261	84,261	84,261
Maverick	**Total**	**95,040**	**91,693**	**87,863**	**87,863**	**87,863**	**87,863**
Starr	Rio Grande	31,191	30,108	29,070	29,070	29,070	29,070
Starr	**Total**	**31,191**	**30,108**	**29,070**	**29,070**	**29,070**	**29,070**
Webb	Rio Grande	20,507	19,548	18,654	18,654	18,654	18,654
Webb	**Total**	**20,507**	**19,548**	**18,654**	**18,654**	**18,654**	**18,654**
Willacy	Nueces-Rio Grande	59,191	60,203	60,623	60,623	60,623	60,623
Willacy	**Total**	**59,191**	**60,203**	**60,623**	**60,623**	**60,623**	**60,623**
Zapata	Rio Grande	6,454	6,121	5,805	5,805	5,805	5,805
Zapata	**Total**	**6,454**	**6,121**	**5,805**	**5,805**	**5,805**	**5,805**
REGION M	**TOTAL**	**1,163,634**	**1,082,232**	**981,748**	**981,748**	**981,748**	**981,748**

PROJECTIONS

Table 2.14: Irrigation Water Demand Projections by Districts in Cameron County (in acre-feet per year)[2]

Water Districts	2010	2020	2030	2040	2050	2060
Adams Garden Irrigation District No. 19	18,624	19,281	19,955	19,955	19,955	19,955
Bayview Irrigation District No. 11	15,836	14,006	12,402	12,402	12,402	12,402
Brownsville Irrigation District	40,186	29,798	22,164	22,164	22,164	22,164
Cameron County Irrigation District No. 2	137,738	121,821	107,867	107,867	107,867	107,867
Cameron County Irrigation District No. 6	47,244	41,785	36,998	36,998	36,998	36,998
Cameron County Water Improvement District No. 16	3,419	3,024	2,677	2,677	2,677	2,677
Hidalgo and Cameron County Irrigation District #9	125,925	105,301	86,365	86,365	86,365	86,365
Harlingen Irrigation District-Cameron County No. 1	84,479	80,175	76,127	76,127	76,127	76,127
La Feria Irrigation District-Cameron County No. 3	69,722	63,795	58,419	58,419	58,419	58,419
Santa Maria Irrigation District-Cameron County No. 4	8,763	8,367	7,992	7,992	7,992	7,992
Valley Acres Water District	1,974	1,980	1,986	1,986	1,986	1,986
Cameron Total	**553,910**	**489,333**	**432,952**	**432,952**	**432,952**	**432,952**

[2] Irrigation demands for irrigation districts are reported as in Special Study No. 2: Classify Irrigation Districts as Water User Groups.

Table 2.15: Irrigation Water Demand Projections by Districts in Hidalgo County (in acre-feet per year)[3]

Water Districts	2010	2020	2030	2040	2050	2060
Delta Lake Irrigation District	99,699	98,835	97,895	97,895	97,895	97,895
Donna Irrigation District-Cameron County No. 2	77,425	73,274	69,379	69,379	69,379	69,379
Engleman Irrigation District	17,874	16,151	14,442	14,442	14,442	14,442
Hidalgo and Cameron County Irrigation District No. 9	109,555	91,612	75,138	75,138	75,138	75,138
Hidalgo County Irrigation District No. 1	68,611	51,121	36,812	36,812	36,812	36,812
Hidalgo County Water Improvement District No. 3	7,815	5,823	4,193	4,193	4,193	4,193
Hidalgo County Irrigation District No. 13	2,498	1,005	410	410	410	410
Hidalgo County Irrigation District No. 16	26,426	21,856	18,109	18,109	18,109	18,109
Hidalgo County Water Control and Improvement District No. 18	4,731	3,913	3,242	3,242	3,242	3,242
Hidalgo County Irrigation District No. 2	82,550	61,506	44,290	44,290	44,290	44,290
Hidalgo County Water Improvement District No. 5	13,464	12,643	11,796	11,796	11,796	11,796
Hidalgo County Irrigation District No. 6	36,154	29,901	24,775	24,775	24,775	24,775
Hidalgo County Irrigation District No. 19	2,138	841	281	281	281	281
Santa Cruz Irrigation District No. 15	79,967	76,296	72,449	72,449	72,449	72,449
United Irrigation Distict of Hidalgo County	55,402	45,821	37,966	37,966	37,966	37,966
Valley Acres Water District	13,213	13,253	13,292	13,292	13,292	13,292
Hidalgo Total	**697,522**	**603,851**	**524,469**	**524,469**	**524,469**	**524,469**

[3] Irrigation demands for irrigation districts are reported as in Special Study No. 2: Classify Irrigation Districts as Water User Groups.

Table 2.16: Irrigation Water Demand Projections by Districts in Willacy County (in acre-feet per year)[4]

Water Districts	2010	2020	2030	2040	2050	2060
Delta Lake Irrigation District	75,212	74,560	73,851	73,851	73,851	73,851
Willacy Total	**75,212**	**74,560**	**73,851**	**73,851**	**73,851**	**73,851**

Cameron County is projected to comprise 31.2 percent and 33.1 percent of the total demand for irrigation water in 2010 and 2060, respectively. Hidalgo County currently accounts for 50.5 percent of the total irrigation demand, decreasing to 46.2 percent in 2060. Not coincidentally, these two counties have the highest percentage of water rights associated with the Amistad/Falcon system.

It is important to note that irrigation demands are highly variable from year to year. Overall agricultural economic conditions, weather conditions, and water availability are factors directly influencing the demand for irrigation water.

Market prices of agricultural commodities influence the amount of irrigated acreage planted each year and the types of crops planted. Also, above-normal or below-normal precipitation in irrigated areas can either suppress or increase irrigation demand, and because Amistad/Falcon irrigation use is based on water availability, irrigation shortages can have the effect of suppressing water demand.

Table 2.17: Irrigation Water Demand Projections by Counties (in acre-feet per year)

COUNTY	2010	2020	2030	2040	2050	2060
CAMERON	367,404	347,771	325,144	325,144	325,144	325,144
HIDALGO	583,030	525,971	453,772	453,772	453,772	453,772
JIM HOGG	817	817	817	817	817	817
MAVERICK	95,040	91,693	87,863	87,863	87,863	87,863
STARR	31,191	30,108	29,070	29,070	29,070	29,070
WEBB	20,507	19,548	18,654	18,654	18,654	18,654
WILLACY	59,191	60,203	60,623	60,623	60,623	60,623
ZAPATA	6,454	6,121	5,805	5,805	5,805	5,805
TOTAL	**1,163,634**	**1,082,232**	**981,748**	**981,748**	**981,748**	**981,748**

2.3.4 Projections for Steam Electric Water Demand

The TWDB [Exhibit B (4.2.4)] states a specific plan of research for estimating demand for steam electric water:

> *"The plan of research includes:*
> - *Description of water-consuming systems currently used in power generation facilities.*
> - *Estimation of water consumption rates for each identified water-consuming system.*

[4] Irrigation demands for irrigation districts are reported as in Special Study No. 2: Classify Irrigation Districts as Water User Groups.

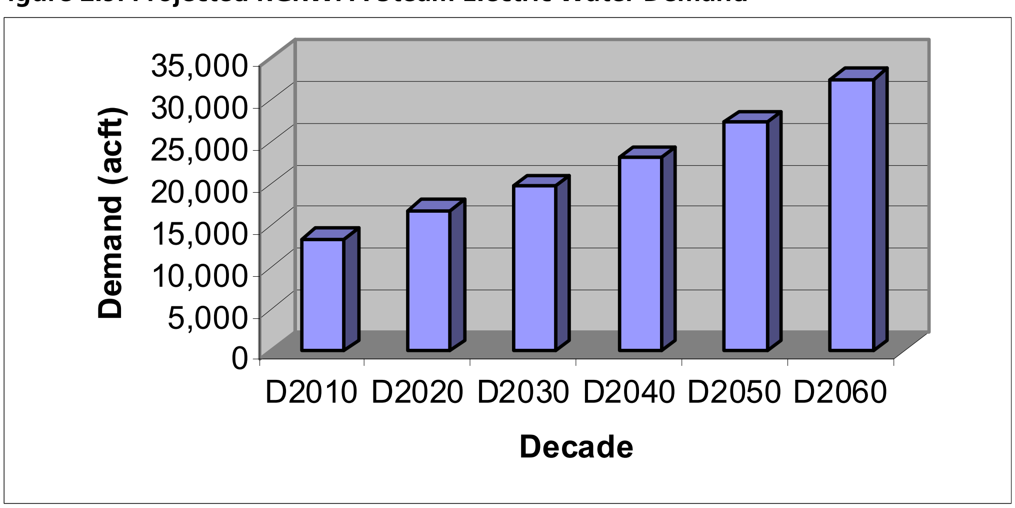
- *Correlation of current state population with current electric use by region.*
- *Projection of electric power consumption requirements by county and for the state, based on population projections.*
- *Identification of current and potential water sources for demand by power generation.*
- *Estimation of future water use by power generation.*
- *Development and application of allocation methodology to derive demand projections by county."*

Annual demand for steam electric water is projected to increase from 13,463 acre-feet per year in 2010 to 32,598 acre-feet per year in 2060 (see Figure 2.9). Most of this increase is expected to occur between 2000 and 2010 as a result of adding new capacity for generating steam electric power in Cameron and Webb counties.

Table 2.18 presents the projected demand for steam electric water, by county, for each of the region's eight counties. Cameron County makes up 12 percent of the demand. Hidalgo County accounts for 77 percent, and Webb County accounts for 11 percent. TWDB has no data about demand for steam electric water in Jim Hogg, Maverick, Starr, Willacy, and Zapata Counties.

TWDB received a 2008 study from the Bureau of Economic Geology (BEG) related to steam electric water demands for existing steam electric water users. Each planning group had the option to determine if they wished to use water demand figures as supplied by the TWDB or the BEG. However, BEG numbers were based on assumptions that differ than previous TWDB studies resulting in large deviations from the 2007 State Water Plan. The Regional Water Planning Group (Region M) took a stance suggesting using the 2007 State Water Plan numbers because of the worst case scenario evaluation.

Figure 2.9: Projected RGRWPA Steam Electric Water Demand



PROJECTIONS

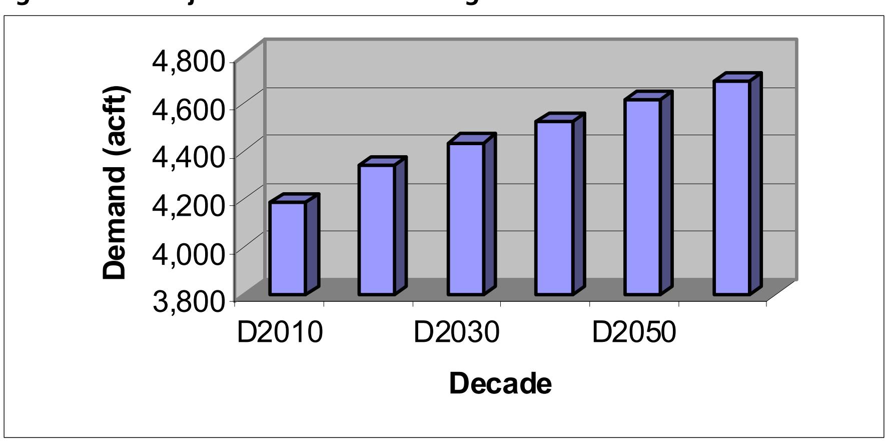
Table 2.18: Steam Electric Water Demand Projections by County (in acre-feet per year)

COUNTY	2010	2020	2030	2040	2050	2060
CAMERON	1,616	1,523	1,780	2,094	2,477	2,944
HIDALGO	10,355	14,151	16,545	19,462	23,018	27,354
JIM HOGG	0	0	0	0	0	0
MAVERICK	0	0	0	0	0	0
STARR	0	0	0	0	0	0
WEBB	1,492	1,190	1,391	1,636	1,935	2,300
WILLACY	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0
TOTAL	**13,463**	**16,864**	**19,716**	**23,192**	**27,430**	**32,598**

2.3.5 Projections for Mining Water Demand

The state's default demand projections for mining water were based on forecasts of future production levels (sorted by mineral category) and their water use rates. These production projections are derived from state and national historic water use rates and are constrained by accessible mineral reserves in the region. Demand for mining water represents less than 1 percent of the region's total water needs and is expected to remain relatively constant over the 50-year planning period (see Figure 2.10). *Use* of mining water is greatest in Webb County (32.6 percent), Starr County (31 percent), and Hidalgo County (30.9 percent). In contrast, Willacy County has the lowest *demand* (less than 1 percent). Table 2.19 represents projected demand for mining water, by county, for the region. In the future, the regional water planning group must identify the potential for water use of gas wells.

Figure 2.10: Projected RGRWPA Mining Water Demand



PROJECTIONS

Table 2.19: Mining Water Demand Projections by County (in acre-feet per year)

COUNTY	2010	2020	2030	2040	2050	2060
CAMERON	6	6	6	6	6	6
HIDALGO	1,442	1,561	1,633	1,704	1,774	1,836
JIM HOGG	33	36	37	38	39	40
MAVERICK	156	162	166	169	172	175
STARR	1,315	1,355	1,373	1,390	1,407	1,426
WEBB	1,204	1,192	1,189	1,187	1,185	1,180
WILLACY	6	6	6	6	6	6
ZAPATA	24	23	23	23	23	23
TOTAL	**4,186**	**4,341**	**4,433**	**4,523**	**4,612**	**4,692**

2.3.6 Projections for Livestock Water Demand

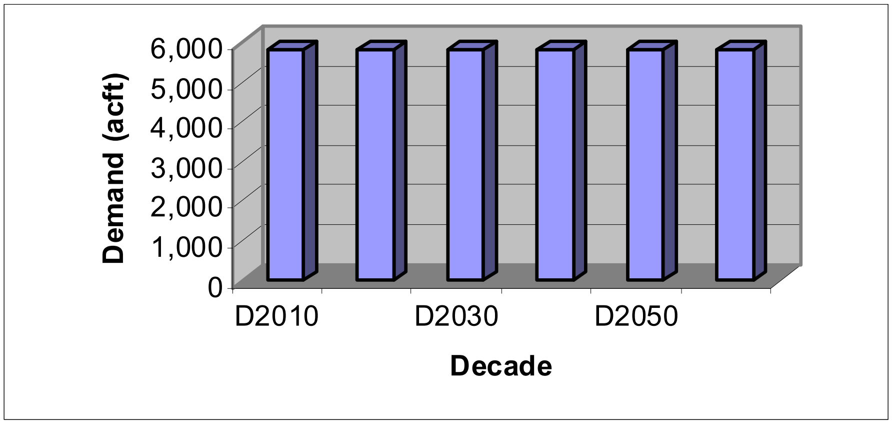
The TWDB's livestock water use projections were developed using Texas Agricultural Statistics Service's estimates of the numbers and types of livestock, and the Texas A&M Agricultural Extension Service's estimates of water usage rates for each type of livestock.

Total livestock water is determined by multiplying consumption for a given livestock type by the number of that type of livestock in each of the eight counties. Exhibit B (Section 4.2.4) states:

> *"The 2006 Regional Water Plan will maintain the same rates of change in livestock water demand as included in the 2002 State Water Plan. Base water use for 2000 will be adjusted using the 2000 livestock inventory along with adjustments in water use per unit, based on research by the Texas Agricultural Experiment Station."*

Livestock types are breeding cattle, dairy cattle, feed cattle, hogs, pigs, sheep, goats, hens, broilers, and horses. Surprisingly, demand for livestock water is low compared with other water demands, comprising only 1% of the region's total water usage. By year 2060, the figure is projected to drop to 0.4% of total water demand.

Figure 2.11: Projected RGRWPA Livestock Water Demand



Livestock water demand is relatively uniform over the eight-county area and is projected to remain fairly constant over the 50-year planning period (see Figure **2.11**). Table 2.20 presents these projected demands, by county.

PROJECTIONS

Table 2.20: Projected Livestock Water Demand by County (in acre-feet per year)

COUNTY	2010	2020	2030	2040	2050	2060
CAMERON	1,103	1,103	1,103	1,103	1,103	1,103
HIDALGO	681	681	681	681	681	681
JIM HOGG	518	518	518	518	518	518
MAVERICK	260	260	260	260	260	260
STARR	1,117	1,117	1,117	1,117	1,117	1,117
WEBB	1,513	1,513	1,513	1,513	1,513	1,513
WILLACY	151	151	151	151	151	151
ZAPATA	474	474	474	474	474	474
TOTAL	5,817	5,817	5,817	5,817	5,817	5,817

2.3.7 Needs for Wholesale Water Providers

Texas Water Development Board guidelines in Exhibit B state that a wholesale water provider is any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-ft of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. Table 2.21 below indicates the water providers that meet the TWDB guidelines to designate them as Wholesale Water Providers for this region. Demand projection figures were compiled through the TWDB's database for the region.

DEMAND PROJECTIONS

Table 2.21: Projected Wholesale Water Provider Demand (in acre-feet per year)

Water Demand Projections for Wholesale Water Providers						
WHOLESALE WATER PROVIDERS	**DEMAND**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
BROWNSVILLE IRRIGATION & DRAINAGE DISTRICT	6,105	6,071	6,071	6,071	6,071	6,071
CAMERON COUNTY WCID #2	15,198	15,198	15,198	15,198	15,198	15,198
DELTA LAKE MUNICIPAL AUTHORITY	8,200	8,200	8,200	8,200	8,200	8,200
DONNA IRRIGATION DISTRICT HIDALGO COUNTY #1	6,880	6,880	6,880	6,880	6,880	6,880
EAGLE PASS CITY OF	7,707	7,707	7,707	7,707	7,707	7,707
HARLINGEN IRRIGATION DISTRICT	5,104	5,117	5,127	5,135	5,142	5,148
HARLINGEN WATER WORKS SYSTEM	19,238	19,238	19,238	19,238	19,238	19,238
HIDALGO COUNTY IRRIGATION DISTRICT #6	8,291	8,291	8,291	8,291	8,291	8,291
HIDALGO COUNTY WCID #1	1,437	1,437	1,437	1,437	1,437	1,437
HIDALGO COUNTY WCID #16	1,047	1,047	1,047	1,047	1,047	1,047
HIDALGO COUNTY WCID #2	24,667	24,667	24,667	24,667	24,667	24,667
HIDALGO COUNTY WCID #3	13,980	13,980	13,980	13,980	13,980	13,980
HIDALGO-CAMERON WCID #9	11,500	11,500	11,500	11,500	11,500	11,500
LA FERIA WCID #3	4,852	4,852	4,852	4,852	4,852	4,852
LA JOYA WSC	1,554	2,057	2,599	2,996	2,996	2,996
LAGUNA MADRE WD	7,480	7,480	7,480	7,480	7,480	7,480
MCALLEN CITY OF	33,548	33,548	33,548	33,548	33,548	33,548
NORTH ALAMO WSC	22,338	22,338	22,338	22,338	22,338	22,344
MILITARY HIGHWAY WSC	3,620	4,020	4,130	4,254	4,369	4,502
SHARYLAND WSC	12,140	12,139	12,139	12,140	12,139	12,140
SOUTHMOST REGIONAL WATER	11,844	11,844	11,844	11,844	11,844	11,844
UNITED IRRIGATION DISTRICT	24,009	24,009	24,009	24,009	24,009	24,009
VALLEY MUD #2	1,382	1,382	1,382	1,382	1,382	1,382
WEBB COUNTY WATER UTILITY	2,311	2,311	2,311	2,311	2,311	2,312
REGION M TOTAL	**254,432**	**255,313**	**255,975**	**256,505**	**256,626**	**256,773**

2.3.8 Other Potential Water Demands

These other potential water demands could affect the regional water supply if developed within the region, but currently no action has been taken.

Ethanol Production

Over the next 20 years, the water consumed by energy production is supposed to increase at a faster rate than any other sector. In fact, the amount of water projected to be consumed by energy production is greater than for any other sector other than irrigation.

A Technical Memorandum has been issued that examines estimated water demand for various energy and non energy sectors.

Nation Energy Technology Laboratory's Existing Plants Research Program, which has an energy-water research effort that focuses on water use at power plants, illustrates the dependency of future energy production on adequate water supplies.

The report projects water consumption at the national and regional levels for the following energy production sectors: oil (crude oil exploration and production, liquids from unconventional sources, and refining), coal (mining and slurry transportation), gas (processing, pipeline transport, and gas from tight sands and shale), biofuels (biodiesel and ethanol production), and hydrogen production. It also projects water consumption for irrigation, domestic/public, industrial/commercial, and livestock uses.

While the growth in water consumption by the energy sector dominates the water-demand forecast over the period, by far the single largest projected consumer of water within the energy sector is biofuels production. Water consumption for biofuels production is projected to increase by 19 billion gallons per day (bgd), or by 2.5 times, between 2005 and 2030. Most of this increase is for the production of corn-based ethanol, which is projected to increase by nearly 13 bgd and accounts for roughly 60% of the nation's total projected increase in water consumption over the next 20 years. Water consumption is expected to more than double for industrial and commercial use in the United States by 2030. According to a report from the U.S. Government Accountability Office, experts have been working on using alternative water sources such as brackish water for biofuel production. However implementing this can be costly. Also, newly innovated dry cooling systems and thermo chemical processes have the potential to reduce the amount of water used by biorefineries, but many of these other options remain untested at the commercial scale

Water-demand projections were derived by multiplying sector-specific water-demand coefficients (e.g., gallons of water consumed per barrel of oil produced with enhanced oil recovery) times sector-specific energy production projections prepared by the U.S. Department of Energy's Energy Information Administration. Projections were made at the national and regional level. Because regions vary depending on energy sectors (e.g., coal supply regions for coal mining, U.S. Census regions for biofuels), a geographical information system was used to prepare overlay maps to allow for visual comparison of regional water-demand trends over the projection period.

The report's analysis of the extent and location of water demand by competing users can help policymakers identify potential constraints for energy supply and production and can identify areas (e.g., biofuels production) that need further research.

Such knowledge can also help decision makers develop policy and technology recommendations to avoid potential supply issues and to ensure that the nation's energy demands are met in a cost-effective manner.

A company called BioFuels Energy Corporation[5] was planning to build Texas' first cellulosic ethanol plants. The company was planning on building a demonstration distillery in Raymondville[6] to evaluate a number of feed stocks used in the production of various fuels, including E85, a low proof ethanol, as well as biodiesel and aviation fuels for airplanes and jets. The low proof ethanol (130 proof) would be produced for use as fuel in a microturbine generator to help power an electric car.

The BioFuels Energy Corporation also planned to build a manufacturing facility where it would construct proprietary distillation parts for cellulosic ethanol production.

Another area of concern is oil wells, which potentially could use a significant amount of water as well.

There is a potential for bioenergy options other than ethanol, especially for Region M. Namely, there is a need to study the economic and water supply feasibility of producing dedicated biomass crops produced as feedstock for energy. This would include the high energy sorghums that have been developed and have the potential for over 12 dry tons per acre as well as energy cane. These dedicated biomass crops could be matched to the sugarcane mill needs and use harvesting and transportation equipment in the off season. The first step is an analysis of the production, harvesting, and storage of the biomass feedstock. As part of production, the water requirements can be estimated for impact on other crops and on irrigation

[5] Ethanol Production Plants are not being considered at this time in the region.
[6] Conversations with Joe Barrera of Brownsville Irrigation District and Troy Allen of Delta Lake Irrigation District have confirmed no Ethanol Production Plants are being considered.

districts. There are conversion technologies being tested that take the biomass to a drop-in fuel such as gasoline, diesel or jet fuel, avoiding the ethanol issues. The water plan for Region M with dedicated biomass feedstock crops has serious potential which offers alternatives to the cropping system, potential to be synergistic with the sugarcane industry and would impact water for irrigation.

Hidalgo County Drainage District No. 1

Another potential project is being conducted by Hidalgo County Irrigation District which is studying the possibility of developing municipal water within the drainage network of the county. The potential of this project could approximate 10% more water for the total needs of the county.

ATTACHMENT 2-1

2010 REGIONAL PROJECTIONS

2010 Regional Water Plan
Population and Water Demand Projections Summary for Region M

Regional Total Projection

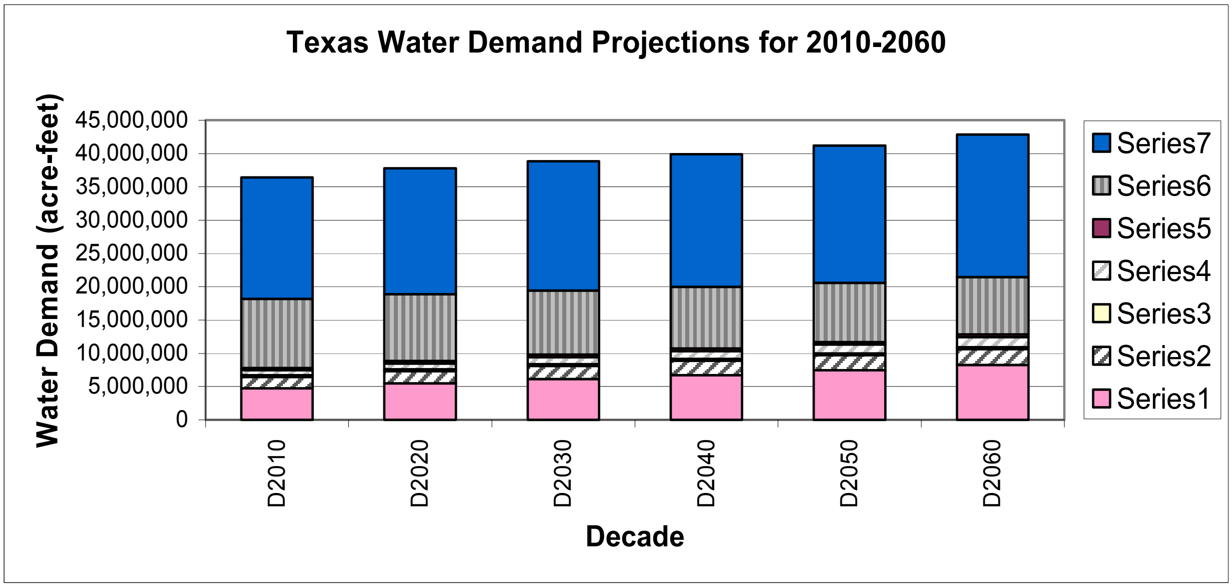
	D2010	D2020	D2030	D2040	D2050	D2060
Population	1,628,278	2,030,994	2,470,814	2,936,748	3,433,188	3,935,223
Irrigation (AF/YR)	1,163,634	1,082,232	981,748	981,748	981,748	981,748
Livestock (AF/YR)	5,817	5,817	5,817	5,817	5,817	5,817
Manufacturing (AF/YR)	7,509	8,274	8,966	9,654	10,256	11,059
Mining (AF/YR)	4,186	4,341	4,433	4,523	4,612	4,692
Municipal (AF/YR)	288,323	349,410	416,396	487,858	565,475	646,006
Steam Eelctric (AF/YR)	13,463	16,864	19,716	23,192	27,430	32,598
Total Water Demand (AF/YR)	1,482,932	1,466,938	1,437,076	1,512,792	1,595,338	1,681,920

Region M Population Projection by County

	D2010	D2020	D2030	D2040	D2050	D2060
Cameron	424,762	510,697	599,672	688,532	777,607	862,511
Hidalgo	775,858	987,920	1,225,227	1,481,812	1,761,811	2,048,909
Jim Hogg	5,593	5,985	6,286	6,538	6,468	6,225
Maverick	58,252	67,929	77,165	85,292	92,831	99,091
Starr	69,370	83,583	98,262	113,102	127,802	141,961
Webb	257,647	333,451	418,332	511,710	613,774	721,586
Willacy	22,763	25,212	27,455	29,276	30,542	31,205
Zapata	14,025	16,217	18,415	20,486	22,354	23,733
REGION M TOTAL	**1,628,278**	**2,030,994**	**2,470,814**	**2,936,748**	**3,433,188**	**3,935,223**

2010 Regional Water Plan
Summary of Water Demand Projections for the state of Texas (ac-ft)

	D2010	D2020	D2030	D2040	D2050	D2060
MUNICIPAL	4,761,887	5,473,988	6,109,591	6,727,858	7,438,852	8,245,271
MANUFACTURING	1,727,808	2,153,551	2,465,789	2,621,183	2,755,335	2,882,524
MINING	296,230	313,327	296,472	285,002	284,640	292,294
STEAM ELECTRIC	733,179	1,010,555	1,160,401	1,316,577	1,460,483	1,620,411
LIVESTOCK	322,966	336,634	344,242	352,536	361,701	371,923
IRRIGATION	10,079,215	9,643,908	9,299,464	9,024,866	8,697,560	8,370,554
TEXAS TOTAL	18,196,776	18,880,368	19,421,142	19,948,900	20,585,977	21,426,835



POPULATION PROJECTIONS PER WUG								
COUNTY	**RIVER BASIN**	**WATER USER GROUP**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
CAMERON	NUECES-RIO GRANDE	BROWNSVILLE	179,054	216,587	255,477	294,353	333,360	370,578
CAMERON	RIO GRANDE	BROWNSVILLE	1,390	1,681	1,983	2,284	2,587	2,875
CAMERON	NUECES-RIO GRANDE	COMBES	3,089	3,655	4,240	4,823	5,407	5,962
CAMERON	NUECES-RIO GRANDE	COUNTY-OTHER	45,008	51,569	58,351	65,113	71,876	78,307
CAMERON	RIO GRANDE	COUNTY-OTHER	82	94	106	118	130	142
CAMERON	NUECES-RIO GRANDE	EAST RIO HONDO WSC	19,904	26,420	33,155	39,869	46,585	52,973
CAMERON	NUECES-RIO GRANDE	EL JARDIN	10,798	13,445	16,182	18,910	21,639	24,234
CAMERON	RIO GRANDE	EL JARDIN	61	76	92	107	122	137
CAMERON	NUECES-RIO GRANDE	HARLINGEN	69,214	79,581	90,333	101,090	111,896	122,218
CAMERON	NUECES-RIO GRANDE	INDIAN LAKE	699	866	1,039	1,211	1,383	1,547
CAMERON	NUECES-RIO GRANDE	LA FERIA	7,954	9,898	11,908	13,912	15,916	17,822
CAMERON	NUECES-RIO GRANDE	LAGUNA MADRE WD	7,725	11,408	15,215	19,010	22,806	26,416
CAMERON	NUECES-RIO GRANDE	LAGUNA VISTA	2,651	3,314	4,008	4,705	5,413	6,094
CAMERON	NUECES-RIO GRANDE	LOS FRESNOS	6,649	8,908	11,243	13,571	15,899	18,114
CAMERON	NUECES-RIO GRANDE	LOS INDIOS	1,418	1,703	1,997	2,290	2,583	2,862
CAMERON	NUECES-RIO GRANDE	MILITARY HIGHWAY WSC	11,278	13,862	16,533	19,196	21,860	24,393
CAMERON	RIO GRANDE	MILITARY HIGHWAY WSC	162	199	237	275	313	349
CAMERON	NUECES-RIO GRANDE	OLMITO WSC	7,261	10,203	13,244	16,275	19,307	22,191
CAMERON	NUECES-RIO GRANDE	PALM VALLEY	1,400	1,400	1,400	1,400	1,400	1,400
CAMERON	NUECES-RIO GRANDE	PALM VALLEY ESTATES UD	344	444	547	650	753	851
CAMERON	NUECES-RIO GRANDE	PORT ISABEL	5,282	5,723	6,179	6,633	7,088	7,520
CAMERON	NUECES-RIO GRANDE	PRIMERA	3,973	4,871	5,806	6,748	7,699	8,613
CAMERON	NUECES-RIO GRANDE	RANCHO VIEJO	2,300	2,350	2,400	2,450	2,500	2,550
CAMERON	NUECES-RIO GRANDE	RIO HONDO	2,223	2,419	2,623	2,829	3,037	3,238
CAMERON	NUECES-RIO GRANDE	SAN BENITO	26,922	30,599	34,400	38,189	41,979	45,584
CAMERON	NUECES-RIO GRANDE	SANTA ROSA	3,472	4,148	4,847	5,543	6,240	6,903
CAMERON	NUECES-RIO GRANDE	SOUTH PADRE ISLAND	3,203	4,028	4,881	5,732	6,583	7,392
CAMERON	NUECES-RIO GRANDE	VALLEY MUD #2	1,066	1,066	1,066	1,066	1,066	1,066
CAMERON	RIO GRANDE	VALLEY MUD #2	180	180	180	180	180	180
CAMERON		**TOTAL**	**424,762**	**510,697**	**599,672**	**688,532**	**777,607**	**862,511**
HIDALGO	NUECES-RIO GRANDE	ALAMO	20,915	28,107	36,163	44,880	54,400	64,166
HIDALGO	NUECES-RIO GRANDE	ALTON	12,342	15,513	19,064	22,907	27,104	31,411
HIDALGO	NUECES-RIO GRANDE	COUNTY-OTHER	75,813	102,960	133,363	166,259	202,193	239,056
HIDALGO	RIO GRANDE	COUNTY-OTHER	4,422	6,104	7,988	10,026	12,252	14,536
HIDALGO	NUECES-RIO GRANDE	DONNA	17,830	20,419	23,311	26,435	29,839	33,325
HIDALGO	NUECES-RIO GRANDE	EDCOUCH	4,076	4,659	5,311	6,013	6,778	7,562
HIDALGO	NUECES-RIO GRANDE	EDINBURG	71,940	92,789	116,092	141,263	168,699	196,813
HIDALGO	NUECES-RIO GRANDE	ELSA	6,267	6,710	7,204	7,736	8,313	8,904
HIDALGO	NUECES-RIO GRANDE	HIDALGO	11,215	15,599	20,507	25,814	31,606	37,546
HIDALGO	RIO GRANDE	HIDALGO	460	641	843	1,061	1,299	1,543
HIDALGO	NUECES-RIO GRANDE	HIDALGO COUNTY MUD #1	5,280	7,476	9,936	12,598	15,505	18,487
HIDALGO	NUECES-RIO GRANDE	LA JOYA	3,030	3,631	4,302	5,027	5,817	6,625
HIDALGO	RIO GRANDE	LA JOYA	1,282	1,536	1,820	2,127	2,461	2,803
HIDALGO	NUECES-RIO GRANDE	MCALLEN	132,249	158,025	186,864	218,039	252,051	286,921
HIDALGO	RIO GRANDE	MCALLEN	18	21	25	29	33	38
HIDALGO	NUECES-RIO GRANDE	MERCEDES	15,775	17,129	18,636	20,260	22,023	23,827
HIDALGO	NUECES-RIO GRANDE	MILITARY HIGHWAY WSC	10,261	12,048	14,050	16,216	18,582	21,009
HIDALGO	RIO GRANDE	MILITARY HIGHWAY WSC	103	121	141	163	187	211
HIDALGO	NUECES-RIO GRANDE	MISSION	68,351	88,532	111,086	135,447	161,998	189,204
HIDALGO	NUECES-RIO GRANDE	NORTH ALAMO WSC	114,538	153,770	197,713	245,263	297,197	350,473

HIDALGO	NUECES-RIO GRANDE	PALMHURST	9,144	14,136	19,727	25,777	32,384	39,162
HIDALGO	NUECES-RIO GRANDE	PALMVIEW	6,258	8,771	11,586	14,632	17,959	21,372
HIDALGO	NUECES-RIO GRANDE	PENITAS	1,261	1,316	1,376	1,441	1,511	1,584
HIDALGO	NUECES-RIO GRANDE	PHARR	65,969	82,640	101,269	121,386	143,309	165,772
HIDALGO	NUECES-RIO GRANDE	PROGRESO	6,348	8,097	10,056	12,176	14,491	16,866
HIDALGO	NUECES-RIO GRANDE	SAN JUAN	39,074	54,082	70,892	89,081	108,947	129,327
HIDALGO	NUECES-RIO GRANDE	SHARYLAND WSC	31,885	36,438	41,538	47,057	53,085	59,268
HIDALGO	RIO GRANDE	SULLIVAN CITY	5,528	7,315	9,317	11,483	13,849	16,276
HIDALGO	NUECES-RIO GRANDE	WESLACO	32,862	37,961	43,658	49,811	56,516	63,385
HIDALGO		**TOTAL**	**774,496**	**986,546**	**1,223,838**	**1,480,407**	**1,760,388**	**2,047,472**
JIM HOGG	NUECES-RIO GRANDE	COUNTY-OTHER	744	796	837	870	861	829
JIM HOGG	RIO GRANDE	COUNTY-OTHER	85	91	95	99	98	94
JIM HOGG	NUECES-RIO GRANDE	HEBBRONVILLE	4,764	5,098	5,354	5,569	5,509	5,302
JIM HOGG		**TOTAL**	**5,593**	**5,985**	**6,286**	**6,538**	**6,468**	**6,225**
MAVERICK	NUECES	COUNTY-OTHER	48	59	69	78	86	92
MAVERICK	RIO GRANDE	COUNTY-OTHER	25,050	30,803	36,243	40,958	45,272	48,772
MAVERICK	RIO GRANDE	EAGLE PASS	26,160	28,212	30,238	32,116	33,937	35,559
MAVERICK	RIO GRANDE	EL INDIO WSC	6,994	8,855	10,615	12,140	13,536	14,668
MAVERICK		**TOTAL**	**58,252**	**67,929**	**77,165**	**85,292**	**92,831**	**99,091**
STARR	NUECES-RIO GRANDE	COUNTY-OTHER	1,470	1,846	2,234	2,624	3,009	3,378
STARR	RIO GRANDE	COUNTY-OTHER	36,356	45,658	55,237	64,893	74,409	83,541
STARR	RIO GRANDE	LA GRULLA	1,640	1,746	1,862	1,985	2,116	2,249
STARR	RIO GRANDE	RIO GRANDE CITY	14,982	16,674	18,447	20,259	22,090	23,878
STARR	RIO GRANDE	RIO WSC	2,942	3,868	4,821	5,782	6,729	7,638
STARR	RIO GRANDE	ROMA CITY	11,989	13,791	15,661	17,559	19,449	21,277
STARR		**TOTAL**	**69,379**	**83,583**	**98,262**	**113,102**	**127,802**	**141,961**
WEBB	NUECES	COUNTY-OTHER	751	873	1,010	1,159	1,323	1,496
WEBB	NUECES-RIO GRANDE	COUNTY-OTHER	1,123	1,306	1,510	1,735	1,981	2,241
WEBB	RIO GRANDE	COUNTY-OTHER	5,777	6,716	7,767	8,923	10,187	11,522
WEBB	RIO GRANDE	EL CENIZO	5,929	8,729	11,865	15,315	19,085	23,068
WEBB	RIO GRANDE	LAREDO	234,423	302,377	378,468	462,176	553,670	650,317
WEBB	RIO GRANDE	RIO BRAVO	8,318	11,566	15,203	19,205	23,579	28,199
WEBB	RIO GRANDE	WEBB COUNTY WATER UTILITY	1,326	1,884	2,509	3,197	3,949	4,743
WEBB		**TOTAL**	**257,647**	**333,451**	**418,332**	**511,710**	**613,774**	**721,586**
WILLACY	NUECES-RIO GRANDE	COUNTY-OTHER	385	385	385	385	385	384
WILLACY	NUECES-RIO GRANDE	LYFORD	2,335	2,512	2,684	2,839	2,972	3,076
WILLACY	NUECES-RIO GRANDE	NORTH ALAMO WSC	7,187	8,649	9,981	11,052	11,781	12,141
WILLACY	NUECES-RIO GRANDE	RAYMONDVILLE	10,071	10,402	10,704	10,947	11,112	11,194
WILLACY	NUECES-RIO GRANDE	SAN PERLITA	747	812	871	919	952	968
WILLACY	NUECES-RIO GRANDE	SEBASTIAN MUD	2,038	2,452	2,830	3,134	3,340	3,442
WILLACY		**TOTAL**	**22,763**	**25,212**	**27,455**	**29,276**	**30,542**	**31,205**
ZAPATA	NUECES-RIO GRANDE	COUNTY-OTHER	9,169	11,361	13,559	15,630	17,498	18,877
ZAPATA	NUECES-RIO GRANDE	ZAPATA	4,856	4,856	4,856	4,856	4,856	4,856
ZAPATA		**TOTAL**	**14,025**	**16,217**	**18,415**	**20,486**	**22,354**	**23,733**
REGION M TOTAL			**1,626,917**	**2,029,620**	**2,469,425**	**2,935,343**	**3,431,766**	**3,933,784**

Water Demand Projections for Wholesale Water Providers									
WHOLESALE WATER PROVIDERS		COUNTY	RIVER BASIN	DEMAND					
				2010	2020	2030	2040	2050	2060
BROWNSVILLE IRRIGATION & DRAINAGE DISTRICT									
	BROWNSVILLE	CAMERON	NUECES-RIO GRANDE	4,466	4,432	4,432	4,432	4,432	4,432
	BROWNSVILLE	CAMERON	RIO GRANDE	34	34	34	34	34	34
	EL JARDIN	CAMERON	NUECES-RIO GRANDE	1,590	1,590	1,590	1,590	1,590	1,590
	EL JARDIN	CAMERON	RIO GRANDE	10	10	10	10	10	10
	COUNTY-OTHER	CAMERON	RIO GRANDE	5	5	5	5	5	5
TOTAL				**6,105**	**6,071**	**6,071**	**6,071**	**6,071**	**6,071**
CAMERON COUNTY WCID #2									
	EAST RIO HONDO WSC	CAMERON	NUECES-RIO GRANDE	2,826	2,826	2,826	2,826	2,826	2,826
	MANUFACTURING	CAMERON	NUECES-RIO GRANDE	2,400	2,400	2,400	2,400	2,400	2,400
	RIO HONDO	CAMERON	NUECES-RIO GRANDE	890	890	890	890	890	890
	SAN BENITO	CAMERON	NUECES-RIO GRANDE	7,032	7,032	7,032	7,032	7,032	7,032
	COUNTY-OTHER	CAMERON	NUECES-RIO GRANDE	2,050	2,050	2,050	2,050	2,050	2,050
TOTAL				**15,198**	**15,198**	**15,198**	**15,198**	**15,198**	**15,198**
DELTA LAKE MUNICIPAL AUTHORITY									
	LYFORD	WILLACY	NUECES-RIO GRANDE	980	980	980	980	980	980
	NORTH ALAMO WSC	HIDALGO	NUECES-RIO GRANDE	300	300	300	300	300	300
	NORTH ALAMO WSC	WILLACY	NUECES-RIO GRANDE	300	300	300	300	300	300
	RAYMONDVILLE	WILLACY	NUECES-RIO GRANDE	5,670	5,670	5,670	5,670	5,670	5,670
	COUNTY-OTHER	HIDALGO	NUECES-RIO GRANDE	950	950	950	950	950	950
TOTAL				**8,200**	**8,200**	**8,200**	**8,200**	**8,200**	**8,200**
DONNA IRRIGATION DISTRICT HIDALGO COUNTY #1									
	DONNA	HIDALGO	NUECES-RIO GRANDE	4,190	4,190	4,190	4,190	4,190	4,190
	NORTH ALAMO WSC	HIDALGO	NUECES-RIO GRANDE	1,345	1,345	1,345	1,345	1,345	1,345
	NORTH ALAMO WSC	WILLACY	NUECES-RIO GRANDE	1,345	1,345	1,345	1,345	1,345	1,345
TOTAL				**6,880**	**6,880**	**6,880**	**6,880**	**6,880**	**6,880**

EAGLE PASS CITY OF								
EAGLE PASS	MAVERICK	RIO GRANDE	6,454	6,140	5,852	5,599	5,372	5,177
EL INDIO WSC	MAVERICK	RIO GRANDE	1,253	1,567	1,855	2,108	2,335	2,530
TOTAL			**7,707**	**7,707**	**7,707**	**7,707**	**7,707**	**7,707**
HARLINGEN IRRIGATION DISTRICT								
PALM VALLEY	**CAMERON**	**NUECES-RIO GRANDE**	331	331	331	331	331	331
PALM VALLEY ESTATES UD	**CAMERON**	**NUECES-RIO GRANDE**	81	94	104	112	119	125
COUNTY-OTHER	**CAMERON**	**NUECES-RIO GRANDE**	4,692	4,692	4,692	4,692	4,692	4,692
TOTAL			5,104	5,117	5,127	5,135	5,142	5,148
HARLINGEN WATER WORKS SYSTEM								
HARLINGEN	CAMERON	NUECES-RIO GRANDE	16,620	16,620	16,620	16,620	16,620	16,620
COMBES	CAMERON	NUECES-RIO GRANDE	430	430	430	430	430	430
EAST RIO HONDO WSC	CAMERON	NUECES-RIO GRANDE	221	221	221	221	221	221
MILITARY HIGHWAY WSC	CAMERON	NUECES-RIO GRANDE	484	484	484	484	484	484
MILITARY HIGHWAY WSC	CAMERON	RIO GRANDE	484	484	484	484	484	484
MILITARY HIGHWAY WSC	HIDALGO	NUECES-RIO GRANDE	1	1	1	1	1	1
MILITARY HIGHWAY WSC	HIDALGO	RIO GRANDE	1	1	1	1	1	1
PALM VALLEY	CAMERON	NUECES-RIO GRANDE	413	413	413	413	413	413
PRIMERA	CAMERON	NUECES-RIO GRANDE	584	584	584	584	584	584
TOTAL			**19,238**	**19,238**	**19,238**	**19,238**	**19,238**	**19,238**
HIDALGO COUNTY IRRIGATION DISTRICT #6								
MANUFACTURING	HIDALGO	NUECES-RIO GRANDE	2,475	2,475	2,475	2,475	2,475	2,475
MANUFACTURING	HIDALGO	NUECES-RIO GRANDE	3,466	3,466	3,466	3,466	3,466	3,466
COUNTY-OTHER	HIDALGO	NUECES-RIO GRANDE	2,232	2,232	2,232	2,232	2,232	2,232
COUNTY-OTHER	HIDALGO	RIO GRANDE	118	118	118	118	118	118
TOTAL			**8,291**	**8,291**	**8,291**	**8,291**	**8,291**	**8,291**
HIDALGO COUNTY WCID #1								
NORTH ALAMO WSC	HIDALGO	NUECES-RIO GRANDE	203	203	203	203	203	203
NORTH ALAMO WSC	WILLACY	NUECES-RIO GRANDE	203	203	203	203	203	203
SHARYLAND WSC	HIDALGO	NUECES-RIO GRANDE	406	406	406	406	406	406
COUNTY-OTHER	HIDALGO	NUECES-RIO GRANDE	625	625	625	625	625	625
TOTAL			**1,437**	**1,437**	**1,437**	**1,437**	**1,437**	**1,437**

HIDALGO COUNTY WCID #16								
LA JOYA	HIDALGO	NUECES-RIO GRANDE	7	7	7	7	7	7
LA JOYA	HIDALGO	RIO GRANDE	6	6	6	6	6	6
COUNTY-OTHER	HIDALGO	RIO GRANDE	517	517	517	517	517	517
COUNTY-OTHER	HIDALGO	NUECES-RIO GRANDE	517	517	517	517	517	517
TOTAL			**1,047**	**1,047**	**1,047**	**1,047**	**1,047**	**1,047**
HIDALGO COUNTY WCID #2								
ALAMO	HIDALGO	NUECES-RIO GRANDE	1,804	1,804	1,804	1,804	1,804	1,804
MCALLEN	HIDALGO	NUECES-RIO GRANDE	3,820	3,820	3,820	3,820	3,820	3,820
MCALLEN	HIDALGO	RIO GRANDE	3,820	3,820	3,820	3,820	3,820	3,820
PHARR	HIDALGO	NUECES-RIO GRANDE	5,743	5,743	5,743	5,743	5,743	5,743
SAN JUAN	HIDALGO	NUECES-RIO GRANDE	2,707	2,707	2,707	2,707	2,707	2,707
COUNTY-OTHER	HIDALGO	RIO GRANDE	1,175	1,175	1,175	1,175	1,175	1,175
COUNTY-OTHER	HIDALGO	NUECES-RIO GRANDE	1,175	1,175	1,175	1,175	1,175	1,175
NORTH ALAMO WSC	HIDALGO	NUECES-RIO GRANDE	329	329	329	329	329	329
NORTH ALAMO WSC	WILLACY	NUECES-RIO GRANDE	328	328	328	328	328	328
COUNTY-OTHER	CAMERON	NUECES-RIO GRANDE	3,766	3,766	3,766	3,766	3,766	3,766
TOTAL			**24,667**	**24,667**	**24,667**	**24,667**	**24,667**	**24,667**
HIDALGO COUNTY WCID #3								
MCALLEN	HIDALGO	NUECES-RIO GRANDE	6,990	6,990	6,990	6,990	6,990	6,990
MCALLEN	HIDALGO	RIO GRANDE	6,990	6,990	6,990	6,990	6,990	6,990
TOTAL			**13,980**	**13,980**	**13,980**	**13,980**	**13,980**	**13,980**
HIDALGO-CAMERON WCID #9								
EDCOUCH	HIDALGO	NUECES-RIO GRANDE	1,340	1,340	1,340	1,340	1,340	1,340
ELSA	HIDALGO	NUECES-RIO GRANDE	1,840	1,840	1,840	1,840	1,840	1,840
LA VILLA	HIDALGO	NUECES-RIO GRANDE	500	500	500	500	500	500
MERCEDES	HIDALGO	NUECES-RIO GRANDE	2,580	2,580	2,580	2,580	2,580	2,580
WESLACO	HIDALGO	NUECES-RIO GRANDE	5,240	5,240	5,240	5,240	5,240	5,240
TOTAL			**11,500**	**11,500**	**11,500**	**11,500**	**11,500**	**11,500**

LA FERIA WCID #3									
	LA FERIA	CAMERON	NUECES-RIO GRANDE	1,800	1,800	1,800	1,800	1,800	1,800
	SANTA ROSA	CAMERON	NUECES-RIO GRANDE	900	900	900	900	900	900
	SEBASTIAN MUD	WILLACY	NUECES-RIO GRANDE	300	300	300	300	300	300
	LA FERIA	CAMERON	NUECES-RIO GRANDE	1,852	1,852	1,852	1,852	1,852	1,852
TOTAL				**4,852**	**4,852**	**4,852**	**4,852**	**4,852**	**4,852**
LA JOYA WSC									
	PALMVIEW	HIDALGO	NUECES-RIO GRANDE	869	1,199	1,570	1,967	1,967	1,967
	SULLIVAN CITY	HIDALGO	RIO GRANDE	685	858	1,029	1,029	1,029	1,029
TOTAL				**1,554**	**2,057**	**2,599**	**2,996**	**2,996**	**2,996**
LAGUNA MADRE WD									
	LAGUNA MADRE WD	CAMERON	NUECES-RIO GRANDE	3,948	3,948	3,948	3,948	3,948	3,948
	LAGUNA VISTA	CAMERON	NUECES-RIO GRANDE	1,022	1,022	1,022	1,022	1,022	1,022
	PORT ISABEL	CAMERON	NUECES-RIO GRANDE	756	756	756	756	756	756
	SOUTH PADRE ISLAND	CAMERON	NUECES-RIO GRANDE	1,754	1,754	1,754	1,754	1,754	1,754
TOTAL				**7,480**	**7,480**	**7,480**	**7,480**	**7,480**	**7,480**
MCALLEN CITY OF									
	MCALLEN	HIDALGO	NUECES-RIO GRANDE	32,424	32,424	32,424	32,424	32,424	32,424
	EDINBURG	HIDALGO	NUECES-RIO GRANDE	1,120	1,120	1,120	1,120	1,120	1,120
	MCALLEN	HIDALGO	RIO GRANDE	4	4	4	4	4	4
TOTAL				**33,548**	**33,548**	**33,548**	**33,548**	**33,548**	**33,548**
NORTH ALAMO WSC									
	NORTH ALAMO WSC	HIDALGO	NUECES-RIO GRANDE	20,658	20,785	20,899	21,007	21,117	21,219
	NORTH ALAMO WSC	WILLACY	NUECES-RIO GRANDE	1,296	1,169	1,055	947	837	741
	COUNTY-OTHER	HIDALGO	RIO GRANDE	264	264	264	264	264	264
TOTAL				**22,218**	**22,218**	**22,218**	**22,218**	**22,218**	**22,224**
MILITARY HIGHWAY WSC									
	LOS INDIOS	CAMERON	NUECES-RIO GRANDE	230	271	311	354	396	439
	MILITARY HIGHWAY WS(	CAMERON	NUECES-RIO GRANDE	1,455	1,610	1,597	1,610	1,561	1,518
	MILITARY HIGHWAY WS(	CAMERON	RIO GRANDE	21	25	29	33	31	29
	MILITARY HIGHWAY WS(	HIDALGO	NUECES-RIO GRANDE	1,325	1,382	1,309	1,200	1,128	1,063
	MILITARY HIGHWAY WS(	HIDALGO	RIO GRANDE	13	15	17	20	19	17
	PROGRESO	HIDALGO	NUECES-RIO GRANDE	576	717	867	1,037	1,234	1,436
TOTAL				**3,620**	**4,020**	**4,130**	**4,254**	**4,369**	**4,502**

SHARYLAND WSC									
	ALTON	HIDALGO	NUECES-RIO GRANDE	3,346	4,153	2,615	2,637	2,653	2,666
	EDINBURG	HIDALGO	NUECES-RIO GRANDE	1,120	1,120	1,120	1,120	1,120	1,120
	PALMHURST	HIDALGO	NUECES-RIO GRANDE	1,157	1,789	2,706	2,967	3,170	3,324
	SHARYLAND WSC	HIDALGO	NUECES-RIO GRANDE	6,517	5,077	5,698	5,416	5,196	5,030
TOTAL				**12,140**	**12,139**	**12,139**	**12,140**	**12,139**	**12,140**
SOUTHMOST REGIONAL WATER AUTHORITY									
	BROWNSVILLE	CAMERON	NUECES-RIO GRANDE	3,903	3,903	3,903	3,903	3,903	3,903
	BROWNSVILLE	CAMERON	RIO GRANDE	3,902	3,902	3,902	3,902	3,902	3,902
	INDIAN LAKE	CAMERON	NUECES-RIO GRANDE	16	16	16	16	16	16
	LOS FRESNOS	CAMERON	NUECES-RIO GRANDE	1,915	1,915	1,915	1,915	1,915	1,915
	VALLEY MUD #2	CAMERON	NUECES-RIO GRANDE	1,054	1,054	1,054	1,054	1,054	1,054
	VALLEY MUD #2	CAMERON	RIO GRANDE	1,054	1,054	1,054	1,054	1,054	1,054
TOTAL				**11,844**	**11,844**	**11,844**	**11,844**	**11,844**	**11,844**
UNITED IRRIGATION DISTRICT									
	MCALLEN	HIDALGO	NUECES-RIO GRANDE	5,625	5,625	5,625	5,625	5,625	5,625
	MCALLEN	HIDALGO	RIO GRANDE	5,625	5,625	5,625	5,625	5,625	5,625
	MISSION	HIDALGO	NUECES-RIO GRANDE	7,175	7,175	7,175	7,175	7,175	7,175
	SHARYLAND WSC	HIDALGO	NUECES-RIO GRANDE	5,584	5,584	5,584	5,584	5,584	5,584
TOTAL				**24,009**	**24,009**	**24,009**	**24,009**	**24,009**	**24,009**
VALLEY MUD #2									
	RANCHO VIEJO	CAMERON	NUECES-RIO GRANDE	373	496	627	755	888	1,015
	COMBES	CAMERON	NUECES-RIO GRANDE	1,009	886	755	627	494	367
TOTAL				**1,382**	**1,382**	**1,382**	**1,382**	**1,382**	**1,382**
WEBB COUNTY WATER UTILITY									
	EL CENIZO	WEBB	RIO GRANDE	880	910	927	938	946	952
	RIO BRAVO	WEBB	RIO GRANDE	1,234	1,205	1,188	1,177	1,169	1,164
	WEBB COUNTY WATER UTILITY	WEBB	RIO GRANDE	197	196	196	196	196	196
TOTAL				**2,311**	**2,311**	**2,311**	**2,311**	**2,311**	**2,312**
REGION M TOTAL				**254,432**	**255,313**	**255,975**	**256,505**	**256,626**	**256,773**

2010 Regional Water Plan								
Municipal Water Demand Projections for 2010 - 2060 (in acft)								
Region M								
Region	**WUG Name**	**County Name**	**D2010**	**D2020**	**D2030**	**D2040**	**D2050**	**D2060**
M	BROWNSVILLE	CAMERON	45,312	54,105	62,990	72,260	81,481	90,584
M	COMBES	CAMERON	208	229	256	281	309	341
M	COUNTY-OTHER	CAMERON	6,970	7,812	8,709	9,572	10,485	11,424
M	EAST RIO HONDO WSC	CAMERON	2408	3,107	3,862	4,555	5,323	6,052
M	EL JARDIN	CAMERON	1,910	2,332	2,771	3,216	3,656	4,095
M	HARLINGEN	CAMERON	11,795	13,306	14,814	16,364	17,998	19,662
M	INDIAN LAKE	CAMERON	49	57	66	76	85	95
M	LA FERIA	CAMERON	855	1,031	1,214	1,403	1,587	1,777
M	LAGUNA MADRE WD	CAMERON	2,310	3,386	4,516	5,622	6,744	7,812
M	LAGUNA VISTA	CAMERON	329	399	476	554	633	713
M	LOS FRESNOS	CAMERON	767	1,008	1,247	1,490	1,745	1,988
M	LOS INDIOS	CAMERON	230	271	311	354	396	439
M	MILITARY HIGHWAY WSC	CAMERON	1,486	1,780	2,066	2,378	2,683	2,993
M	OLMITO WSC	CAMERON	952	1,314	1,691	2,060	2,444	2,809
M	PALM VALLEY	CAMERON	412	407	400	393	389	387
M	PALM VALLEY ESTATES UD	CAMERON	85	108	132	155	180	203
M	PORT ISABEL	CAMERON	2,645	2,846	3,052	3,254	3,470	3,681
M	PRIMERA	CAMERON	609	732	856	989	1,121	1,255
M	RANCHO VIEJO	CAMERON	320	311	305	297	295	292
M	RIO HONDO	CAMERON	429	459	490	520	556	593
M	SAN BENITO	CAMERON	4,916	5,484	6,050	6,630	7,241	7,863
M	SANTA ROSA	CAMERON	331	376	429	478	531	588
M	SOUTH PADRE ISLAND	CAMERON	2,504	3,136	3,789	4,443	5,095	5,722
M	VALLEY MUD #2	CAMERON	858	854	850	846	843	843
		CAMERON Total	**88,690**	**104,850**	**121,342**	**138,190**	**155,290**	**172,211**
M	ALAMO	HIDALGO	1,703	2,413	3,243	4,172	5,178	6,276
M	ALTON	HIDALGO	1,208	3,401	4,275	5,253	6,312	7,469
M	COUNTY-OTHER	HIDALGO	7,833	9,886	13,072	16,626	20,536	24,981
M	DONNA	HIDALGO	2,101	2,537	2,904	3,316	3,761	4,245
M	EDCOUCH	HIDALGO	460	562	642	731	828	934
M	EDINBURG	HIDALGO	6,460	9,590	12,368	15,475	18,830	22,487
M	ELSA	HIDALGO	1,063	1,200	1,285	1,380	1,482	1,592
M	HIDALGO	HIDALGO	730	1,164	1,620	2,128	2,680	3,281
M	HIDALGO COUNTY MUD #1	HIDALGO	1,116	1,733	2,454	3,261	4,135	5,089

M	LA JOYA	HIDALGO	359	468	562	665	779	899
M	LA VILLA	HIDALGO	240	250	253	255	258	262
M	MCALLEN	HIDALGO	24,436	30,372	36,292	42,916	50,074	57,886
M	MERCEDES	HIDALGO	1,835	2,120	2,302	2,505	2,723	2,961
M	MILITARY HIGHWAY WSC	HIDALGO	1,195	1,405	1,649	1,923	2,220	2,544
M	MISSION	HIDALGO	7,579	11,408	14,776	18,540	22,607	27,037
M	NORTH ALAMO WSC	HIDALGO	8,706	12,317	16,535	21,261	26,374	31,959
M	PALMHURST	HIDALGO	622	1,168	1,805	2,519	3,292	4,135
M	PALMVIEW	HIDALGO	589	897	1,258	1,661	2,098	2,575
M	PENITAS	HIDALGO	149	161	168	176	184	193
M	PHARR	HIDALGO	6,899	9,754	12,220	14,974	17,948	21,190
M	PROGRESO	HIDALGO	456	597	762	946	1,146	1,363
M	SAN JUAN	HIDALGO	2,497	3,720	5,149	6,750	8,482	10,373
M	SHARYLAND WSC	HIDALGO	4,420	5,036	5,755	6,561	7,432	8,384
M	SULLIVAN CITY	HIDALGO	403	557	737	939	1,158	1,396
M	WESLACO	HIDALGO	4,978	6,074	7,016	8,069	9,206	10,445
		HIDALGO Total	**88,037**	**118,790**	**149,102**	**183,002**	**219,723**	**259,956**
M	COUNTY-OTHER	JIM HOGG	147	153	159	164	167	165
M	HEBBRONVILLE (CDP)	JIM HOGG	705	747	799	840	873	864
		JIM HOGG Total	**852**	**900**	**958**	**1,004**	**1,040**	**1,029**
M	COUNTY-OTHER	MAVERICK	2,223	2,727	3,249	3,742	4,183	4,573
M	EAGLE PASS	MAVERICK	4,720	5,509	5,941	6,368	6,763	7,147
M	EL INDIO WSC	MAVERICK	968	1,293	1,637	1,962	2,244	2,502
		MAVERICK Total	**7,911**	**9,529**	**10,827**	**12,072**	**13,190**	**14,222**
M	COUNTY-OTHER	STARR	4,866	6,228	7,663	9,141	10,663	12,141
M	LA GRULLA	STARR	643	871	927	989	1,054	1,124
M	RIO GRANDE CITY	STARR	2,404	3,020	3,362	3,719	4,085	4,454
M	RIO WSC	STARR	351	498	654	815	978	1,138
M	ROMA CITY	STARR	2,413	3,008	3,460	3,930	4,406	4,881
		STARR Total	**10,677**	**13,625**	**16,066**	**18,594**	**21,186**	**23,738**
M	COUNTY-OTHER	WEBB	1,226	1,388	1,575	1,786	2,025	2,296
M	EL CENIZO	WEBB	417	697	1,027	1,396	1,801	2,245
M	LAREDO	WEBB	39,558	52,517	67,741	84,788	103,541	124,038
M	RIO BRAVO	WEBB	759	1,137	1,581	2,078	2,625	3,222
M	WEBB COUNTY WATER UTILITY	WEBB	158	247	350	467	594	734
		WEBB Total	**42,118**	**55,986**	**72,274**	**90,515**	**110,586**	**132,535**

M	COUNTY-OTHER	WILLACY	216	215	213	212	211	210
M	LYFORD	WILLACY	290	343	369	393	417	436
M	NORTH ALAMO WSC	WILLACY	613	773	930	1,073	1,188	1,267
M	RAYMONDVILLE	WILLACY	1,668	1,726	1,783	1,834	1,876	1,904
M	SAN PERLITA	WILLACY	99	109	118	127	134	139
M	SEBASTIAN MUD	WILLACY	212	267	321	371	411	438
		WILLACY Total	**3,098**	**3,433**	**3,734**	**4,010**	**4,237**	**4,394**
M	COUNTY-OTHER	ZAPATA	1,001	1,232	1,514	1,792	2,048	2,293
M	ZAPATA (CDP)	ZAPATA	1,050	1,050	1,050	1,050	1,050	1,050
		ZAPATA Total	**2,051**	**2,282**	**2,564**	**2,842**	**3,098**	**3,343**
		Region M Total	**252,043**	**414,245**	**498,209**	**588,419**	**683,640**	**783,639**

2010 Regional Water Plan

Manufacturing Water Demand Projections for 2010 - 2060 (in acft[1])

Region M

Region	County Name[2)]	D2010	D2020	D2030	D2040	D2050	D2060
M	CAMERON	4,156	4,590	4,983	5,372	5,709	6,165
M	HIDALGO	3,236	3,559	3,851	4,143	4,403	4,742
M	JIM HOGG	0	0	0	0	0	0
M	MAVERICK	64	69	73	77	80	85
M	STARR	0	0	0	0	0	0
M	WEBB	28	31	34	37	39	42
M	WILLACY	25	25	25	25	25	25
M	ZAPATA	0	0	0	0	0	0
	Region M Total	**7,509**	**8,274**	**8,966**	**9,654**	**10,256**	**11,059**

[1)] An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.
[2)] If the "(P)" is present for a county entry, then the county has been split by Regional boundaries and the data listed in the row represent only the county's water demands within the particular region, not the county's total.

2011 Regional Water Plan							
Steam Electric Water Demand Projections for 2010 - 2060 (in acft[1])							
Region M							
Region	**County Name[2)]**	**D2010**	**D2020**	**D2030**	**D2040**	**D2050**	**D2060**
M	CAMERON	1,616	1,523	1,780	2,094	2,477	2,944
M	HIDALGO	10,355	14,151	16,545	19,462	23,018	27,354
M	JIM HOGG	0	0	0	0	0	0
M	MAVERICK	0	0	0	0	0	0
M	STARR	0	0	0	0	0	0
M	WEBB	1,492	1,190	1,391	1,636	1,935	2,300
M	WILLACY	0	0	0	0	0	0
M	ZAPATA	0	0	0	0	0	0
	Region M Total	**13,463**	**16,864**	**19,716**	**23,192**	**27,430**	**32,598**

1) An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.
2) If the "(P)" is present for a county entry, then the county has been split by Regional boundaries and the data listed in the row represent only the county's water demands within the particular region, not the county's total.

2010 Regional Water Plan							
Livestock Water Demand Projections for 2010 - 2060 (in acft[1])							
Region M							
Region	**County Name[2)]**	**D2010**	**D2020**	**D2030**	**D2040**	**D2050**	**D2060**
M	CAMERON	1,103	1,103	1,103	1,103	1,103	1,103
M	HIDALGO	681	681	681	681	681	681
M	JIM HOGG	518	518	518	518	518	518
M	MAVERICK	260	260	260	260	260	260
M	STARR	1,117	1,117	1,117	1,117	1,117	1,117
M	WEBB	1,513	1,513	1,513	1,513	1,513	1,513
M	WILLACY	151	151	151	151	151	151
M	ZAPATA	474	474	474	474	474	474
	Region M Total	**5,817**	**5,817**	**5,817**	**5,817**	**5,817**	**5,817**

1) An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.
2) If the "(P)" is present for a county entry, then the county has been split by Regional boundaries and the data listed in the row represent only the county's water demands within the particular region, not the county's total.

2010 Regional Water Plan							
Irrigation Water Demand Projections for 2010 - 2060 (in acft[1])							
Region M							
Region	County Name[2)]	D2010	D2020	D2030	D2040	D2050	D2060
M	CAMERON	367404	347771	325144	325144	325144	325144
M	HIDALGO	583,030	525,971	453,772	453,772	453,772	453,772
M	JIM HOGG	817	817	817	817	817	817
M	MAVERICK	95,040	91,693	87,863	87,863	87,863	87,863
M	STARR	31,191	30,108	29,070	29,070	29,070	29,070
M	WEBB	20,507	19,548	18,654	18,654	18,654	18,654
M	WILLACY	59,191	60,203	60,203	60,203	60,203	60,203
M	ZAPATA	6,454	6,121	5,805	5,805	5,805	5,805
	Region M Total	**1,163,634**	**1,082,232**	**981,328**	**981,328**	**981,328**	**981,328**

1) An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.
2) If the "(P)" is present for a county entry, then the county has been split by Regional boundaries and the data listed in the row represent only the county's water demands within the particular region, not the county's total.

2010 Regional Water Plan							
Mining Water Demand Projections for 2010 - 2060 (in acft[1])							
Region M							
Region	County Name[2)]	D2010	D2020	D2030	D2040	D2050	D2060
M	CAMERON	6	6	6	6	6	6
M	HIDALGO	1,442	1,561	1,633	1,704	1,774	1,836
M	JIM HOGG	33	36	37	38	39	40
M	MAVERICK	156	162	166	169	172	175
M	STARR	1,315	1,355	1,373	1,390	1,407	1,426
M	WEBB	1,204	1,192	1,189	1,187	1,185	1,180
M	WILLACY	6	6	6	6	6	6
M	ZAPATA	24	23	23	23	23	23
	Region M Total	**4,186**	**4,341**	**4,433**	**4,523**	**4,612**	**4,692**

1) An acft is an amount of water to cover one acre with one foot of water and equals 325,851 gallons.
2) If the "(P)" is present for a county entry, then the county has been split by Regional boundaries and the data listed in the row represent only the county's water demands within the particular region, not the county's total.

Texas Water Development Board 2010 Regional Water Plan Regional and State Total Population Projections for 2010 - 2060						
REGION	**P2010**	**P2020**	**P2030**	**P2040**	**P2050**	**P2060**
A - Panhandle	388,104	423,380	453,354	484,954	516,729	541,035
B - Region B	210,642	218,918	223,251	224,165	223,215	221,734
C - Region C	6,649,684	7,944,665	9,140,995	10,365,152	11,608,488	13,004,766
D - North East Texas	771,711	842,470	908,045	977,354	1,072,095	1,210,788
E - Far West Texas	863,190	1,032,970	1,175,743	1,298,436	1,420,877	1,542,824
F - Region F	618,889	656,480	682,132	700,806	714,045	724,094
G - Brazos G	1,811,226	2,121,615	2,413,413	2,705,355	2,994,701	3,277,741
H - Region H	6,020,078	6,995,442	7,986,480	8,998,002	10,132,237	11,346,082
I - East Texas	1,090,382	1,166,057	1,232,138	1,294,976	1,377,760	1,482,448
J - Plateau	135,723	158,645	178,342	190,551	198,594	205,910
K - Lower Colorado	1,412,834	1,714,282	2,008,142	2,295,627	2,580,533	2,831,937
L - South Central Texas	2,460,599	2,892,933	3,292,970	3,644,661	3,984,258	4,297,786
M - Rio Grande	1,628,278	2,030,994	2,470,814	2,936,748	3,433,188	3,935,223
N - Costal Bend	616,406	693,203	757,690	809,913	853,227	884,928
O - Llano - Estacado	489,522	518,601	537,428	548,634	550,126	548,264
P - Lavaca	49,491	51,419	52,138	51,940	51,044	49,663
Texas State Total	**25,216,759**	**29,462,074**	**33,513,075**	**37,527,274**	**41,711,117**	**46,105,223**

References

"U.S. GAO - Energy-Water Nexus: Many Uncertainties Remain about National and Regional Effects of Increased Biofuel Production on Water Resources." *U.S. Government Accountability Office (U.S. GAO)*. Web. 20 Jan. 2010. <http://www.gao.gov/products/GAO-10-116>.

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CHAPTER 3.0: EVALUATION OF THE ADEQUACY OF CURRENT WATER SUPPLIES

3.1 INTRODUCTION

An understanding of the availability of current water supplies is critical to effectively plan for meeting the future water demands that are projected to occur in the Rio Grande Regional Water Planning Area (RGRWPA). Both surface water and groundwater are currently used within the region; however, surface water from the Rio Grande provides the vast majority of the supply for municipal, industrial, and irrigation purposes. The dependence upon surface water from the Rio Grande as the predominant source of supply for the RGRWPA is not expected to change over the next 50 years.

Guidelines from the Texas Water Development Board (TWDB) pursuant to the provisions of 31 TAC 357 regarding regional water supply planning require that data be developed regarding the current water supplies available to the RGRWPA for each decade through the year 2060. These data have been compiled and summarized using specific data entry forms provided by the TWDB. The first, referred to in the TWDB guidelines as "Form 1," summarizes the total quantities of water available to the region from individual and unique sources, including amounts of water available by river basin, by river or stream course, by reservoir, by aquifer, and by county. The second form, referred to by the TWDB as "Form 2," contains information similar to Form 1, but presents it for specific "water user groups" by county in the RGRWPA. Water user groups (WUGs) typically are cities or communities that provide water to their citizens and to other users in adjacent areas; however, they also can include utilities or groups of utilities that provide water for municipal use, rural or unincorporated areas relying on local water supply sources or served by small water supply entities. WUGs also are designated for certain water use categories aggregated on a county basis, such as manufacturing, steam electric power generation, mining, irrigation, and/or livestock. The last form developed by the TWDB, "Form 3," is intended to present a summary of the available current water supplies for entities designated as "wholesale water providers". For the RGRWPA, no wholesale water providers have been designated; therefore, Form 3 has not been used. The data and procedures used in developing the current water supply amounts for the region and a discussion of these results are presented in subsequent sections of this chapter.

A general indication of the quantities of water that are projected to be available by decade in the RGRWPA over the next 50 years based on current supplies is provided by the bar chart in Figure 3.1. The distribution of these available supplies among various water use categories is indicated on each of the bars in the chart. As is the case today, most of the available water supply is projected to be used for irrigation of crops over the next 50 years; however, as urbanization continues to encroach into agricultural areas and as the overall agricultural economy is potentially diminished, the indicated available supplies of irrigation water are likely to be reduced as demands for municipal and manufacturing water increase. The portions of the available supplies derived from surface water and from groundwater each decade also are plotted on the chart. As shown, surface water, almost entirely from Amistad and Falcon Reservoirs on the Rio Grande, will provide most of the available supply for the region.

It is important to recognize that the current water supply information for the RGRWPA as presented on the bar chart in Figure 3.1 reflects certain limiting criteria and assumptions set forth by the TWDB in its guidelines for conducting regional water supply planning studies.

First of all, the available current water supply amounts reflect "drought of record" conditions. This means that they represent the annual amounts of water that would be available if the worst drought known to have previously occurred in the region as documented by existing hydrologic records should reoccur in the future. As will be discussed later, much of the Rio Grande Basin in Texas and Mexico currently is experiencing an extended drought, and this drought very likely could be the new drought of record for the river with respect to Amistad and Falcon Reservoirs and the water supplies these reservoirs provide to the United States and Mexico, exceeding the severity of the drought of the 1950s. Hence, the firm annual yield[1] of the Amistad-Falcon reservoir system with respect to United States water as determined by the hydrologic conditions corresponding to the drought of record may be changing, and, of course, it is the firm annual yield of these reservoirs that limits, to a large extent, the available supply of water in the RGRWPA. Other factors that have been considered in establishing the amounts of water available for the RGRWPA based on current supplies include the current capacity of existing groundwater well fields; the hydrogeologic properties of aquifers in the region; the quality of existing water supplies with regard to usability; current water rights, permits, and other regulatory restrictions; the hydraulic capacity of existing conveyance infrastructure; current contracts and/or option agreements; and obligations that a WUG may have in terms of contracts or direct/indirect water sales to other WUGs. In some instances, one or more of these factors have determined the available water supply of individual water users.

This chapter presents information regarding the baseline data used to develop the future water supply estimates for the RGRWPA and describes the procedures and methodologies applied in analyzing current water supply sources for the region as a whole and for individual water users (WUGs). Also included are descriptions of and results from special studies that have been undertaken as part of the overall investigation of the available supplies of water for the RGRWPA, including an

[1] The firm annual yield of a reservoir or a system of reservoirs is defined as the maximum amount of water that can be withdrawn from the reservoir(s) each year during the occurrence of the drought of record without causing the reservoir(s) to go dry.

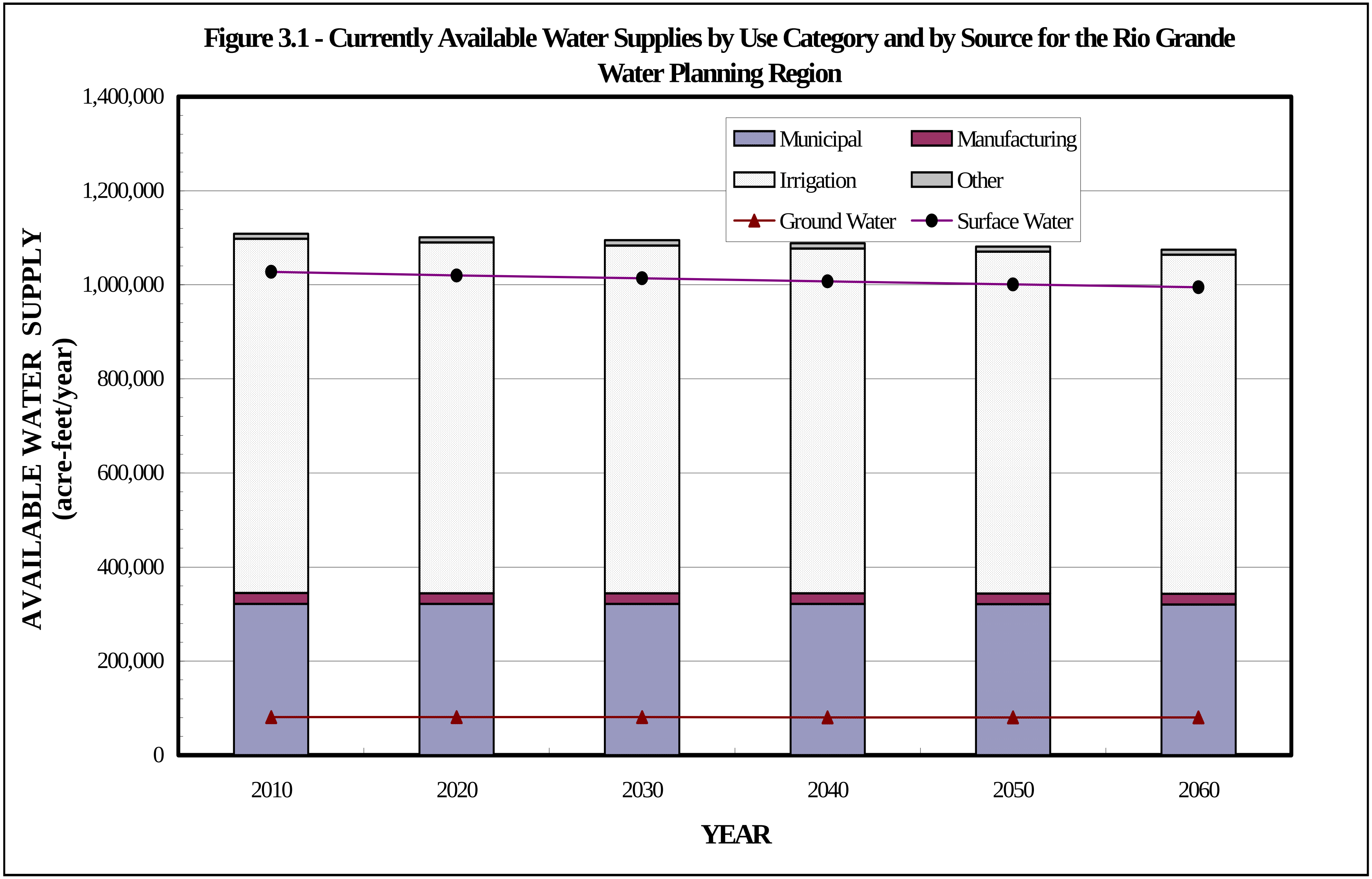

Figure 3.1 - Currently Available Water Supplies by Use Category and by Source for the Rio Grande Water Planning Region
AVAILABLE WATER SUPPLY (acre-feet/year)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Municipal
Manufacturing
Irrigation
Other
Ground Water
Surface Water
2010
2020
2030
2040
2050
2060
YEAR

evaluation of the extent to which Rio Grande water could be delivered to municipalities in the Lower Rio Grande Valley during a severe drought without the benefit of irrigation carrying water in the river or in the irrigation district canal systems, an analysis of the potential impacts of Mexico's water use and tributary reservoir development on the yield of the international reservoirs on the Rio Grande and the supply of surface water available to the United States from the Rio Grande under the 1944 Treaty, and a review of the quality of the surface water and groundwater supplies that are projected to be available to the RGRWPA.

3.2 SURFACE WATER SOURCES

The RGRWPA includes eight counties that encompass portions of three river or coastal basins, the Rio Grande Basin, the Nueces River Basin, and the Nueces-Rio Grande Coastal Basin. The RGRWPA counties are identified on the map of the region in Figure 3.2 along with the boundaries of the three basins.

Although water users are located in all three of these basins within the RGRWPA, practically all rely upon surface water from the Rio Grande or groundwater for their water supplies. Some very limited use is made of surface water supplies available from tributaries of the Rio Grande in Maverick, Webb, Zapata, and Starr counties; from the Arroyo Colorado, which flows through southern Hidalgo County and northern Cameron County to the Laguna Madre; from the pilot channels within the floodways that convey local runoff and floodwaters from the Rio Grande through the Lower Rio Grande Valley to the Laguna Madre; and from isolated lakes and resacas in Hidalgo and Cameron counties.

3.2.1 Rio Grande

The Rio Grande Basin extends southward from the Continental Divide in southern Colorado through New Mexico and Texas to the Gulf of Mexico. The Rio Grande forms the international boundary between the United States and Mexico from El Paso, Texas, to the Gulf, a straight-line distance of about 700 miles and a river-mile distance of almost 1,250 miles. The entire Basin (United States and Mexico) covers approximately 355,500 square miles; however, only about half of this area yields runoff to the Rio Grande. The non-contributing areas drain into internal closed sub-basins. The area of the contributing watershed is approximately 176,000 square miles, of which about 89,000 square miles, or 50.4 percent, are located within the United States. A map of the entire Rio Grande Basin is presented in Figure 3.3.

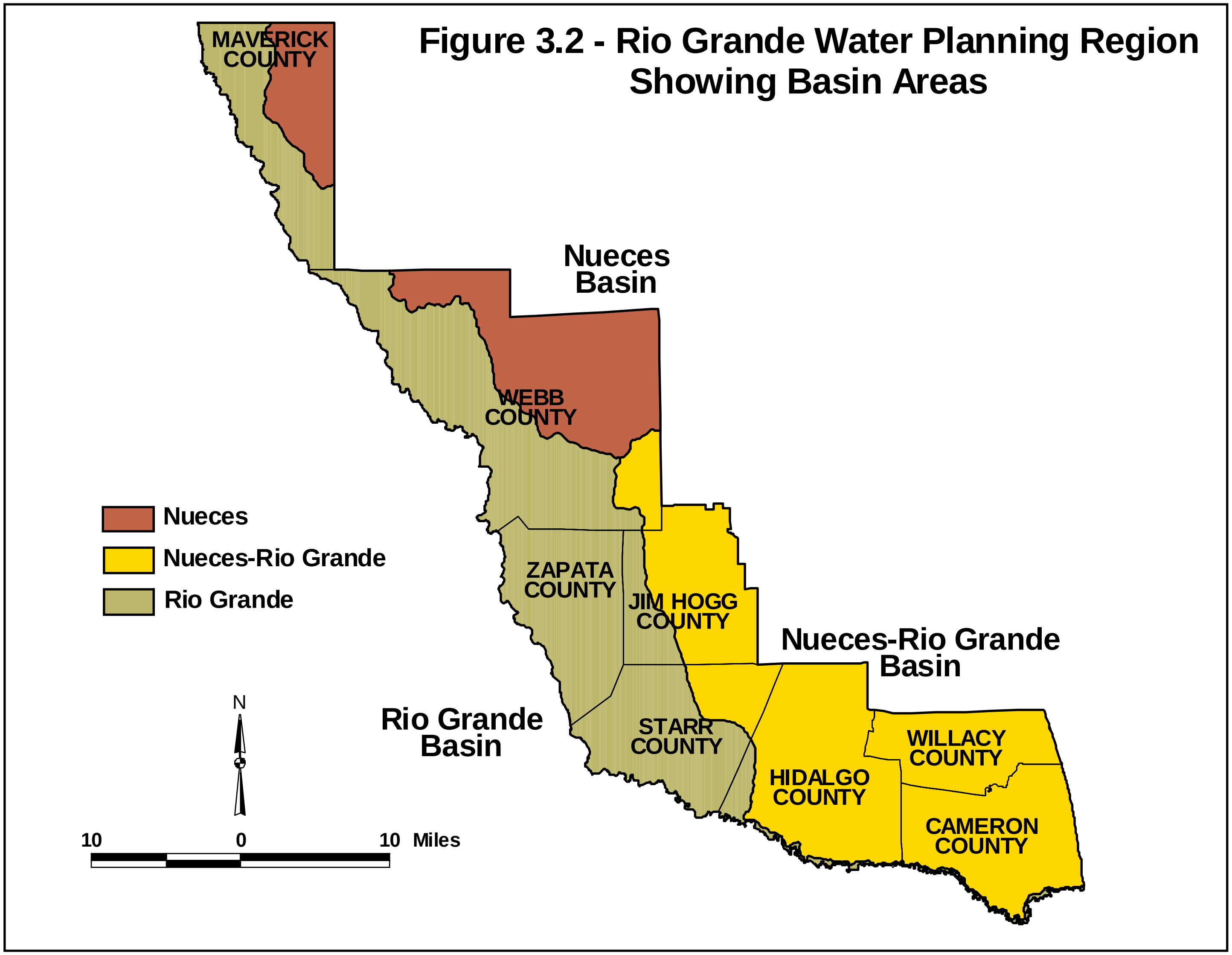
Figure 3.2 - Rio Grande Water Planning Region
Showing Basin Areas
MAVERICK COUNTY
Nueces Basin
WEBB COUNTY
ZAPATA COUNTY
JIM HOGG COUNTY
STARR COUNTY
HIDALGO COUNTY
WILLACY COUNTY
CAMERON COUNTY
Nueces-Rio Grande Basin
Rio Grande Basin
Nueces
Nueces-Rio Grande
Rio Grande
N
10
0
10 Miles

The Texas portion of the contributing watershed of the Rio Grande Basin encompasses about 54,000 square miles, or about one third of the total contributing watershed. In addition, there are about 8,100 square miles within the Texas portion of the basin that do not contribute runoff to the Rio Grande. These noncontributing areas extend generally southward from the New Mexico state line and include a large closed basin in portions of Hudspeth, Culberson, Jeff Davis, and Presidio counties in extreme western Texas.

The Pecos and Devils Rivers are the principal tributaries of the Rio Grande in Texas. Both of these rivers flow into the Amistad Reservoir on the Rio Grande, which is located upstream of Del Rio, Texas, about 600 river miles from the mouth of the Rio Grande. On the Mexican side, the Rio Conchos, Rio Salado, and Rio San Juan are the largest tributaries. The Rio Conchos drains over 26,000 square miles and flows into the Rio Grande near Presidio, Texas, about 350 river miles upstream of Amistad Reservoir. The Rio Salado has a drainage area of about 23,000 square miles and discharges directly into Falcon Reservoir on the Rio Grande. Falcon Reservoir is located between Laredo, Texas and Rio Grande City, Texas, about 275 river miles upstream from the Gulf of Mexico. The Rio San Juan enters the Rio Grande about 36 river miles below Falcon Dam near Rio Grande City. The drainage area of the Rio San Juan covers about 13,000 square miles.

The Pecos River at this time is dealing with effects of saltcedar. Saltcedar is a plant that does more harm than good; it tends to grow faster than normal native plants. These saltcedars are of concern because of the hydraulic implications they have. One river mile has roughly 30 to 40 acres of saltcedar. An invasion of floodplain or river bank by saltcedar usually leads to depletion of stream/river flow, lowered water table, an increase in the area inundated by floods, and an increase in sedimentation production. Steps have been taken to get control of the problem; fire burn is the easiest way to top kill the saltcedar, however it does not kill the root. A study is being done on the chemical Arsenal which can help control for a year's time.

The Texas portion of the Rio Grande Basin is fairly broad upstream of the Devils River with a maximum width of about 200 miles. Downstream from the Devils River to below Falcon Dam, the Basin tapers down to a relatively narrow band bordering the Rio Grande and varying in width from 10 to 30 miles. In Hidalgo and Cameron counties, at the extreme lower end of the basin, the watershed is confined between levees and is generally less than a few miles in width. This system of levees and the associated drainage channels were constructed by the United States and Mexico to control flooding of the extensive agricultural and urbanized areas along the river in the Lower Rio Grande Valley.

The vast majority of the Rio Grande Basin is comprised of rural, undeveloped land that is used principally for farming and ranching operations. In Texas, the major urban centers include El Paso in the far western end of the state; Del Rio, Eagle Pass, and Laredo on the river in the central portion of the basin; and, Mission, McAllen, Harlingen, and Brownsville in the Lower Rio Grande Valley. Although these and most other cities in the Lower Valley actually are located outside of the contributing watershed of the Rio Grande, the river serves as the primary source for their water supplies. Substantial quantities of surface water are diverted from the Rio Grande in Texas to meet both municipal and agricultural demands. Much of this demand is in the Lower Rio Grande Valley where approximately over 1.2 million people reside and where irrigated farming is extensively practiced.

For the most part, the water that is diverted from the Rio Grande in the Lower Valley is not returned to the river either as irrigation tailwater or treated wastewater effluent because of the natural slope of the land away form the river due to historical depositions of sediment along the floodplain of the river. Generally, these return flows are discharged into interior drainage channels and floodways that ultimately flow into the Laguna Madre and the Gulf of Mexico. An exception is the city of Brownsville, which has a wastewater discharge into the Rio Grande.

3.2.1.1 Rio Grande Reservoirs

Amistad and Falcon Reservoirs are the two major international reservoirs that are located on the Rio Grande. These impoundments provide controlled storage for over 8 million acre-feet of water owned by the United States and Mexico, of which 2.25 million acre-feet are allocated for flood control purposes and 6.05 million acre-feet are reserved for silt and conservation storage (water supply). Falcon Reservoir, completed in 1953 and located on the river about midway between Laredo and McAllen, was the first major reservoir constructed on the Rio Grande under the 1944 Treaty between the United States and Mexico. Today, it is considered to be the "lowest major international dam or reservoir" on the river in accordance with the provisions of the 1944 Treaty. The United States has 58.6 percent (or 1.56 million acre-feet) of the silt and conservation storage in Falcon Reservoir; Mexico owns the balance, 1.10 million acre-feet. In Amistad Reservoir, which was completed in 1968 just upstream of Del Rio, the United States utilizes and controls 56.2 percent of the total conservation storage capacity, or about 1.77 million acre-feet. The remainder of the conservation storage capacity, 1.38 million acre-feet, is owned and used by Mexico. Together, Amistad and Falcon Reservoirs make available a substantial supply of water for the United States and Mexico, and they provide significant flood control benefits for properties along the middle and lower reaches of the river.

Anzalduas Dam, completed in 1960 just south of Mission, Texas, provides for the diversion of the United States' share of the Rio Grande floodwaters into an interior floodway system, and it also enables the gravity diversion of water into Mexico's main water supply canal, referred to as the Anzalduas Canal.

Figure 3.3 - Rio Grande Basin

Anzalduas Reservoir has a total storage capacity of about 15,000 acre-feet at its normal maximum operating level of 104.5 feet above mean sea level. Of this amount, between 3,037 and 4,214 acre-feet are available as conservation storage for use by the United States. Anzalduas Reservoir serves as a storage and flow regulation facility for partially controlling and managing the United States' share of water in the lower reach of the Rio Grande.

3.2.1.2 Mexican Tributary Reservoirs

To develop its water resources, Mexico has constructed an extensive system of reservoirs on tributaries of the Rio Grande whose combined storage capacity substantially exceeds the total storage capacity available to Mexico in Amistad and Falcon Reservoirs on the mainstem of the Rio Grande. Water stored in these tributary reservoirs is used for municipal, industrial, and irrigation purposes in the vicinity of the reservoirs and downstream along the tributaries and the Rio Grande. Because the 1944 Treaty between the United States and Mexico stipulates that the United States is to receive certain minimum quantities of inflows to the Rio Grande from some of the Mexican tributaries on which reservoirs have been constructed (see Section 3.2.1.6.1 of this report), the potential impacts of these reservoirs on the delivery of the required minimum amounts of water to the United States are of particular concern with regard to water supply planning for the RGRWPA.

This is especially critical since Mexico has stated that it does not operate its tributary reservoirs for the purpose of meeting its obligations under the 1944 Treaty, but rather, solely to capture water for meeting its own internal water demands. In light of the fact that Mexico currently has accrued a deficit with respect to the minimum tributary inflows to the Rio Grande required by the 1944 Treaty[2], the supply of water that will be available in the future to the United States and to the RGRWPA from Mexico remains somewhat uncertain.

The major reservoirs located in the Rio Grande Basin in Mexico are identified on the map in Figure 3.4. Pertinent features of these reservoirs are summarized in Table 3.1. As illustrated on the map, much of the reservoir development within Mexico has occurred in the Rio Conchos Basin in the State of Chihuahua. As noted previously, the Rio Conchos flows into the Rio Grande upstream of Amistad Reservoir, and it is one of the six Mexican tributaries of the Rio Grande that are named in the 1944 Treaty from which the United States is allocated a portion of the inflows to the Rio Grande.

As shown in Table 3.1, the combined conservation storage capacity of all of Mexico's major reservoirs on Rio Grande tributaries is approximately 6,358,000 acre-feet, which is about 2.5 times the available conservation storage capacity that Mexico has in Amistad and Falcon Reservoirs on the Rio Grande. The seven major tributary reservoirs located in the Rio Conchos Basin have a combined storage capacity of about 3,212,000 acre-feet, which includes the largest of the tributary reservoirs, La Boquilla, with a storage capacity of 2,353,500 acre-feet. Above Falcon Dam, including the Rio Conchos Basin, the combined storage capacity of the Mexican tributary reservoirs is approximately 4,424,000 acre-feet. Below Falcon Dam on the Rio Alamo and Rio San Juan, the combined storage capacity of the Mexican tributary reservoirs is about 1,934,000 acre-feet.

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[2] On March 10, 2005, the United States and Mexico jointly announced that Mexico supposedly had agreed to fully repay its deficit under the 1944 Treaty by the end of September 2005 through transfers of water stored in Amistad/Falcon Reservoirs and deliveries made at Anzalduas Dam.

The year in which construction of each of the tributary reservoirs was completed also is indicated in Table 3.1. As shown, the oldest tributary reservoir is La Boquilla on the Rio Conchos, which was completed in 1916. The most recent reservoirs were constructed in 1993, El Cuchillo on the Rio San Juan and Pico de Aguila on the Rio Florido in the Rio Conchos Basin, and in 2000, Las Blancas on the Rio Alamo, which diverts water and conveys it by canal to the existing Marte R. Gomez Reservoir on the Rio San Juan.

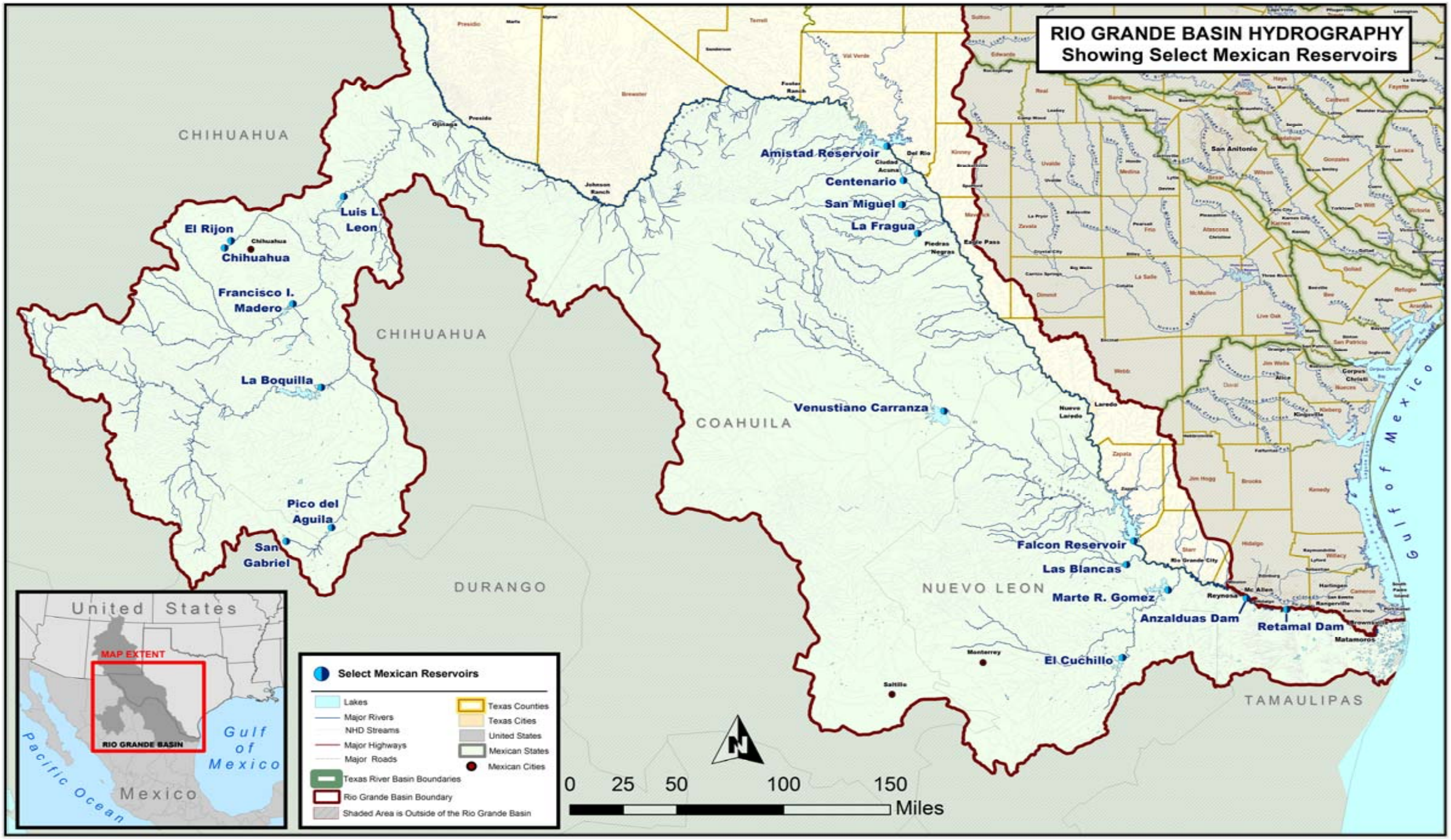
3.2.1.3 Rio Grande Flood Flow Operations

All of the mainstem dams and reservoirs located on the Rio Grande within Texas are under the sole supervision and control of the International Boundary and Water Commission (IBWC). The International Boundary Commission was originally created as a joint commission by the United States and Mexico at the Convention of March 1, 1889, for the purpose of establishing the exact boundary between the two countries. Now, following a change in its name by the 1944 Treaty, the United States Section of the IBWC functions as an arm of the U. S. Department of State and is responsible for addressing all boundary and water issues along the United States-Mexico border.

When the potential for flooding occurs, the reservoirs are operated by IBWC to minimize flood flows and flood damages along the middle and lower Rio Grande within the RGRWPA. Both the United States and Mexico maintain interior floodway systems in the Lower Rio Grande Valley that receive flood flows diverted from the Rio Grande during high runoff periods. Each of these floodways is designed to carry up to 105,000 cfs (cubic feet per second). With the floodway diversions, the design discharge for the river can be reduced from 250,000 cfs at Rio Grande City (River Mile 235[3]) to 20,000 cfs below Retamal Dam (i.e., the lowest point where flood waters are diverted into the Mexican floodway system). A discharge level of 20,000 cfs is considered to be the safe capacity of the levee reach of the lower Rio Grande through the Brownsville-Matamoros urban area; however, to the extent possible, IBWC attempts to limit flows through this reach to no greater than 15,000 cfs.

[3] The term "River Mile" refers to the distance in statute miles along the course of the Rio Grande upstream from its mouth at the Gulf of Mexico.

Figure 3.4: Major Reservoirs Located on Rio Grande Tributaries Within Mexico



Source: IBWC 2009

Table 3.1 - Pertinent Features of Major Reservoirs Located on Rio Grande and Tributaries in Mexico							
River Basin / Name	River	State	Year	Storage Capacity		Average Capacity	
			Closed	Million M^3	Acre-Feet	Million M^3	Acre-Feet
Rio Conchos Basin							
La Boquilla	Rio Conchos	Chihuahua	1916	2,903	2,353,501	1,634	1,324,705
La Colina	Rio Conchos	Chihuahua	1927	24	19,538	N/A	N/A
Francisco I. Madero	Rio San Pedro	Chihuahua	1948	348	282,128	218	176,735
Chihuahua	Rio Chuviscar	Chihuahua	1960	26	21,079	9	7,296
Luis L. Leon	Rio Conchos	Chihuahua	1968	356	288,614	391	316,989
San Gabriel	Rio Florido	Durango	1979	255	206,732	127	102,961
Pico del Aguila	Rio Florido	Chihuahua	1993	50	40,536	18	14,593
Rio Conchos Basin Total Reservoir Storage Capacity:				3,962	3,212,127	2,397	1,943,280
Rio San Diego Basin							
San Miguel	Rio San Diego	Coahuila	1935	20	16,214	6	4,864
Centenario	Rio San Diego	Coahuila	1936	26	21,322	11	8,918
Rio San Diego Basin Total Reservoir Storage Capacity:				46	37,536	17	13,782
Rio San Rodrigo Basin							
La Fragua	Rio San Rodrigo	Coahuila	1991	45	36,482	33	26,754
Rio San Rodrigo Basin Total Reservoir Storage Capacity:				45	36,482	33	26,754
Rio Salado Basin							
Venustiano Carranza	Rio Salado	Coahuila	1930	1,385	1,122,838	534	432,921
Laguna de Salinillas	Rio Salado	Nuevo Leon	1931	19	15,404	10	8,107
Rio Salado Basin Total Reservoir Storage Capacity:				1,404	1,138,241	544	441,028
Rio Alamo Basin (1)							
Las Blancas	Rio Alamo	Tamaulipas	2000	124	100,514	54	43,779
Rio Alamo Basin Total Reservoir Storage Capacity:					100,514	54	43,779
Rio San Juan Basin (1)							
Rodrigo Gomez (La B	Rio San Juan	Nuevo Leon	1957	41	33,239	31	25,132
El Cuchillo	Rio San Juan	Nuevo Leon	1993	1,123	910,512	554	449,135
Marte R. Gomez	Rio San Juan	Tamaulipas	1943	1,097	889,271	619	501,832
Rio San Juan Total Reservoir Storage Capacity:				2,261	1,833,023	1,204	976,099
Total Tributary Reservoir Storage Capacity:				7,718	6,357,923	4,232	3,444,722

Water in these reservoirs is dedicated to Mexico by treaty.

Mexico's Share of Conservation Storage in Major International Reservoirs on the Rio Grande							
River Basin / Name	River	State	Year	Storage Capacity		Average Capacity	
			Closed	Million M^3	Acre-Feet	Million M^3	Acre-Feet
Rio Grande Basin							
Falcon	Rio Grande	Tamaulipas	1953	1,355	1,098,674	N/A	N/A
Amistad	Rio Grande	Coahuila	1968	1,703	1,380,278	N/A	N/A
Total Rio Grande Reservoir Storage Capacity:				3,058	2,478,952	N/A	N/A

3.2.1.4 Rio Grande Normal Flow Operations

During non-flood periods, when low to average flows occur in the Rio Grande, requests for releases of water from the conservation storage pools in Amistad and Falcon Reservoirs are made to the IBWC by water users in both the United States and Mexico. In Texas, these requests are made through the Rio Grande Watermaster, an official employed by the Texas Commission on Environmental Quality (TCEQ).

Water users along the Rio Grande between Amistad and Falcon Reservoirs are delivered water released from Amistad Reservoir. Major municipal water users include the cities of Ciudad Acuna, Piedras Negras, and Nuevo Laredo in Mexico; and the cities of Eagle Pass and Laredo in Texas. Most of the water released from Amistad Reservoir is used for irrigation along the Rio Grande in both countries. The majority of the water diverted for irrigation along this reach in Texas is used in Maverick County.

Water released from Falcon Reservoir at the request of Mexico is diverted from the river primarily through the Anzalduas Canal, which has its headgates located in Anzalduas Reservoir near the city of Mission, Texas. The city of Matamoros, located downstream and across the river from Brownsville, also diverts water directly from the river for municipal and industrial use. In addition, there are several other small Mexican diverters that are unauthorized, but are known to pump water from the river for domestic and agricultural purposes. In Texas, water is diverted from the river at hundreds of locations extending along the entire length of the Rio Grande below Falcon Dam. The vast majority of the diversions are made by irrigation districts that supply water to agricultural users, as well as to municipalities and industries in the Lower Rio Grande Valley. The principal municipal water users include the cities of Raymondville, Harlingen, Brownsville, McAllen, Mission, Edinburg, Pharr, Weslaco, and Rio Grande City, and North Alamo Water Supply Corporation.

3.2.1.5 Rio Grande Watermaster

Requests for releases from the United States' conservation pools in Amistad and Falcon Reservoirs are administered and processed by the Rio Grande Watermaster under the purview of the TCEQ.

The Rio Grande Watermaster makes daily requests to the IBWC for releases from the reservoirs to meet municipal, industrial, and agricultural demands in the Lower Rio Grande Valley below Falcon Dam, as well as, along the mainstem of the Rio Grande in the Middle Rio Grande Valley between Falcon and Amistad Reservoirs. For some users at the extreme lower end of the river, the requests are made five to seven days in advance of need to allow for the travel time required for the released water from Falcon Reservoir to flow downstream along the more than 200 miles of river channel to the various points of diversion.

In determining the reservoir release amounts for downstream users, the Rio Grande Watermaster considers the quantity of water requested by all diverters and their respective locations along the river, potential channel losses and gains, watershed runoff and tributary inflows, channel and bank storage, waters impounded by instream weirs operated by individual diverters, and any available United States water that may be stored in Anzalduas Reservoir. To project the magnitude and timing of the releases needed to satisfy the requested individual diversions at their respective locations along the river, the Rio Grande Watermaster uses a series of seven river reaches below Falcon Dam and six river reaches between Amistad Dam and Falcon Reservoir, with each reach having a theoretical travel time equal to one day. These reaches are identified and described in Table 3.2. By knowing the number of days typically required for released water from either Amistad or Falcon Reservoirs to flow (travel) to the individual reaches under normal flow conditions, the Watermaster can schedule releases from the reservoirs in the proper amounts and on the proper days in response to the requested demands. To aid in the operation of the delivery system, the IBWC provides the Watermaster instantaneous data pertaining to streamflow rates at various locations along the river and preliminary estimates of the United States' share of these flows and of the water stored in Anzalduas Reservoir.

3.2.1.6 Rio Grande Water Allocations

3.2.1.6.1 United States - Mexico Treaties

Two treaties between the United States and Mexico contain basic provisions regarding the development and use of Rio Grande waters by the two countries. The 1906 Treaty[4] provides for delivery to Mexico by the United States of 60,000 acre-feet of water annually in the El Paso-Juarez Valley upstream from Fort Quitman, Texas. If shortages occur in the water supply for United States, then deliveries to Mexico are to be reduced in the same proportion as deliveries to the United States. The 1906 Treaty also includes a provision whereby Mexico "waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican Canal and Fort Quitman, Texas."

The 1944 Treaty between the United States and Mexico[5], which is administered by the IBWC, contains provisions relating to the allocation of Rio Grande waters along the reach of the river between Fort Quitman and the Gulf of Mexico, which includes the RGRWPA. This treaty provides for the allocation of all waters within this reach of the Rio Grande between the two countries and for the joint construction of as many as three major

[4] Convention between the United States and Mexico, Equitable Distribution of the Waters of the Rio Grande; Proclaimed January 16, 1907; Washington, D. C.

[5] "Treaty Between the United States and Mexico, Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande"; February 3, 1944; Washington, D. C.

international reservoirs on the mainstem of the river for water supply and flood control purposes.

Development of hydroelectric power at the reservoirs is also authorized under the treaty, with any hydropower generated divided equally between the two countries. Article 4 of the 1944 Treaty allocates the waters in the Rio Grande below Fort Quitman, Texas, between the United States and Mexico according to the following stipulations:

* "RM" refers to river miles upstream from the mouth of the Rio Grande at the Gulf of Mexico

A. To Mexico:

(a) All of the waters reaching the main channel of the Rio Grande (Rio Bravo) from the San Juan and Alamo Rivers, including the return flow from the lands irrigated from the latter two rivers.

(b) One-half of the flow in the main channel of the Rio Grande (Rio Bravo) below the lowest major international storage dam, so far as said flow is not specifically allotted under this Treaty to either of the two countries.

(c) Two-thirds of the flow reaching the main channel of the Rio Grande (Rio Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo, subject to the provisions of subparagraph (c) of Paragraph B of this Article.

(d) One-half of all other flows not otherwise allotted by this Article occurring in the main channel of the Rio Grande (Rio Bravo), including the contributions from all the unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam.

Table 3.2 – River Reaches Used by Rio Grande Watermaster for Facilitating Water Deliveries from Amistad and Falcon Reservoirs to Downstream Users

Middle Rio Grande

Reach 1	Amistad Dam (RM 571.8)* to the IBWC streamflow gage at Del Rio, Texas (RM 561.2)
Reach 2	IBWC streamflow gage at Del Rio, Texas (RM 561.2) to IBWC streamflow gage at Eagle Pass, Texas (RM 497.0)
Reach 3	IBWC streamflow gage at Eagle Pass, Texas (RM 497.0) to IBWC streamflow gage near El Indio, Texas (RM 460.4)
Reach 4	IBWC streamflow gage at El Indio, Texas (RM 460.4) to IBWC streamflow gage at Laredo, Texas (RM 359.8)
Reach 5	IBWC streamflow gage at Laredo, Texas (RM 359.8) to San Ygnacio, Texas (at the headwaters of Falcon Reservoir)
Reach 6	San Ygnacio, Texas (at the headwaters of Falcon Reservoir) to Falcon Dam (RM 274.8)

Lower Rio Grande

Reach 1	Falcon Dam (RM 274.8) to the IBWC streamflow gage at Rio Grande City, Texas (RM 235.0)
Reach 2	IBWC streamflow gage at Rio Grande City, Texas (RM 235.0) to Anzalduas Dam (RM 170.3)
Reach 3	Anzalduas Dam (RM 170.3) to Retamal Dam (RM 132.5)
Reach 4	Retamal Dam (RM 132.5) to the IBWC streamflow gage at San Benito, Texas (RM 96.8)
Reach 5	IBWC streamflow gage at San Benito, Texas (RM 96.8) to Cameron County WCID No. 6 river diversion point (RM 68.4)
Reach 6	Cameron County WCID No. 6 river diversion point (RM 68.4) to IBWC streamflow gage near Brownsville, Texas (RM 48.7)
Reach 7	IBWC streamflow gage near Brownsville, Texas (RM 48.7) to the Gulf of Mexico (RM 0.0)

B. To the United States:

(a) All of the waters reaching the main channel of the Rio Grande (Rio Bravo) from the Pecos and Devils Rivers, Good-enough Spring, and Alamito, Terlingua, San Felipe and Pinto Creeks.

(b) One-half of the flow in the main channel of the Rio Grande (Rio Bravo) below the lowest major international storage dam, so far as said flow is not specifically allotted under this Treaty to either of the two countries.

(c) One-third of the flow reaching the main channel of the Rio Grande (Rio Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo, provided that this third shall not be less, as an average amount in cycles of five consecutive years, than 350,000 acre-feet (431,721,000 cubic meters) annually. The United States shall not acquire any right by the use of the waters of the tributaries named in this subparagraph, in excess of the said 350,000 acre-feet (431,721,000 cubic meters) annually, except the right to use one-third of the flow reaching the Rio Grande (Rio Bravo) from said tributaries, although such one-third may be in excess of that amount.

(d) One-half of all other flows not otherwise allotted by this Article occurring in the main channel of the Rio Grande (Rio Bravo), including the contributions from all the unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam.

In the event of extraordinary drought or serious accident to the hydraulic systems on the measured Mexican tributaries, making it difficult for Mexico to make available the run-off of 350,000 acre-feet (431,721,000 cubic meters) annually, allotted in subparagraph (c) of paragraph B of this Article to the United States as the minimum contribution from the aforesaid Mexican tributaries, any deficiencies existing at the end of the aforesaid five-year cycle shall be made up in the following five-year cycle with water from the said measured tributaries.

Whenever the conservation capacities assigned to the United States in at least two of the major international reservoirs, including the highest major reservoir, are filled with waters belonging to the United States, a cycle of five years shall be Considered as terminated and all debits fully paid, where upon a new five-year cycle shall commence.

These treaty provisions are routinely applied by the IBWC to determine the ownership of waters between the United States and Mexico in the lower and middle Rio Grande. Historical data are available from the IBWC indicating the monthly quantities of each country's water that have flowed into the Rio Grande, that have been stored in Amistad and Falcon Reservoirs on the Rio Grande and in tributary reservoirs in each country, that have been released from the mainstem impoundments, that have been diverted from the Rio Grande, and that have passed the Brownsville streamflow gage and flowed to the Gulf of Mexico.

With regard to the repayment of deficits that may be incurred by Mexico under paragraph B(c) of Article 4 of the 1944 Treaty, the United States and Mexican Sections of the IBWC conducted investigations in 1969 that culminated in the joint issuance of Minute No. 234. This Minute established the starting date for water accounting pursuant to paragraph B(c) and outlined procedures and methods for making up deficiencies in the actual amounts of water delivered by Mexico to the United States under the terms of Article 4. Specifically, Mexico and the United States agreed to the following provisions as stated in Minute No. 234:

1. That accounting of the waters of the Rio Grande allotted to the United States from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo shall begin October 1, 1953.

2. That in the event of a deficiency in a cycle of five consecutive years in the minimum amount of water allotted to the United States from the said tributaries, the deficiency shall be made up in the following five-year cycle, together with any quantity of water which is needed to avoid a deficiency in the aforesaid following cycle, by one or a combination of the following means:

- *a. With water of that portion of the said tributary contributions to the Rio Grande allotted to the United States in excess of the minimum quantity guaranteed by the Water Treaty.*
- *b. With water of that portion of the said tributary contributions to the Rio Grande allotted to Mexico, when Mexico gives advance notice to the United States and the United States is able to conserve such water; and*
- *c. By transfer of Mexican waters in storage in the major international reservoirs, as determined by the Commission, provided that at the time of the transfer, United States storage capacity is available to conserve them.*

3. That the provisions of Article 4 of the Water Treaty relating to the waters of the Rio Grande from the Conchos, San Diego, San Rodrigo, *Escondido and Salado Rivers and the Las Vacas Arroyo allotted to the United States be considered satisfied to September 30, 1968.*

It is important to note here that Mexico has been in a deficit condition with respect to the minimum inflow requirements stipulated in paragraph B(c) of the 1944 Treaty for the United States from the six Mexican tributaries since the end of the five-year accounting cycle that ended October 2, 1997 (see Section 3.8.3 of this report). The total official deficit as of January 31, 2010 was 187,780 acre-feet.

3.2.1.6.2 Rio Grande Valley Water Case

The United States' share of water stored in Amistad and Falcon Reservoirs and diverted from the lower and middle Rio Grande for domestic, municipal, industrial, and irrigation purposes is administered by the TCEQ in compliance with the decision of the Thirteenth Court of Civil Appeals in the landmark case styled "State of Texas, et al. vs. Hidalgo County Water Control and Improvement District No. 18, *et al."* and commonly referred to as the Rio Grande Valley Water Case. The original suit was filed by the State of Texas in 1956 to restrain the diversion of water from the Rio Grande for irrigation when the share of water due the United States from water impounded in Falcon Reservoir was 50,000 acre-feet or less. The storage amount of 50,000 acre-feet was the quantity of water that the Texas Board of Water Engineers (a predecessor agency to the TCEQ) had determined at that time to be necessary to meet municipal, domestic and livestock demands for a three-month period without additional inflows into Falcon Reservoir. Earlier efforts to apply voluntary restrictions on diversions of water had collapsed due to severe drought conditions and the consequent shortage of water supplies.

The original trial of the Valley Water Case lasted from January 1964 to August 1966, and the final judgment of the appellate court was entered in 1969. In 1971, the Texas Water Rights Commission (a predecessor agency to the TCEQ) adopted rules and regulations implementing the court decision. According to the judgment rendered in this case, a storage reserve in Falcon Reservoir equal to 60,000 acre-feet was established to meet municipal and industrial demands, and a total of approximately 155,000 acre-feet of water rights (annual usage) were allocated for domestic, municipal, and industrial uses. Irrigation water from the Rio Grande was allocated for 742,808.6 acres of agricultural land below Falcon Dam. Of this amount, 641,221 acres were assigned Class A irrigation rights, and the remaining acres were awarded Class B irrigation rights.

Whereas municipal uses, which include uses for domestic, industrial, manufacturing, and steam electric power generation purposes, were granted the highest water supply priority, the result of the Valley Water Case was to establish a weighted priority system along the lower Rio Grande for allocating the remaining surface water supply to irrigation (and mining) uses.

The two classes of irrigation water rights that were established, (Class A and Class B) today provide a means for differentiating the rates at which water is credited to individual irrigation storage accounts in Amistad and Falcon Reservoirs. The Class A water right accrues water at a rate 1.7 times greater than the Class B water right. Although this weighted priority system for irrigation water users generally has little significance during years when water is abundant, its effect in water-short years is to distribute the shortage among all users, with the greater shortages occurring on lands with the Class B water rights.

In 1982, water rights in the Middle Rio Grande Basin; i.e., from Amistad Dam downstream to Falcon Reservoir, were adjudicated pursuant to Title 2, Subtitle B, Chapter 11, Subchapter G of the Texas Water Code. As a result of these proceedings, those water users located along the middle Rio Grande that were dependent upon water stored in Amistad or Falcon Reservoirs were assigned water rights based on the same allocation and accounting principles established in the Valley Water Case. Water users located on tributaries within the Middle Rio Grande Basin were assigned water rights based on the Prior Appropriation Doctrine.

Today, the Texas Rio Grande Watermaster is responsible for allocating the amount of water that can be diverted by each Class A and Class B irrigator and for supervising all use of water in the Lower and Middle Rio Grande Basins.

3.2.1.6.3 TCEQ Rio Grande Operating Rules

As a result of the Lower Rio Grande Valley Water Case, rules have been adopted by the State's water agencies, now the TCEQ, that regulate the operation of lower and middle Rio Grande system and the allocation of water among all users[6]. The rules applied by the TCEQ in administering mainstem water rights in the Lower and Middle Rio Grande Basins affect not only the amount of water that can be diverted from the Rio Grande and its tributaries, but also the operation of the storage pools in Amistad and Falcon Reservoirs. The current rules provide a reserve of 225,000 acre-feet of storage in Amistad and Falcon Reservoirs for domestic, municipal, and industrial uses, which is referred to as the "DMI pool," and an operating reserve that fluctuates between 380,000 acre-feet and 150,000 acre-feet, depending on the amount of water in conservation storage in the reservoirs. The stated purpose of the operating reserve in the TCEQ rules is to provide for: (1) loss of water by seepage, evaporation and conveyance; (2) emergency requirements; and, (3) adjustments of amounts in storage, as may be necessary by finalization of IBWC provisional United States-Mexico water ownership computations. The operating reserve is calculated monthly

[6] *"Chapter 303: Operation of the Rio Grande"; 31 Texas Administrative Code, §§ 303.1-303.73; Texas Water Commission Rules; August 26, 1987; Austin, Texas.*

by multiplying the percentage of total United States conservation storage in the Amistad-Falcon system times the maximum operating reserve of 380,000 acre-feet. The calculated reserve cannot be less than 275,000 acre-feet, unless there is insufficient water stored in the reservoirs, in which case, the balance of the water in storage, after allocations for the DMI pool and irrigation account balances, is assigned to the operating reserve. Under no circumstances can the operating reserve be less than 75,000 acre-feet, unless in emergency situations or as determined by the watermaster.

Consideration is being given to revising the TCEQ's Rio Grande operating rules by altering the storage amounts for the DMI reserve and the operating reserve. Investigations of the impacts of different reserve amounts on overall water availability and the yield of the Amistad-Falcon reservoir system are being undertaken as part of this Region M water supply planning study. The TCEQ Rio Grande Watermaster administers the water allocations to municipal/domestic, industrial, agricultural and other user storage accounts. Such allocations are based on the available water in storage in Falcon and Amistad Reservoirs, as reported by the IBWC on the last Saturday of each month, less dead storage. To determine the amount of water to be allocated to various accounts, the Watermaster makes the following computations at the beginning of each month:

1. From the amount of water in usable storage, 225,000 acre-feet are deducted to re-establish the reserve; i.e., the DMI pool, for domestic, municipal, and industrial uses; hence, these uses are given the highest priority;

2. From the remaining storage, the total end-of-month account balances for all lower and middle Rio Grande irrigation and mining allottees are deducted; and,

3. From the remaining storage, the operating reserve is deducted.

After the above computations are made, the remaining storage, if any, is allocated to the irrigation and mining accounts. The allotment for irrigation and mining uses is divided into the Class A and Class B water rights categories. Class A rights (allottees) receive 1.7 times as much water as that allotted to Class B rights. An irrigation allottee cannot accumulate in storage more than 1.41 times its annual authorized diversion right, and, if an allottee does not use water for two consecutive years, its account is reduced to zero. If there is not sufficient water in storage to fully restore the operating reserve in Step 3 above, then the TCEQ rules authorize the Watermaster to make negative allocations of water from the irrigation and mining accounts in sufficient amounts to provide the minimum 75,000 acre-feet of operating reserve capacity.

Generally, under the current rules and regulations of the TCEQ, all United States water that is diverted from the lower and middle Rio Grande by authorized diverters is accounted for by the Rio Grande Watermaster with appropriate charges against annual authorized diversion accounts in accordance with existing individual water rights and against individual storage accounts in Falcon and Amistad Reservoirs. The rules specify that an allottee is charged for water requested and released as follows:

1. A diverter is charged with the actual amount diverted if the total diversion is within plus or minus 10 percent of the amount requested;

2. A diverter is charged with 90 percent of the certification (requested) amount, if the total diversion is less than 90 percent of the amount requested; and,

3. If the quantity of water diverted is more than 110 percent of the amount requested, the diverter is charged with the actual amount of water diverted.

The Rio Grande Watermaster maintains records of daily, weekly and monthly diversions made by all existing water rights along the lower and middle Rio Grande. Monthly and annual reports are provided to all users.

3.2.1.6.4 No Charge Pumping

There are some circumstances, however, when the water use and storage accounts of water rights holders along the lower and middle Rio Grande are not charged for water diverted from the river. These are referred to as "no charge pumping" periods, and diversions during such periods are authorized by an Order issued by the Texas Water Commission on August 4, 1981[7].

Generally the Rio Grande Watermaster allows no charge pumping when there are substantial flows in the river due to high runoff conditions or when there are flood spills or releases from Amistad and/or Falcon Reservoirs. When no-charge pumping is declared by the Rio Grande Watermaster, water from the Rio Grande can be diverted by authorized water rights holders in unlimited quantities, to the extent it is available, without their respective annual water use and storage accounts being charged. For the lower Rio Grande below Falcon Dam, the Rio Grande Watermaster makes a determination regarding no-charge pumping conditions taking into account the quantity of flow passing Anzalduas Dam, the amount of United States water stored in Anzalduas Reservoir, any anticipated storm water inflows from Mexico, and whether or not spills or flood releases are occurring at Falcon Dam.

[7] Order issued pursuant to §11.0871 of the Texas Water Code.

3.2.1.7 Rio Grande Hydrology

Because of the international significance of the Rio Grande and the various treaties and agreements between the United States and Mexico regarding the ownership and use of the waters in the basin, extensive efforts have been undertaken by both countries, through their respective sections of the IBWC, to monitor and measure the flows in the Rio Grande, as well as, the inflows to and diversions from the river system. As such, a network of streamflow gages has been in operation for many years, with daily flow records available from most gages since the early 1950s. Some older records date back to the 1930s, and flow measurements for the gage on the Rio Grande at El Paso have been available since 1889. Most of these records are published in IBWC's annual Water Bulletins[8].

3.2.1.7.1 Historical Reservoir Inflows

Based on historical streamflow gage records and water balance calculations, the IBWC has determined the historical monthly inflows of United States water and Mexican water into Amistad Reservoir from the upper Rio Grande watershed and into Falcon Reservoir from the intervening watershed between Amistad Dam and Falcon Dam. A listing of these annual inflows is presented in Table 3.3 for the period 1945-2003[9]. Total annual inflows into both reservoirs for each country are listed by year and then by rank in descending order based on magnitude.

Over the 59-year period of available inflow data, the total amount of United States water that has flowed into Amistad and Falcon Reservoirs has averaged about 1,750,000 acre-feet per year, and the total amount of inflow to the reservoirs from Mexico has averaged about 1,280,000 acre-feet per year. In the wettest years, the reservoir inflows for each of the countries have approached four million acre-feet. As indicated, the lowest quantity of United States water that has flowed into the reservoirs is 708,265 acre-feet, which occurred in 1956. For Mexico, the lowest annual inflow is 297,488 acre-feet, which occurred in 2000. These inflow amounts reflect both the 1950s drought and the 1990s-2000s drought, which are generally considered to be the most severe droughts of record for the lower and middle Rio Grande. For comparison purposes, the annual inflows to the

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8 International Boundary and Water Commission, United States Section and Mexico Section; "Flow of the Rio Grande and Related Data From Elephant Butte Dam, New Mexico to the Gulf of Mexico, 2001"; Water Bulletin No.71 and other previous Water Bulletins; El Paso, Texas.

9 The historical 1945-1997 reservoir inflow data base as used in this study includes the revised estimates of monthly historical inflows to Amistad and Falcon Reservoirs for the United States and Mexico as derived by Perez-Freese & Nichols during Phase II of the previous Lower Rio Grande Integrated Water Resource Planning Study that was undertaken by the Lower Rio Grande Valley Development Council in association with the Valley Water Policy and Management Council of the Lower Rio Grande Water Committee, Inc. in 1999. The historical inflows for 1998-2003 have been obtained from the IBWC during the current Region M water supply planning study.

reservoirs during the drought period for the years 1993 through 2003 are highlighted. Certainly, as shown, the inflows that occurred during 1993-2003, particularly for Mexico, were some of the lowest experienced during the last sixty years, but for the United States, they still are not quite as low as those that occurred during the 1950s drought. However, as will be discussed later relative to the firm annual yield of the Amistad-Falcon reservoir system, the 1990s-2000s drought maybe be the critical drought of record for both the United States and Mexico.

3.2.1.7.2 Historical Rio Grande Streamflows

Historical monthly and annual mean and median flow rates for several gaging stations on the Middle and lower Rio Grande are summarized in Table 3.4. These mean and median flow values have been derived using daily streamflow data compiled by the IBWC and presented in the annual Rio Grande Water Bulletins for the period 1960-2003 for stations on the lower Rio Grande and for the period 1968-2003 for the middle Rio Grande. These timeframes reflect the most recent periods for which published data are available since the currently existing reservoirs on the Rio Grande have been in place and operating. For the lower Rio Grande, 1960 is when Anzalduas Reservoir was constructed. Amistad Reservoir was constructed on the middle Rio Grande in 1968.

As expected, the average flows in the Rio Grande below Amistad Dam gradually increase from station to station in the downstream direction as influenced by tributary inflows from both the United States and Mexico. The effects of significant diversions into the Maverick Canal in Maverick County are evident by the reduction in flow at the Jimenez gage. The most prominent reductions in flow in the Rio Grande occur below Falcon Dam where significant diversions are made by water users in the United States at numerous locations and in Mexico through the Anzalduas Canal. The effects of inflows from the Rio San Juan are apparent in the Rio Grande flows measured at the gage at Rio Grande City.

3.2.1.7.3 Historical Lower and Middle Rio Grande Water Balances

To provide an overview of hydrologic conditions in the lower and middle Rio Grande in terms of the inflows to the system and the various diversions and outflows from the system, the available IBWC flow records have been reviewed and analyzed to establish general trends and average flow values. Using data from IBWC's published annual Water Bulletins, together with information obtained from IBWC regarding the historical monthly quantities of United States and Mexican water released from Amistad and Falcon Reservoirs and flowing to the Gulf of Mexico, average annual inflows to, and outflows from, the lower Rio Grande have been determined for the period 1960-2003. These results are displayed on the conceptual drawing presented in Figure 3.5. Similar inflow and outflow values also have been determined for the middle Rio Grande between Amistad and Falcon Reservoirs for the period 1968-2003, and these results are presented in Figure 3.6.

The timeframes used to develop the average flow values for these water balances also reflect the most recent periods for which data are available since the currently existing reservoirs on the Rio Grande have been in place and operating.

As shown in Figure 3.5, an average of about 1.20 million acre-feet per year of United States water have been released (or spilled during flood periods) from Falcon Reservoir, while Mexico has released (or spilled) an average of approximately 1.00 million acre-feet per year during the period 1960 through 2003. Mexico also has received significant inflows of water from Rio Alamo and Rio San Juan, all of which is allocated to Mexico under the terms of the 1944 Treaty between Mexico and the United States. Inflows from the Rio Alamo and the Rio San Juan historically have averaged about 430,000 acre-feet per year; however, much of this water has occurred as flood flows and, without any means to capture and store the water, it has flowed to the Gulf. As shown on the diagram, an average of 410,000 acre-feet per year of Mexican water has flowed to the Gulf of Mexico since 1960. On the United States side, of the average amount of water that has been released (or spilled) from Falcon Reservoir (1.20 million acre-feet per year) and that has flowed into the river as runoff from the ungaged watershed below Falcon Dam, an average of 0.96 million acre-feet per year has been diverted by United States users along the lower Rio Grande. During the period between 1960 and 2003, the United States share of water flowing to the Gulf of Mexico averaged about 240,000 acre-feet per year.

For the middle Rio Grande, as shown in Figure 3.6, the amounts of water that have been released from Amistad Reservoir have averaged about 0.88 million acre-feet per year for the United States and about 0.53 million acre-feet per year for Mexico. The corresponding inflows to Falcon Reservoir from the intervening watershed below Amistad Reservoir have been 0.48 million acre-feet per year for the United States and 0.58 million acre-feet per year for Mexico. As shown, most of the diversions from the river along this reach of the Rio Grande have been from the United States side.

3.2.1.7.4 Historical Storage in Amistad and Falcon Reservoirs

The monthly variations in the quantities of water stored in Amistad and Falcon Reservoirs since they were constructed are illustrated on the graphs in Figures 3.7 and 3.8, respectively. On each graph, the amounts of water in storage owned by the United States and by Mexico are indicated, along with the total storage values. The maximum conservation storage capacity of each of the reservoirs also is delineated. As shown, the level of storage in Amistad Reservoir typically has been higher relative to its maximum storage capacity than that in Falcon Reservoir. Similarly, Amistad Reservoir has spilled more often than Falcon Reservoir. This trend is consistent with the operating procedures for the two reservoirs whereby Amistad Reservoir is maintained as full as possible to more effectively conserve water with minimal evaporation losses, while releases from Falcon Reservoir are used primarily to meet the water demands of downstream users.

As illustrated, the lowest storage level to which Amistad Reservoir has ever fallen, since it was initially filled, was about 770,000 acre-feet in July 1998. Since the initial filling of Falcon Reservoir, the lowest level that it has dropped to was 160,000 acre-feet in January 1957; however, its storage did fall to near or just below 200,000 acre-feet on several occasions during the 2000-2002 period. Hence, the severity of the current drought on the lower and middle Rio Grande, which began in late 1992, is evident from the low storage levels experienced in Amistad and Falcon Reservoirs.

Table 3.3 - Historical Annual United States and Mexican Inflows to the Rio Grande Above Amistad Reservoir and Between Amistad and Falcon Reservoirs (Source: IWBC)

Year	United States Inflows, ac-ft			Mexican Inflows, ac-ft			Inflows Ranked In Descending Order				
	Above Amistad Reservoir	Below Amistad Reservoir	Total Annual Inflows	Above Amistad Reservoir	Below Amistad Reservoir	Total Annual Inflows	Year	Total U.S. Inflows ac-ft	RANK	Year	Total Mex. Inflows ac-ft
1945	1,163,203	285,000	1,448,203	883,389	278,000	1,161,389	1971	3,984,106	1	1971	3,794,270
1946	1,212,854	506,000	1,718,854	909,841	521,000	1,430,841	1954	3,970,792	2	1958	3,501,723
1947	973,130	426,000	1,399,130	669,063	371,000	1,040,063	1974	3,317,228	3	1981	2,668,850
1948	1,454,024	595,000	2,049,024	507,768	702,000	1,209,768	1958	3,257,139	4	1976	2,467,178
1949	1,666,097	783,000	2,449,097	1,042,898	442,000	1,484,898	1981	2,882,903	5	1978	2,318,497
1950	1,093,569	248,000	1,341,569	786,227	128,000	914,227	1976	2,669,234	6	1990	2,226,809
1951	743,512	371,000	1,114,512	404,486	326,000	730,486	1990	2,495,386	7	1991	2,215,339
1952	644,293	92,000	736,293	428,901	64,000	492,901	1949	2,449,097	8	1987	1,952,463
1953	505,469	380,000	885,469	222,231	1,003,000	1,225,231	1987	2,428,644	9	1992	1,906,695
1954	3,764,424	206,368	3,970,792	788,961	325,559	1,114,520	1991	2,336,391	10	1988	1,761,635
1955	1,161,083	262,728	1,423,811	677,209	344,411	1,021,620	1957	2,304,200	11	1986	1,748,591
1956	562,134	146,131	708,265	296,764	153,390	450,154	1978	2,299,662	12	1975	1,662,148
1957	1,670,650	633,550	2,304,200	564,144	727,886	1,292,030	1986	2,264,727	13	1979	1,566,850
1958	1,969,349	1,287,790	3,257,139	1,567,841	1,933,882	3,501,723	1992	2,220,265	14	1974	1,517,152
1959	1,400,966	413,263	1,814,229	667,730	489,555	1,157,285	1964	2,152,091	15	1949	1,484,898
1960	1,183,084	304,220	1,487,304	848,707	307,596	1,156,303	1948	2,049,024	16	1972	1,473,295
1961	1,173,210	438,643	1,611,853	624,584	583,960	1,208,544	1988	2,009,094	17	1967	1,467,261
1962	906,681	222,588	1,129,269	511,070	240,095	751,165	1975	1,974,648	18	1946	1,430,841
1963	770,142	259,995	1,030,137	481,290	307,161	788,451	1972	1,876,700	19	1973	1,420,827
1964	1,673,626	478,465	2,152,091	672,900	548,188	1,221,088	1979	1,839,699	20	1966	1,420,305
1965	1,039,969	334,430	1,374,399	489,720	350,059	839,779	1959	1,814,229	21	1980	1,361,638
1966	1,318,285	391,422	1,709,707	1,003,086	417,219	1,420,305	1980	1,738,551	22	1957	1,292,030
1967	954,207	713,220	1,667,427	523,436	943,825	1,467,261	1946	1,718,854	23	1953	1,225,231
1968	991,330	294,637	1,285,967	841,232	382,091	1,223,323	1966	1,709,707	24	1968	1,223,323
1969	843,864	346,676	1,190,540	705,083	382,759	1,087,842	1967	1,667,427	25	1964	1,221,088
1970	844,695	297,120	1,141,815	620,385	283,218	903,603	1977	1,627,565	26	1948	1,209,768
1971	1,783,089	2,201,017	3,984,106	692,998	3,101,272	3,794,270	1973	1,625,856	27	1961	1,208,544
1972	1,307,088	569,612	1,876,700	802,803	670,492	1,473,295	1961	1,611,853	28	1945	1,161,389
1973	918,028	707,828	1,625,856	679,907	740,920	1,420,827	2003	1,487,507	29	1959	1,157,285
1974	3,029,423	287,805	3,317,228	1,211,470	305,682	1,517,152	1960	1,487,304	30	1960	1,156,303
1975	1,284,972	689,676	1,974,648	748,604	913,544	1,662,148	1998	1,478,242	31	1985	1,146,181
1976	1,607,050	1,062,184	2,669,234	773,967	1,693,211	2,467,178	1985	1,467,746	32	1954	1,114,520
1977	1,163,283	464,282	1,627,565	550,896	554,875	1,105,771	1982	1,458,930	33	1977	1,105,771
1978	1,743,638	556,024	2,299,662	1,517,216	801,281	2,318,497	1945	1,448,203	34	1969	1,087,842
1979	1,275,063	564,636	1,839,699	878,202	688,648	1,566,850	1993	1,431,890	35	1947	1,040,063
1980	1,329,313	409,238	1,738,551	817,103	544,535	1,361,638	1955	1,423,811	36	2003	1,030,149
1981	1,888,274	994,629	2,882,903	1,238,430	1,430,420	2,668,850	2000	1,407,189	37	1955	1,021,620
1982	1,118,780	340,150	1,458,930	664,349	338,840	1,003,189	1947	1,399,130	38	1984	1,018,808
1983	910,765	342,907	1,253,672	497,472	291,291	788,763	1965	1,374,399	39	1993	1,018,709
1984	1,086,407	234,142	1,320,549	775,321	243,487	1,018,808	1950	1,341,569	40	1982	1,003,189
1985	1,043,484	424,262	1,467,746	682,379	463,802	1,146,181	1989	1,333,316	41	1950	914,227
1986	1,887,478	377,249	2,264,727	1,208,462	540,129	1,748,591	1984	1,320,549	42	1970	903,603
1987	1,797,750	630,894	2,428,644	1,203,973	748,490	1,952,463	1968	1,285,967	43	1989	874,095
1988	1,469,121	539,973	2,009,094	929,864	831,771	1,761,635	1983	1,253,672	44	1965	839,779
1989	1,055,062	278,254	1,333,316	589,071	285,024	874,095	1999	1,239,456	45	1999	790,198
1990	2,076,817	418,569	2,495,386	1,728,668	498,141	2,226,809	2001	1,227,186	46	1983	788,763
1991	2,027,658	308,733	2,336,391	1,892,590	322,749	2,215,339	1994	1,219,854	47	1963	788,451
1992	1,702,861	517,404	2,220,265	1,283,085	623,610	1,906,695	2002	1,198,871	48	1962	751,165
1993	1,181,767	250,123	1,431,890	788,586	230,123	1,018,709	1969	1,190,540	49	1994	744,394
1994	924,654	295,200	1,219,854	488,813	255,581	744,394	1996	1,184,139	50	1951	730,486
1995	895,126	218,838	1,113,964	387,891	240,841	628,732	1997	1,177,454	51	2002	705,751
1996	956,466	227,673	1,184,139	441,577	259,854	701,431	1970	1,141,815	52	1996	701,431
1997	951,291	226,163	1,177,454	398,567	242,833	641,400	1962	1,129,269	53	1997	641,400
1998	1,141,780	336,462	1,478,242	314,958	313,171	628,128	1951	1,114,512	54	1995	628,732
1999	899,246	340,210	1,239,456	379,527	410,671	790,198	1995	1,113,964	55	1998	628,128
2000	1,178,741	228,448	1,407,189	206,208	91,279	297,488	1963	1,030,137	56	1952	492,901
2001	935,554	291,632	1,227,186	183,849	133,833	317,682	1953	885,469	57	1956	450,154
2002	840,966	357,906	1,198,871	304,054	401,696	705,751	1952	736,293	58	2001	317,682
2003	954,473	533,034	1,487,507	360,704	669,445	1,030,149	1956	708,265	59	2000	297,488
AVG	1,288,971	456,651	1,745,622	734,924	549,786	1,284,710	- -	- -	- -	- -	- -

Table 3.4 - Historical Monthly and Annual Mean and Median Flows in the Middle and Lower Rio Grande

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MIDDLE RIO GRANDE													
Rio Grande below Amistad Dam - RM 571.8													
Mean, Acre-Feet	85,560	111,995	138,481	157,000	217,675	159,028	131,286	144,683	164,795	149,558	88,418	77,746	1,626,225
Mean, cfs	1,392	2,001	2,252	2,638	3,540	2,673	2,135	2,353	2,769	2,432	1,486	1,264	2,245
Median, cfs	1,238	1,506	2,224	2,167	3,130	2,459	1,608	1,821	1,583	1,384	1,207	1,184	2,289
Rio Grande at Del Rio – RM 561.2													
Mean, Acre-Feet	90,456	115,549	142,091	162,174	223,104	162,022	134,407	150,475	171,010	155,879	94,882	82,846	1,684,895
Mean, cfs	1,471	2,064	2,311	2,725	3,628	2,723	2,186	2,447	2,874	2,535	1,595	1,347	2,326
Median, cfs	1,358	1,614	2,313	2,320	3,196	2,364	1,654	2,054	1,542	1,474	1,261	1,227	2,327
Rio Grande near Jimenez – RM 530.3													
Mean, Acre-Feet	43,548	68,099	83,864	105,408	162,610	110,212	90,979	110,619	128,803	131,227	58,253	41,056	1,134,677
Mean, cfs	708	1,217	1,364	1,771	2,645	1,852	1,480	1,799	2,165	2,134	979	667.7038956	1,565
Median, cfs	433	524	1,132	1,235	2,139	1,425	858	1,276	963	867	524	377	1,566
Rio Grande at Piedras Negras - RM 497.0													
Mean, Acre-Feet	110,301	131,887	148,918	166,886	232,495	183,749	177,479	181,006	205,443	209,561	126,846	109,695	1,984,265
Mean, cfs	1,794	2,356	2,422	2,805	3,781	3,088	2,886	2,944	3,453	3,408	2,132	1,784	2,738
Median, cfs	1,458	1,939	2,430	2,190	3,320	2,795	1,855	2,472	2,045	2,089	1,664	1,604	2,550
Rio Grande near El Indio - RM 460.4													
Mean, Acre-Feet	117,623	136,373	154,713	174,668	245,449	195,694	185,855	190,393	216,449	219,562	136,266	115,091	2,088,135
Mean, cfs	1,913	2,435	2,516	2,935	3,992	3,289	3,023	3,096	3,638	3,571	2,290	1,872	2,881
Median, cfs	1,685	2,015	2,282	2,449	3,586	2,890	1,914	2,460	2,169	2,422	1,648	1,567	2,775
Rio Grande at Laredo – RM 359.8													
Mean, Acre-Feet	120,988	141,307	158,991	177,774	263,267	221,667	192,631	196,680	227,954	248,285	139,553	117,719	2,206,816
Mean, cfs	1,968	2,524	2,586	2,988	4,282	3,725	3,133	3,199	3,831	4,038	2,345	1,915	3,044
Median, cfs	1,645	2,099	2,442	2,289	3,862	3,104	2,051	2,729	2,648	3,230	1,746	1,577	2,883

Source: 1968-2005 Historical data reported by IBWC for the Middle Rio Grande

Table 3.4 - Historical Monthly and Annual Mean and Median Flows in the Middle and Lower Rio Grande, cont'd

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
LOWER RIO GRANDE													
Rio Grande below Falcon Dam - RM 274.8													
Mean, Acre-Feet	196,315	133,430	128,032	325,846	359,589	235,552	153,865	202,201	134,877	146,120	76,531	79,226	2,171,584
Mean, cfs	3,193	2,381	2,082	5,476	5,848	3,959	2,502	3,288	2,267	2,376	1,286	1,288	2,996
Median, cfs	2,842	1,956	1,780	4,993	6,310	3,352	2,258	2,219	1,160	1,494	989	922	2,926
Rio Grande at Rio Grande City - RM 235.0													
Mean, Acre-Feet	199,160	144,905	130,126	319,657	365,263	260,565	181,800	224,126	268,360	224,408	100,488	93,170	2,512,028
Mean, cfs	3,239	2,586	2,116	5,372	5,940	4,379	2,957	3,645	4,510	3,650	1,689	1,515	3,466
Median, cfs	2,947	2,142	1,770	4,872	6,461	3,664	2,383	2,540	1,854	2,213	1,200	986	3,242
Rio Grande Below Anzalduas Dam - RM 169.8													
Mean, Acre-Feet	88,441	68,472	77,622	124,926	157,335	179,689	136,588	133,615	196,939	177,256	81,116	71,587	1,493,585
Mean, cfs	1,438	1,221	1,262	2,099	2,559	3,020	2,221	2,173	3,310	2,883	1,363	1,164	2,059
Median, cfs	1,168	907	1,109	1,907	2,493	2,470	1,757	1,372	1,141	1,081	838	749	1,472
Rio Grande near San Benito - RM 96.8													
Mean, Acre-Feet	37,714	35,855	30,650	43,770	68,552	75,393	64,895	68,015	114,600	126,156	55,352	45,900	766,853
Mean, cfs	613	638	498	736	1,115	1,267	1,055	1,106	1,926	2,052	930	746	1,057
Median, cfs	384	339	293	425	675	735	430	374	487	385	304	294	531
Rio Grande near Brownsville - RM 48.7													
Mean, Acre-Feet	29,541	30,135	24,562	30,187	52,705	59,043	54,115	56,806	102,717	121,049	53,768	43,507	658,133
Mean, cfs	480	536	399	507	857	992	880	924	1,726	1,969	904	708	907
Median, cfs	191	245	170	178	402	375	208	189	367	285	315	227	375

Source: 1960-2005 Historical data reported by IBWC for the Lower Rio Grande

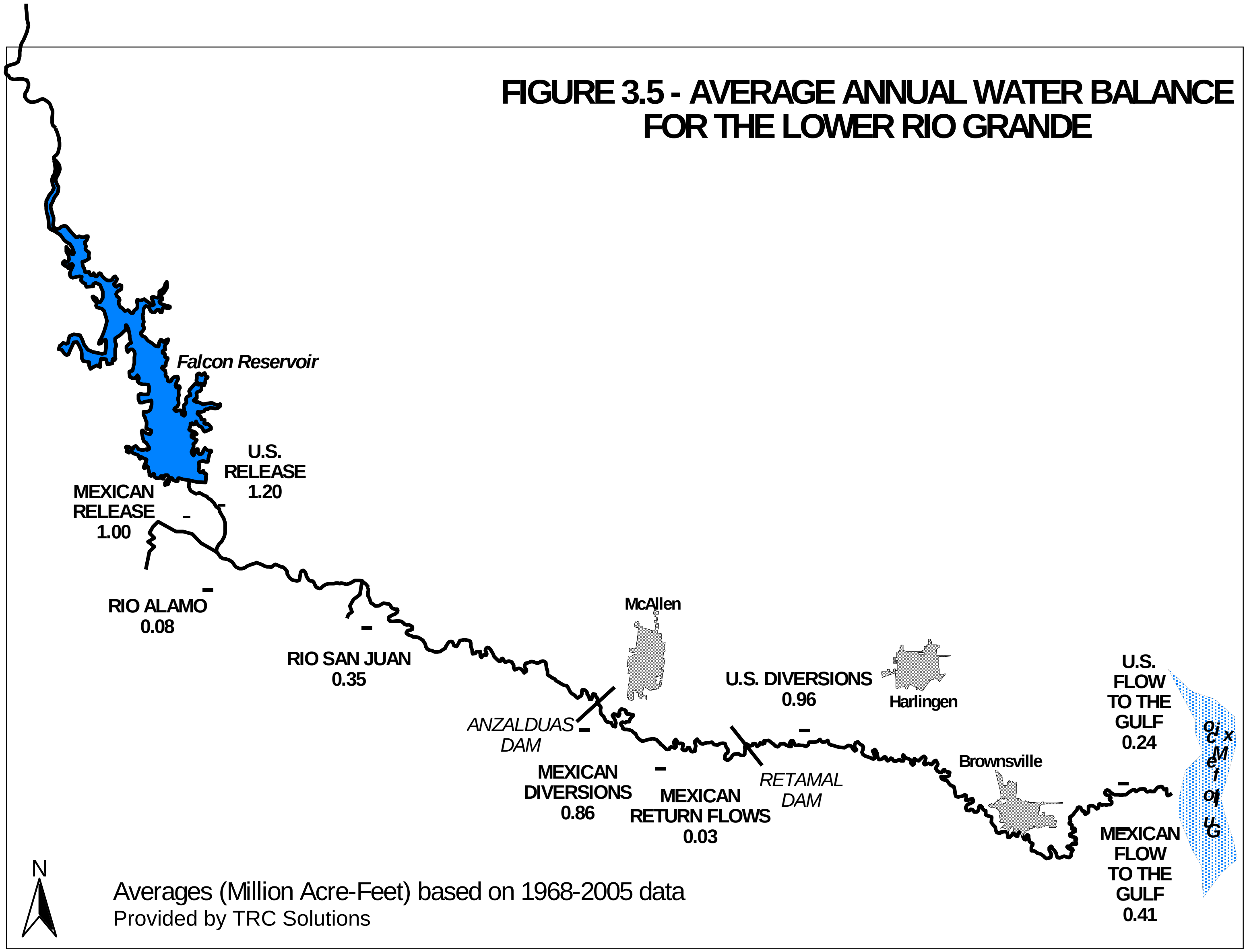
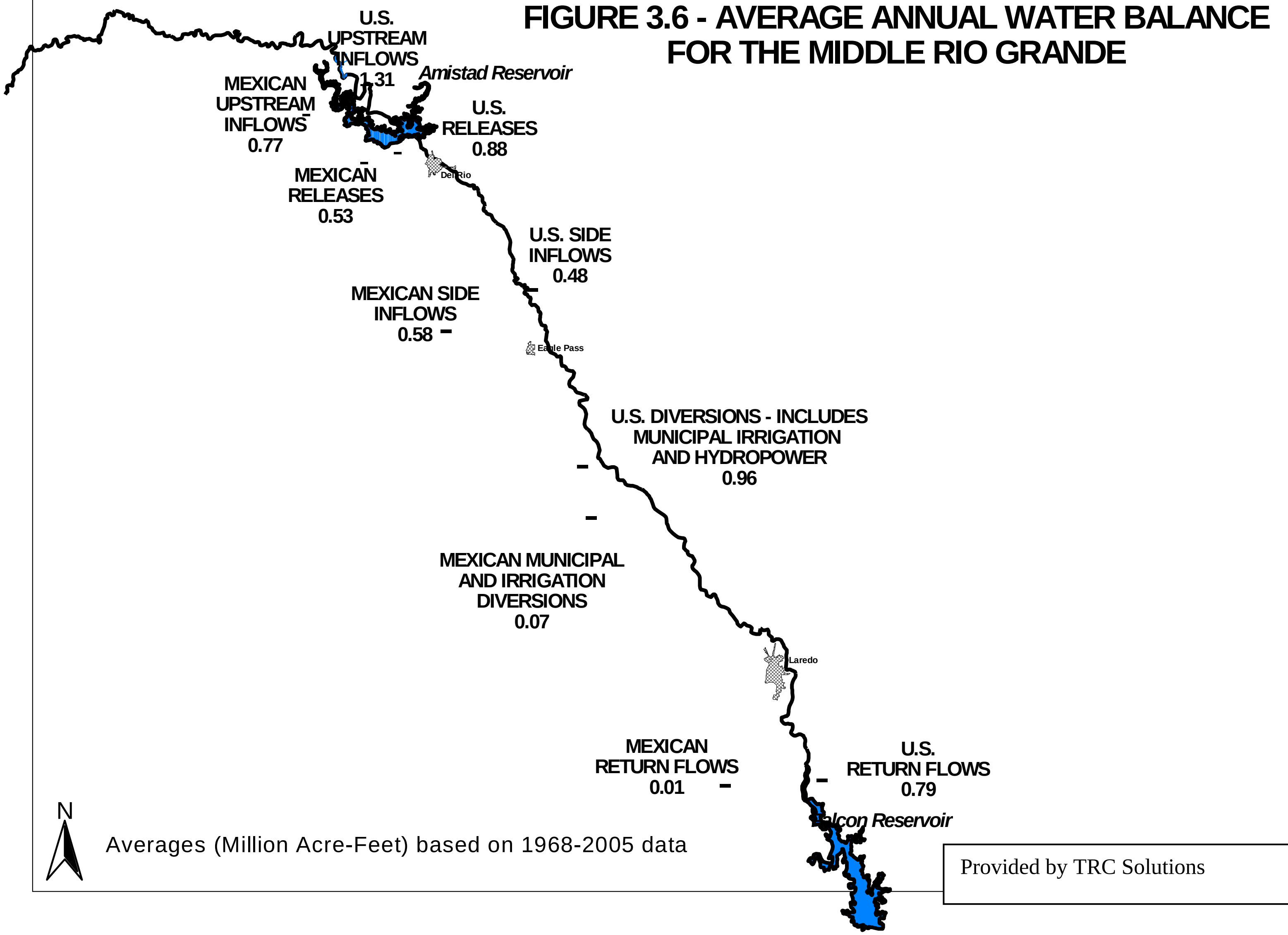


FIGURE 3.5 - AVERAGE ANNUAL WATER BALANCE FOR THE LOWER RIO GRANDE

FIGURE 3.6 - AVERAGE ANNUAL WATER BALANCE FOR THE MIDDLE RIO GRANDE



Provided by TRC Solutions

3.2.1.7.5 Historical Storage in Mexican Tributary Reservoirs

The historical monthly variations in the quantities of water stored in the reservoirs located on tributaries of the Rio Grande in Mexico since 1950 are illustrated on the graphs in Figures 3.9 and 3.10. Figure 3.9 shows the historical combined storage in the major reservoirs located on tributaries that flow into the Rio Grande upstream of Falcon Dam. This includes the twelve reservoirs located on streams in the Rio Conchos, Rio San Diego, Rio San Rodrigo, and Rio Salado Basins as listed in Table 3.1. The historical combined storage in the reservoirs located on tributaries that enter the Rio Grande downstream from Falcon Dam, i.e. in the three reservoirs on the Rio San Juan as listed in Table 3.1, is illustrated by the graph in Figure 3.10.

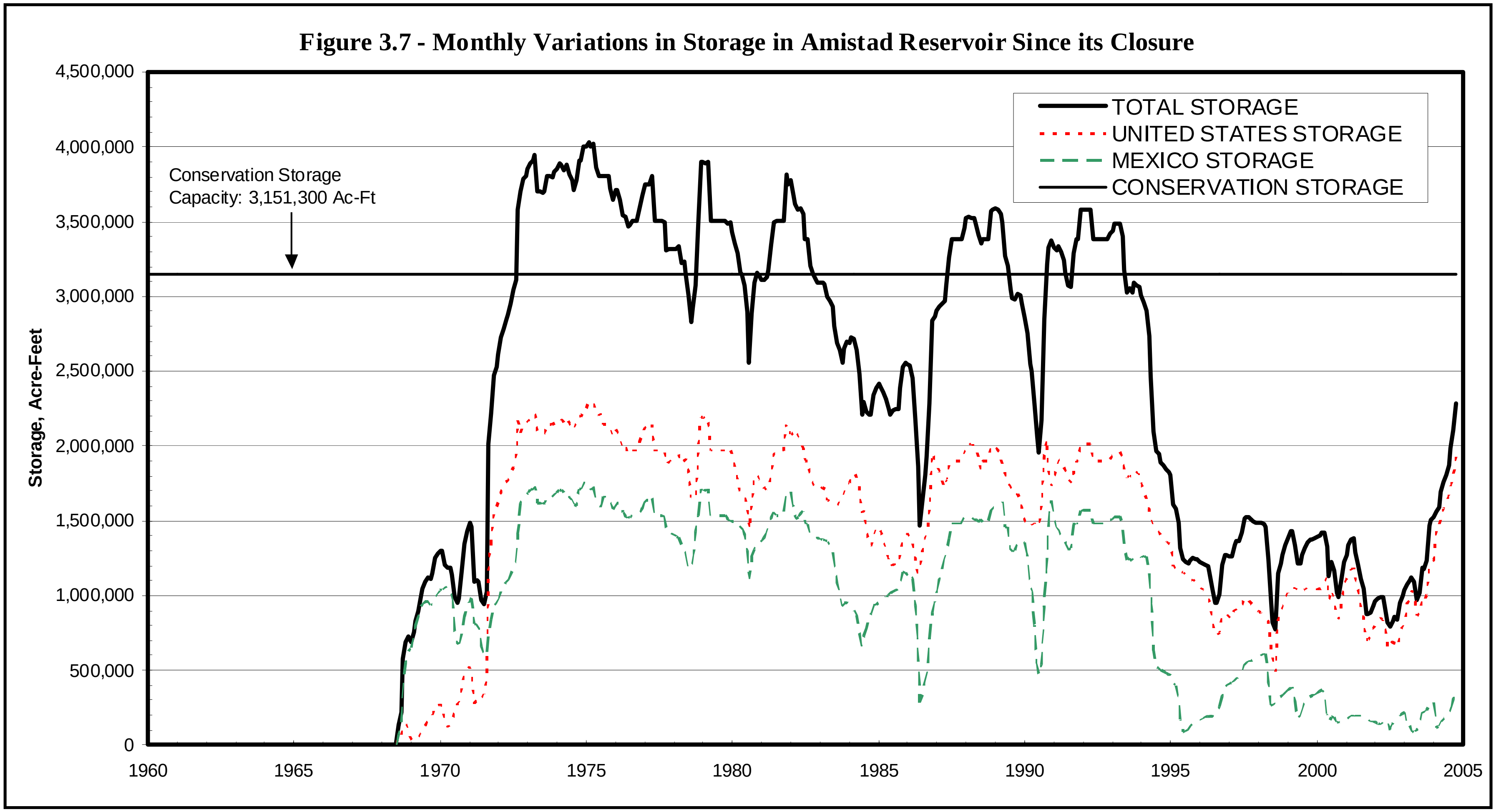
As indicated by the plots, the amount of water Mexico has had stored in these tributary reservoirs has ranged from a few hundred thousand acre-feet to nearly five million acre-feet. Since the beginning of the current drought in the Rio Grande Basin, the minimum storage in these reservoirs was approximately 821,000 acre-feet in May 1995. Further discussion of storage in the Mexican tributary reservoirs and the current deficit accrued by Mexico with respect to its 1944 Treaty obligation to deliver minimum amounts of water to the United States from its tributaries is presented in Section 3.8 of this report.

3.2.1.8 Rio Grande Drought of Record

As illustrated by the historical annual inflows to Amistad and Falcon Reservoirs listed in Table 3.3 for the period 1945 through 2003, the flows in the Rio Grande during the 1950s and the 1990s-2000s appear to have been the lowest experienced during the last half century. Another analysis of long-term inflows of only United States water into Amistad and Falcon Reservoirs is presented by the graph in Figure 3.11. This plot shows the monthly variation of the 12-month and the 60-month running-average annual inflows for the period from 1900 through 1999. These historical reservoir inflows have been obtained from data originally developed by the IBWC for the period 1900 through 1944[10], and from inflows provided directly by the IBWC for the period from 1945 through October 1999, with some modifications to adjust for revised gage data[11].

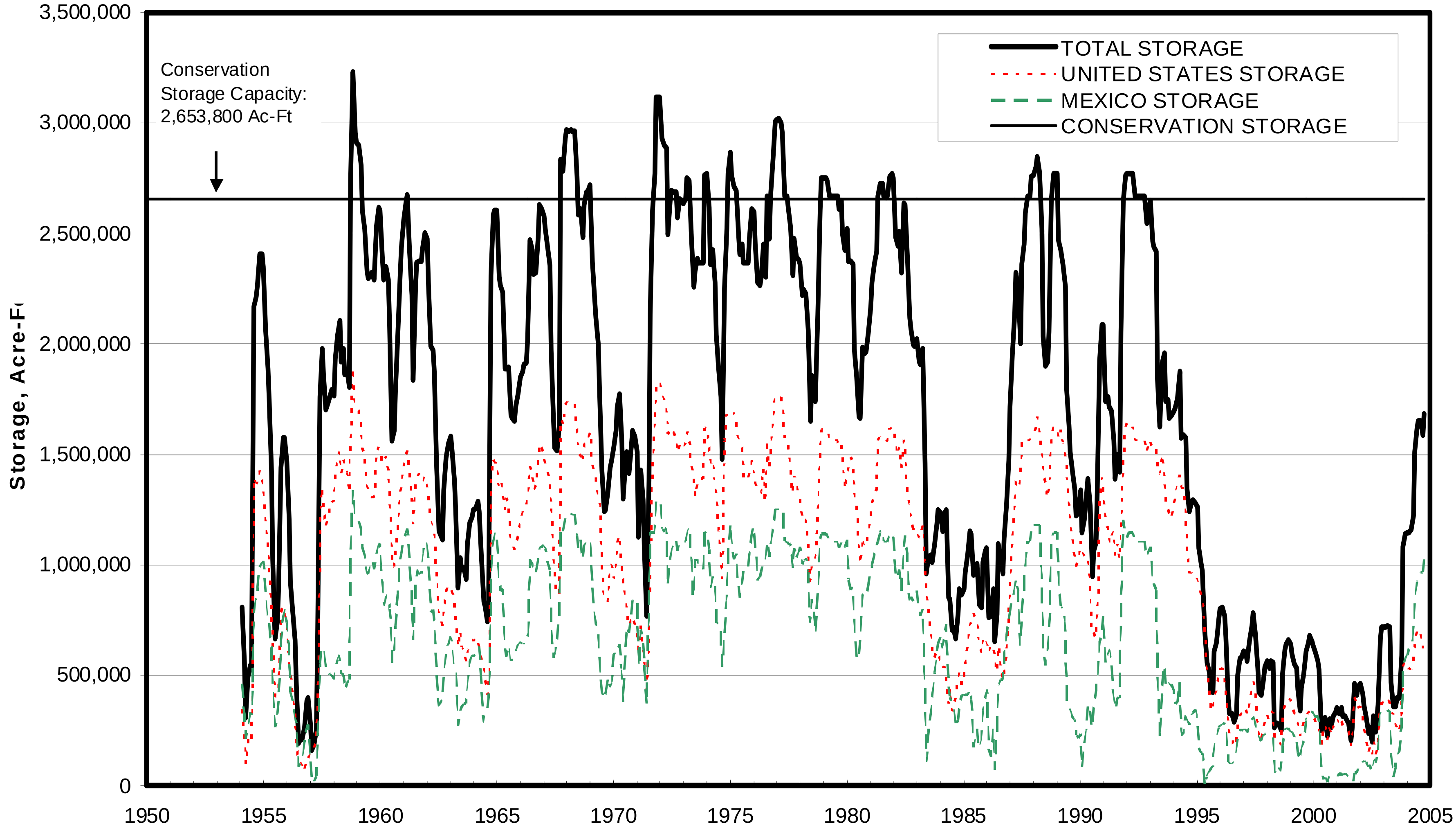
[10] Unpublished computer simulations of the operation of Amistad and Falcon Reservoirs.

[11] Revised estimates of monthly inflows to Amistad and Falcon Reservoirs for the United States and Mexico were derived by Perez-Freese & Nichols during Phase II of the previous Lower Rio Grande Integrated Water Resource Planning Study in 1999.



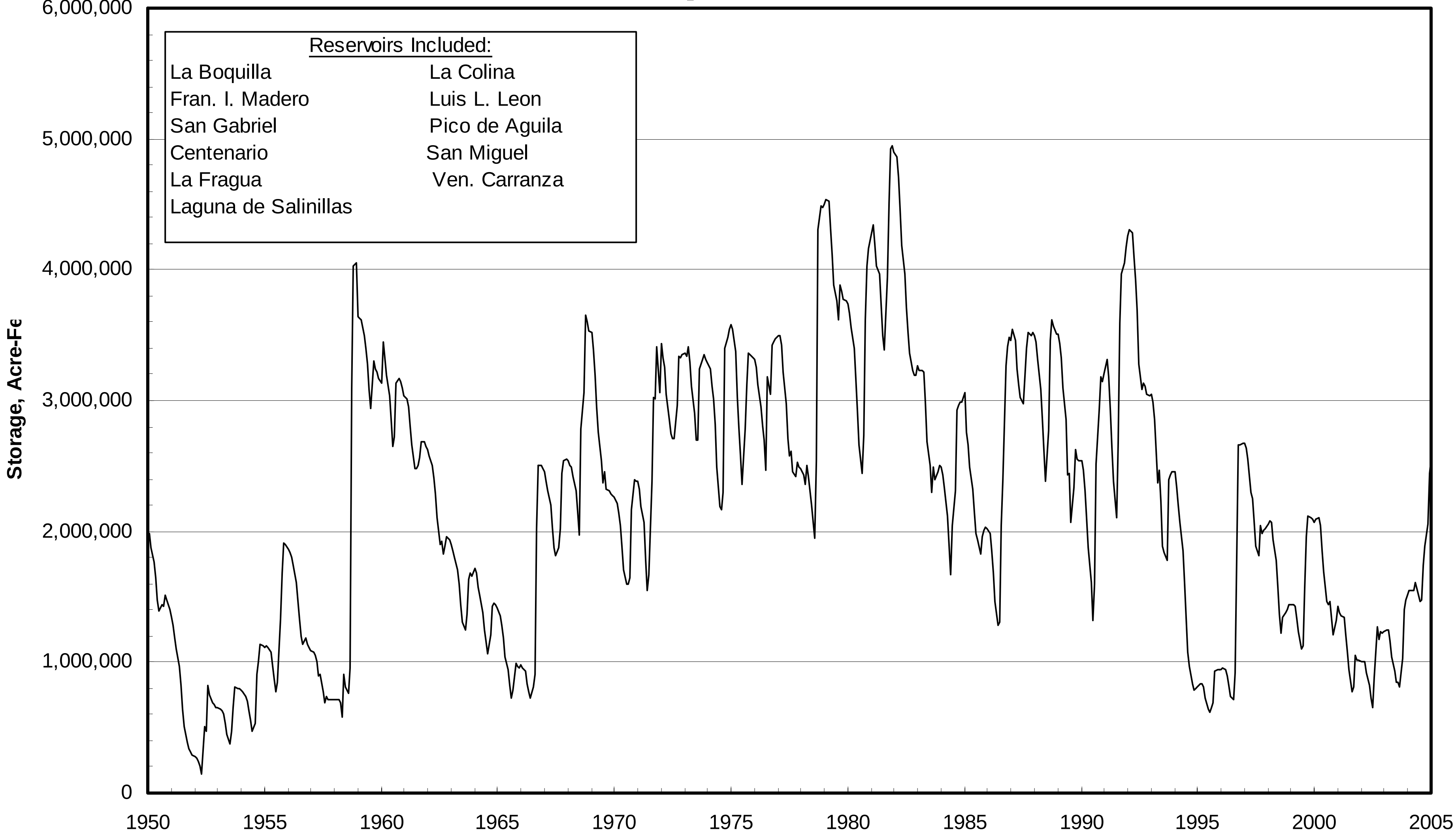
Provided by IBWC

Figure 3.8 - Monthly Variations in Storage in Falcon Reservoir Since Its Closure



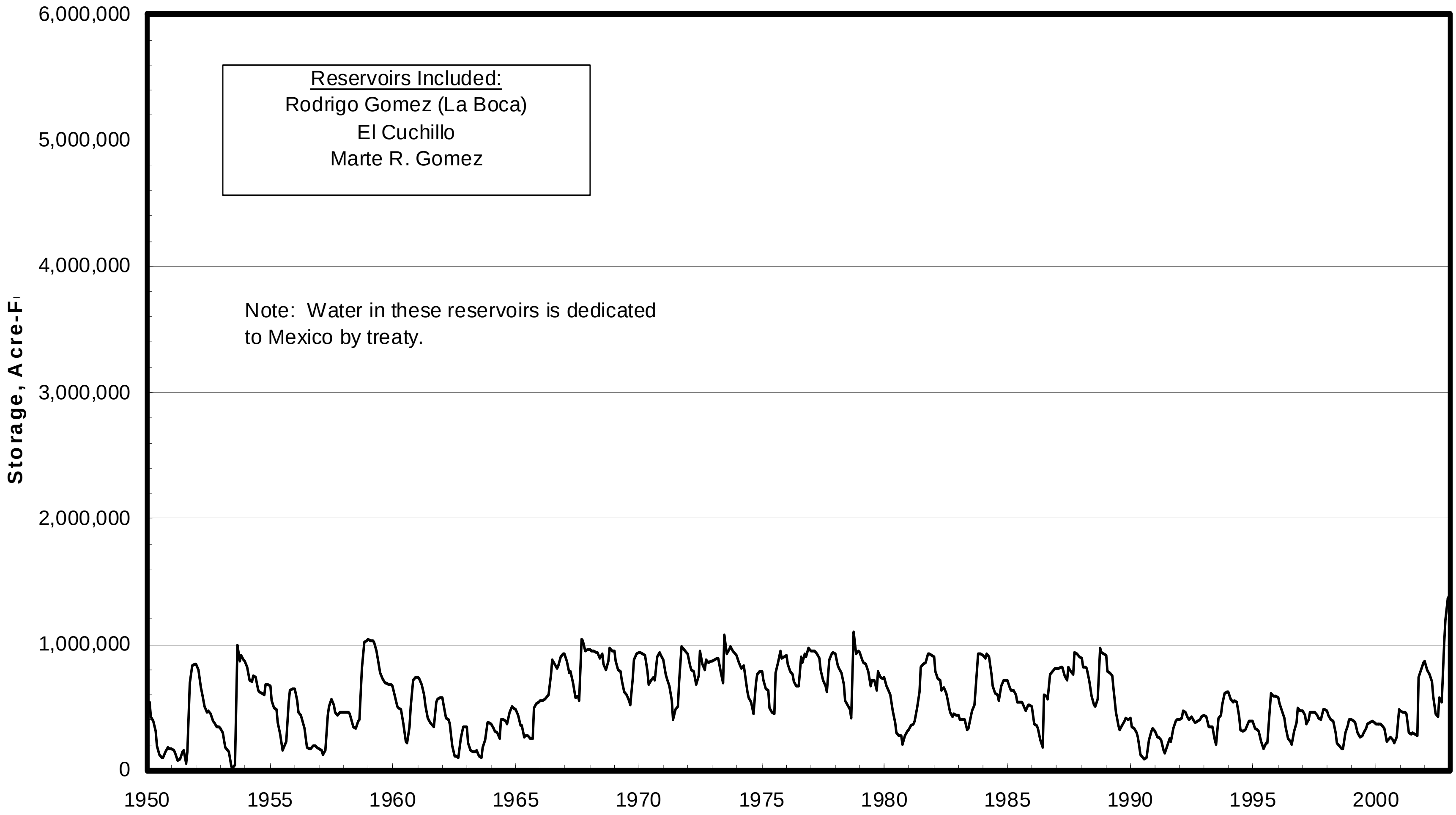
Provided by IBWC

Figure 3.9 - Monthly Variations in Combined Storage in Mexican Reservoirs Located on Tributaries of the Rio Grande Upstream of Falcon Dam



Provided by IBWC

Figure 3.10 - Monthly Variations in Combined Storage in Mexican Reservoirs Located on Tributaries of the Rio Grande Downstream from Falcon Dam



Provided by IBWC

As indicated by the curves in Figure 3.11, the drought of the 1950s appears to be the most severe when considering 12-month reservoir inflows, but the lowest 60-month average inflow for the drought of the 1990s-2000s appears to be more severe and longer in duration. The 60-month lowest average annual inflow value is indicative of the average amount of annual water usage that might be sustained over the duration of a multi-year critical drought, with adequate storage in Amistad and Falcon Reservoirs.

3.2.2 Other Rio Grande Tributaries

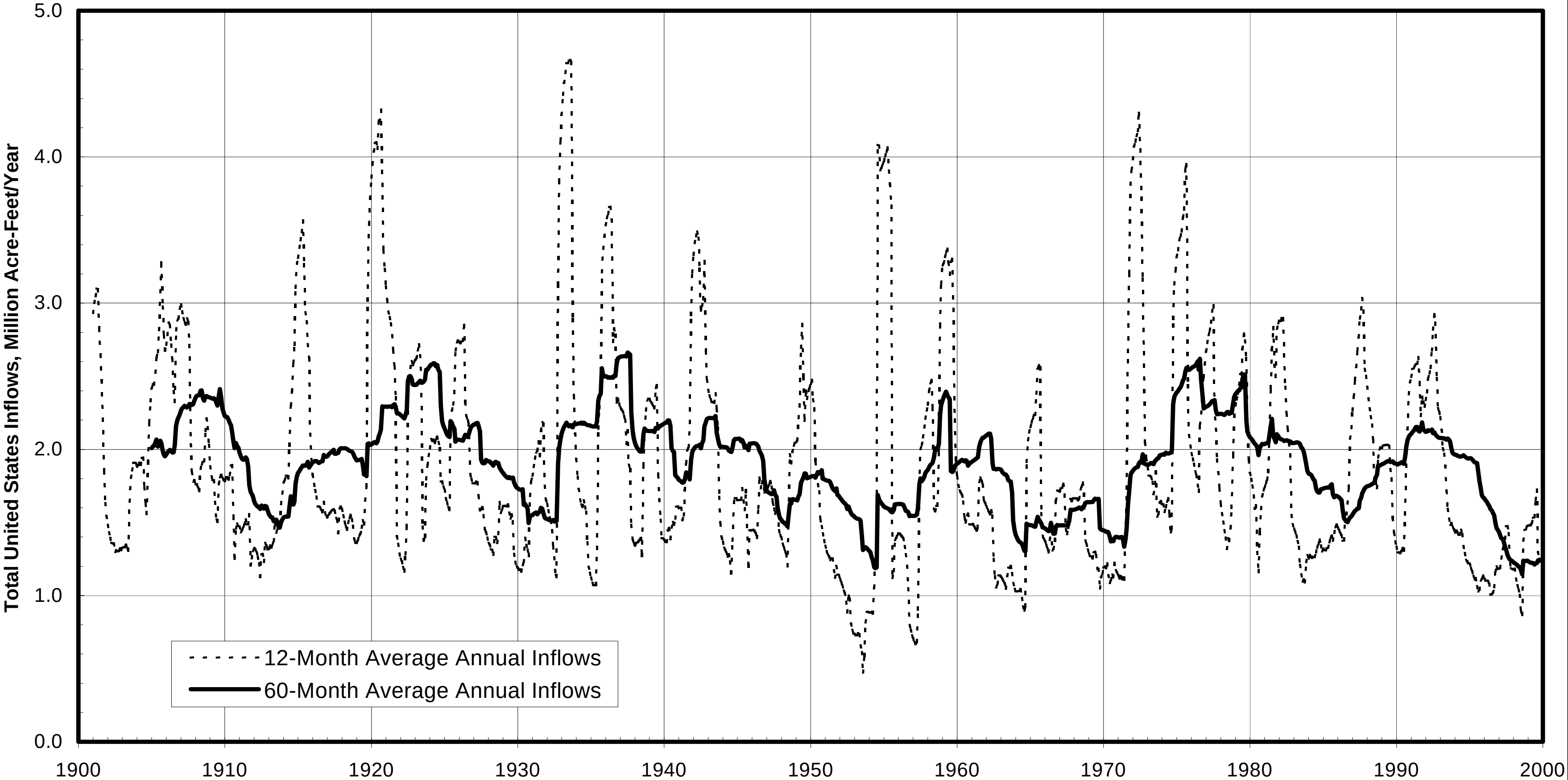
In the Middle Rio Grande Basin, there are some existing water rights that authorize diversions from tributaries of the Rio Grande, primarily for irrigation and mining uses. These tributaries include Javalin Creek in Zapata County; the North Branch of Manadas Creek, Chacon Creek, Becerro Creek and Salado Creek in Webb County; Los Olmos Creek in Starr County; and Rosita Creek in Maverick County. Streamflows in these tributaries typically are intermittent and occur only after rainfall periods. Hence, the water supplies provided by these tributaries generally are not dependable, and are available only during local runoff events.

No future development of the water resources, such as with on-channel or off-channel reservoirs, of these tributaries, or any other tributaries of the Rio Grande, is likely to occur because of the over-appropriated nature of the Rio Grande itself, particularly with regard to Amistad and Falcon Reservoirs. Although the reliability and availability of the water supplies from these tributaries as authorized by the existing water rights are questionable, particularly during drought of record conditions, it is possible that some water supplies could be provided from these sources. As described later in this report, only limited portions of the authorized diversion amounts of these Rio Grande tributary water rights have been accounted for in estimating the available current water supplies for the affected counties.

3.2.3 Arroyo Colorado

The Arroyo Colorado is an abandoned channel of the Rio Grande that extends eastward for about 90 miles from near Mission through southern Hidalgo County to Harlingen in Cameron County, eventually discharging into the Laguna Madre near the Cameron-Willacy county line. The watershed of the Arroyo Colorado drains approximately 700 square miles and generally consists of coastal plain that slopes gently toward the Gulf of Mexico. Figure 3.12 presents a map showing the Arroyo Colorado and its watershed. Flows in the Arroyo Colorado are sustained by treated wastewater discharges from cities in the region, irrigation return flows (tailwater),

Figure 3.11 - Variations in 12-Month and 60-Month Average Annual Total Inflows to the Rio Grande for the 1900-1999 Period



Source: IBWC

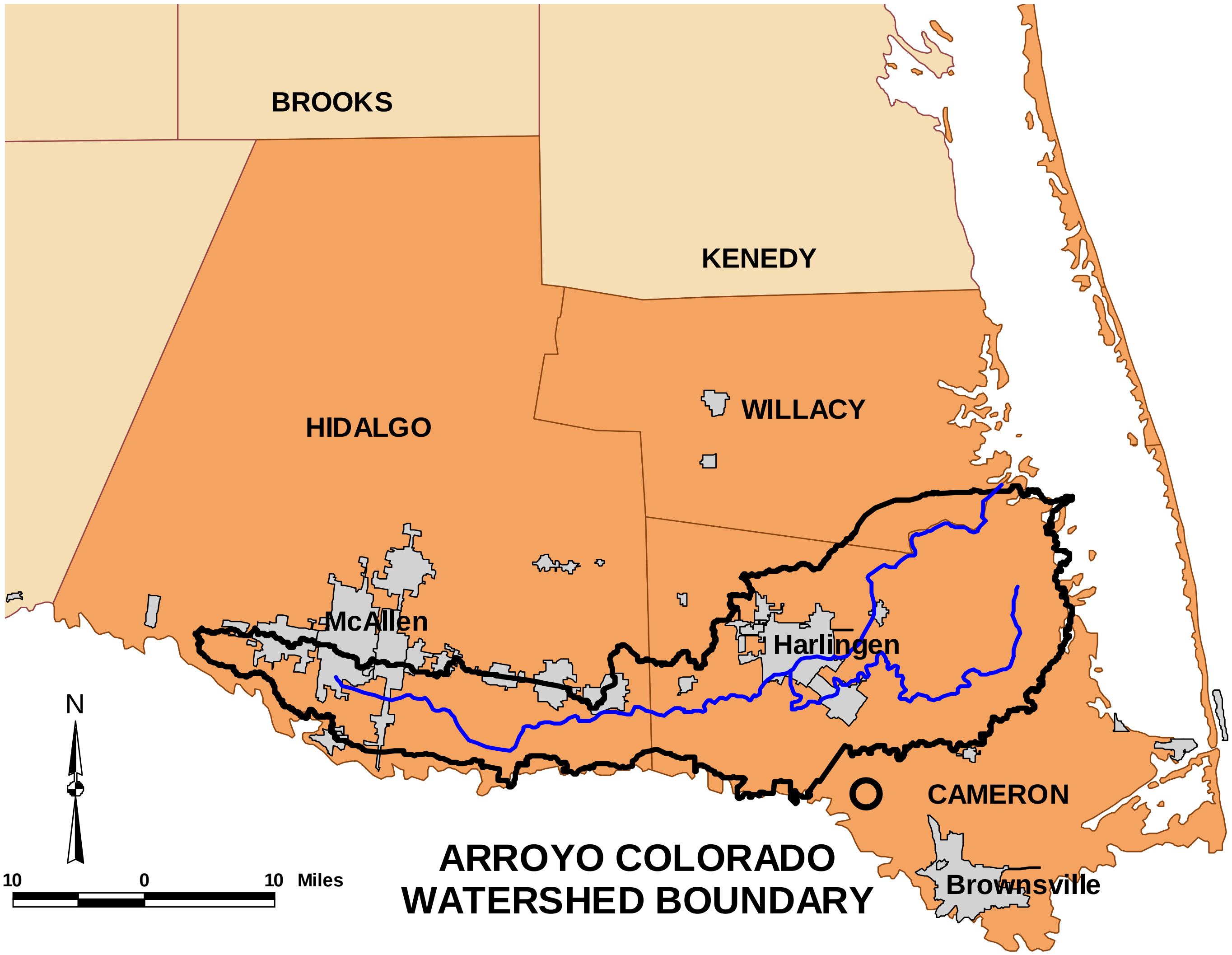
other agricultural runoff, storm water runoff, and base flows from groundwater. Flood flows from the Rio Grande also are occasionally diverted into portions of the Arroyo Colorado during major flood events on the river.

The Laguna Atascosa National Wildlife Refuge and several county and city parks are located along the banks of the Arroyo Colorado. The lower one-third of the watercourse is used for commercial shipping from the Gulf Intracoastal Waterway in the Laguna Madre upstream to the Port of Harlingen. Probably the most important use of the Arroyo Colorado, however, is as a source of freshwater inflows to the lower Laguna Madre. This portion of the Laguna Madre serves as an economically and ecologically important coastal water body in the region and the availability of freshwater inflows from the Arroyo Colorado is critical to maintaining its biological resources.

Use of the water in the Arroyo Colorado for municipal, industrial, or irrigation purposes is severely limited because of poor quality conditions. Salinity concentrations in the Arroyo typically exceed the limits considered desirable for human consumption, as well as those acceptable for irrigation of crops. Furthermore, water quality and fish tissue testing have found that: (1) low dissolved oxygen levels have impaired the fish community and other aquatic life downstream from the Port of Harlingen; (2) elevated levels of pesticides (chlordane, toxaphene, and DDE), and PCBs in the Donna Canal have resulted in a fish consumption advisory upstream from the Port of Harlingen; and, (3) bacteria levels are occasionally elevated indicating a potential health risk to people who swim or wade in the Arroyo upstream from the Port of Harlingen. In response to these use impairments, the TCEQ has performed a Total Maximum Daily Load (TMDL) study to assess the specific causes of the observed pesticide and PCB problems and to determine the pollution controls necessary to restore water quality in the Arroyo Colorado. A plan to reduce the pollutants is currently being implemented.

Because of the water quality problems that exist in the Arroyo Colorado, it has been assumed for purposes of this water planning study that there is no water currently available in the Arroyo Colorado for municipal, industrial, or irrigation uses within the RGRWPA. Some limited use of the water in the lower reach of the Arroyo Colorado occurs for aquaculture operations (shrimp farming), and this type of use may be expanded in the future. However, because of the importance of the freshwater inflows from the Arroyo Colorado to the biological resources of the Laguna Madre, future efforts to divert additional water from the Arroyo may be strongly resisted.

Figure 3.12 - Arroyo Colorado and its Watershed



3.2.4 Nueces-Rio Grande Resacas

In the Lower Rio Grande Valley, particularly in Cameron County, there are a number of existing water rights that authorize surface water diversions from small isolated lakes referred to as resacas. For the most part, these resacas are old abandoned channels of the Rio Grande that now receive inflows from local runoff, irrigation return flows, groundwater, and, in some cases, diversions from the Rio Grande, and they normally are relatively full. Because the topography along the Rio Grande in this area generally slopes away from the river, these resacas actually are located outside of the Rio Grande watershed and are in the Nueces-Rio Grande Coastal Basin. The resacas in Cameron County with authorized diversions include Resaca Quates, Resaca Fresnos, Resaca De Los, and Resaca Del Ran.

The water rights permits for diversions from these resacas authorized 225 acre-feet of water per year for municipal use and 13,684 acre-feet per year for irrigation use. It appears that these resacas are capable of serving as effective sources of water for meeting localized demands. As such, it has been assumed that the authorized diversion amounts of these resaca water rights will be available as part of the overall water supply for Cameron County.

3.2.5 Springs

According to available publications and literature[12,13], there are few existing springs within the Region M portions of the Rio Grande Basin and the Nueces-Rio Grande Coastal Basin and they are small in terms of their discharge rates. Much of the area is underlain by shales and marls, which cannot store or transmit much water. Typically, the flow rate of the existing springs is less than 20 gallons per minute, with most springs flowing at a rate of only a few gallons per minute. There are no major springs that are extensively relied upon for water supply purposes. Many of the small springs do provide water for livestock and wildlife when they are flowing.

3.2.6 San Felipe Springs

This summary describes a study[14] or evaluation on the San Felipe Springs system and the impact of ground water withdrawals on the flow which directly leads to the Rio Grande. Water from San Felipe Springs eventually makes its way to the Rio Grande, as it passes from the Plateau Water Planning Region to the Rio Grande Water Planning Region. Currently, groundwater models have not been constructed and calibrated that accurately represent the groundwater system in this area and, therefore, were not considered in this study. This report includes evaluating hydrology, available information on the current and past flow conditions of the Springs and potential impact to the Rio Grande inflows due to groundwater withdrawal from the San Felipe Springs area.

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[12] Gunnar Brune; "Springs of Texas: Vol. 1; Branch-Smith, Inc.; Fort Worth, Texas; 1981.

[13] Gunnar Brune; "Major and Historical Springs of Texas"; Texas Water Development Board; Report 189; Austin, Texas; 1975.

[14] The Final Report on San Felipe Springs can be found in the appendix.

San Felipe Springs is one of 48 springs in Val Verde County identified by Brune and is considered the fourth largest spring in Texas. San Felipe Springs is actually a combination of about 10 individual springs emanating from the Edwards limestone that form the headwaters of San Felipe Creek, which is a tributary to the Rio Grande. It has never stopped flowing throughout recorded history; spring discharge at San Felipe Springs was first established and documented by the International Boundary and Water Commission (IBWC). The recharge area for the respective springs in not directly known but is surmised to be a large area extending into northern Val Verde, Kinney and Edwards Counties. Long periods of Below-normal rainfall lead to reduced recharge and to lower water levels in the aquifer. As the aquifer levels fall, the volume of water discharging from San Felipe Springs into the San Felipe Creek decrease. Since Lake Amistad was filled in 1968, average discharge from San Felipe Springs has increased and has averaged 7,167 ac-ft/month.

Two of the ten springs that compose San Felipe Springs, referred to as the East Spring and West Spring, supply all the public supply water currently used by the City of Del Rio and Laughlin Air Force Base. Pumps are installed in the San Felipe East Spring and into a cave that feeds into the San Felipe West Spring Lake. Spring water is pumped through a microfiltration plant, treated with chlorine and then supplied to the city and base. The City of Del Rio has a water right authorizing it to divert up to 11,416 ac-ft/yr from the surface-water portion of the Springs for municipal use. The City of Del Rio reports their usage to the state individually as surface and ground water, even though all of their usage emanates from San Felipe Springs. The water withdrawn from the wells installed in the cave near the spring outlet at the West Spring is technically considered groundwater. The City's monthly usage for groundwater peaks in July and August, ranging from more than 600 to more than 900 ac-ft/month, respectively. Maximum capacity of the City's microfiltration plant is 55.8 ac-ft/day or about 20,000 ac-ft/yr. At full capacity, the city can extract and treat about 23 percent of the daily average flow from the springs; San Felipe Springs averages about 238 ac-ft/day.

Irrigation water is also removed from San Felipe Creek downstream of the Springs prior to its confluence with the Rio Grande. San Felipe Manufacturing and Irrigation Company has a water right authorizing to divert 4,962 ac-ft/yr for irrigation use and 50 ac-ft/yr for industrial use from San Felipe Creek. The total authorized surface water amount withdrawn from San Felipe Creek is 16,428 ac-ft/yr with the other irrigation and industrial permitted uses; however, this does not include water that is considered groundwater that is removed from the Springs by the City of Del Rio.

Historically, the San Felipe Springs system has accounted for a relatively small overall contribution of about 8 percent of the total volume of water to the Rio Grande near Del Rio. Currently, the prominent threat to future flows from San Felipe Springs into the Rio Grande is the possibility of expanding irrigation or large scale commercial endeavors to produce and supply groundwater entities outside the County. These endeavors have been rumored but as of yet have not materialized.

3.3 SURFACE WATER RIGHTS

In general, all users that divert or store surface water in Texas are required to possess a water right that authorizes, as necessary, a specified amount of surface water that can be diverted from a particular stream or reservoir, the maximum rate of diversion, the maximum storage capacity for a reservoir, and, in the case of irrigation, the location of the fields that are to be irrigated. The TCEQ is the State agency responsible for issuing and administering water rights in Texas.

For the RGRWPA, the water rights master file of the TCEQ has been reviewed and analyzed, and all water rights authorizing surface water diversions and use within the planning region have been identified and summarized. A compilation of these individual water rights according to owner, grouped by basin, county and type of use, is contained in the Appendix, of this report. For each county in the region, the water rights are listed separately for the Rio Grande Basin and for the Nueces-Rio Grande Coastal Basin. The water rights are further categorized according to type of use; i.e., municipal, industrial (manufacturing), irrigation, and mining.

Table 3.5 presents a summary of the surface water rights in each of the eight counties in the RGRWPA. The values contained in Table 3.5 represent the maximum amounts of water that can be diverted annually under the authority of the existing water rights, expressed in acre-feet. Where water rights are registered in one county, but the water use is in a different county or multiple counties, they have been transferred into the county of actual use for the purposes of this table. Similarly, where a water right is listed for a certain use, such as domestic and livestock, but is actually authorized to be used for a different use, such as municipal, the actual use is reflected in this table. As shown, a total of 2,226,495 acre-feet per year of surface water diversion rights currently exist within the region. Of this amount, about 14% (305,997 acre-feet per year) is for municipal uses and about 3% (64,626 acre-feet per year) is for industrial uses. The vast majority of the surface water rights in the region (1,853,179 acre-feet per year or about 83%) are authorized for irrigation. Most of the surface water rights in the region are located in Hidalgo County (1,244,037 acre-feet of diversions per year or about 56%) and in Cameron County (681,043 acre-feet of diversions per year or about 31%). Approximately 96% of the total diversions authorized by the water rights in the RGRWPA are in the Rio Grande Basin, and practically all of these are associated with Amistad and Falcon Reservoirs.

3.4 AMISTAD-FALCON RESERVOIR SYSTEM

As noted previously, the vast majority of the water used in the RGRWPA is diverted from the Rio Grande. For the most part, this water originates as releases from Amistad and Falcon Reservoirs, both of which are located on the mainstem of the river. For this reason, it is important to understand the operation of the Amistad-Falcon reservoir system and to quantify the amount of water that potentially could be provided by these reservoirs during the drought of record.

3.4.1 Water Availability Model

The TCEQ is responsible for developing water availability models for all basins in Texas. The basic procedure applied in analyzing water availability in a particular river basin involves developing naturalized streamflows throughout the basin from historical hydrologic and other data, then simulating on a monthly basis the ability of individual water rights to meet their authorized diversions or storage quantities in accordance with the prior appropriation doctrine and, for the Rio Grande Basin, the TCEQ Rio Grande operating rules.

The simulations are performed using the Water Rights Analysis Package computer program (referred to as "WRAP") that was developed by Dr. Ralph A. Wurbs of Texas A&M University[15]. An essential element of the Rio Grande WAM is the operation of the Amistad-Falcon reservoir system. Naturalized streamflows represent historical streamflow conditions, including typical wet, dry, and normal flow periods, without the influence of man's historical activities as they relate to water rights and water use. In essence, naturalized streamflows exclude the effects of historical diversions, return flows, and reservoir storage and evaporation. For the Rio Grande WAM, the naturalized streamflow database that has been developed covers the 61-year period from January 1940 through December 2000. The 1940-2000 historical period also includes the droughts of the 1950s and 1990s, both of which represent extreme drought conditions for most of the Rio Grande Basin. However, it is important to note that the 1990s drought has continued beyond the year 2000, and those streamflows are not included in the WAM.

The WRAP program simulates the allocation of prescribed amounts of water within a river basin to individual water rights, i.e. diversions and storage, subject to the prior appropriation doctrine ("first in time, first in right") as it is applied for water rights administration in Texas. The priority dates have been adjusted for the Rio Grande WAM to reflect the use-based priority system for water rights dependent on storage in Amistad and Falcon Reservoirs, international treaty obligations, and for water rights in Mexico, known as "concessions." The Mexico concessions used in the WAM are listed in Table 3.6.

WRAP utilizes a network of control points with interconnected links to describe flow paths and the locations of inflows, diversions, reservoirs, return flows, and other points of interest. Figure 3.13 presents a map showing the locations of all control points in the Rio Grande WAM. Computations within the model are performed on a monthly basis using monthly time series values of specified inflows, reservoir net evaporation rates, and water demands subject to prescribed water rights conditions and reservoir system operating rules. Results from the WRAP program include monthly diversion and storage amounts for each water right and the remaining unappropriated water at selected locations throughout the basin. The program also

[15] Wurbs, R.A., *Water Rights Analysis Package (WRAP) Modeling System Reference and Users Manuals*, Texas Water Resources Institute (TWRI), Technical Reports 255 and 256, August 2003, Revised December 2003; and Wurbs, R.A., *WRAP Revisions Since August 2003*, Texas Water Resources Institute (TWRI), February 2004.

produces the regulated streamflow at every control point, reflecting the effects of flow depletions by upstream water rights and flow pass-throughs for downstream water rights.

Because all of the Rio Grande Basin below the New Mexico state line, including the Mexican portion of the basin, is included in the Rio Grande WAM, it has been necessary to incorporate into the WAM the essential provisions of existing international agreements between the United States and Mexico regarding the ownership of the water flowing in the Rio Grande. These agreements include the 1944 Treaty, which addresses the ownership of water downstream of Fort Quitman, and the 1906 Convention, which divides the water between the U.S. and Mexico above Fort Quitman.

One of the most important aspects of this process involves the transfer of Mexican water from certain Mexican tributaries of the Rio Grande to the U.S. segment of the WAM. This requirement stems from the 1944 Treaty as described earlier in Section 3.2.1.6.1, and it is accomplished in the WAM after all of Mexico's demands and reservoirs on these tributaries have been simulated, with no provisions in the model for Mexico to deliver the average of 350,000 acre-feet per year in accordance with paragraph B(c) of Article 4 of the 1944 Treaty. One-third of the remaining flow at the mouths of each of the six named Mexican tributaries then is diverted and subsequently discharged as a return flow to the U.S. segment of the river. Demands for water along the Rio Grande by both U.S. and Mexican water users downstream of these Mexican tributaries then are simulated in the model. The treaty provision requiring a minimum of 350,000 acre-feet per year to be delivered to the U.S. from the six named Mexican tributaries has not been incorporated into the WAM. The future compliance of this treaty provision is uncertain.

Another international aspect of the WAM relates to the equal split of the flows in the Rio Grande at Fort Quitman. It should be pointed out that the equal split of the Fort Quitman flows is the procedure currently used by the IBWC in its accounting of U.S. and Mexican ownership of water flowing in the Rio Grande. This procedure does not seem to be consistent, however, with language adopted by the 1906 Convention, which states that except for the delivery of Rio Grande Project water to Mexico at the Acequia Madre, all water flowing in the Rio Grande above Fort Quitman is owned by the United States. This would suggest that the U.S. owns all of the river water passing Fort Quitman, but this is not how the current accounting is performed by IBWC nor how the WAM is constructed.[16]

Whereas the result of the Valley Water Case was to grant the highest water supply priority to municipal and industrial uses, the remaining Class A and B irrigation and mining water rights were subject to an allocation system dependent on the amount of storage remaining in Amistad and Falcon Reservoirs after water first was reserved

[16] More information on the accouting procedures at Fort Quitman and the Water Availability Module (WAM) can be found in "Special Study No. 1: Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing water Rights on the Lower and Middle Rio Grande" in the appendix.

for the municipal and industrial users and certain reservoir operating requirements. These procedures, which are discussed in Section 3.2.1.6.2 and are reflected in the TCEQ Rio Grande operating rules as described in Section 3.2.1.6.3, have been incorporated into the Rio Grande WAM and are used for each of the water rights dependent upon storage in the Amistad-Falcon reservoir system. As stipulated in the TCEQ rules, the prior appropriation doctrine is fully exercised for all water rights located on tributaries of the Rio Grande.

Table 3.5 - Surface Water Rights by County (acre-ft/yr)

Basin/Use	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata	Region M
RIO GRANDE BASIN									
Municipal	132,743[17]	135,123	-	9,756	6,881	48,349	998	2,566	336,417
Industrial	2,420	8,881	-	114	-	1,645	-	-	13,059
Irrigation	573,586	928,927	-	138,538	40,651	27,113	88,287	10,205	1,807,307
Mining	10	530	-	90	53	1,668	-	344	2,694
County Total	708,759	1,073,461	-	148,498	47,584	78,774	89,284	13,115	2,159,476
NUECES-RIO GRANDE BASIN									
Municipal	225	-	-	-	-	-	-	-	225
Industrial	38,210[b]	300	-	-	-	-	3,250	-	41,760
Irrigation	27,606	7,549	-	-	-	-	10,717	-	45,872
Mining	-	-	-	-	-	-	-	-	-
County Total	66,041	7,849	-	-	-	-	13,967	-	87,857
REGION M TOTAL									
Municipal	132,968	135,123	-	9,756	6,881	48,349	998	2,566	336,642
Industrial	40,630	9,181	-	114	-	1,645	3,250	-	54,819
Irrigation	601,193	936,476	-	138,538	40,651	27,113	99,003	10,205	1,853,179
Mining	10	530	-	90	53	1,668	-	344	2,694
County Total	774,801	1,081,310	-	148,498	47,584	78,774	103,251	13,115	2,247,333

[17] Includes Brownsville Permit #1838 for 40,000 ac-ft of “excess flows” not supplied by Amistad-Falcon.

Table 3.6 - Mexico Water Use Concessions[18] Included In WAM

NAME OF CONCESSION	TYPE OF USE	DIVERSION AMOUNT acre-feet/year	STREAM NAME	ASSOCIATED RESERVOIR
103 Rio Florido Irrigation District 1	Irrigation	10,343	Rio Florido	San Gabriel
103 Rio Florido Irrigation District 2	Irrigation	74,849	Rio Florido	Pico del Aguila
005 Delicias Irrigation District 1	Irrigation	837,042	Rio Conchos	La Boquilla
005 Delicias Irrigation District 2	Irrigation	163,263	Rio Conchos	Francisco Madero
090 Lower Conchos Irrigation District	Irrigation	130,223	Rio Conchos	Luis Leon
006 Palestina Irrigation District 1	Irrigation	2,406	Rio Grande	Amistad
006 Palestina Irrigation District 2	Irrigation	1,968	Rio Grande	Amistad
006 Palestina Irrigation District 3	Irrigation	3,634	Arroyo de las Vacas	None
006 Palestina Irrigation District 4	Irrigation	14,376	Rio San Diego	San Miguel
006 Palestina Irrigation District 5	Irrigation	20,514	Rio San Diego	Centenario
Local Irrigation	Irrigation	21,006	Rio San Rodrigo	La Fragua
Local Irrigation	Irrigation	20,000	Rio Escondido	None
050 Acuna Falcon Irrigation District	Irrigation	23,361	Rio Grande	Amistad
004 Don Martin Irrigation District	Irrigation	285,337	Rio Salado	Venustiano Carranza
058 Alto Rio San Juan Irrigation District	Irrigation	6,090	Rio San Juan	None
031 Las Lajas Irrigation District	Irrigation	19,454	Rio San Juan	El Cuchillo
026 Bajo Rio San Juan Irrigation District 1	Irrigation	342,755	Rio San Juan	Marte R. Gomez

[18] Authorized use and is equivalent to a water right.

Table 3.6, cont'd.

NAME OF CONCESSION	TYPE OF USE	DIVERSION AMOUNT acre-feet/year	STREAM NAME	ASSOCIATED RESERVOIR
026 Bajo Rio San Juan Irrigation District 2	Irrigation	6,016	Rio Grande	Falcon
026 Bajo Rio San Juan Irrigation District 3	Irrigation	27,414	Rio Grande	Falcon
025 Bajo Rio Bravo Irrigation District - Anz.	Irrigation	697,555	Rio Grande	Falcon
TOTAL IRRIGATION:		2,707,606		
Acequia Madre-Juarez	Mun./Irr.	60,000	Rio Grande	Elephant Butte
La Colina - Downstream	Municipal	24,318	Rio Conchos	La Colina
Ciudad Acuna	Municipal	2,496	Rio Grande	Amistad
Piedras Negras	Municipal	10,425	Rio Grande	Amistad
Nuevo Laredo	Municipal	29,263	Rio Grande	Amistad
Ciudad Anahuac	Municipal	6,671	Salado	Venustiano Carranza
Ciudad Miguel Aleman	Municipal	7,636	Rio Grande	Falcon
Reynosa	Municipal	54,351	Rio Grande	Falcon
Matamoros, et al	Municipal	38,990	Rio Grande	Falcon
Monterrey - La Boca	Municipal	27,172	Rio San Juan	La Boca El Cuchillo
Monterrey - El Cuchillo	Municipal	59,788	Rio San Juan	El Cuchillo
Monterrey - Huasteca	Municipal	57,550	Rio San Juan	El Cuchillo La Boca
TOTAL MUNICIPAL:		378,480		

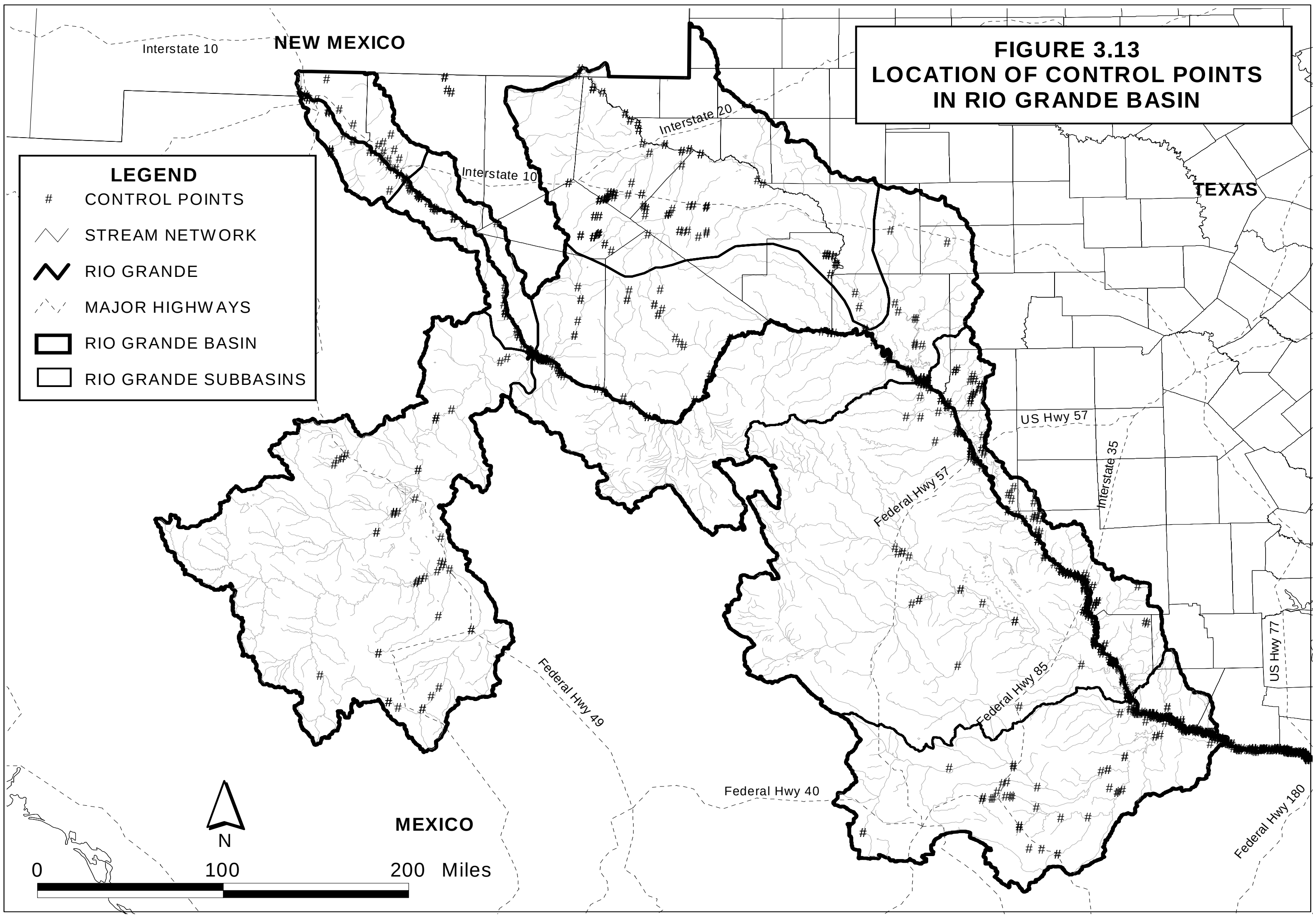


FIGURE 3.13
LOCATION OF CONTROL POINTS
IN RIO GRANDE BASIN
LEGEND
CONTROL POINTS
STREAM NETWORK
RIO GRANDE
MAJOR HIGHWAYS
RIO GRANDE BASIN
RIO GRANDE SUBBASINS
NEW MEXICO
TEXAS
MEXICO
Interstate 10
Interstate 20
Interstate 35
US Hwy 57
US Hwy 77
Federal Hwy 57
Federal Hwy 85
Federal Hwy 49
Federal Hwy 40
Federal Hwy 180
N
0
100
200 Miles

Generally, the maximum conservation storage capacity for each reservoir has been specified in the Rio Grande WAM in accordance with the maximum authorized storage amounts specified in the TCEQ water rights data base. As noted below, for purposes of this water supply planning study, these storage capacities have been reduced to reflect the effects of sedimentation over the next 50 or so years.

The United States pools in Amistad and Falcon Reservoirs are operated as a reservoir system. In the WAM, assumed operational rules are employed to store water primarily in Amistad Reservoir (the uppermost international impoundment) pursuant to the provisions of the 1944 Treaty between the U.S. and Mexico, while maintaining a lower operating pool in Falcon Reservoir to facilitate day-to-day releases to the water users in the Lower Rio Grande Valley.

The WAM has not been updated for this round of regional planning.

3.4.2 Projected Reservoir Sedimentation Effects

Fundamental to properly simulating the storage behavior of Amistad and Falcon Reservoirs and to effectively account for evaporation losses is an accurate description of the relationships between the water surface elevation of each of the reservoirs and surface area and storage volume. These relationships, often referred to as "elevation-area-capacity" relationships, typically are derived from topographic maps of the reservoir sites before they were constructed or from bathymetric surveys of the reservoir bottoms after they have been impounded. As the reservoirs have aged over time, their elevation-area-capacity relationships have changed primarily due to sediment loadings that have been discharged into the reservoirs with inflows from their respective watersheds. Typically, the bottom contours of the reservoirs have been altered as sediment has been deposited, and the storage volume of the reservoirs has been reduced. The reduced storage volume of the reservoirs, in turn, can result in corresponding reductions in the firm annual yield of the reservoirs.

Hence, for water supply planning purposes, it is important to project the degree to which future sediment loadings may further reduce the storage capacity of the reservoirs and how these storage reductions may impact the yield of the reservoirs.

The IBWC has developed elevation-area-capacity relationships for both Amistad and Falcon Reservoirs at different times since they were initially impounded. The most recent relationships were based on bathymetric surveys conducted in 1992 for both reservoirs. Prior to 1992, elevation-area-capacity relationships were determined in 1980 for Amistad Reservoir and in 1972 for Falcon Reservoir. Comparison of these sets of relationships for each of the reservoirs provides insight regarding the most recent sedimentation rates that have been effective in reducing the storage volumes of the reservoirs. Figure 3.14 presents a plot of the variation of storage volume in Amistad Reservoir with water surface elevation for the 1980 and the 1992 sedimentation conditions. A similar graph for Falcon Reservoir is presented in Figure 3.15 for the 1972 and the 1992 sedimentation conditions.

Examination of the storage-versus-elevation graphs indicates that Amistad Reservoir experienced moderate storage volume reductions due to sedimentation during the period between 1980-1992, whereas the reduction in the storage volume of Falcon Reservoir during the 1972-1992 period appears to have been minimal. One reason for these differences in sedimentation rates is that Amistad Reservoir is located upstream of Falcon Reservoir and, in effect, captures sediment loadings carried by the Rio Grande before they can enter Falcon Reservoir. Another possible cause is that the average inflows to Amistad Reservoir from its upstream watershed are about twice the average inflows into Falcon Reservoir from the intervening watershed between Amistad and Falcon Reservoirs. Hence, sediment loadings into Amistad Reservoir should be somewhat greater.

The average reservoir sedimentation rates exhibited by the changes in storage volume of Amistad and Falcon Reservoirs shown on the graphs in Figures 3.14 and 3.15 provide a means for projecting future sedimentation conditions in the reservoirs for water supply planning purposes. For Amistad Reservoir, the average sedimentation rate between 1980 and 1992 was on the order of 19,400 acre-feet per year, whereas for Falcon Reservoir between 1972 and 1992, the average sedimentation rate was only about 700 acre-feet per year. These rates of sedimentation in the reservoirs represent corresponding annual reductions in their conservation storage capacities equal to about 0.6 percent for Amistad and about 0.03 percent for Falcon.

During previous water planning efforts for the Lower Rio Grande Valley, the above observed sedimentation rates for Amistad and Falcon Reservoirs also were examined for purposes of projecting the effects of future sedimentation in the reservoirs on their respective elevation-area-capacity relationships and firm annual yields over the next 50 years. The results from these earlier investigations have been adopted for use in this water supply planning study for the RGRWPA. For Amistad Reservoir, the observed sedimentation rate during the 1980-1992 period was applied to develop adjusted elevation-area-capacity relationships for each decade through the year 2060. The resulting storage-versus-elevation curves for each decade between the year 2000 and 2060 are plotted in Figure 3.16. As expected, these curves gradually shift over time in the direction of lesser amounts of available conservation storage in the reservoir. The corresponding maximum amounts of conservation storage available to the United States and to Mexico in Amistad Reservoir by decade based on these curves are listed below in Table 3.7.

For Falcon Reservoir, the historical volume reduction due to sedimentation that occurred during the 1972-1992 period (0.03 % per year) was considered to be negligible; therefore, no adjustments in the elevation-area-capacity relationships were considered necessary to reflect future reservoir sedimentation effects. Consequently, the 1992 storage-versus-elevation curve presented in Figure 3.15 has been used in this study for all analyses of the future operation and yield of Falcon Reservoir.

3.4.3 Reservoir System Firm Annual Yield

The firm annual yield of a reservoir or system of reservoirs is defined as the maximum amount of water that can be withdrawn from the reservoir(s) every year during the occurrence of the drought of record without causing the reservoir(s) to go dry. For water supply planning purposes, the TWDB requires that no more than this amount of surface water be considered as available from a reservoir, or reservoir system, for meeting future water demands. Hence, for purposes of the Rio Grande water supply planning effort, it is has been necessary to develop projections of the future firm annual yield of the Amistad-Falcon reservoir system since this system currently supplies and will continue to supply over the 50-year planning horizon the vast majority of the water used in the region.

Firm annual yield has been determined using the Rio Grande WAM with hydrologic conditions corresponding to the 1940-2000 period as described in Section 3.4.1. As described earlier with respect to the structure of the Rio Grande WAM, all Mexico demands and reservoirs are simulated during each monthly time step of the simulation process before the demands and reservoirs on the U.S. side of the river are simulated, including Amistad and Falcon Reservoirs. Furthermore, there are no provisions in the WAM to limit Mexico's use of its tributary flows, and the only water that reaches the Rio Grande from Mexico in the WAM is local runoff from adjacent watersheds, the unused runoff from below Mexico's lowest tributary reservoirs and any spills of floodwater from these reservoirs. This means that the minimum delivery of 350,000 acre-feet per year by Mexico as required by the 1944 Treaty, except "in the event of extraordinary drought or serious accident to the hydraulic systems on the measured Mexican tributaries," is not provided for. For determining the firm yield of the Amistad-Falcon reservoir system with the WAM, diversions from the reservoir system for the United States and for Mexico, stipulated in accordance with current demand distributions (geographically and by type of use) and use patterns (by month of the year), were reduced below the authorized amounts until no shortages were experienced, while maintaining all other water rights and Mexican concessions in the basin at their full authorized amounts. The minimum volume remaining in the reservoirs during the critical period was virtually zero for the firm yield demands, except for the required reserves as stipulated in the TCEQ Rio Grande operating rules. The resulting total demand for each country as specified in the WAM then was considered to be each country's share of the firm annual yield of the Amistad-Falcon reservoir system.

Figure 3.14 - Elevation-Storage Relationships for Amistad Reservoir
Based on 1980 and 1992 Bathymetric Surveys

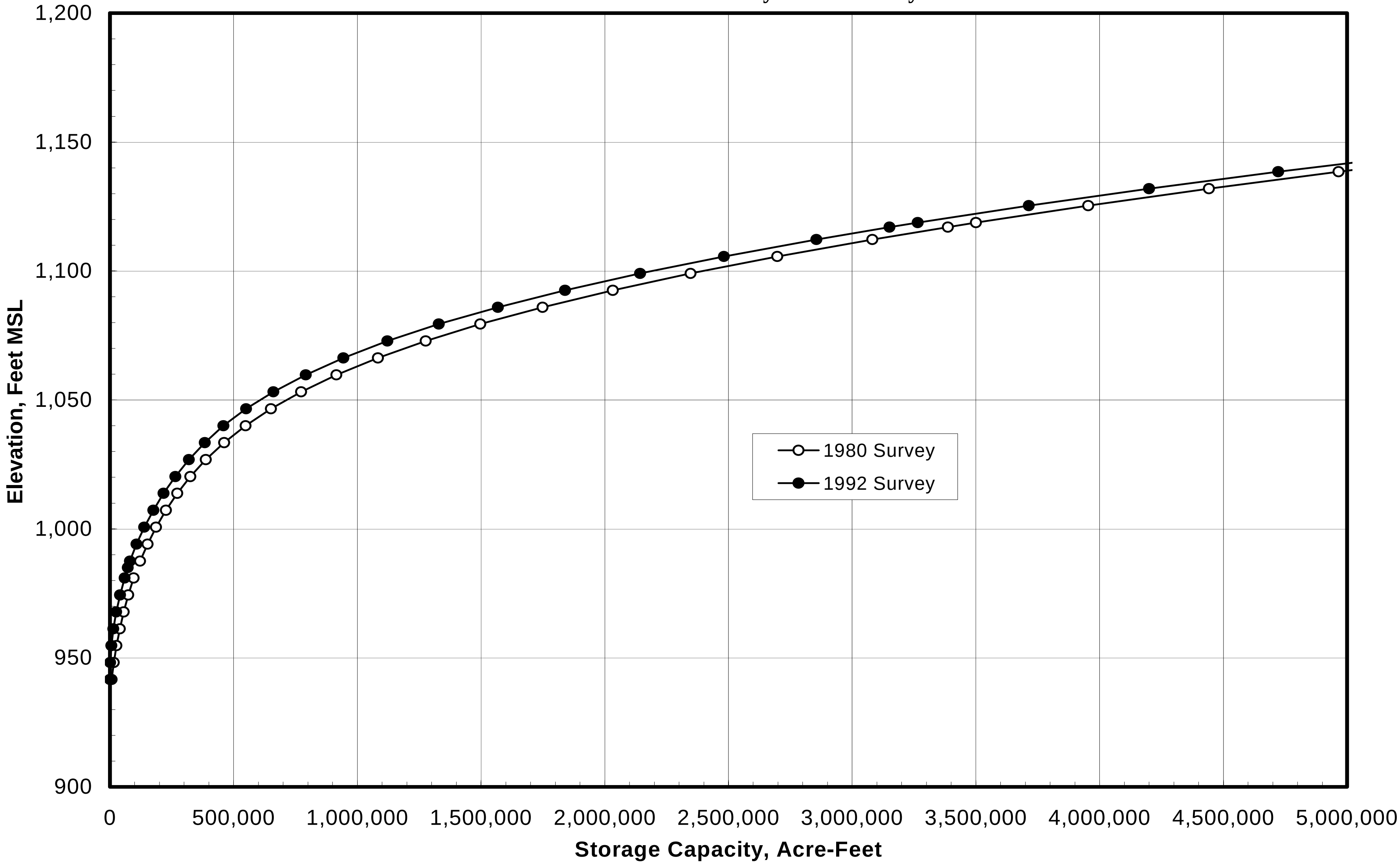


Figure 3.15 - Elevation-Storage Relationships For Falcon Reservoir Based on 1972 and 1992 Bathymetric Surveys

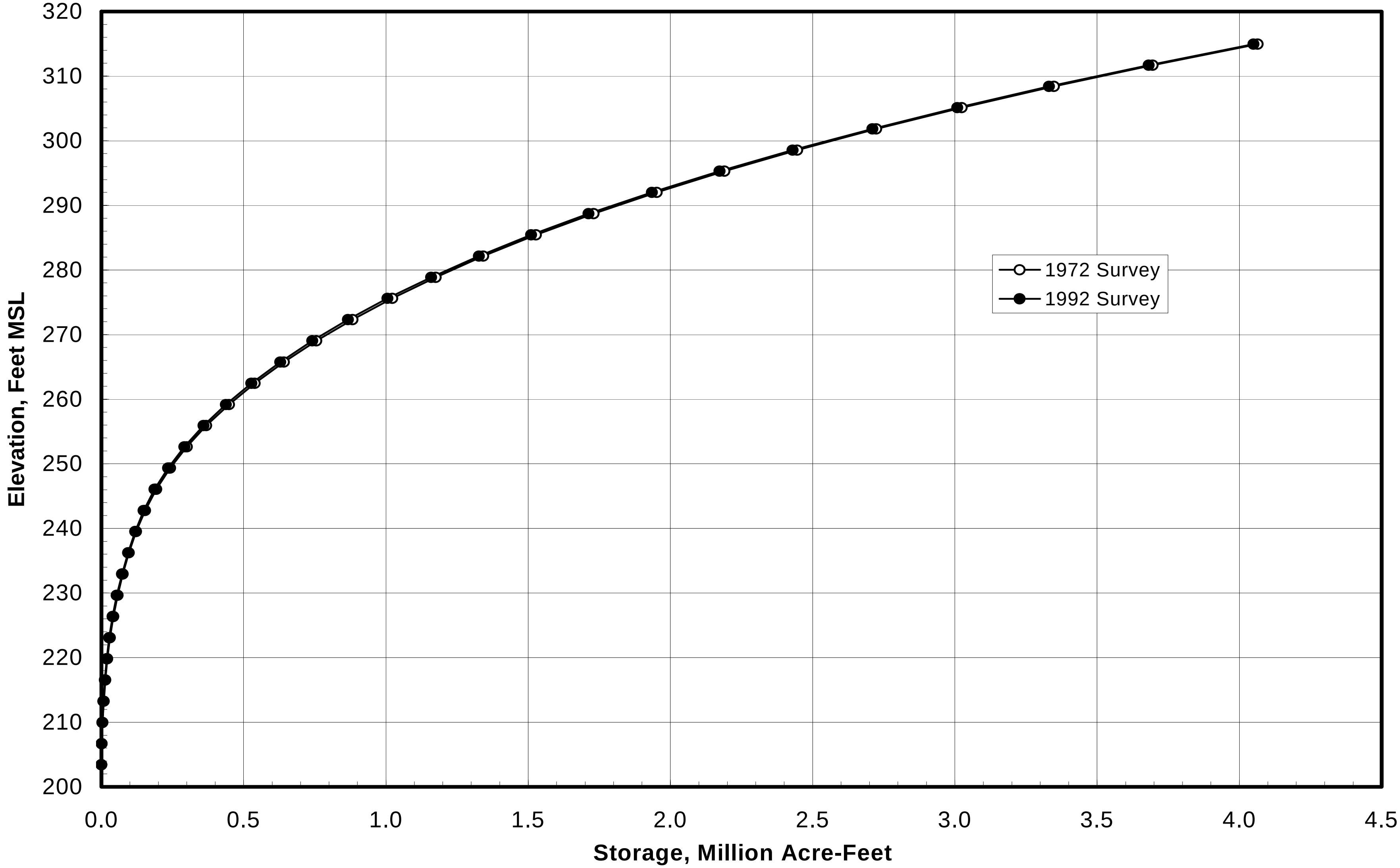


Figure 3.16 Elevation-Storage Relationships for Amistad Reservoir Projected to 2060 Based on 1980 and 1992 Bathymetric Surveys

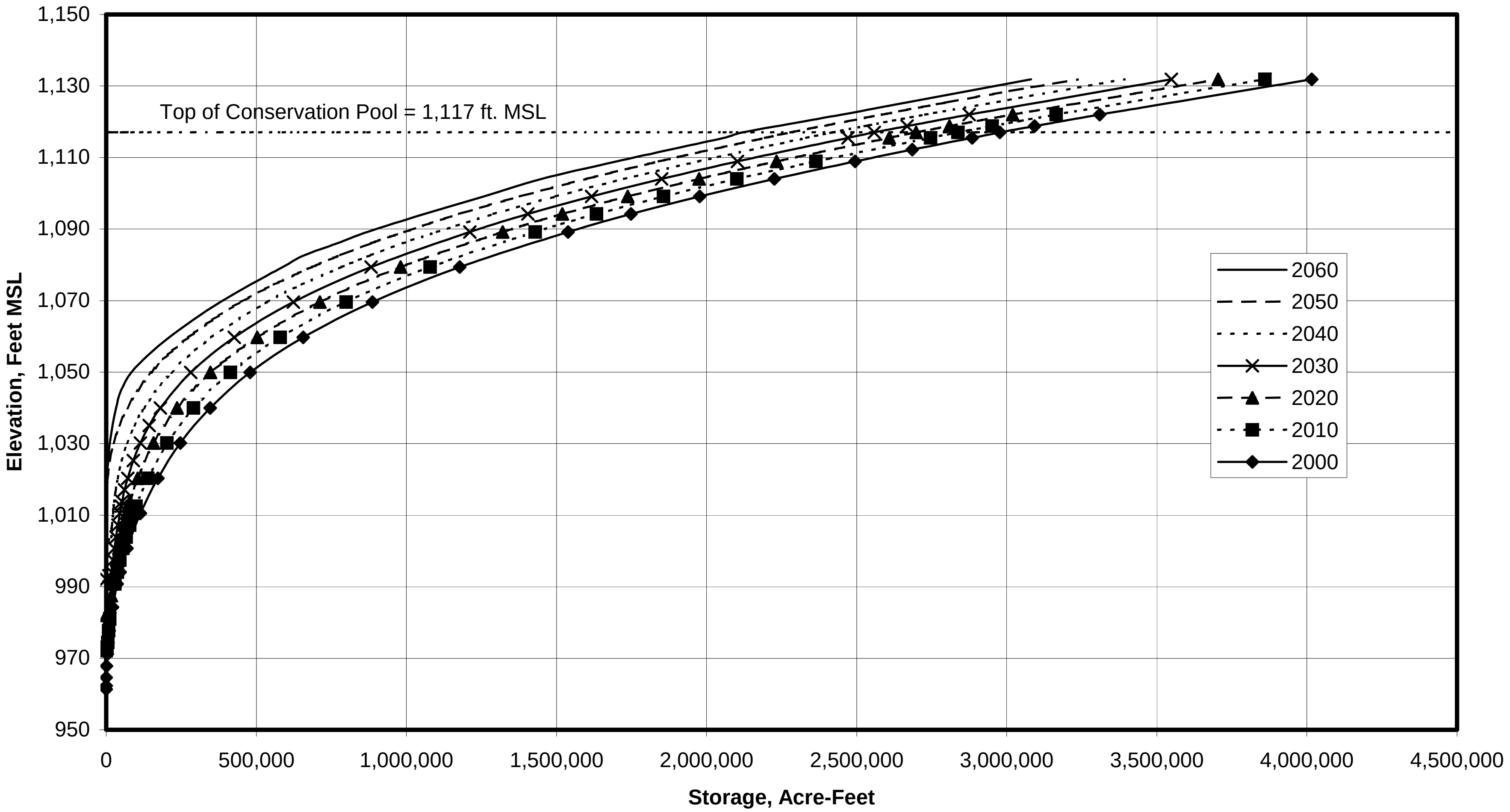


Table 3.7: Projected Maximum Conservation Storage Available in Amistad Reservoir

Year	United States Conservation Storage Acre-Feet	Mexico Conservation Storage Acre-Feet
2010	1,594,648	1,242,804
2020	1,516,541	1,181,696
2030	1,437,833	1,120,588
2040	1,359,425	1,059,481
2050	1,281,018	998,373
2060	1,187,200	932,800

This procedure has been applied for each of the projected elevation-area-capacity relationships for the reservoirs as described above for the years 2010, 2020, 2030, 2040, 2050, and 2060. As the available conservation storage capacity in the reservoirs has been reduced over time due to sedimentation effects, the resulting firm annual yield of the system also has decreased.

Results from the firm annual yield analyses of the Amistad-Falcon reservoir system are presented in Table 3.8. Values of the firm annual yield are listed for both the United States and Mexico by decade for the period 2010 through 2060. As expected, the firm yield of the system for both countries gradually decreases in the future as sedimentation of the reservoirs is projected to occur over time and reduce the reservoirs' storage capacity. The United States' share of the firm annual yield of the reservoir system decreases from 1,011,976 acre-feet per year in the year 2010 to 979,200 acre-feet per year in the year 2060, a reduction of about six percent. The Amistad-Falcon reservoir system firm yield analysis is then broken down by water use type in Table 3.9 per decade. Figure 3.17 also shows the firm yield of Amistad-Falcon and their respective use as well as a percentage breakdown in Table 3.10. Again, these yield values represent the maximum amount of water that can be withdrawn from the reservoirs on a continual basis by the United States should conditions similar to the drought of record recur.

Table 3.8 - Projected Firm Annual Yields of the Amistad-Falcon Reservoir System for the United States and Mexico by Decade (acre-feet/year)

Year	United States	Mexico	Total
2010	1,011,976	888,200	1,955,510
2020	1,004,976	879,700	1,936,419
2030	998,476	869,200	1,918,165
2040	991,976	858,700	1,900,327
2050	985,476	846,700	1,881,292
2060	979,476	835,700	1,860,687

Table 3.9 Current Firm Yield of Amistad-Falcon

CURRENT SUPPLIES OF AMISTAD-FALCON (Firm Yield)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
NON-IRRIGATION	303,353	303,925	304,528	304,965	304,978	305,067
IRRIGATION	701,262	694,273	687,785	681,297	674,807	668,818
UNALLOCATED	7,361	6,778	6,163	5,714	5,691	5,591
Total Firm Yield	1,011,976	1,004,976	998,476	991,976	985,476	979,476

Figure 3.17 Current Supplies from Amistad-Falcon Reservoir System

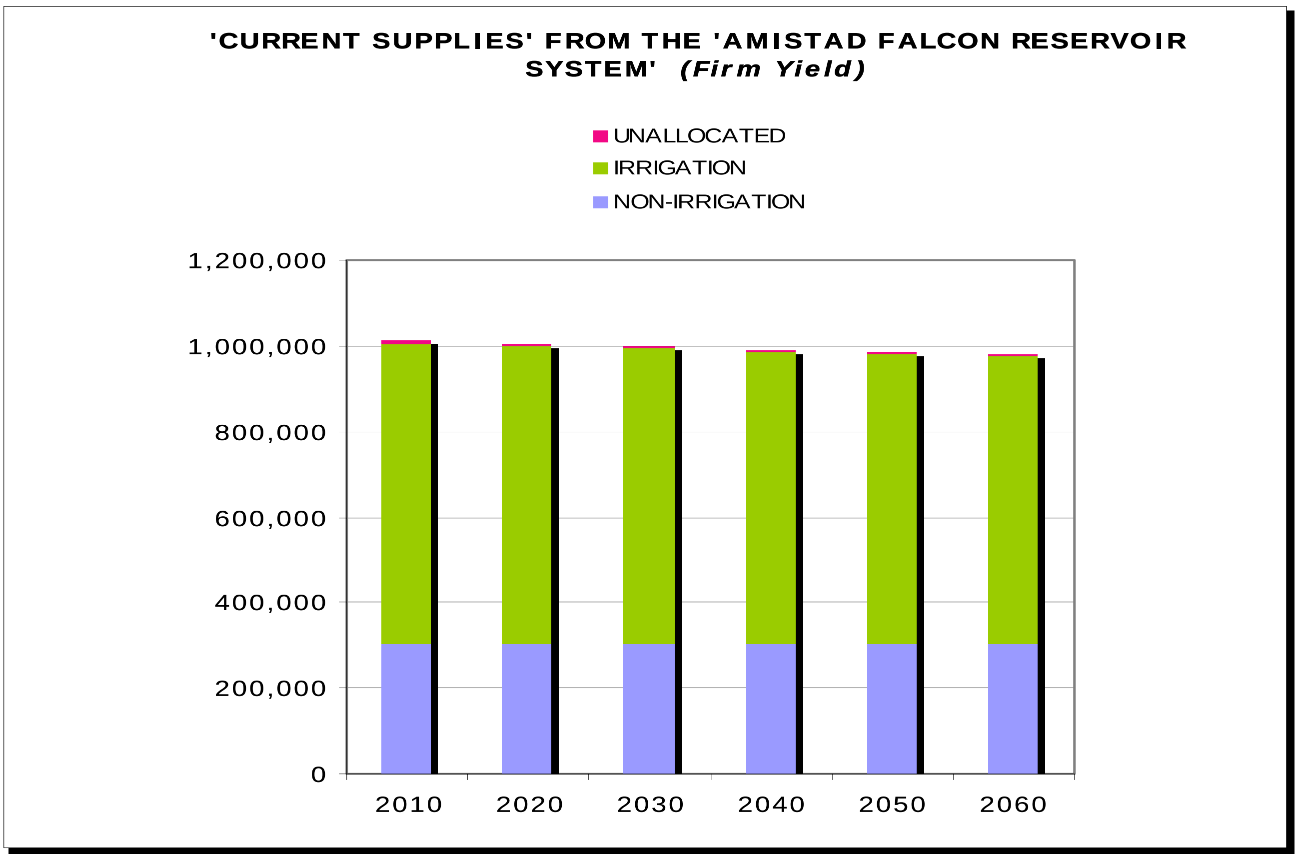


Table 3.10 Amistad-Falcon Use Percentage Breakdown

Use Category	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
IRRIGATION USE	69%	69%	69%	69%	68%	68%
NON-IRRIGATION USE	30%	30%	30%	31%	31%	31%
UNALLOCATED	1%	1%	1%	1%	1%	1%

For Mexico, the firm annual yield of the reservoir system is projected to decrease from about 888,200 acre-feet per year in the year 2010 down to about 835,700 acre-feet per year in 2060. Mexico's yield from the reservoirs is different from that of the United States because each country receives different amounts of inflows to the reservoirs in accordance with actual historical hydrologic conditions and the terms of the 1944 Treaty and because the amounts of conservation storage owned by each of the countries in the reservoirs are different.

This level of minimum storage occurs because of the provisions in the TCEQ's Rio Grande operating rules that require the domestic, municipal, and industrial (DMI) pool and the operating reserve to be fully restored and maintained each month and because at one month's irrigation supply must always be available in storage in the Amistad-Falcon reservoir system in the WAM to avoid an irrigation demand shortage. The minimum United States storage amount that is simulated for the reservoirs during the critical drought period because of the minimum reserve requirements, in effect, provides an additional water supply beyond the firm annual yield of the reservoir system that serves as a factor of safety with regard to supplying DMI water demands.

3.5 GROUNDWATER SOURCES

Throughout the RGRWPA, groundwater has provided water supplies that range from sustainable municipal supplies to quantities of water suitable for irrigation, livestock, and industrial supplies. The major aquifers that exist within the region include the Gulf Coast aquifer, which underlies the entire coastal region of Texas, and the Carrizo-Wilcox aquifer that exists in a broad band that sweeps across the state beginning at the Rio Grande north of Laredo, then continuing northeasterly in an arc south and then east of San Antonio before continuing on to the northeastern corner of Texas and into Louisiana. These aquifers are delineated on the map in Figure 3.18 ("major and minor aquifers" in the Rio Grande Water Planning Region).

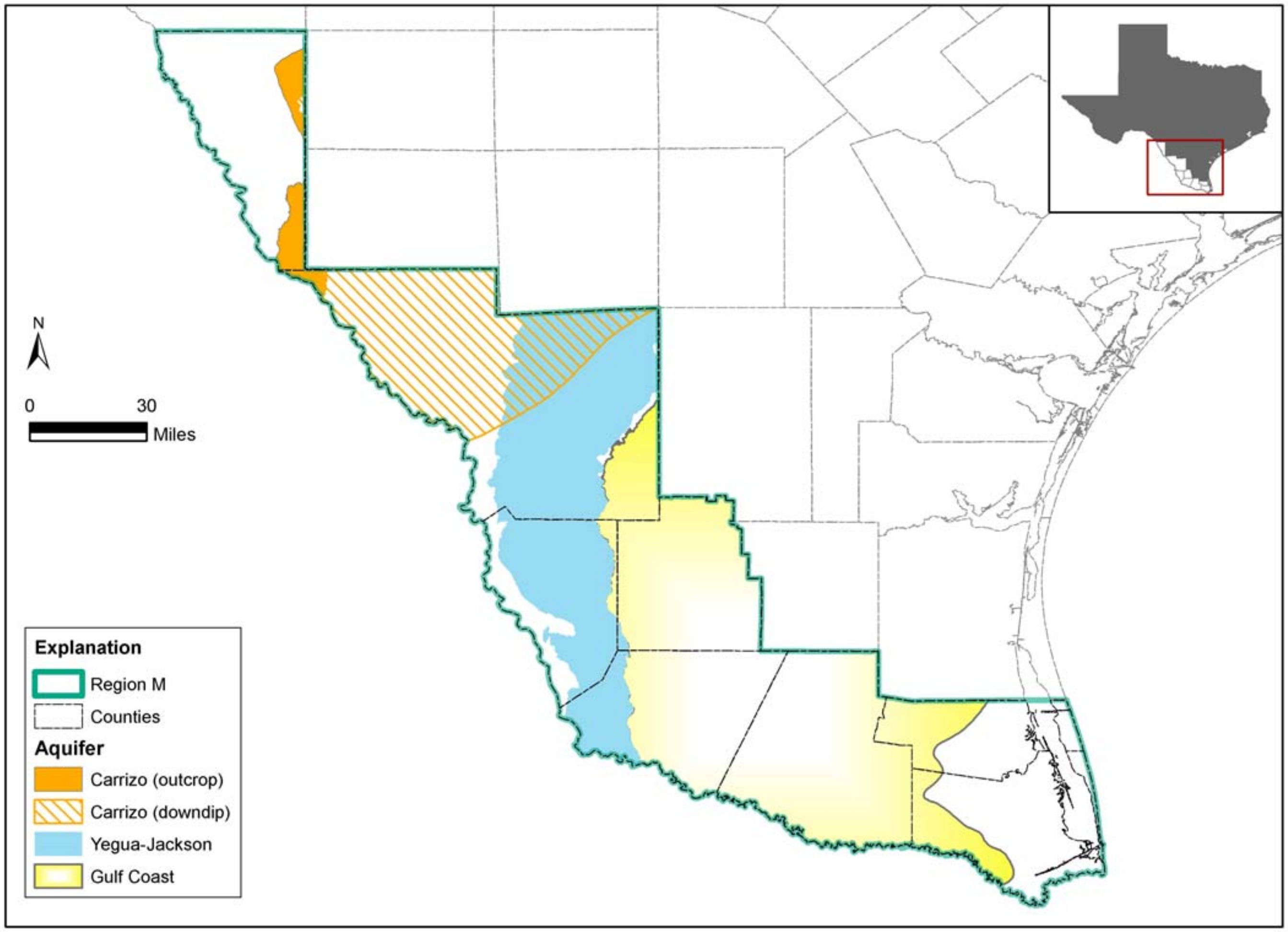
In 2002, the TWDB designated the Yegua-Jackson aquifer as a minor aquifer in the State of Texas. The primary rationale for this designation is that water use from the Yegua-Jackson aquifer ranks in the upper half of annual water use for the minor aquifers, with more than 11,000 acre-feet of water produced in 1997 across the State of Texas. In the RGRWPA, the Yegua-Jackson aquifer extends in a narrow band from the Rio Grande through Starr, Zapata, and Webb counties (Figure 3.18).

Less significant aquifers that exist within the region have not been designated by the TWDB as "minor aquifers," but they provide important water supplies for smaller areas. In the RGRWPA, other aquifers include the Rio Grande Alluvium, which is also called the Rio Grande aquifer, and the Laredo Formation.

The concepts of groundwater availability and aquifer sustainability have been debated significantly in recent years. For groundwater source availability, the TWDB planning guidelines (Exhibit B) require that regional planning groups *"Calculate the largest annual amount of water that can be pumped from a given aquifer without violating the most restrictive physical or regulatory or policy conditions limiting withdrawals, under drought-of-record conditions. Regulatory conditions refer specifically to any limitations on pumping withdrawals imposed by groundwater conservation districts through their rules and permitting programs."* This guideline requires that planning groups make a policy decision as to the interpretation of the term "most restrictive" as it relates to long-term groundwater availability.

TWDB Exhibit B further requires that "Once GAM (Groundwater Availability Model) information is accessible for an area within a region, the Planning Group shall incorporate this information in its next planning cycle unless better site-specific information is developed." The Rio Grande planning group concluded that the two available GAMs are the most appropriate tool for analyzing regional groundwater availability in the Region for the two major aquifers, the Carrizo-Wilcox and Gulf Coast aquifers.

Figure 3.18: Major and Minor Aquifers in the Rio Grande Water Planning Region



A GAM has not been completed for the Yegua-Jackson aquifer. Therefore, the ground-water availability assessment for the Yegua-Jackson and other small aquifers were based on published information, historical water use data from these aquifers, available well and water level records, and the knowledge base of the consultant team. The planning group determined that it is in the best interest of the Region to maintain an acceptable level of aquifer sustainability during the 50-year planning window as well as for future generations beyond the 50-year planning period. Thus, for the two major aquifers for which GAMs exist, the groundwater availability for the planning period was defined as the amount of groundwater that could be withdrawn from aquifers over the next 50 years that would not cause more than 100 feet of water level decline in the aquifers as compared to water levels in 2010. These criteria were used to guide the development of the ground-water availability assessment and to determine groundwater supply for each aquifer in each county. As noted above, water supply for the Yegua-Jackson and other small aquifers was estimated from other information. The planning group acknowledges that additional water does occur in storage within the aquifers and that a portion of that water (above than the estimated supply) could be pumped if there is not a groundwater conservation district in place to prevent such withdrawals.

Much of the groundwater in the region is brackish (i.e., above 1000 mg/L of total dissolved solids). In order to be used for municipal supply, the brackish groundwater requires treatment. The portion of groundwater that is brackish has been estimated by looking at the overall water quality in each county on an aquifer-by-aquifer basis. The groundwater quality information is discussed in more detail in the following sections.

3.5.1 Gulf Coast Aquifer

3.5.1.1 Location and Use

The Gulf Coast aquifer exists in an irregular band along the Texas coast from the Texas-Louisiana border to Mexico. Historically the Gulf Coast aquifer has been used to supply varying quantities of water in Cameron, Hidalgo, Jim Hogg, eastern Starr, southeastern Webb, and southern Willacy counties as shown in Figure 3.19 (Approximate Productive Areas of Groundwater in the Lower Rio Grande Valley) as derived from McCoy, 1990[19] and Baker, 1979[20].

Total groundwater pumpage was approximately 22,770 acre-feet in 1997. In 1997, municipal pumpage accounted for 11,665 acre-feet, irrigation for 6,550 acre-feet, manufacturing use for 850 acre-feet, electric power generation for 720 acre-feet, mining for 2,410 acre-feet, and livestock use for 575 acre-feet. The greatest total groundwater use in recent years was estimated at 37,990

[19] T. Wesley McCoy; Texas Water Development Board; "Evaluation of Ground-Water Resources In The Lower Rio Grande Valley, Texas"; Report 316; January, 1990; Austin Texas.
[20] E. T. Baker, Jr.; Texas Department of Water Resources; "Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas"; Report 236; July 1979;Austin, Texas.

acre-feet in 1991, primarily driven by irrigation demands of 26,540 acre-feet. The largest volume of groundwater used to meet municipal demands was 11,685 acre-feet in 1996. Because groundwater is usually considered as a secondary source, the higher demand for groundwater has usually coincided with times when there was less surface water available.

3.5.1.2 Hydrogeology

The Gulf Coast aquifer consists of interbedded clays, silts, sands, and gravels, which are hydrologically connected to form a leaky aquifer system. In general, there are four components of this system: the deepest zone is the Catahoulla; above the Catahoulla is the Jasper aquifer located within the Oakeville Sandstone; the Evangeline aquifer contained within the Fleming and Goliad sands is separated from the Jasper by the Burkeville confining layer; and the uppermost aquifer—the Chicot—consists of the Lissie, Willis, Bentley, Montgomery, Beaumont, and overlying alluvial deposits. In the RGRWPA, these overlying alluvial deposits include portions of the Rio Grande alluvium. These zones extend into Zapata and Webb counties, but produce smaller quantities of water in these areas. Figure 3.20 provides a stratigraphic cross-section of the Gulf Coast aquifer system in the Lower Rio Grande Valley.

Figure 3.19: Approximate Productive Areas of Groundwater in the Lower Rio Grande Valley

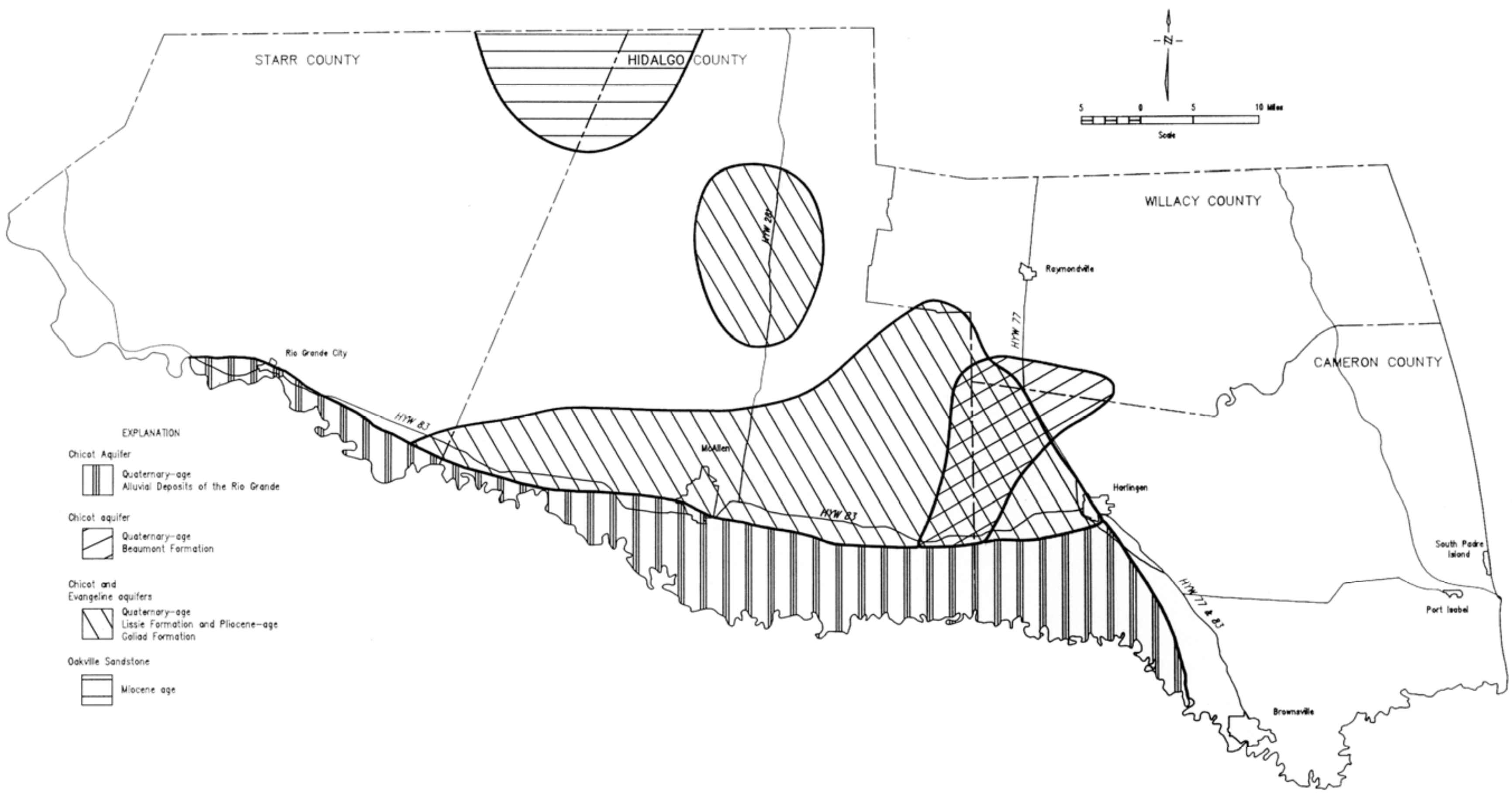


Figure 3.20 - Approximate Productive Areas of Groundwater in the Lower Rio Grande Valley

The primary water-producing zone varies from one area of the region to another. The Chicot aquifer is the primary water-producing zone in western Cameron and eastern Hidalgo counties. The Evangeline aquifer produces significant quantities of water in Cameron, Hidalgo, and Willacy counties. The Oakville Sandstone produces significant quantities of water in northeastern Starr County, northwestern Hidalgo County, and a portion of Jim Hogg County. The Catahoula formation produces small to moderate quantities of water in Webb County.

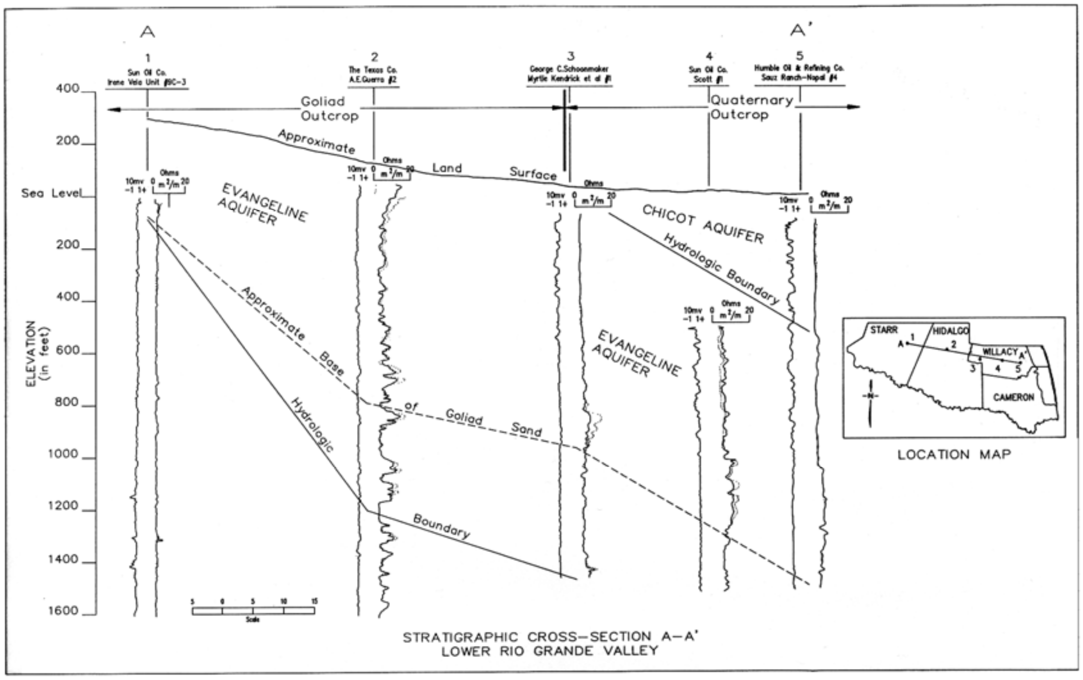
Recharge to the Gulf Coast aquifer occurs primarily through percolation of excess precipitation, which is precipitation that does not run off of the land surface or is not lost through evapotranspiration. This may be supplemented in some areas by the addition of irrigation water from the Rio Grande. In some areas recharge may be limited by shallow subsurface drainage systems designed to control the buildup of salts resulting from continued irrigation operations.

Although there are significant quantities of groundwater available, groundwater has not been heavily used and water levels have remained relatively stable over the years. The Gulf Coast aquifer is basically considered to be full. Well yields can vary significantly. In the Oakville Sandstone, average production is about 120 gallons per minute (gpm), while in the Chicot aquifer the average well yield is about 10 times this rate, or 1,200 gpm. In the Catahoula formation, yields range from 30 to 150 gpm.

3.5.1.3 Water Availability

The estimated volumes of groundwater available for development from the Gulf Coast Aquifer are provided in Table 3.11. As discussed in Section 3.5.1, these groundwater availability estimates for the Gulf Coast aquifer were based on simulations with the Southern Gulf Coast GAM. It should be noted that boundary conditions representing the hydraulic connection between Gulf of Mexico and the Gulf Coast aquifer in the Southern Gulf Coast GAM might lead to an over-estimation of groundwater availability in Cameron County. Therefore, groundwater availability in Cameron County has been decreased by 30% to account for this limitation, but it is difficult to simulate the true long-term impact of pumping in this county under the current model architecture.

Figure 3.20: A Stratigraphic Cross-Section of the Gulf Coast Aquifer System in the LRGV



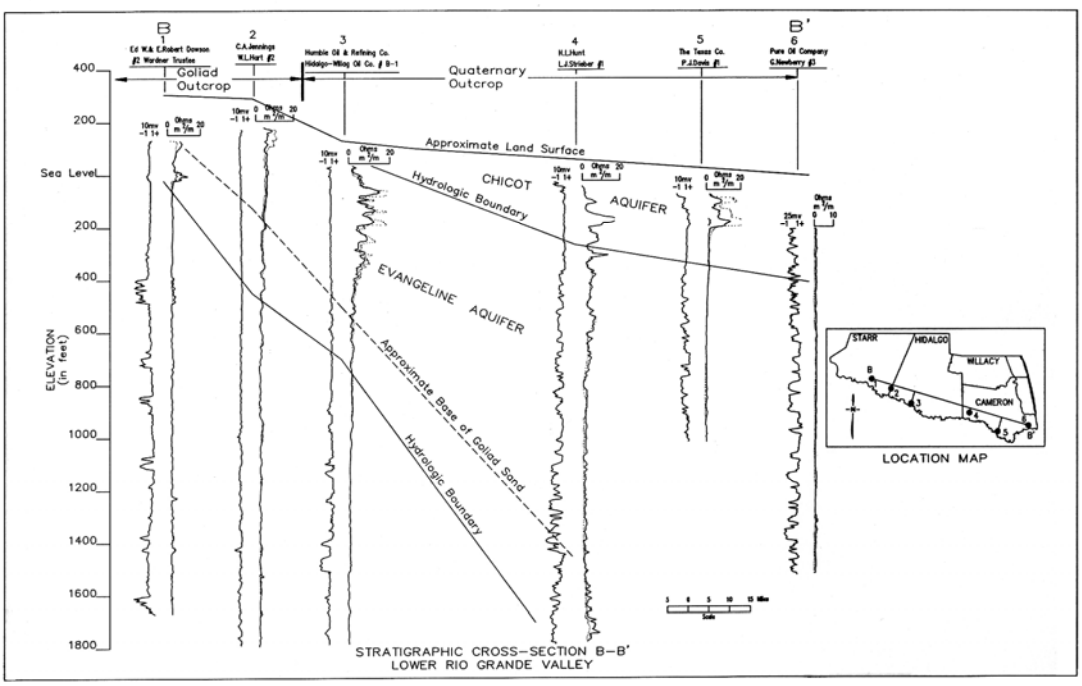


Table 3.11: Projected Groundwater Availability from the Gulf Coast Aquifer for Each County and River Basin by Decade

Gulf Coast Aquifer							
Water Available (acre-feet/year)							
County	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Cameron	Nueces-Rio Grande	97,965	97,965	97,965	97,965	97,965	97,965
Cameron	Rio Grande	6,735	6,735	6,735	6,735	6,735	6,735
Cameron	**Total**	**104,700**	**104,700**	**104,700**	**104,700**	**104,700**	**104,700**
Hidalgo	Nueces-Rio Grande	47,277	47,277	47,277	47,277	47,277	47,277
Hidalgo	Rio Grande	5,253	5,253	5,253	5,253	5,253	5,253
Hidalgo	**Total**	**52,530**	**52,530**	**52,530**	**52,530**	**52,530**	**52,530**
Jim Hogg	Nueces-Rio Grande	3,904	3,904	3,904	3,904	3,904	3,904
Jim Hogg	Rio Grande	976	976	976	976	976	976
Jim Hogg	**Total**	**4,880**	**4,880**	**4,880**	**4,880**	**4,880**	**4,880**
Starr	Nueces-Rio Grande	3,040	3,040	3,040	3,040	3,040	3,040
Starr	Rio Grande	4,560	4,560	4,560	4,560	4,560	4,560
Starr	**Total**	**7,600**	**7,600**	**7,600**	**7,600**	**7,600**	**7,600**
Webb	Nueces	400	400	400	400	400	400
Webb	Nueces-Rio Grande	1,800	1,800	1,800	1,800	1,800	1,800
Webb	Rio Grande	800	800	800	800	800	800
Webb	**Total**	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**
Willacy	Nueces-Rio Grande	90,140	90,140	90,140	90,140	90,140	90,140
Willacy	**Total**	**90,140**	**90,140**	**90,140**	**90,140**	**90,140**	**90,140**
Zapata	Rio Grande	500	500	500	500	500	500
Zapata	**Total**	**500**	**500**	**500**	**500**	**500**	**500**
REGION M	**TOTAL**	**263,350**	**263,350**	**263,350**	**263,350**	**263,350**	**263,350**

3.5.2 Carrizo-Wilcox Aquifer

3.5.2.1 Location and Use

The Carrizo Sand outcrops in a very small area in northwest Webb County, approximately 60 miles to the north-northwest of Laredo (see Figure 3.18, above). The formation continues north into Dimmit, Zavala, and Maverick counties, roughly parallel in orientation to those formations occurring to the east and south.

3.5.2.2 Hydrogeology

The Carrizo Sand is the principal and most prolific aquifer within the northern portion of the RGRWPA. The Carrizo Sand is a coarse to fine grained, massive, loosely cemented, cross-bedded sandstone with some interbedded thinner sandstones and shales. It yields moderate to large quantities of groundwater, but the yield decreases with distance from the outcrop as the formation dips southeastward. Figure 3.21 provides a hydrogeologic section of the Carrizo Sand formation[21] across portions of Maverick, Zavala, Dimmit, LaSalle, and Webb counties. Recharge occurs primarily through exposure of the Carrizo Sand to precipitation at the outcrop and where the outcrop is incised by creeks or streams. A groundwater model has recently been developed for the Carrizo aquifer and further study is underway by the TWDB to fully assess the recharge and potential yield of this aquifer.

3.5.2.3 Water Availability

The projected quantities of water available from the Carrizo aquifer are presented in Table 3.12 below. These estimates are derived by assessing the Southern Carrizo-Wilcox GAM results based on the projected pumping that was incorporated into the predictive simulation[22]. The estimated groundwater supply for each county is based on the criteria of not allowing more than 100 feet of additional drawdown from the water levels.

Table 3.12: Projected Groundwater Availability from the Carrizo-Wilcox Aquifer for Each County and River Basin by Decade

Carrizo-Wilcox Aquifer							
Water Available (acre-feet/year)							
County	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Maverick	Nueces	1,033	1,033	1,033	1,033	1,033	1,033
Maverick	Rio Grande	1,033	1,033	1,033	1,033	1,033	1,033
Maverick	**Total**	**2,066**	**2,066**	**2,066**	**2,066**	**2,066**	**2,066**
Webb	Nueces	8,088	8,088	8,088	8,088	8,088	8,088
Webb	Nueces-Rio Grande	500	500	500	500	500	500
Webb	Rio Grande	8,588	8,588	8,588	8,588	8,588	8,588
Webb	**Total**	**17,176**	**17,176**	**17,176**	**17,176**	**17,176**	**17,176**
Region M	**Total**	**19,242**	**19,242**	**19,242**	**19,242**	**19,242**	**19,242**

[21] William Klempt, et. al.; Texas Water Development Board; "Groundwater Resources of the Carrizo Aquifer in the Winter Garden Area of Texas, Volume 1"; Report 210; September 1976; Austin, Texas.

[22] V.A. Kelley, et. al.; Texas Water Development Board; "Groundwater Availability Model for the Queen City and Sparta Aquifers", October 2004; Austin, Texas.

Figure 3.21: A Hydrogeologic Section of the Carrizo Sand Formation Across Portions of Maverick, Zavala, Dimmit, LaSalle, and Webb Counties

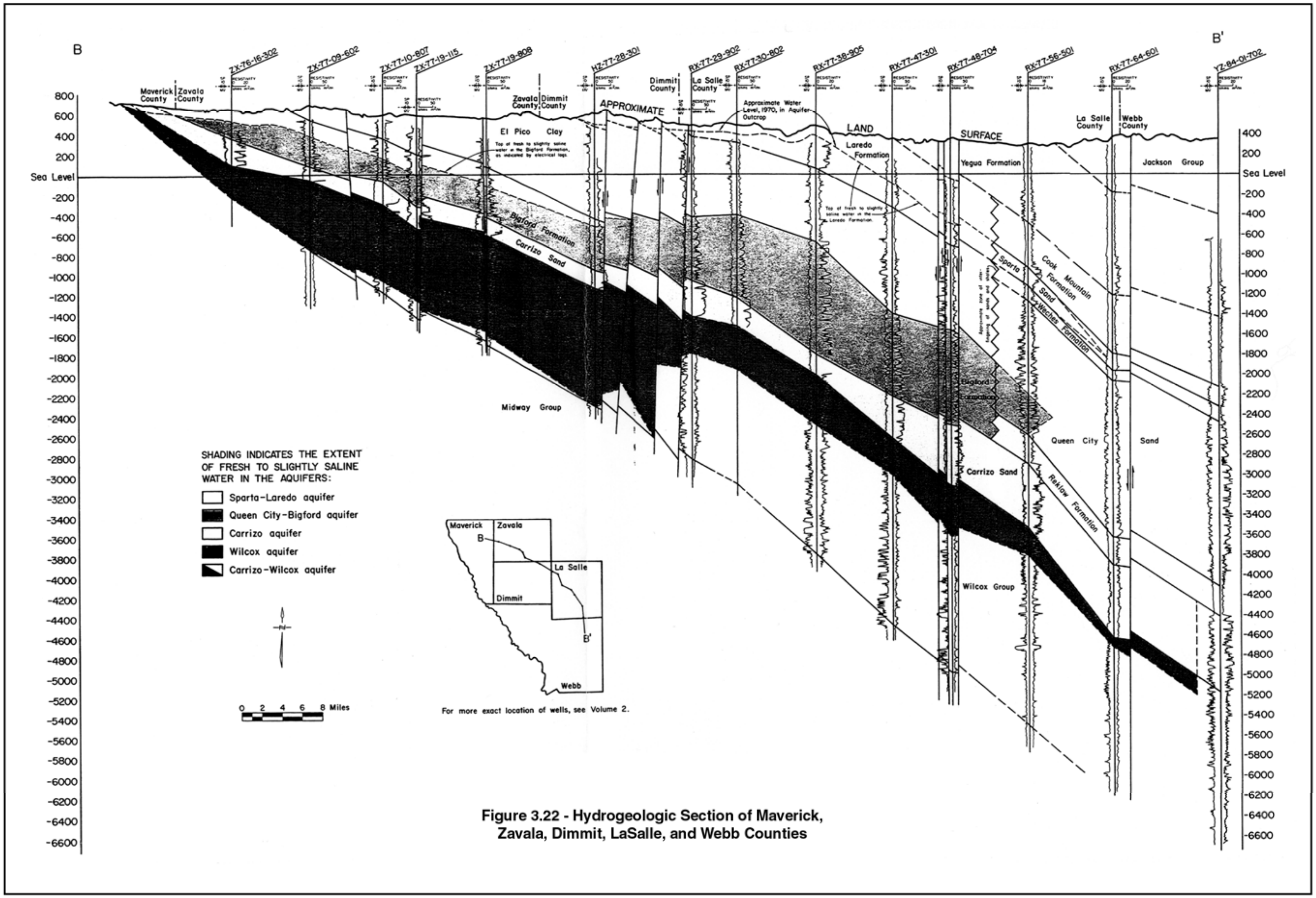


Figure 3.22 - Hydrogeologic Section of Maverick, Zavala, Dimmit, LaSalle, and Webb Counties

3.5.3 Minor and Other Aquifers

Other aquifers included in the RGRWPA that are known to supply groundwater include the Yegua-Jackson aquifer, Rio Grande Alluvium and the Laredo Formation. Although the Rio Grande Alluvium exists in the northern portion of the RGRWPA, most of the production from this formation occurs in the three most southern counties - Cameron, Hidalgo, and Starr. The Laredo Formation is primarily utilized in Webb County.

3.5.3.1 Location and Use

The Yegua-Jackson aquifer extends in a narrow band from the Rio Grande and Mexico across the State to the Sabine River and Louisiana. In the RGRWPA, the Yegua-Jackson aquifer extends in a narrow band from the Rio Grande through Starr, Zapata, and Webb counties (Figure 3-18). The amount and type of use from the Yegua-Jackson aquifer vary across the region.

The Rio Grande Alluvium primarily provides water in Hidalgo and Starr counties within about five miles of the Rio Grande. The quantities of water produced from this formation are probably included in the estimates of pumpage from the Gulf Coast aquifer by the TWDB because it is difficult to separate the surface deposits of the Rio Grande Alluvium from those of the Gulf Coast aquifer. The main differentiating characteristic is that the Rio Grande Alluvium is considered to be more permeable. The Laredo Formation is located in southeastern Webb County and northern Zapata County.

The estimates of past groundwater use from "other aquifers" in the RGRWPA includes four counties: Maverick, Webb, Zapata, and Starr. The aquifers that may be included in these estimates of use are the Rio Grande Alluvium, Laredo Formation, and the Catahoula Formation in Webb County. The total estimated groundwater use for each year is 1,172 acre-feet.

3.5.3.2 Hydrogeology

The Yegua-Jackson aquifer consists of complex associations of sand, silt, and clay deposited during the Tertiary Period. Net sand thickness is generally less than 200 feet at any location within the aquifer. Water quality varies greatly within the aquifer, and shallow occurrences of poor-quality water are not uncommon, and this is especially true in the RGRWPA. In general, however, small to moderate amounts of usable quality water can be found within shallow sands (less than 300 feet deep) over much of the Yegua-Jackson aquifer. Although the occurrence, quality, and quantity of water from this aquifer are erratic, domestic and livestock supplies are available from shallow wells over most of its extent. Locally water for municipal, industrial, and irrigation purposes is available. Yields of most wells are small, less than 50 gallons per minute, but in some areas, yields of adequately constructed wells may be as high as 500 gallons per minute.

The Rio Grande Alluvium exists in Hidalgo County as a river alluvium, but transitions in Cameron County to a more deltaic type of deposit. The material composing the alluvium is highly variable from one location to another. The alluvium has generally been divided into three layers: shallow (less than 75 feet), middle (75 to 150 feet), and deep (150 to 225 feet).

Yields are generally higher in the deeper zone and closer to the Rio Grande. Recharge is primarily through interaction with the river, with some surface recharge. Water levels have generally been stable. There is currently additional research being done by the TWDB to further identify the thickness and properties of this groundwater source.

The Laredo Formation is composed of a thick, fine- to very fine-grained sandstone and clay. It yields small to moderate quantities of water to wells in Webb County. The Cook Mountain Formation and Sparta Sand are generally equivalent to the Laredo Formation in the northeast portion of Webb County and have similar yields.

3.5.3.3 Water Availability

The TWDB has not tracked water usage in the Yegua-Jackson aquifer because it was designated a minor aquifer in 2002. There will be a GAM available for the Yegua-Jackson aquifer in the future. Therefore, estimates of groundwater availability for the Yegua-Jackson aquifer (Table 3.13) were based in part on the historical TWDB estimate of groundwater from the "other" aquifers in the region. Historically, the TWDB has arbitrarily set a limit of 10,000 acre-feet per year for Other Aquifers in select counties (Table 3.14). This may exceed what can actually be produced in many cases, and in some cases may be much less than actual production. It is beneficial to note that the total historical use for all "other aquifers" in all counties has not exceeded 5,000 acre-feet per year. The existing TWDB estimates of water availability have been adopted.

Table 3.13: Projected Groundwater Availability from the Yegua-Jackson Aquifer for Each County by Decade

Yegua-Jackson Aquifer							
Water Available (acre-feet/year)							
County	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Jim Hogg	Rio Grande	100	100	100	100	100	100
Jim Hogg	**Total**	**100**	**100**	**100**	**100**	**100**	**100**
Starr	Rio Grande	2,000	2,000	2,000	2,000	2,000	2,000
Starr	**Total**	**2,000**	**2,000**	**2,000**	**2,000**	**2,000**	**2,000**
Webb	Nueces	2,500	2,500	2,500	2,500	2,500	2,500
Webb	Rio Grande	2,500	2,500	2,500	2,500	2,500	2,500
Webb	**Total**	**5,000**	**5,000**	**5,000**	**5,000**	**5,000**	**5,000**
Zapata	Rio Grande	2,000	2,000	2,000	2,000	2,000	2,000
Zapata	**Rio Grande**	**2,000**	**2,000**	**2,000**	**2,000**	**2,000**	**2,000**
REGION M	**TOTAL**	**9,100**	**9,100**	**9,100**	**9,100**	**9,100**	**9,100**

Table 3.14: Projected Groundwater Availability from "Other Aquifers" for Each County and River Basin by Decade

Other Aquifer							
Water Available (acre-feet/year)							
County	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Hidalgo	Nueces-Rio Grande	5,000	5,000	5,000	5,000	5,000	5,000
Hidalgo	Rio Grande	5,000	5,000	5,000	5,000	5,000	5,000
Hidalgo	**Total**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
Maverick	Nueces	8,788	8,788	8,788	8,788	8,788	8,788
Maverick	Rio Grande	1,212	1,212	1,212	1,212	1,212	1,212
Maverick	**Total**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
Starr	Nueces-Rio Grande	2,291	2,291	2,291	2,291	2,291	2,291
Starr	Rio Grande	7,709	7,709	7,709	7,709	7,709	7,709
Starr	**Total**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
Webb	Nueces	4,463	4,463	4,463	4,463	4,463	4,463
Webb	Nueces-Rio Grande	617	617	617	617	617	617
Webb	Rio Grande	4,920	4,920	4,920	4,920	4,920	4,920
Webb	**Total**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
Zapata	Rio Grande	10,000	10,000	10,000	10,000	10,000	10,000
Zapata	**Total**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
REGION M	**TOTAL**	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**

3.6 GROUNDWATER MANAGEMENT AREAS

On September 1, 2005, the Texas Legislature passed House Bill 1763 that presented changes in how groundwater availability is determined in Texas. In its more important changes, HB1763: 1)regionalizes decisions on groundwater availability, 2) requires regional water planning groups to use groundwater availability numbers from the groundwater conservation districts, and 3)defines a permitting target/cap for groundwater production. These changes affect the rules and plans of groundwater conservation districts, various groundwater supply projects planned around the state, and the regional and state water plans. It also affects the ability of political subdivisions to get state loans for groundwater projects, even if those projects are in areas with no groundwater conservation districts.

Groundwater Management Areas have been around for more than 50 years. Until September 2001, the main purpose was the creation of groundwater conservation districts. After 2001, the primary purpose has been joint planning. However, in 2005, HB1763 required joint planning among groundwater conservation districts within groundwater management areas. The most important part of the joint planning is to determine desired future conditions and calculate managed available groundwater values.

Before HB1763, regional water planning groups were only required to consider the information from the groundwater management plans. This in turn allowed the planning group to determine planning values for groundwater availability without being required to use those values submitted in the groundwater management plans. With the passage of HB1763, regional water planning groups are now required to use managed available groundwater for their groundwater availability estimates. The TWDB recommends that regional water planning groups consider broadening their strategies in terms of both quantity and source to take into consideration changes in groundwater availability for planning purposes.

The process begins with the development of desired future conditions. These are defined as the desired, quantified conditions of groundwater resources (i.e. water levels, water quality, spring flows, or volumes) at a specified time or times in the future or in perpetuity. Groundwater Conservation Districts must go through the process of joint planning to define these desired future conditions. Groundwater Availability Models (GAMs) must be used in this analysis. When submitting desired future conditions, the TWDB requires the following: 1) physically compatible conditions, 2) copies of the groundwater management area meeting postings and minutes, with the complete voting record by member, of the groundwater management area’s public meetings at which the desired future conditions were adopted, 3) a resolution signed by the groundwater management are member district representatives adopting the desired future conditions, 4) the name of a designated representative of the groundwater management area for TWDB staff to contact as necessary, and 5) any other information the Executive Administrator of the TSDB or designee may require. After this information is submitted, the TWDB provides each district and regional water planning group in the groundwater management area with the values of managed available groundwater based on the desired future conditions.

State law allows for the filing of a petition with the TWDB appealing the reasonableness of a desired future condition. A person with a legally defined interest in groundwater in the groundwater management area, a groundwater conservation district in or adjacent to the groundwater management area, or a regional water planning group for a region in the groundwater management area may file a petition with the TSDB appealing the approval of a desired future condition. The petition must be filed within one calendar year of the adoption of the desired future conditions. The complete petition must first be provided to the groundwater conservation districts 30 days before a petition is filed with the TWDB. After a series of notices and hearings, the Executive Administrator will prepare a list of findings based on the evidence and may provide a summary, an analysis, and recommendations relating to the groundwater conservation districts' groundwater management plans and desired future condition. If the Board finds that the desired future condition is reasonable, the Executive Administrator will send a letter to the petitioner and the groundwater conservation districts noting the Board's decision. If the Board finds that the desired future condition is not reasonable, then the Board will prepare a report that includes a list of findings and recommended revisions to the desired future condition. The groundwater conservation districts are then required to revise their desired future condition in accordance with the Board's recommendations and submit the revised desired future condition to the TWDB.

Statute requires that groundwater conservation districts in groundwater management areas submit their desired future conditions to the TWDB by September 1, 2010. However, it has been noted that, in order for the managed available groundwater figures to be included in the current round of regional planning, they would need to be submitted to the regional water planning groups by January 1, 2008. The Region M Regional Planning group did not receive revised managed available groundwater figures from the conservation districts.

Currently four groundwater conservation districts exist in the region, Brush Country, Kenedy County, Red Sands, and Starr County. Each district was contacted to find their district's area location and the current status of the district. However, the fourth round of regional water planning should include more detailed information as the Districts progress in the future. New managed groundwater figures should be available at that time.

Brush Country Groundwater Conservation District

The Brush Country Groundwater Conservation District ("Brush Country GCD") was created by legislative enactment in 2009 and was confirmed by voters at a confirmation election held on November 3, 2009. Based on the confirmation election, the Brush Country GCD territory includes the following areas: all of Jim Hogg County; the area of Jim Wells County outside of the City of Alice and outside the Kenedy County

Groundwater Conservation District; the area of Brooks County outside of the Kenedy County Groundwater Conservation District; and a small area in northern Hidalgo County. Brush Country GCD is currently working to develop its groundwater management plan, has been actively participating in Groundwater Management Area (GMA) 16 meetings for the development of the Desired Future Conditions for the aquifers within the GMA 16 and Brush Country GCD boundaries, and has been working towards becoming fully operational. In the near future, Brush Country GCD intends to hire a General Manager to manage Brush Country GCD's daily operations, to develop rules for the District, and to begin the process of registering wells within Brush Country GCD boundaries.

Kenedy County Groundwater Conservation District

The Kenedy County Groundwater Conservation District covers 1,686,888.82 acres, including all land within Kenedy County and parts of Brooks, Hidalgo, Jim Wells, Kleberg, Nueces, and Willacy counties. The District includes 44,310.58 acres of northern Willacy County and 73,006.26 acres of northeastern Hidalgo County. The District's mission is to develop and implement an efficient, economical and environmentally sound groundwater management program to protect and enhance the groundwater resources of the District. KCGCD is currently implementing a groundwater monitoring program to gather data that will aid in the sound management of the District's groundwater resources.

Red Sands Groundwater Conservation District

The majority of Red Sands Groundwater Conservation District is located in Hidalgo County and in the southern parts of Willacy County. It runs from Raymondville, TX south through Hidalgo County and to the U.S. border. Red Sands is currently in the process of registering all wells in the district and issuing permits for those wells. There is a very restrictive water supply in the Red Sands Groundwater Conservation District; many of the wells are inactive. Red Sands is in the process of plugging those inactive wells at this time. Many of the groundwater wells water were located in the first 90 feet, but studies have confirmed that multiple acre-feet water is located 400 to 500 feet below ground level. More studies by Red Sands Groundwater Conservation District are being performed at this time.

Starr County Groundwater Conservation District

Starr County Groundwater Conservation District is located in Starr County. They just completed appointing its board of directors for the district and have been working closely with TWDB and other local districts to help construct their Groundwater Conservation Management Plan. The District is currently in the process of registering all wells and receiving the required permits for the wells.

3.7 AVAILABLE CURRENT WATER SUPPLIES

The development of estimates of the current water supplies that are available for meeting projected future water demands in the RGRWPA has been accomplished through two separate, but interrelated activities; one for surface water and one for groundwater. Both of these activities have proceeded in generally the same fashion, i.e., they both have examined existing sources of water for the region with regard to the maximum supply available under drought of record conditions, taking into consideration other supply restrictions such as the current capacity of existing groundwater well fields; the hydrogeologic properties of aquifers in the region; the quality of existing water supplies with regard to usability; current water rights, permits and other regulatory restrictions; the hydraulic capacity of existing conveyance infrastructure; current contracts and/or option agreements; and obligations that a water user group (WUG) may have in terms of contracts or direct/indirect water sales to other WUGs. In some instances, one or more of these factors have determined the available water supply for individual water users.

Presented in the following sections are the specific steps and procedures that have been undertaken in arriving at the estimated quantities of surface and ground water that are considered to be available from currently existing sources for meeting future water demands in the RGRWPA.

3.7.1 Surface Water Supply Analysis

The analysis of available surface water supplies for the RGRWPA has focused, of course, on the Rio Grande, primarily on Amistad and Falcon Reservoirs. Other lesser sources of surface water such as tributaries of the Rio Grande in Maverick, Webb, Zapata, and Starr counties; the Arroyo Colorado, which flows through southern Hidalgo County and northern Cameron County to the Laguna Madre; the pilot channels within the floodways that convey local runoff and floodwaters from the Rio Grande through the Lower Rio Grande Valley to the Laguna Madre; and isolated lakes and resacas in Hidalgo and Cameron counties also have been considered in this investigation.

The existing priorities for allocating the United States' share of surface water stored in Amistad and Falcon Reservoirs as set forth in the TCEQ Rio Grande operating rules[23] have provided the primary means for determining how the firm annual yield supply of the reservoir system would be apportioned among the various water user groups in the RGRWPA. In essence, these rules stipulate that during drought periods when water shortages may occur, domestic, municipal, and industrial water uses must be supplied first, followed by irrigation and mining water uses. This is the general allocation procedure that has been used in this study.

[23] "Chapter 303: Operation of the Rio Grande"; 31 Texas Administrative Code, §§ 303.1-303.73; Texas Water Commission Rules; August 26, 1987; Austin, Texas.

Table 3.15: Ground Water Availability Volumes by County and Basin Location

SURFACE WATER AVAILABILITY								
COUNTY	SOURCE	RIVER BASIN	2010	2020	2030	2040	2050	2060
RESERVOIR	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	RIO GRANDE	1,011,976	1,004,976	998,476	991,976	985,476	979,476
CAMERON	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	NUECES-RIO GRANDE	2,610	2,610	2,610	2,610	2,610	2,610
HIDALGO	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	NUECES-RIO GRANDE	79	79	79	79	79	79
MAVERICK	RIO GRANDE RUN-OF-RIVER	RIO GRANDE	243	243	243	243	243	243
WEBB	RIO GRANDE RUN-OF-RIVER	RIO GRANDE	151	151	151	151	151	151
WILLACY	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	NUECES-RIO GRANDE	899	899	899	899	899	899
TOTAL			1,015,958	1,008,958	1,002,458	995,958	989,458	983,458

Following is a description of the step-by-step procedures and analyses that have been undertaken in determining the quantities of surface water available for meeting future needs in the RGRWPA for specific categories of water use:

Step 1 Municipal/Manufacturing Surface Water Supply – Amistad-Falcon Reservoir System: All of the existing water rights[24] authorizing municipal and/or industrial (manufacturing) uses of water from Amistad and Falcon Reservoirs have been assumed to be fully supplied through the year 2060 by the firm annual yield of the reservoir system. These are the water rights with the highest priority for being allocated water stored in Amistad and Falcon Reservoirs under the TCEQ rules; therefore, they would be entitled first to the United States' share of the firm annual yield of the reservoir system. As indicated in Table 3.5, the total amount of annual diversions that are authorized by existing water rights within the Rio Grande Basin for municipal and/or industrial uses, including water from the Amistad-Falcon system, is approximately 391,000 acre-feet per year. Hence, with the United States' share of the firm annual yield of the Amistad-Falcon system projected to be on the order of 1,000,000 acre-feet per year over the next 50 years (Table 3.8), the supply of water represented by the municipal and industrial

[24] Based on the water rights master file of the TCEQ as of May 17, 2004.

(manufacturing) water rights that are dependent upon the reservoir system has been assumed to be fully reliable and available all of the time.

Step 2 <u>Municipal Surface Water Supply – Amistad-Falcon Reservoir System:</u> The supply of water represented by the municipal water rights dependent upon the Amistad-Falcon reservoir system, which totals 336,642 acre-feet per year (Table 3.5), has been distributed to individual WUGs (cities, water districts, water supply corporations, irrigation districts, etc.) based on the actual water rights owned by these entities and/or on agreements between these entities and other water rights owners. In this manner, the entire authorized diversion amounts of all municipal water rights that use water from Amistad and Falcon Reservoirs have been fully allocated for planning purposes.

It is important to recognize that municipal water suppliers in Rio Grande Region that are dependent upon the Amistad-Falcon reservoir system for their water supplies operate under rules and regulations that originate from the 1969 final judgment of the Thirteenth Court of Civil Appeals in the water dispute commonly referred to as the "Rio Grande Valley Water Case." Among other things, this judgment allocated specific amounts of water in the Lower Rio Grande Valley to individual domestic, municipal and industrial (DMI) water users (typically cities) that were in existence at the time and had documented historical water usage, and it assigned these DMI water rights to specific irrigation districts, which had pumping facilities on the river, for the subsequent diversion and delivery of river water to the DMI users. In effect, the irrigation districts were assigned municipal water rights that were specifically designated for certain individual domestic, municipal, and industrial water users.

Today, most of the DMI water users in the Lower Rio Grande Valley continue to obtain their water supplies from the irrigation districts under the original water rights that are owned by the irrigation districts but that have specific assignments to the DMI users. In this regard, the irrigation districts request releases from Falcon Reservoir, pump this water from the Rio Grande into their own distribution systems, and ultimately deliver the water, less losses, to the DMI users.

In some cases, there are written contracts between the DMI users and the irrigation districts for water delivery; however, often there are only general agreements between the DMI users and the irrigation districts that water will be delivered pursuant to the requirements of the original water rights that specifically assigned water to the DMI users. When these delivery contracts or agreements expire, they normally are simply extended with revised rates to cover pumping costs. Sometimes when the annual allotment for DMI water as stipulated in a water right is exceeded by an individual DMI water user, the irrigation district will continue to supply DMI water to the DMI user under the district's own water right and then charge the DMI user for this additional water. This one-time delivery of water is referred to as "contract water," but it really has nothing to do with a formal long-term contractual agreement. It simply means that water is being delivered to a DMI user on a short-term contractual basis.

What is most important from a water supply perspective with regard to these water supply arrangements between individual DMI users and irrigation districts in the Lower Rio Grande Valley is the total amount of DMI water that is available under the existing water rights, not whether or not there is a formal contract in place to guarantee the delivery of the water. The DMI water users are guaranteed the water because of the water rights themselves, and it is these water rights that determine the extent of the overall DMI supply. Since DMI water was assigned the highest priority relative to other types of uses; e.g., irrigation and mining, as a result of the Rio Grande Valley Water Case, the DMI water supply is guaranteed, as noted above, by the firm yield of the Amistad-Falcon reservoir system.

For these reasons, the currently available DMI water supplies for individual WUGs have been determined based primarily on allotments specified in existing water rights. It is these allotments that are of most importance to the WUGs with respect to their future water supplies, not the terms of any contract or other agreement. It is only when the projected municipal water usage by a WUG approaches the annual allotment for DMI water that is specified in the WUG's existing water rights that the WUG should be concerned with obtaining an additional water supply. Otherwise, its water supply will be provided in accordance with existing water rights. This is the procedure that has been applied herein, and it is considered to be the most appropriate for projecting currently available municipal water supplies.

It should be recognized, however, that there are some municipal water users that do have their own water rights, which they have acquired (usually purchased) from the irrigation districts. As with all municipal water rights, the projected water supplies associated with these municipal user-owned water rights have been set equal to their authorized annual diversion amounts since, because of their priority, they are fully protected by the firm yield of the Amistad-Falcon reservoir system. There also are some municipal water users that have specific contracts for DMI water from the irrigation districts under the districts' water rights (exclusive of the original allotments from the Rio Grande Valley Water Case). For these municipal water users with identifiable and known contracts, the projected water supplies that have been considered to be available for future use have been those specified in the contracts, with the term of the existing contracts taken into account.

The specific amounts of available current municipal water supplies that have been projected for the individual WUGs within the RGRWPA have been assigned to the respective WUGs. The balance of the available current municipal water supplies from Amistad and Falcon Reservoirs based on existing DMI water rights has been assigned to the municipal use category referred to by the TWDB as "County-Other."

Step 3 Municipal Surface Water Supply – Amistad-Falcon Reservoir System: To verify the accuracy of the available current water supplies as derived above, questionnaires were sent to specific municipal WUGs[25] summarizing their water supply sources and available amounts and requesting any additional information considered necessary to refine or update the water supply data. Follow-up meetings and telephone calls with each of the WUGs verified the water supply information. This revised information then was incorporated into the estimates of available current water supplies as appropriate.

Step 4 Municipal Surface Water Supply – Amistad-Falcon Reservoir System: To verify the accuracy of information regarding water supply agreements between specific water users and specific water suppliers as developed in Step 2 above, questionnaires also were sent to all irrigation districts believed to supply surface water from the Rio Grande to individual cities in the Lower Rio Grande Valley. Additionally, the irrigation districts were contacted directly to clarify water supply data and information. This revised information also was incorporated into the estimates of available current water supplies as appropriate.

Step 5 Municipal Surface Water Supply – Nueces-Rio Grande Resacas: As described in Section 3.6.4 above, the surface water supplies associated with water rights that authorize diversions from certain resacas in Cameron County have been assumed to be available for localized municipal use. Hence, a total of 225 acre-feet of water per year have been included in the "Municipal" water use category for Cameron County.

Step 6 Manufacturing Surface Water Supply – Amistad-Falcon Reservoir System: As with the available current supplies of water from the Amistad-Falcon system for municipal use, the available supplies for the "Manufacturing" (industrial) water use category also have been established based on the fully authorized diversion amounts of the existing Amistad-Falcon water rights that are designated for industrial purposes. As indicated in Table 3.5, the total amount of annual diversions within the Rio Grande Basin that are authorized by existing water rights for industrial uses is 18,849 acre-feet per year. Since industrial water rights include water that is used for steam electric power generation, a portion of the total authorized diversion amount for industrial use has been transferred to the "Steam Electric" water use category in accordance with existing water rights ownership and supply agreements. The

[25] The same specifically named cities within the RGRWPA for which projected water demand information is available from the Texas Water Development Board.

water rights holders and the amounts of diversions transferred are summarized below by county:

Cameron County		
Central Power & Light	2,400	acre-feet/year
Hidalgo County		
AEP Electric	2,475	acre-feet/year
Webb County		
AEP Electric	1,645	acre-feet/year
Total Steam Electric Transfers	6,520	acre-feet/year

With these transfers, the total available supply for the “Manufacturing” water use category based on existing Amistad-Falcon water rights (industrial) is reduced to 6,539 acre-feet per year. These total amounts of available supply have been distributed by county.

Step 7 Manufacturing Surface Water Supply – Reuse: In addition to the firm supplies available for manufacturing uses from the Amistad-Falcon system as described in Step 6 above, there also is projected to be a certain amount of water available for manufacturing through reuse of treated wastewater effluent. The City of Harlingen previously provided Fruit of the Loom with up to 2,240 ac-ft/yr of reuse water. However, that plant has closed and the reuse program is no longer active. The City still has a valid water right for that amount, so for planning purposes, this amount has been assumed as the available current supply of reuse water for the “Manufacturing” water use category within the RGRWPA.

Step 8 Steam Electric Surface Water Supply – Amistad-Falcon Reservoir System: As noted in Step 6 above, 6,520 acre-feet of water per year from the Amistad-Falcon Reservoir system are available for use for steam electric generation purposes as a result of the supply transfers from the “Manufacturing” water use category. In addition, there are other sources of Amistad-Falcon water that are currently used for steam electric generation through agreements with individual water rights holders. In Hidalgo County, the Hidalgo County Irrigation District No. 6 supplies 3,466 acre-feet of “Municipal” water per year to Frontera Generation for steam electric generation purposes. Considering both water rights and agreements, the available current water supply for steam electric generation in the RGRWPA totals 9,986 acre-feet per year, and this amount is distributed among the individual counties in accordance with the locations where it is used.

Step 9 Steam Electric Surface Water Supply - Reuse: Reuse of treated municipal wastewater effluent also provides an additional source of water for steam electric generation. Currently, the City of McAllen has agreements to supply 4.5 million gallons of wastewater effluent per day (5,040 acre-feet/year) to the Calpine Power Plant. Hence, for planning purposes, the total water supply currently available through reuse of treated municipal wastewater effluent within the RGRWPA has been assumed to be 5,040 acre-feet per year, and this amount has been assigned to Hidalgo County.

Step 10 Irrigation and Mining Surface Water Supply – Amistad-Falcon Reservoir System: As noted in Table 3.5, the existing water rights in the Rio Grande Basin authorize the use of water from Amistad and Falcon Reservoirs for irrigation and mining purposes up to approximately 1.8 million acre-feet per year. This amount of usage far exceeds the projected firm annual yields of the reservoir system as indicated by the yield amounts presented in Table 3.8. Hence, the reservoir system is over-appropriated with regard to the total diversion amount authorized in existing water rights for irrigation and mining uses. In accordance with the water allocation priorities set forth in TCEQ's Rio Grande operating rules, water stored in Amistad and Falcon Reservoirs is available for irrigation and mining uses only after the demands for domestic, municipal, and industrial uses (including manufacturing and steam electric uses) have been supplied (to the extent authorized by existing water rights) and after the DMI pool and the operating reserve in the reservoirs have been fully restored. In effect, for purposes of water supply planning in accordance with TWDB guidelines, this means that the available water supply from Amistad and Falcon Reservoirs for irrigation and mining uses is represented by the balance of the firm annual yield of the reservoir system after the domestic, municipal, and industrial (including manufacturing and steam electric) water demands have been satisfied and after the DMI pool and the operating reserve in the reservoirs have been fully restored.

Therefore, in this study, the available water supply from Amistad and Falcon Reservoirs for irrigation and mining uses has been determined by operating the Rio Grande WAM in a manner that apportions the remaining firm annual yield of the reservoir system to irrigation and mining uses after first allowing for the expected municipal, manufacturing, and steam electric surface water supplies. For these analyses, which have been performed for each of the future decades through the year 2060, the municipal, manufacturing, and steam electric water supplies that are expected to be available from Amistad and Falcon Reservoirs have been specified in the WAM as the total authorized diversions for municipal, manufacturing and steam electric uses as stipulated in existing water rights. These supplies have been assigned the highest demand priority in accordance with the TCEQ rules included in the WAM. With these municipal, manufacturing, and steam electric demands specified in the WAM, and with the demands for all other non Amistad-Falcon water rights in the Rio Grande Basin set at their authorized amounts, the WAM has been operated to determine the remaining yield of the reservoirs that would be available for irrigation and mining uses under the projected reservoir sedimentation conditions for each decade. These remaining yield amounts for each decade represent the current water supplies available from Amistad and Falcon Reservoirs for irrigation and mining uses, and they have been apportioned among the counties of the RGRWPA based on the proportional authorized diversion amounts in each county as summarized in Table 3.5. The resulting available current water supplies for irrigation and mining uses in each county within the RGRWPA are listed in Table 3.16 for each decade through the year 2060. As shown, the available supplies of Amistad-Falcon firm yield for irrigation and mining uses vary from approximately 702,000 acre-feet in 2010 down to about 670,000 acre-feet in the year 2060.

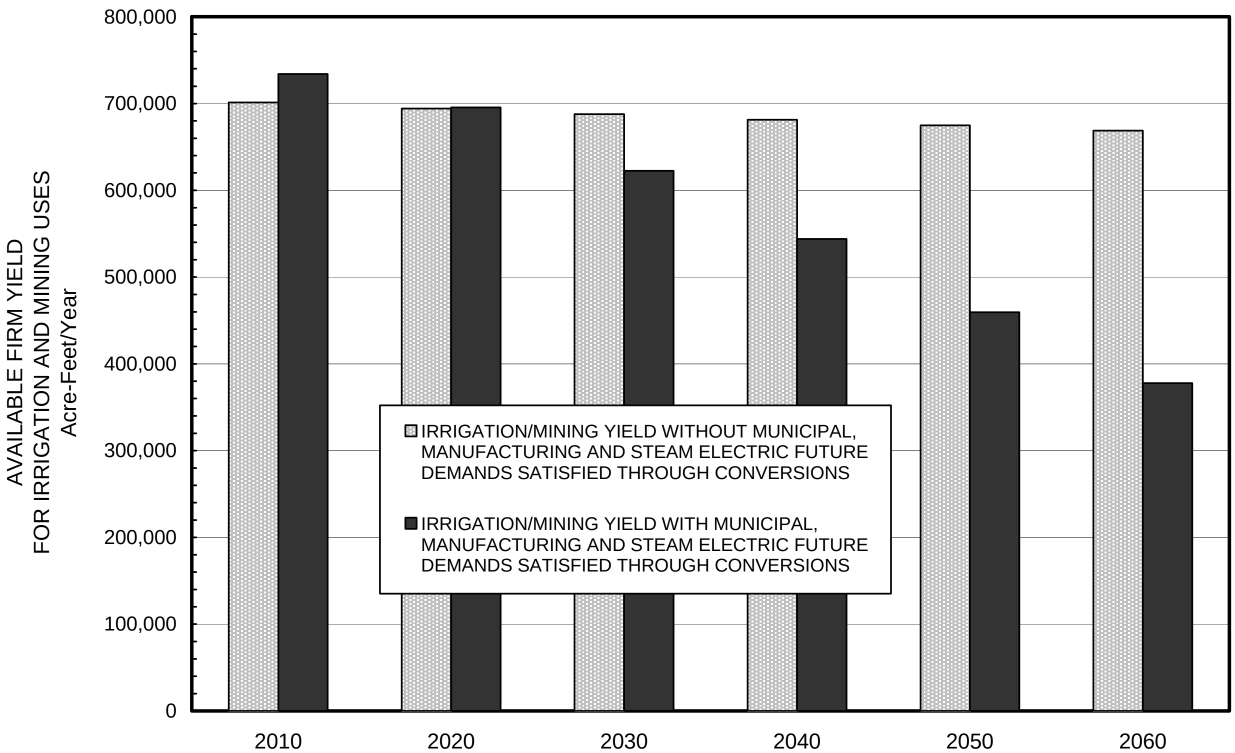
It is generally accepted that a large part of the future demands for municipal, manufacturing, and steam electric uses in the RGRWPA will be supplied through the conversion of irrigation and mining water rights that utilize water from Amistad and Falcon Reservoirs. As urbanization continues to encroach into agricultural areas and as the overall agricultural economy is potentially diminished, the available supplies of irrigation and mining water indicated in Table 3.16 are likely to be reduced as demands for municipal, manufacturing, and steam electric water increase and begin to be satisfied with converted irrigation and mining water rights from the Amistad-Falcon reservoir system.

To provide some indication of how such conversions might affect the available supply of Amistad-Falcon water for irrigation and mining in the future, another set of firm yield analyses has been performed with the WAM. Keep in mind that water rights are converted from irrigation use to municipal use on a 2:1 ratio. For these simulations, the projected future demands for municipal, manufacturing, and steam electric uses were assumed to be entirely met through the conversion of irrigation and mining water rights, and the diversion amounts for these uses as specified in the WAM were set equal to their projected demands as set forth in Chapter 2 without any regard for the authorized diversion amounts for these uses specified in existing Amistad-Falcon water rights. The results from these WAM firm yield analyses are compared to the previous yield results on the graph in Figure 3.22 for each of the future decades through 2060. As expected, the available supplies of irrigation water from the Amistad-Falcon reservoir system are substantially reduced over the next 50 years because of the increased demands for municipal, manufacturing, and steam electric uses, which are assumed to be satisfied through the conversion of the existing irrigation and mining water rights. The 2060 available supply of irrigation water from the reservoirs is approximately 390,000 acre-feet, whereas without the conversion of the existing irrigation and mining rights to satisfy the projected future municipal, manufacturing, and steam electric demands, the available supply of irrigation water from the reservoirs is estimated to be approximately 670,000 acre-feet.

Table 3.16 Projected Firm Annual Yield Amounts for Irrigation and Mining Uses from the Amistad-Falcon Reservoir System After Satisfying Future Reservoir-Dependent Municipal, Manufacturing, and Steam Electric Demands Limited to Existing Authorized Diversions						
AVAILABLE RESERVOIR YIELDS FOR IRRIGATION USES						
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Cameron	222,560	220,342	218,282	216,224	214,164	212,263
Hidalgo	360,437	356,846	353,511	350,176	346,841	343,762
Jim Hogg	0	0	0	0	0	0
Maverick	53,755	53,219	52,722	52,224	51,727	51,268
Starr	15,773	15,616	15,470	15,324	15,178	15,043
Webb	10,520	10,415	10,318	10,221	10,123	10,034
Willacy	34,257	33,915	33,598	33,281	32,964	32,672
Zapata	3,960	3,920	3,884	3,847	3,810	3,776
TOTAL	701,262	694,273	687,785	681,297	674,807	668,818
AVAILABLE RESERVOIR YIELDS FOR MINING USES						
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Cameron	4	4	4	4	4	4
Hidalgo	206	204	202	200	198	195
Jim Hogg	0	0	0	0	0	0
Maverick	35	35	34	34	34	33
Starr	20	20	20	20	20	19
Webb	647	641	635	629	623	617
Willacy	0	0	0	0	0	0
Zapata	134	132	131	130	129	127
TOTAL	1,046	1,036	1,026	1,017	1,008	995
AVAILABLE RESERVOIR YIELDS FOR IRRIGATION AND MINING USES						
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
All Counties	702,308	695,309	688,811	682,314	675,815	669,813

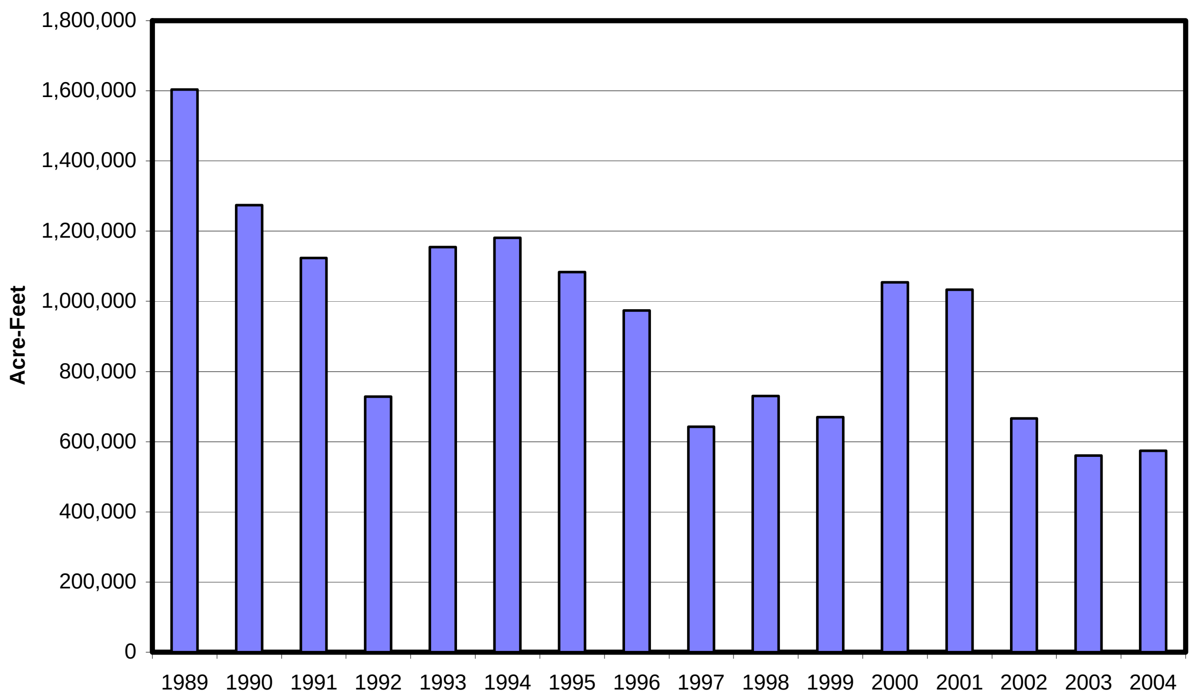
It should be noted that both of the sets of results presented in Figure 3.22 reflect the amount of irrigation and mining water available during critical drought conditions. This is consistent with the conditions under which the projected demands have been developed for this plan. However, actual irrigation demands are highly variable and depend largely on meteorological and hydrologic conditions and the availability of irrigation water stored in the Amistad-Falcon reservoir system. If substantial water is available in storage at the beginning of a planting cycle, then more crops are grown that season or year with the prior knowledge that sufficient water will be available for irrigation should it be needed. Actual annual quantities of irrigation and mining water used from Amistad and Falcon Reservoirs in the lower and middle Rio Grande during the 1989-2004 period are shown in Figure 3.23. Irrigation water use represents more than 99.9% of the water used for these two purposes. As shown, the total water used varies substantially from year to year. The use generally is highest during years when adequate supplies were available. An exception is the year 1992, which was an extremely wet year with the Amistad-Falcon reservoir system completely full much of the time, but with very small demands for irrigation water because of more than adequate rainfall. In general, the lowest annual usage amounts correspond

Figure 3.22 Amistad-Falcon Irrigation and Mining Yields Without and With Future Municipal, Manufacturing, and Steam Electric Water Demands Satisfied Through Conversions of Irrigation and Mining Water Rights



to years when the available storage in the Amistad-Falcon system and the irrigation account balances were very low. This graph demonstrates that a single annual demand quantity for irrigation use in the middle and lower Rio Grande basins may not necessarily be representative of actual operations, even under drought conditions.

Figure 3.23 Total Historical Irrigation and Mining Water Use From Amistad and Falcon Reservoirs



Source: Rio Grande Watermaster

Step 11 Irrigation and Mining Surface Water Supply – Rio Grande Tributaries: As described in Section 3.2.2 above, the surface water supplies that are available for irrigation and mining uses under existing water rights on some of the tributaries of the Rio Grande are not continuous and are dependent upon local runoff conditions. These are prior appropriation water rights and are not dependent on Amistad-Falcon water. Supplies available for these water rights have been determined using the WAM during critical drought conditions in accordance with the water rights' established priority dates.

Step 12 Irrigation Surface Water Supply – Reuse: In addition to the supplies available for irrigation from the Amistad-Falcon system and from certain Rio Grande tributaries, there also is surface water available for irrigation through reuse of treated wastewater effluent. Most of this water is currently used for irrigating golf courses in the region. Based on information from the TWDB[26] and from direct contacts with individual entities, it is estimated that 5,557 acre-feet per year of treated wastewater are being supplied within the RGRWPA for irrigation purposes. Specific users of this reuse water and the annual amounts used are listed below by county. For planning purposes,

[26] Texas Water Development Board Web Site; "Municipal Wastewater Reuse in Texas"; Austin, Texas.

5,557 acre-feet of reuse water per year have been assumed to be available for irrigation purposes within the RGRWPA, and this amount has been distributed to the individual counties in accordance with the indicated usage.

Cameron County		
Harlingen Treasure Hills Golf Course	246	acre-feet/year
Valley MUD#2 Rancho Viejo G. C.	239	acre-feet/year
Hidalgo County		
Mission Golf Course	2	acre-feet/year
N. Alamo San Carlos Grass Irrig.	80	acre-feet/year
Weslaco Golf Course	600	acre-feet/year
Pharr Golf Course	1,120	acre-feet/year
McAllen Palmview Golf Course	2,240	acre-feet/year
Other	4,534	acre-feet/year
Webb County		
Laredo Golf Courses	1,120	acre-feet/year
Total Amount of Irrigation Reuse	9,935	acre-feet/year

Step 13 Livestock Surface Water Supply – Other Local Supply: Projected demands for livestock watering have been made for the RGRWPA, and these are described in Chapter 2. While water supplies for domestic and livestock demands sometimes are provided under existing water rights that are designated for municipal or irrigation uses, these types of demands typically are supplied using groundwater or surface water from local unpermitted sources such as small streams and stock ponds. In this study, it has been determined that the projected livestock water demands are met by existing groundwater supplies and no transfers of water from other sources has been made.

3.7.2 Groundwater Supply Analysis

The analysis of groundwater supplies available to users throughout the RGRWPA has been based on information from a variety of sources. The general steps used in developing the groundwater supply quantities are described below.

Step 1 A list of water user groups (WUGs) for the RGRWPA was compiled based on information listed in water supply allocation tables provided by the TWDB. The allocation tables indicate which water supplies are available to a user and how much of each supply is potentially to be allocated to that user. The amount of water that is available to each user is either listed as a limited quantity (acre-feet/year) or as a percentage value of the total supply.

Step 2 As indicated above, each WUG was assigned to a water supply. A groundwater supply has been defined as that portion of an aquifer within each basin of each county. Therefore, the total water available from an aquifer within the area of the RGRWPA has been divided among the counties of the region crossed by that aquifer and split between the basins within that portion of each county. Some water users, particularly municipalities, draw water from wells located in more than one basin of a county. These wells, however, may or may not tap separate aquifers. A separate entry has been included for each groundwater supply allocated to a user.

Step 3 Each WUG has been allocated a volume of water (acre-feet/year). This amount was calculated based on the water available and the allocation tables from the TWDB. Where the allocation tables indicated a limit value, that volume was entered. The allocation limit may be based on the user's pumping capacity during a drought, on an established legal limit, or on other information obtained from the individual user. Individual users were contacted by telephone to obtain additional information regarding system, pumping, and/or well limitations. Where the allocation tables indicated that a user was allocated a percentage of the available supply, that percent value was multiplied times the total available supply.

Step 4 After allocation values were established for each user listed, the total amount allocated from each groundwater supply was totaled and compared with actual groundwater availability. Cases of over allocations were resolved by reducing the allocation percentages (some supplies were distributed among several users with each allocated 100 percent of the available supply) and the allocation limits. The highest priority was given to municipalities and users listed as "County-Other." Other information such as a user's pumping capacity during drought (for municipalities) and whether a user also had surface water supplies available were taken into consideration. Where necessary to further resolve over-allocations, the tables of user demand information from the TWDB and from Chapter 2 of this report were also considered.

3.7.3 Summary of Water Supply Results

Table 3.17 provides a summary of the total amounts of available current water supplies for the entire RGRWPA by water use category and by source of supply for each decade through the year 2060. This table is a regional summary of the county data.

As shown at the bottom of Table 3.17, the total available current water supply for the RGRWPA ranges from approximately 1,101,000 acre-feet in the year 2010 down to about 1,075,000 acre-feet in the year 2060. This reduction in the total water supply for the region is caused, of course, primarily by the decrease in the firm annual yield of the Amistad-Falcon reservoir system during this period as sedimentation in the reservoirs reduces their available conservation storage capacity. Some of the reduction also is due to gradually declining groundwater supplies. In accordance with the priorities for allocating water within the Rio Grande Basin as stipulated in the TCEQ's Rio Grande operating rules, the projected reduction in the water supply for the region is translated directly to irrigation and mining uses. Hence, the projected water supplies for these uses exhibit declines similar to those for the region. The projected water supplies for municipal, manufacturing and steam electric uses generally remain fairly level over the next 50 years as these supplies are provided for, to a large extent, from the firm annual yield of the Amistad-Falcon system.

An indication of the water supplies available to each of the counties within the RGRWPA over the next 50 years by decade is provided by the bar charts in Figures 3.24 through 3.31. These charts have been developed from the water supply data developed through the stepped processes described above for surface water and groundwater. On each of these charts, the quantities of supplies available by type of use are shown. Also shown are the portions of the total supplies for each county that are projected to be from surface water and from groundwater.

Table 3.17 - Summary of Total Amounts of Currently Available Water Supplies for the RGWPG by Water Use Category and by Source of Supply

Water Use Category / Source of Supply	2010	2020	2030	2040	2050	2060
MUNICIPAL						
Water User Groups						
Surface Water - Amistad/Falcon System	288,947	289,529	290,142	290,588	290,610	290,712
Surface Water - Other Local Supply	0	0	0	0	0	0
Surface Water - Rio Grande Tributaries	0	0	0	0	0	0
Surface Water - Direct Reuse	7,462	7,462	7,462	7,462	7,462	7,462
Surface Water - Nueces/Rio Grande Resacas	0	0	0	0	0	0
Ground Water - Gulf Coast	23,877	24,118	24,024	23,926	23,739	23,509
Ground Water - Carrizo-Wilcox	1,515	4,462	6,777	7,352	7,352	7,353
Ground Water - Other Aquifer	2,083	2,083	2,083	2,083	2,083	2,083
MUNICIPAL - TOTAL	323,884	327,654	330,488	331,411	331,246	331,119
MANUFACTURING						
Surface Water - Amistad/Falcon System	3,374	3,374	3,374	3,374	3,374	3,374
Surface Water - Other Local Supply	0	0	0	0	0	0
Surface Water - Rio Grande Tributaries	0	0	0	0	0	0
Surface Water - Reuse	2,240	2,240	2,240	2,240	2,240	2,240
Surface Water - Nueces/Rio Grande Resacas	0	0	0	0	0	0
Ground Water - Gulf Coast	908	908	908	908	908	908
Ground Water - Carrizo-Wilcox	0	0	0	0	0	0
Ground Water - Other Aquifer	28	31	34	37	39	42
MANUFACTURING - TOTAL	6,550	6,553	6,556	6,559	6,561	6,564
STEAM ELECTRIC						
Surface Water - Amistad/Falcon System	9,986	9,986	9,986	9,986	9,986	9,986
Surface Water - Other Local Supply	0	0	0	0	0	0
Surface Water - Rio Grande Tributaries	0	0	0	0	0	0
Surface Water - Reuse	5,040	5,040	5,040	5,040	5,040	5,040
Surface Water - Nueces/Rio Grande Resacas	0	0	0	0	0	0
Ground Water - Gulf Coast	1,190	1,190	1,190	1,190	1,190	1,190
Ground Water - Carrizo-Wilcox	0	0	0	0	0	0
Ground Water - Other Aquifer	0	0	0	0	0	0
STEAM ELECTRIC - TOTAL	16,216	16,216	16,216	16,216	16,216	16,216

Table 3.17 - Summary of Total Amounts of Currently Available Water Supplies for the RGWPG by Water Use Category and by Source of Supply, cont'd.

Water Use Category / Source of Supply	2010	2020	2030	2040	2050	2060
MINING						
Surface Water - Amistad/Falcon System	1,046	1,036	1,026	1,017	1,008	995
Surface Water - Other Local Supply	0	0	0	0	0	0
Surface Water - Rio Grande Tributaries	0	0	0	0	0	0
Surface Water - Reuse	0	0	0	0	0	0
Surface Water - Nueces/Rio Grande Resacas	0	0	0	0	0	0
Ground Water - Gulf Coast	2,971	3,122	3,211	3,297	3,382	3,460
Ground Water - Carrizo-Wilcox	597	596	597	598	598	598
Ground Water - Other Aquifer	327	334	335	337	341	343
MINING - TOTAL	4,941	5,088	5,169	5,249	5,329	5,396
IRRIGATION						
Surface Water - Amistad/Falcon System	701,262	694,273	687,785	681,297	674,807	668,818
Surface Water - Rio Grande Run of River	394	394	394	394	394	394
Surface Water - Reuse	9,935	9,935	9,935	9,935	9,935	9,935
Surface Water - Nueces/Rio Grande Resacas	3,588	3,588	3,588	3,588	3,588	3,588
Ground Water - Gulf Coast	29,127	29,127	29,127	29,127	29,127	29,127
Ground Water - Carrizo-Wilcox	2,542	2,542	2,542	2,542	2,542	2,542
Ground Water - Other Aquifer	10,320	10,320	10,320	10,320	10,320	10,320
IRRIGATION - TOTAL	757,168	750,179	743,691	737,203	730,713	724,724
LIVESTOCK						
Surface Water - Amistad/Falcon System	0	0	0	0	0	0
Surface Water - Other Local Supply	0	0	0	0	0	0
Surface Water - Rio Grande Tributaries	0	0	0	0	0	0
Surface Water - Reuse	0	0	0	0	0	0
Surface Water - Nueces/Rio Grande Resacas	0	0	0	0	0	0
Ground Water - Gulf Coast	3,818	3,818	3,818	3,818	3,818	3,818
Ground Water - Carrizo-Wilcox	1,020	1,020	1,020	1,020	1,020	1,020
Ground Water - Other Aquifer	979	979	979	979	979	979
LIVESTOCK - TOTAL	5,817	5,817	5,817	5,817	5,817	5,817
REGION M - TOTAL	**1,114,576**	**1,111,507**	**1,107,937**	**1,102,455**	**1,095,882**	**1,089,836**

Figure 3.24 - Currently Available Water Supplies by Use Category and by Source for Cameron County

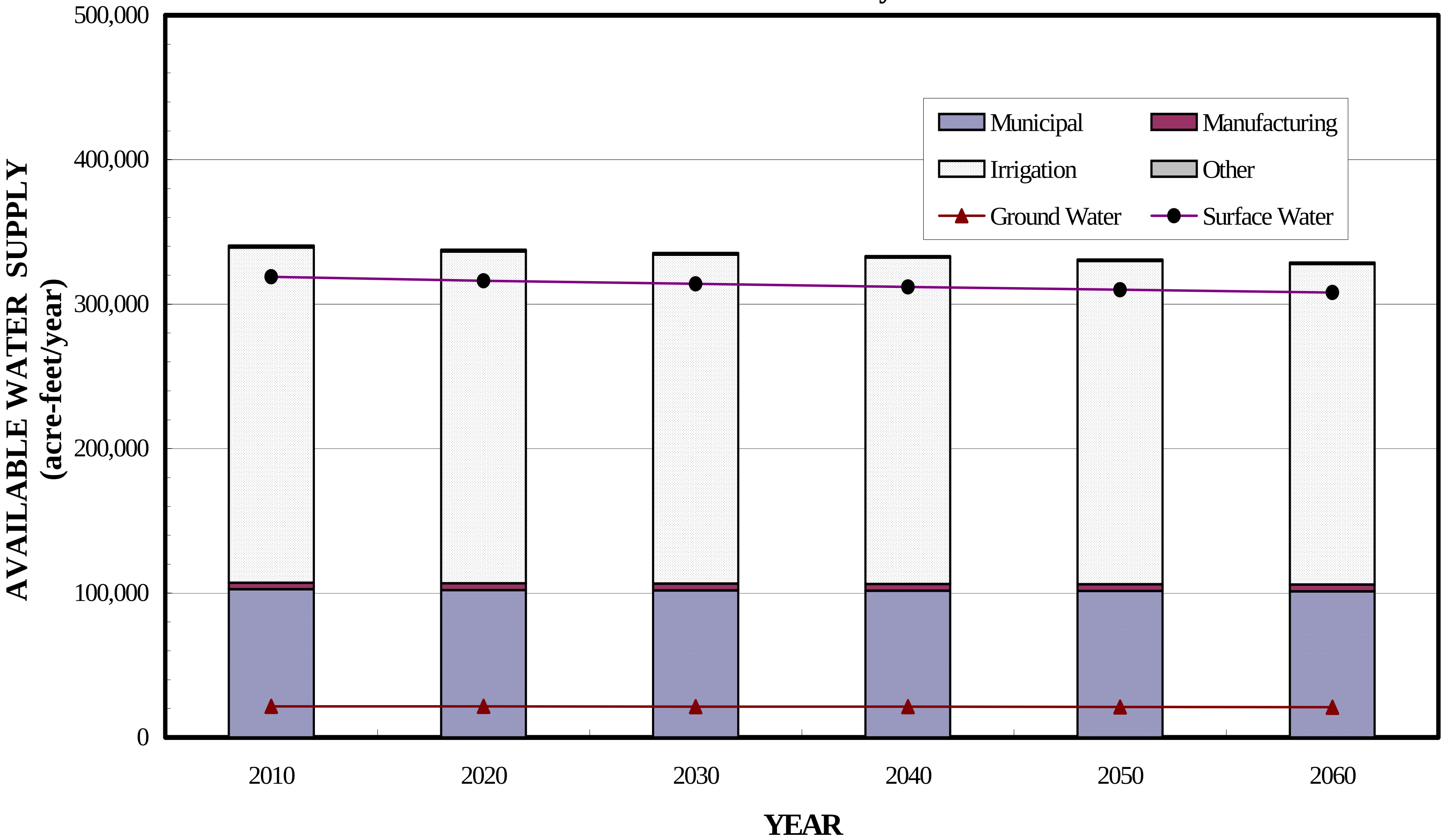


Figure 3.25 - Currently Available Water Supplies by Use Category and by Source for Hidalgo County

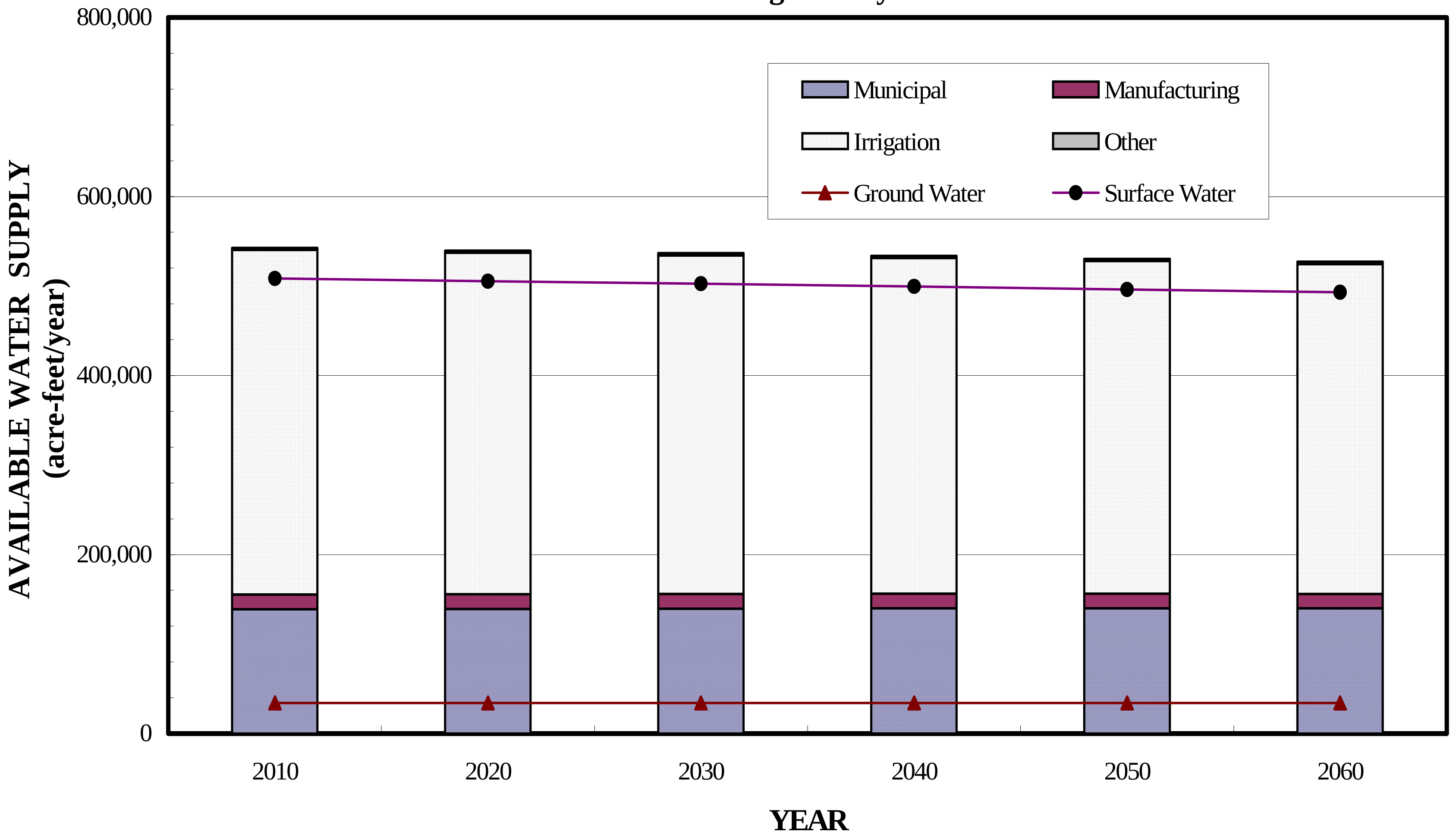


Figure 3.26 - Currently Available Water Supplies by Use Category and by Source for Jim Hogg County

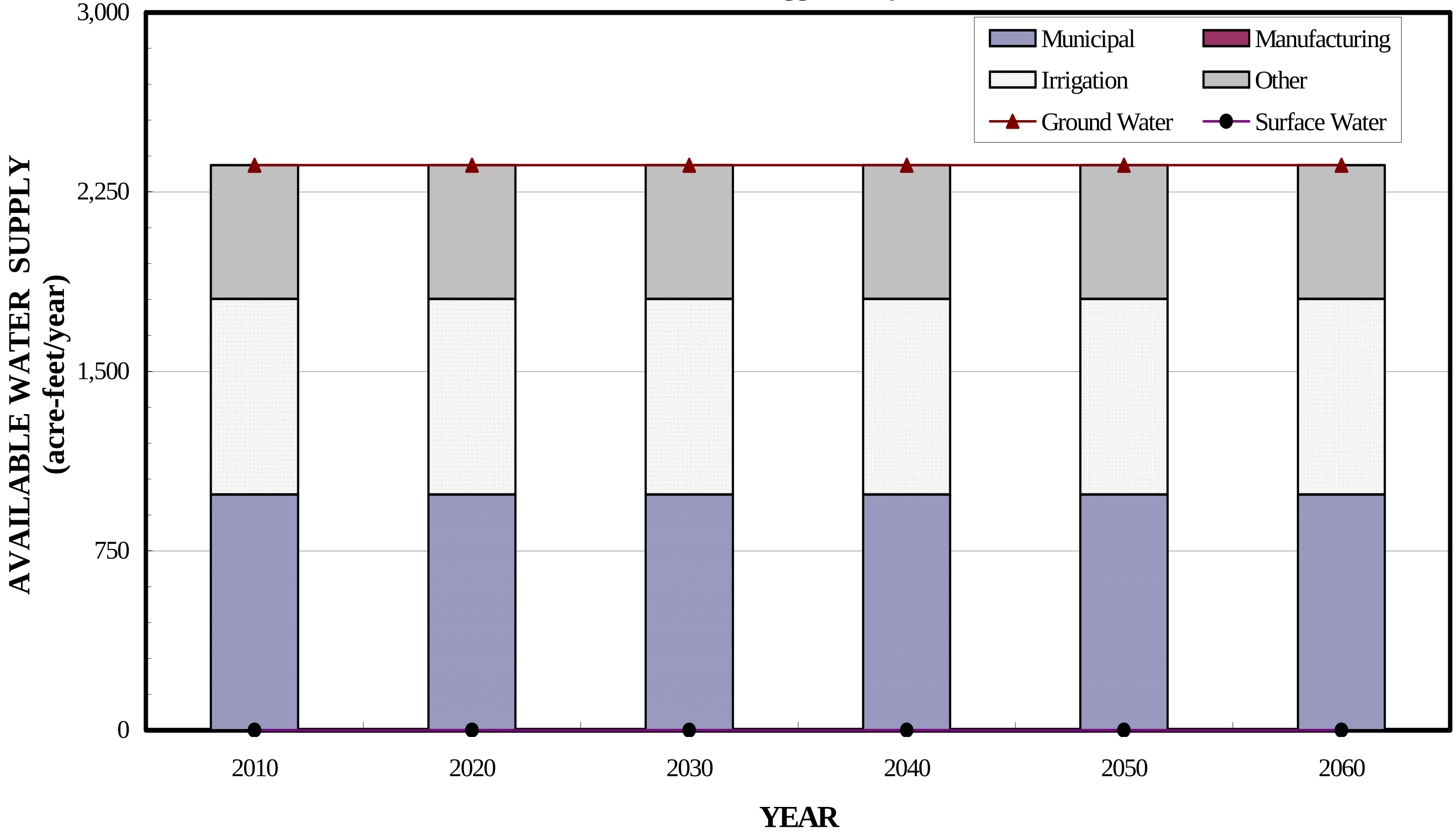


Figure 3.27 - Currently Available Water Supplies by Use Category and by Source for Maverick County

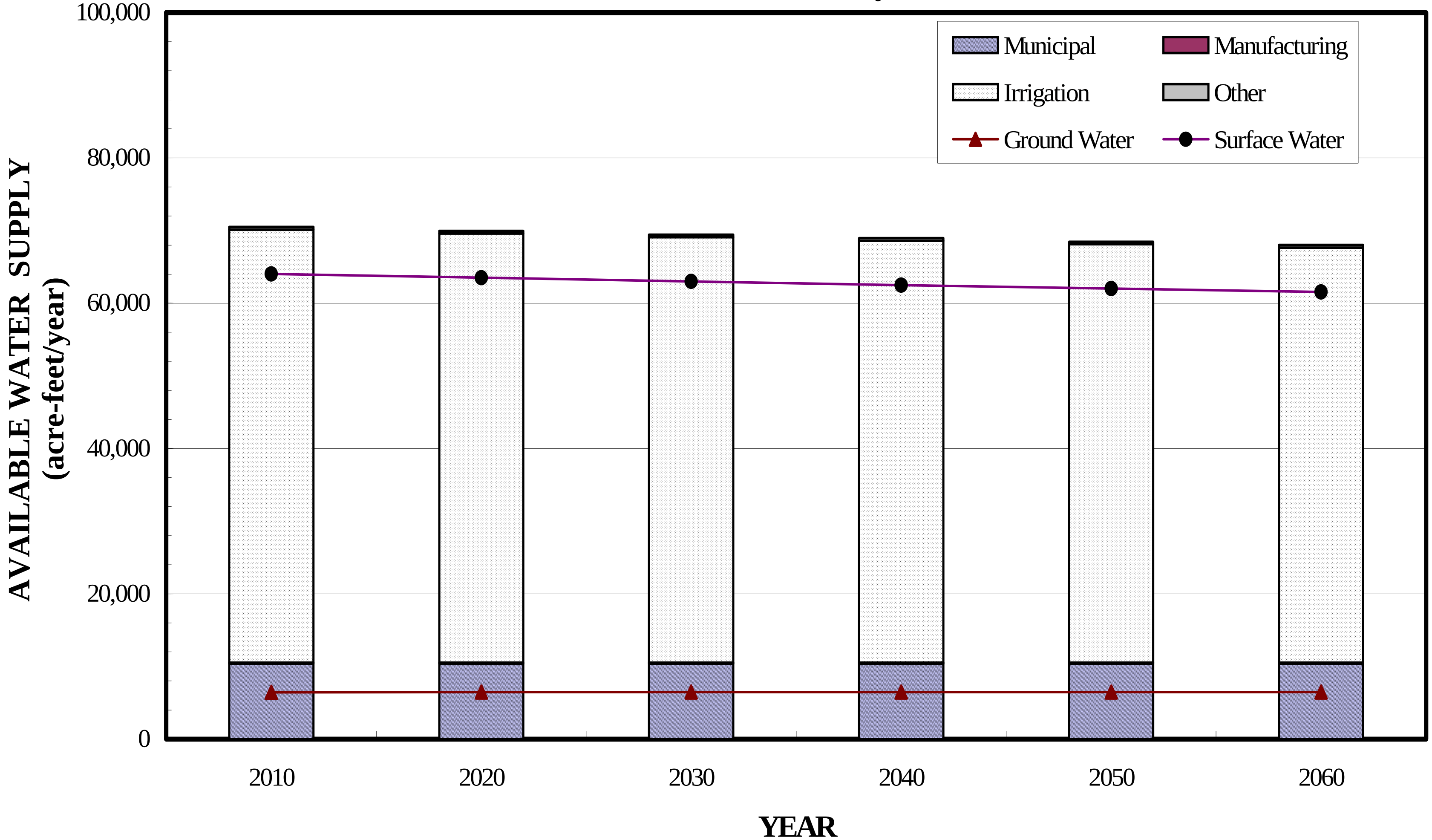


Figure 3.28 - Currently Available Water Supplies by Use Category and by Source for Starr County

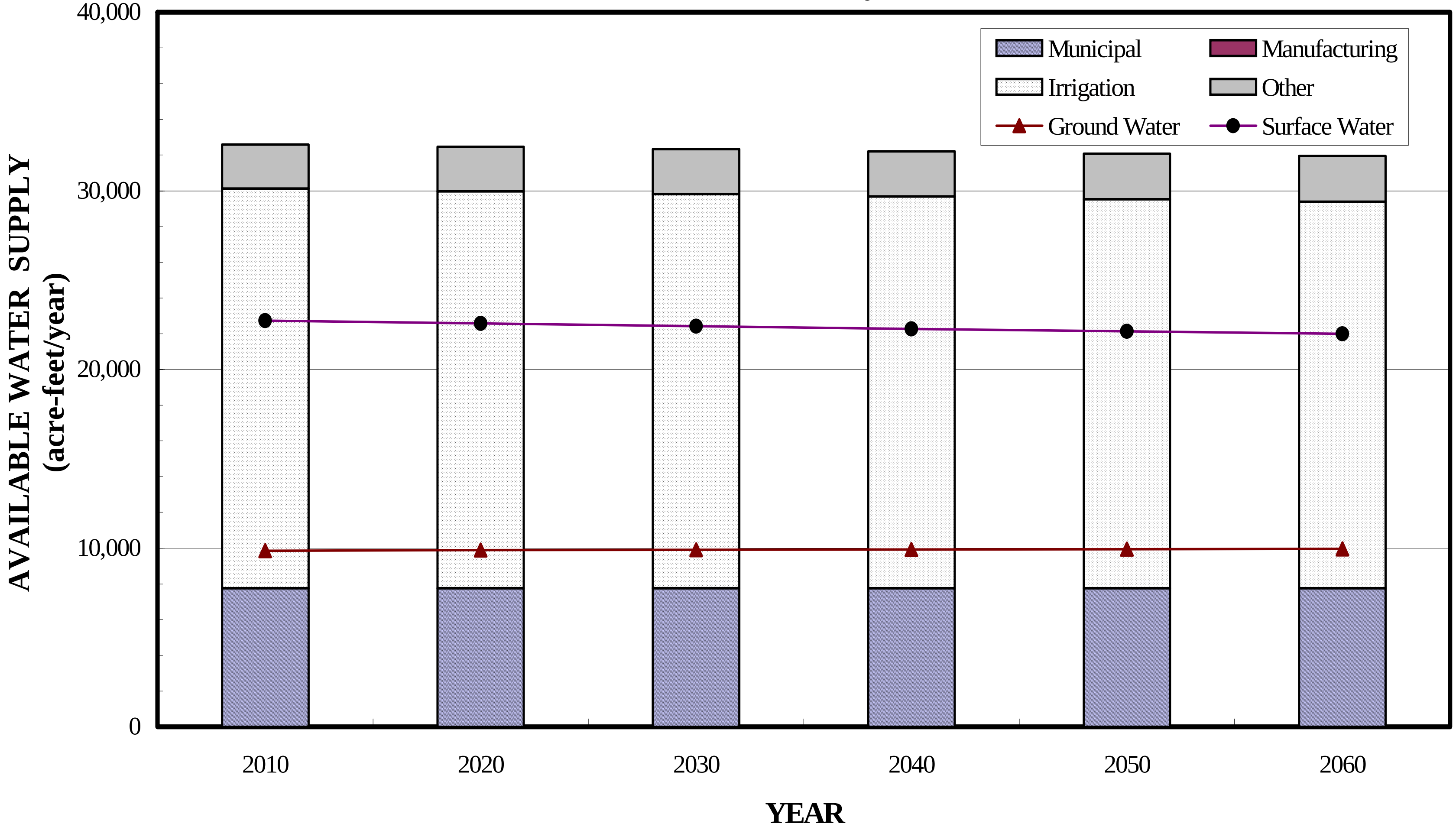


Figure 3.29 - Currently Available Water Supplies by Use Category and by Source for Webb County

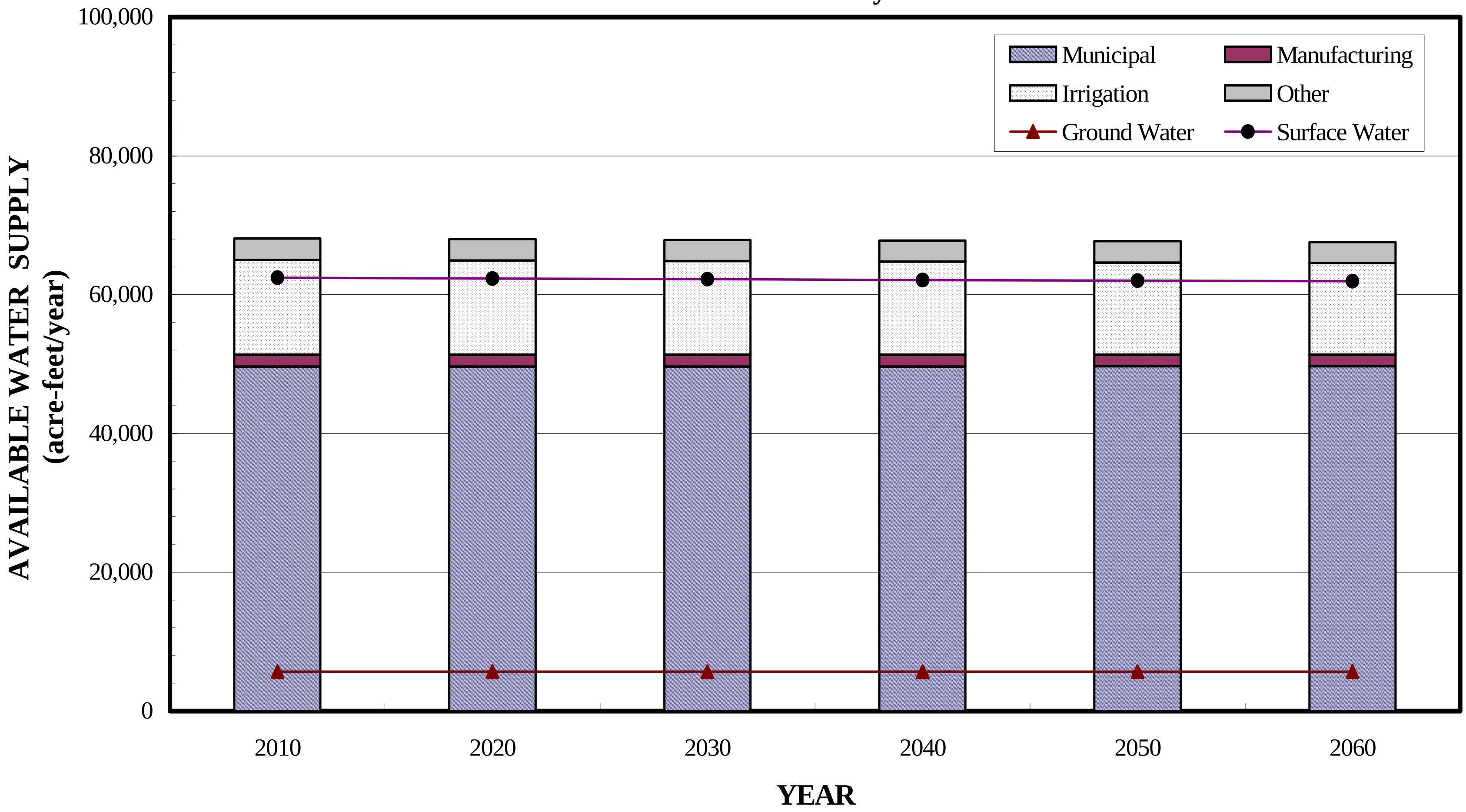
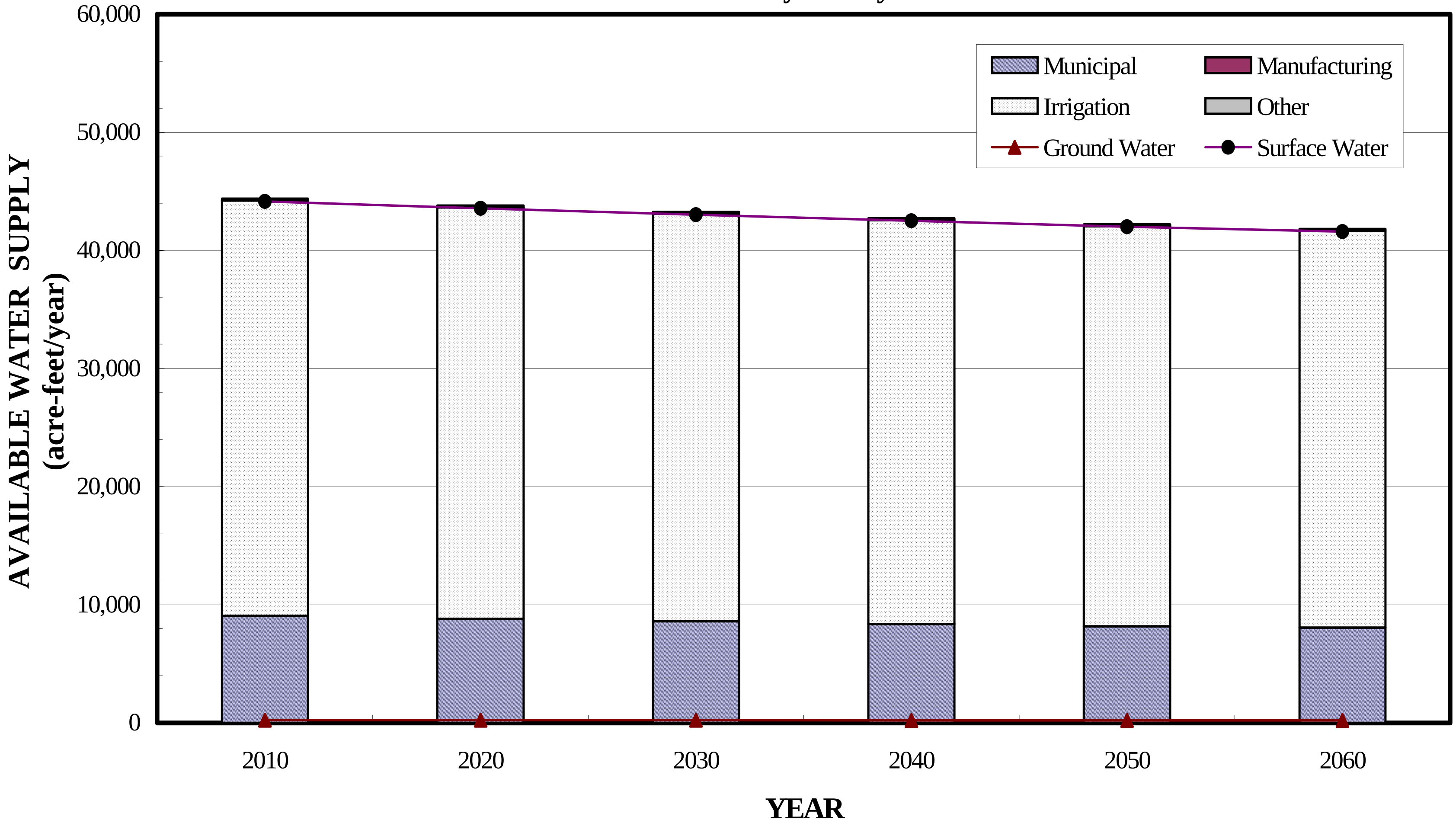


Figure 3.30 - Currently Available Water Supplies by Use Category and by Source for Willacy County



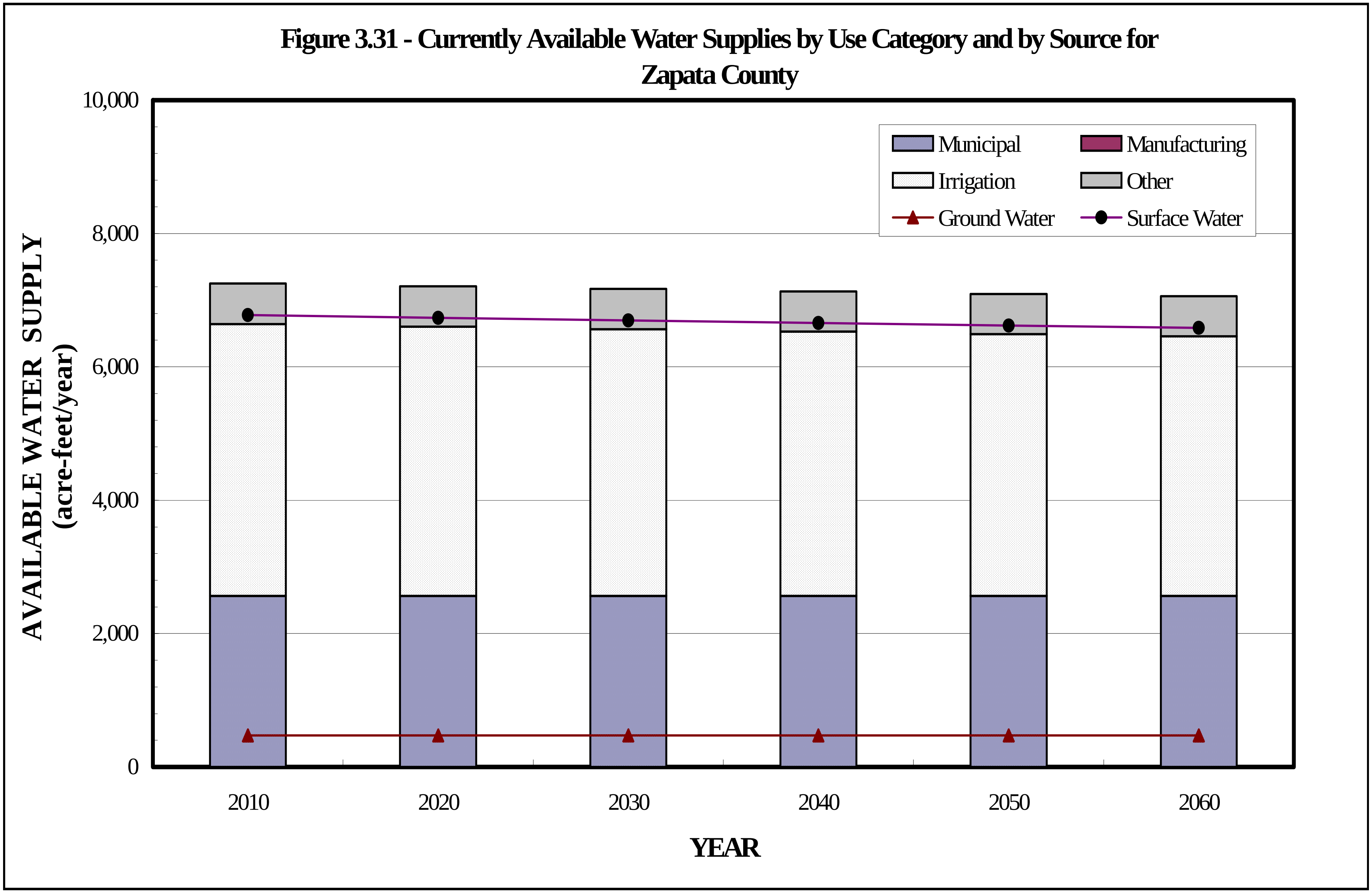


Figure 3.31 - Currently Available Water Supplies by Use Category and by Source for Zapata County
AVAILABLE WATER SUPPLY (acre-feet/year)
10,000
8,000
6,000
4,000
2,000
0
Municipal
Manufacturing
Irrigation
Other
Ground Water
Surface Water
2010
2020
2030
2040
2050
2060
YEAR

3.8 SPECIAL STUDIES PERFORMED FOR REGION M

The analysis and exploration of viable solutions to meet projected water demands in RGRWPA has been accomplished through three studies. They are classified as Study No.'s 1, 2, and 3. Study No. 1 explored the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependant on Amistad and Falcon Reservoirs for their supply. These implications relate primarily to any changes in the available water supply from the two respective reservoirs for the different types of water users and uses that might occur as a result of implementing different water management strategies. In any case, Study No. 2 was intended to add a sense of transparency to actual need for water conservation efforts specific to Region M. It did so by analyzing individual Irrigation Districts which make up nearly 85% of the total regional demand. Study No. 3 analyzed two demonstration projects in order to add substantial value and information to the regional water plan. The two demonstration studies consisted of an evaluation of on-farm water conservation and a seawater reverse osmosis pilot study. These three studies are outlined in the following sections.

3.8.1 STUDY NO. 1: ALTERNATE WATER SUPPLY MANAGEMENT STRATEGIES REGARDING THE USE AND CLASSIFICATION OF EXISTING WATER RIGHTS

The primary purpose of this study[27] was to investigate the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependant on Amistad and Falcon Reservoirs for their supply. These implications relate primarily to any changes in the available water supply from Amistad and Falcon Reservoirs for the different types of water users and uses that might occur as a result of implementing different water management strategies as may be considered by the Rio Grande Regional Planning Group (RPG).

The Rio Grande Water Availability Model (WAM), developed by the Texas Commission on Environmental Quality (TCEQ), was used extensively in this study to evaluate the effects of potential changes in various aspects of the existing Rio Grande Operating Rules. The Texas Commission on Environmental Quality (TCEQ) regulates the operation of the Lower and Middle Rio Grande System and the allocation of water stored in Amistad and Falcon Reservoirs among all users. The Rio Grande WAM simulates the allocation of prescribed amounts of water within the basin to individual Texas water rights. Simulations and analyses have been

[27] This study has been undertaken by TRC/Brandes as a subcontractor to NRS Consulting Engineers, the primary consultant to the Rio Grande Regional Planning Group for development and preparation of the Rio Grande Regional Water Plan. This work is part of the first phase of the third round of Regional Water Planning that is administered and conducted by the Texas Water Development Board pursuant to authorization in Senate Bill 1 as passed by the 77th Texas Legislature. The full report can be found in the appendix.

undertaken to investigate the impacts on water availability and the reliability of Amistad-Falcon water supplies if different assumptions regarding changes in future demands from irrigation to all municipal use, modifications to storage allocations in Amistad and Falcon Reservoirs for irrigation and mining water rights and for the domestic-municipal-industrial reserve, classifying all municipal water rights the same as Class A irrigation and mining rights with similar water allocation procedures, and modification to the accounting procedures used by the International Boundary and Water Commission for allotting flows in the Rio Grande at Fort Quitman between the United States and Mexico.

There were several findings and recommendations as a result of this study. The 2010 firm annual yield of the Amistad-Falcon reservoir system with all water used for DMI purposes is about 12% more compared the yield of the reservoir system with the current mix of municipal, industrial, irrigation and mining uses. Based on the estimated firm yield of the Amistad-Falcon reservoir system, the projected DMI demands over the next 50 years along the Lower and Middle Rio Grande can be fully satisfied if irrigation/mining water rights were converted to DMI use. Results from these and additional WAM simulations and analyses were presented to the Rio Grande RPG. Members discussed the general findings and determined that further evaluations to investigate the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system with respect to Amistad and Falcon Reservoirs were not warranted at that time and should not be undertaken.

3.8.2 STUDY NO. 2: CLASSIFY INDIVIDUAL IRRIGATION DISTRICTS AS WATER USER GROUPS

The purpose of this study is to better clarify actual need for water conservation efforts specific to Region M. In the previous rounds of regional planning, water supply and demand analysis were performed for a multitude of Water User Groups (WUGs) in the region including the classification of irrigation water users as a county-wide group (i.e. Irrigation – Cameron County). Utilizing this classification system creates a difficult set of circumstances in which to accurately evaluate irrigation water users including the development of accurate water supply and demand figures and developing water management strategies for implementation.

Irrigation Districts deliver the majority of raw water to municipal users; irrigation Districts make up nearly 85% of the total regional demand for water. Therefore, the in depth analysis of individual Irrigation Districts will allow for a better understanding of the Region's water supply and demand. Such an analysis would include the study of conveyance systems which are in place for the conveyance of both irrigation and raw water. The efficiencies of the respective systems would also need to be examined. Additionally, Irrigation Districts have irrigation water demands that vary significantly as a result of various states of urbanization which they face. In other words, urbanization plays a vital role in water demand and, thus, must be taken into account. Most importantly, a breakdown of the different types of crops which are being planted with respect to their planting and harvesting schedules and the different amounts of water needed to produce such crops; the types of crops planted could be modified to better utilize rainfall and optimize the use of delivered irrigation water. With this information, the Region will gain valuable insight and be better able to evaluate specific water management strategies needed to meet future water deficits. Once thereafter, funding recommendations for the implementation of specific projects by specific entities can be better made.

A thorough analysis of irrigation water supply and demand data is critical. In Region M, irrigation demand is primarily based on the available supply from the Amistad-Falcon reservoir system. During droughts, supply is limited and allowable irrigation water is allocated accordingly, resulting in a perceived reduction in demand. Ultimately, the demand on any given Irrigation District would be such that all land in the District that is included as flat-rate acreage would have the option to receive irrigation water. In turn, Irrigation Districts typically own enough irrigation water rights (class A, class B, or a combination of both) to serve irrigation water users within their boundaries should the water be available in the reservoir.

External factors come into play when attempting to predict future water demands; that is to say, external factors which influence future irrigation water demands must be taken into consideration. However, these factors cannot be accurately quantified and are therefore not included in the demand projections. This specifically pertains to agriculture and the future planting schedule. The aforementioned impact of urbanization is substantial and plays a major role in predicting future demand. Also, climate change could drastically change the amount of irrigation water needed to sustain an equivalent crop yield; the amount of rainfall is a huge factor in irrigation. Improvements to irrigation systems can have a tremendous impact on crop schedules and, in turn, can alter water demand figures; improving distribution efficiency can skew predicted figures by two-fold. A potential increase in energy and fossil fuels would increase chemical costs, fertilizer costs, and tractor operation costs. Additionally, changes to crop subsidies, crop prices, and overall changes to the type of crop being planted would have a direct impact on water requirements. Although these factors cannot be specifically analyzed, the potential impacts deserve notice and discussion.

3.8.3 STUDY NO. 3: ANALYZE RESULTS OF DEMONSTRATION PROJECTS

Since the last round of regional planning was complete, a number of demonstration projects have been undertaken. Included in these demonstration projects are two studies that will add substantial information to the regional water plan. Both of these demonstrations are designed to gain some sort of insight on different methods which can be implemented in order to achieve a common goal; ultimately, these studies will be used to solve future water necessities that pertain to Region M and serve as a foundation for new innovative ways which must be explored and exploited because of their potential impact. These studies surfaced via previously recommended water management strategies for the respective region.

The Harlingen Irrigation District undertook a comprehensive analysis aimed at evaluating on-farm water conservation. The analysis specifically targeted irrigation technologies and methods and was to be implemented over a ten-year period. The analysis was funded by a grant from the Texas Water Development Board and was initiated in 2005. The aforementioned project is actually composed of five different parts or projects. Namely, drip and furrow flood irrigation in annual crops and multi-year crops; surge, automated surface and precision surface irrigation; low elevation spray application, low pressure in canopy, and low energy precision application center pivot sprinkler demonstration sites; automated and manual on-farm measurement systems; and, variable speed pump control and optimized delivery of on-farm demands. Implementation of the respective on-farm water conservation measures would require individual agricultural producers to adopt new irrigation technologies and management practices. These practices have proven to be successful in regards to water reduction. However, to achieve recommended rates of implementation, it is vital to expand state and federal technical assistance programs, provide initiatives, and/or financial assistance to irrigators. Feasibility and viability of these on-farm solutions depend on this expansion as well as the analysis of optimal irrigation strategies for alternative crops in the region; different crops use different amounts of water and, specifically, high-value crops tend to use larger volumes of water. These two things, among some other things, add up destructively and could potentially lead to a pitfall of on-farm solutions.

A seawater reverse osmosis pilot study was performed by the Public Utility Board of the City of Brownsville. The notion stemmed from a Feasibility Study, which took place in 2004, that determined that the Lower Rio Grande Valley region would be confronted with a water supply deficit by 2050 and that seawater desalination was a viable alternative. The pilot study commenced in 2007 and its primary purpose was to provide an opportunity to evaluate actual performance of proposed water treatment systems under site-specific conditions. The final study scope developed by BPUB and TWDB called for the comparison of four types of pretreatment technologies by means of protocol tests: Eimco Conventional System, GE Zenon Ultrafiltration, Norit Ultrafiltration, and Pall Microfiltation. In addition, three RO membranes were tested during the pilot study and supplemented value to the pilot study as a whole.

Both demonstrations served as valuable knowledge and have successfully accomplished the objective; they demonstrated that there are viable solutions to our future water necessities and have done so by implementing water management strategies. The demonstration project carried out by the Harlingen Irrigation District indicates that on-farm conservation is a viable water management strategy for the region and has proven that water consumption can be reduced by implementing on-farm conservation while maintaining crop yields similar to more water intensive methods. Moreover, the Brownsville PUB pilot study was also successful; the study proved that water seawater desalination is a feasible and recommended water management strategy for the region.

3.9 LOWER RIO GRANDE MUNICIPAL DELIVERIES DURING SEVERE DROUGHTS

One of the concerns regarding the availability of water in the Lower Rio Grande Valley pertains to the delivery of water to municipal users during severe drought periods when irrigation water use may be curtailed or ceased all together as the total supply of United States water stored in Amistad and Falcon Reservoirs falls to low levels. Under the current Rio Grande operating rules, the available supply of water in the reservoirs for irrigation use is gradually depleted as irrigation diversions are made during periods when the inflows to the reservoirs are low. During extended periods of continued irrigation use and low reservoir inflows, the available quantity of irrigation water stored in the reservoirs can be reduced to zero. Should such conditions occur, no releases of irrigation water would be made from Falcon Reservoir. This would mean that deliveries of municipal water from the reservoir to entities in the Lower Rio Grande Valley would have to be made without the normal carrying water provided by the irrigation water deliveries. Under these circumstances, the water losses, due to such factors as seepage and evaporation, that may be experienced either along the river channel or within the irrigation district delivery systems that are used to convey raw water from the river to the municipal water users could be substantial. Also of concern under these conditions is whether or not the existing diversion facilities on the lower Rio Grande would be able to physically withdraw water from the river because of the potentially lower river levels.

3.9.1 Irrigation District Municipal Water Supply Network

Studies recently have been made to identify the municipalities in the Lower Rio Grande Valley that are dependent on irrigation district canal systems for the delivery of their water supplies and to delineate the portions of those canal systems that are actually used for delivering water from the Rio Grande to the municipalities[28]. There are 39 municipal water treatment plants that take raw water from the water distribution networks of 14 irrigation districts in Hidalgo and Cameron Counties in the Lower Rio Grande Valley. For purposes of this report, those portions of the water distribution networks of irrigation districts that also are used to convey and deliver municipal water from the Rio Grande are referred to as the municipal supply network (MSN). As of 2008, the MSN consisted of the various facilities and features summarized in Table 3.18.

[28] Fipps, Guy, P.E.; "The Municipal Water Supply Network of the Lower Rio Grande Valley"; Irrigation District Program, Irrigation Technology Center, Texas Cooperative Extension, Texas Agricultural Experimental Station; Texas A&M University, College Station, Texas; February, 2004.

Table 3.18 – Summary of Municipal Water Supply Network Characteristics

Component	Width/Diameter	Length (miles)	Surface Area (acres)	Static Volume (acre-feet)
Lined Canals	4 – 80 feet	~92	~229	~721 – ~866
Unlined Canals	10 – 150 feet	~168	~1,137	~4,382 – ~6,527
Pipelines	14 – 72 inches	~25	n/a	~27
Resacas	n/a	n/a	~377	~2,484
Reservoirs	n/a	n/a	~3,845	~8,216
TOTALS	n/a	~285	~5,588	~15,830 – ~18,120

Table 3.19 summarizes the various types, lengths and sizes of facilities used in each of the 14 irrigation districts to deliver municipal water. Figure 3.32 is a map of a portion of the Lower Rio Grande Valley showing the irrigation districts and conveyance facilities used for delivering municipal water.

Table 3.19 - Municipal Water Supply Network Characteristics by Irrigation District[29]

District	Canals	Pipeline	Total	Resacas	Reservoirs
	Miles	Miles	Miles	Area (acres)	Area (acres)
Delta Lake Irrigation District	69.43	7.71	77.14	n/a	2,377.0
Donna Irrigation District No. 2	32.49	0.8	33.29	n/a	370.0
Hidalgo County Irrigation District No. 1	35.54	24.37	59.91	n/a	n/a
Harlingen Irrigation District No. 1	52.78	7.65	60.43	n/a	160.0
Hidalgo County Water Irrigation District No. 3	9.7	3.67	13.37	n/a	n/a
Hidalgo County Irrigation District No. 16	15.17	2.25	17.42	n/a	273.1
Cameron County Irrigation District Cameron County No. 3	43.74	4.02	47.76	n/a	292.8

[29] Information is from Study No. 2 Classify Irrigation Districts as Water User Groups

Cameron County Irrigation District No. 6	41.82	0	41.82	1130	n/a
Hidalgo and Cameron Counties Irrigation District No. 9	71.8	2.74	74.54	81.1	750
Hidalgo County Irrigation District No. 6	19.42	0	19.42	n/a	175
Cameron County Irrigation District No. 2	108.52	0.74	109.26	320	530
Hidalgo County Irrigation District No. 2	37.5	50.48	87.98	n/a	350
Santa Cruz Irrigation District No. 15	34.06	4.58	38.64	n/a	127
Cameron County Irrigation District No. 16	3.51	0	3.51	n/a	165
Cameron County Irrigation District Cameron County No. 4	2.92	0	2.92	n/a	n/a
Valley Acres Irrigation District	5.66	10.29	15.95	n/a	325
Bayview Irrigation District	14.06	0.43	14.49	n/a	n/a
Brownsville Irrigation District	2.36	31.08	33.44	531	n/a
Hidalgo County Improvement District No. 19	4.58	0	4.58	n/a	n/a
Engleman Irrigation District	12.43	5.7	18.13	n/a	60
Hidalgo County	0	4.61	4.61	n/a	n/a

Irrigation District No. 13					
Hidalgo County Water Irrigation District No. 3	9.7	3.67	13.37	n/a	n/a
Hidalgo County Water Control and Improvement District No. 18	0	0	0	n/a	n/a
Hidalgo County Irrigation District No. 5	0.8	20.54	21.34	n/a	48
Adams Gardens Irrigation District No. 19	21.49	2.01	23.5	n/a	470
United Irrigation District	29.11	5.9	35.01	n/a	n/a
TOTALS	678.59	193.24	871.83	2062.10	6472.90

Table 3.20: Irrigation Districts Holding Water Rights of Municipal Users

IRRIGATION DISTRICT	WR#	AF/yr
HARLINGEN IRR DIST	831	18320
CAMERON CO WID #16	838	189
CAMERON CO IRR DIST NO 2	841	5500
CAMERON CO IRR DIST NO 2	841	4767.5
CAMERON CO IRR DIST NO 2	841	890
CAMERON CO IRR DIST NO 2	841	750
BROWNSVILLE IRRIGATION DISTRICT	843	6071
BAYVIEW IRR DIST 11	4548	45
HIDALGO COUNTY IRR DIST 16	802	1500
LA FERIA ID CAMERON CO 3	803	1800
LA FERIA ID CAMERON CO 3	803	900
LA FERIA ID CAMERON CO 3	803	300
DONNA ID HIDALGO CO 1	805	4190
HIDALGO CO IRR DIST 2	808	11777.5
ENGLEMAN IRRIGATION DISTRICT	809	518.475
DELTA LAKE IRR DIST	811	610
DELTA LAKE IRR DIST	811	600
DELTA LAKE IRR DIST	811	5670
HIDALGO & CAMERON CO WCID NO 9	812	1500
HIDALGO & CAMERON CO WCID NO 9	812	2580
HIDALGO & CAMERON CO WCID NO 9	812	5240
HIDALGO & CAMERON CO WCID NO 9	812	1340
HIDALGO & CAMERON CO WCID NO 9	812	1840
HIDALGO & CAMERON CO WCID NO 9	812	500

HIDALGO CO IRR DIST 1	816	5390
HIDALGO CO IRR DIST 1	816	625
HIDALGO CO IRR DIST NO 6	828	5816
UNITED IRRIGATION DISTRICT	846	5000
UNITED IRRIGATION DISTRICT	846	8125
UNITED IRRIGATION DISTRICT	846	1190
UNITED IRRIGATION DISTRICT	849	5300

In Table 3.18, static volume is defined as the volume of water needed to fill the MSN to normal operating levels for agricultural water deliveries. Static means that the water is not flowing in the system. Usually, water in the MSN is not static, but moves or flows continuously. The *transient volume* is somewhat higher than the static volume presented in Table 3.18. The static volume of each of the components of the MSN has been determined by multiplying the cross-sectional area of each component (when filled to its normal operating volume) by its length. Most of the irrigation canals have a trapezoidal cross-sectional shape; however, because the cross-sectional shape of some of the canals was not known, the static volume calculations for these canals were based on two different assumed cross sections; parabolic (minimum) and rectangular (maximum).

The resulting static volumes for the various components of the MSN within each of the irrigation districts are summarized in Table 3.21. As shown, to fill the MSN entirely with municipal water, assuming no irrigation water is being conveyed through the irrigation district canal systems, would require on the order of 16,000 acre-feet to 18,000 acre-feet of water. This is water that would have to be released from Falcon Reservoir, and it likely would have to be charged against the municipal accounts.

Figure 3.32: Municipal Water Supply Network

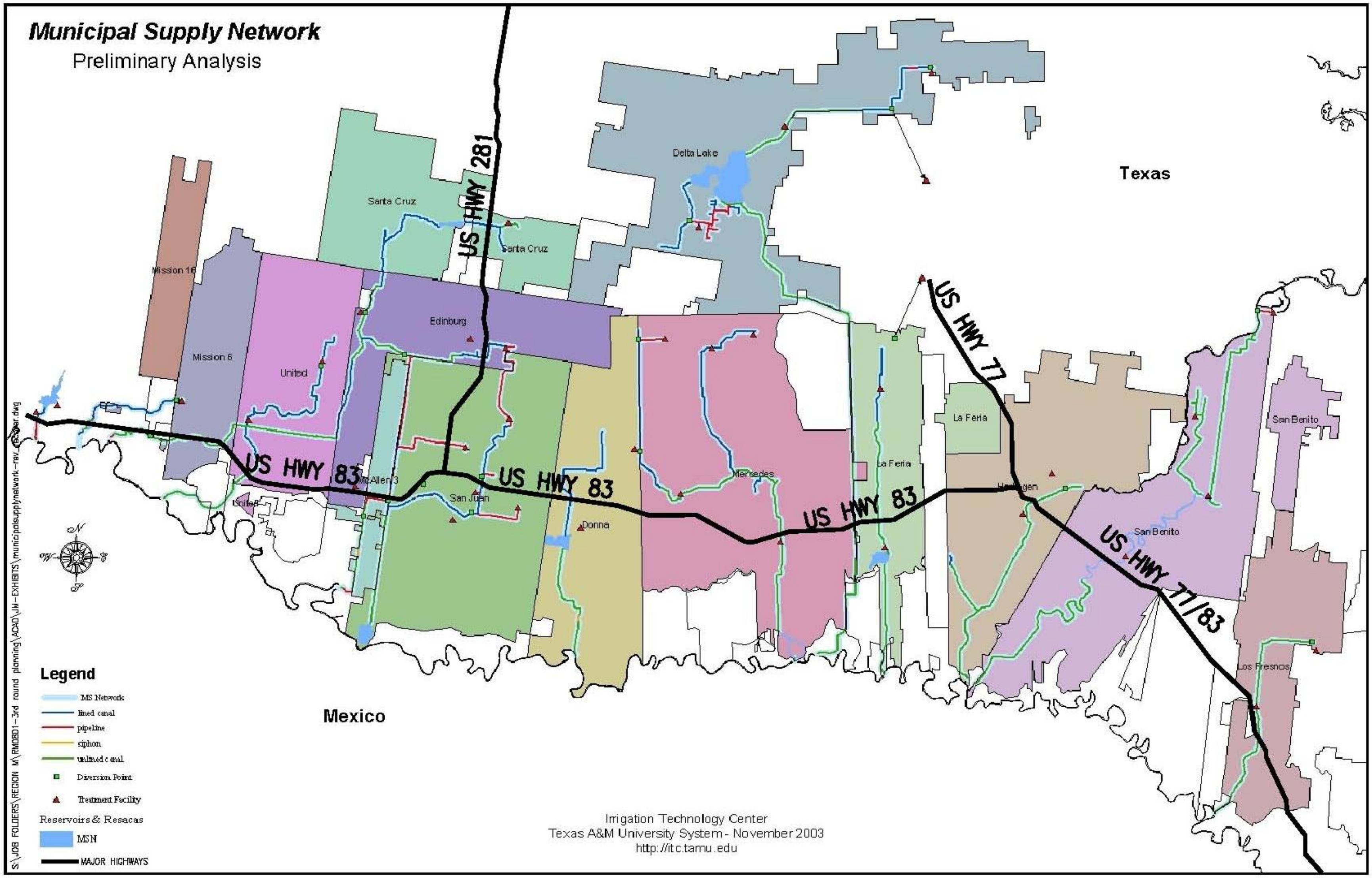


Table 3.21: Static Volumes of Municipal Water Supply Network Components Within Each Irrigation District

District	Lined Canals			Unlined Canals			Pipelines	Resacas	Reservoirs	Total	
	Unknown Shape		Trap. Shape	Unknown Shape		Trap. Shape					
	Min	Max		Min	Max					Min	Max
Delta Lake Irrigation District	82.9	131.1	n/a	856.6	1,840.2	n/a	1.9	n/a	943.0	1,884.4	2,916.2
Donna Irrigation District No. 2	60.2	90.4	n/a	174.6	261.9	n/a	n/a	n/a	1,480.0	1,714.8	1,832.3
Hidalgo County Irrigation District No. 1	69.8	110.4	n/a	618.4	927.6	n/a	n/a	n/a	n/a	688.2	1,038.0
Harlingen Irrigation District No. 1	n/a	n/a	n/a	348.7	523.1	n/a	n/a	n/a	27.0	375.7	550.1
Hidalgo County Water Irrigation District No. 3	n/a	n/a	n/a	70.9	106.4	n/a	4.1	n/a	n/a	75.0	110.5
Hidalgo County Irrigation District No. 16	5.4	8.5	n/a	n/a	n/a	n/a	2.6	n/a	2,000.0	2,008.0	2,011.1

Cameron County Irrigation District No. 16	n/a	n/a	21.7	n/a	n/a	332.4	n/a	n/a	1,171.2	1,525.3	1,525.3
Cameron County Irrigation District No. 6	n/a	n/a	n/a	186.6	279.9	n/a	n/a	n/a	n/a	186.6	279.9
Hidalgo and Cameron Counties Irrigation District No. 9	n/a	n/a	111.0	514.1	771.1	n/a	0.7	827.8	n/a	1,453.8	1,710.6
Hidalgo County Irrigation District No. 6	35.9	53.8	n/a	18.6	27.8	n/a	n/a	n/a	350.0	404.5	431.6
Cameron County Irrigation District No. 2	n/a	n/a	n/a	402.8	586.8	n/a	0.3	1,656.2	n/a	2,059.1	2,243.3
Hidalgo County Irrigation District No. 2	n/a	n/a	138.9	n/a	n/a	514.6	17.0	n/a	1,674.4	2,344.9	2,344.9
Santa Cruz Irrigation District No. 15	68.2	70.06	n/a	23.7	35.6	n/a	n/a	n/a	570.0	661.9	676.2
United Irrigation District	4.5	6.7	123.3	n/a	n/a	319.9	n/a	n/a	n/a	447.7	449.9
TOTALS	326.9	471.5	394.9	3,215.0	5,360.4	1,166.9	26.6	2,484.0	8,215.6	15,829.9	18,119.9

3.9.2 River Channel and Irrigation District Delivery System Water Losses

Preliminary estimates of the potential water losses that could be experienced when only municipal water is released from Falcon Reservoir during critical drought periods have been made in previous investigations that were undertaken as part of Phase II of the Lower Rio Grande Valley Regional Integrated Water Resources Planning Study (LRGIWRP-II Study) conducted by the Lower Rio Grande Valley Development Council[30]. In these investigations, an Amistad-Falcon Reservoir Operations Model (ROM) was modified and operated to evaluate the extent of the water losses that could be experienced along the lower Rio Grande and within the irrigation district water delivery systems during drought periods with only municipal water being released for the United States from Falcon Reservoir. As the basis for developing and structuring the ROM for the Amistad-Falcon reservoir system, the existing SIMYLD-II reservoir system model, or computer program, was used[31]. The original version of this program was formulated and coded by the TWDB. The fundamental concept in applying the SIMYLD-II program is that the physical reservoir system can be transformed into a capacitated network flow problem. In making this transformation, the real system's physical elements are represented as a combination of two possible network components - nodes and links. The basic SIMYLD-II program, as applied to the Amistad-Falcon system, provides a multi-reservoir simulation model capable of describing the movement and storage of water through a system of river reaches, canals, reservoirs and non-storage river junctions over a specified period of time.

Simulations were made with the ROM for a hypothetical period between 1995-2000, which was based on actual historical hydrologic and demand conditions through March 1998, and on assumed 1995 critical drought hydrologic conditions and year-2000 municipal demands for the period from April 1998 through December 2000[32]. With routines incorporated into the ROM to describe the channel losses along the lower Rio Grande and the anticipated losses within the irrigation district water delivery systems, the results from the ROM simulations provide an indication of the total quantities of water losses that could be experienced with only municipal water deliveries made in the Lower Rio Grande Valley without the benefit of irrigation carrying water.

[30] R. J. Brandes Company; "Evaluation of Amistad-Falcon Water Supply Under Current and Extended Drought Conditions"; Phase II, Lower Rio Grande Valley Regional Integrated Water Resources Planning Study; Lower Rio Grande Valley Development Council and the Valley Water Policy and Management Council of the Lower Rio Grande Water Committee, Inc.; Austin, Texas; March, 1999.

[31] Texas Water Development Board; "Economic Optimization & Simulation Techniques for Management of Regional Water Resource Systems, River Basin Simulation Model, SIMYLD-II Program Description"; July, 1972; Austin, Texas.

[32] Actual hydrologic and demand conditions were used only for the period extending through March, 1998 because March, 1998 was the last month for which these data were available from the International Boundary and Water Commission at the time this investigation was undertaken. The year-2000 demands were obtained from the TWDB and were effective as of January 1999.

For these simulations, five reaches of the river were delineated for describing river channel losses between Falcon Dam and Brownsville. These reaches are identified on the map of the four-county Lower Rio Grande Valley in Figure 3.33, and they are the same as those used by the Rio Grande Watermaster for facilitating water deliveries to the Lower Rio Grande Valley as previously described in Table 3.2. The expanded SIMYLD II link-node network for the Amistad-Falcon ROM is shown in Figure 3.34. The projected year-2000 municipal demands for the United States water users in the Lower Valley were distributed among the different nodes in the revised ROM based on geographical location and available information regarding which cities divert water directly from the river and which irrigation districts deliver river water to which cities.

Table 3.22 summarizes the distribution of the year-2000 United States municipal water demands among the different river reaches and model nodes (Nodes 9, 11, 14, 16, 18, and 20). The various cities assigned to specific reaches and nodes in the ROM are listed in the table, and the corresponding sums of the year-2000 municipal water demands associated with each node are indicated. The locations of these cities within the four-county Lower Rio Grande Valley also are shown on the map in Figure 3.33.

Also included in Table 3.22 are the water demands for Mexico that were assigned to the nodes representing the Anzalduas Canal (Node 12) and the city of Matamoros and other Mexican water users in the Lower Rio Grande Valley below Anzalduas Dam (Node 19). The annual demand for the Anzalduas Canal node was based on the actual year 1995 canal diversions as reported by the IBWC during periods when irrigation usage by Mexico was minimal. For Matamoros and other lower Rio Grande Mexican water users that divert their water directly from the Rio Grande, the annual demand in Table 3.22 reflects the actual 1995 releases of Mexico's water from Anzalduas Reservoir during non-irrigation periods.

For purposes of estimating seepage, evaporation and other losses that are typically experienced when United States water is conveyed through the irrigation district water delivery systems in the Lower Rio Grande Valley, information compiled and analyzed by other investigators during the LRGIWRP-II Study were used. In those investigations, it was concluded that, as an overall average, about 20 percent of the total amount of water diverted from the river by all of the districts is typically lost and not actually delivered to water users. Hence, the 20-percent loss rate also was assumed to be an appropriate average value for estimating the quantities of municipal water that potentially could be lost through the irrigation district delivery systems without irrigation carrying water. However, in order to provide for some level of variation in the estimated loss quantities, values of 15 percent and 25 percent also were incorporated into the analyses.

It should be noted that these levels of percentage loss rates for the irrigation district delivery systems under conditions with only municipal water being conveyed through the systems are strictly estimates. Values for these loss rates were not verified with any field measurements or actual system data because such data and information were not known to exist for conditions similar to those that would occur with only municipal water being delivered. The historical average values of loss rates on the order of 20 percent for the irrigation district systems very likely were derived from actual data and observations that represented normal conditions when the systems were fully charged with water. Hence, the 20-percent loss rate reflects total seepage and evaporation losses from all components (canals, pipelines, and storage reservoirs) of the district delivery systems when full irrigation and municipal deliveries were being made. With only municipal water being delivered, it is reasonable to expect that only the essential canals and pipelines within each district system would be used to convey the municipal water; hence, the quantities of the associated losses should be less than those that normally would occur if all of the canals and pipelines were being used to convey water. The question that remains unanswered is whether the losses from the essential canals and pipelines that would be used to convey the municipal water would still be on the order of 20 percent of the quantity of municipal water being conveyed. In some cases, these losses certainly could be higher than 20 percent because the essential canals and pipelines would likely include the largest components; i.e., those with the largest surface area and wetted perimeter that are located nearest the river within a given irrigation district system. However, it is also likely that these largest components of a given irrigation district system would be those that probably have been improved and possibly lined to minimize losses.

These offsetting factors suggest that assuming average loss rates on the order of 20 percent for the irrigation district delivery systems may be appropriate even when only municipal water is being conveyed.

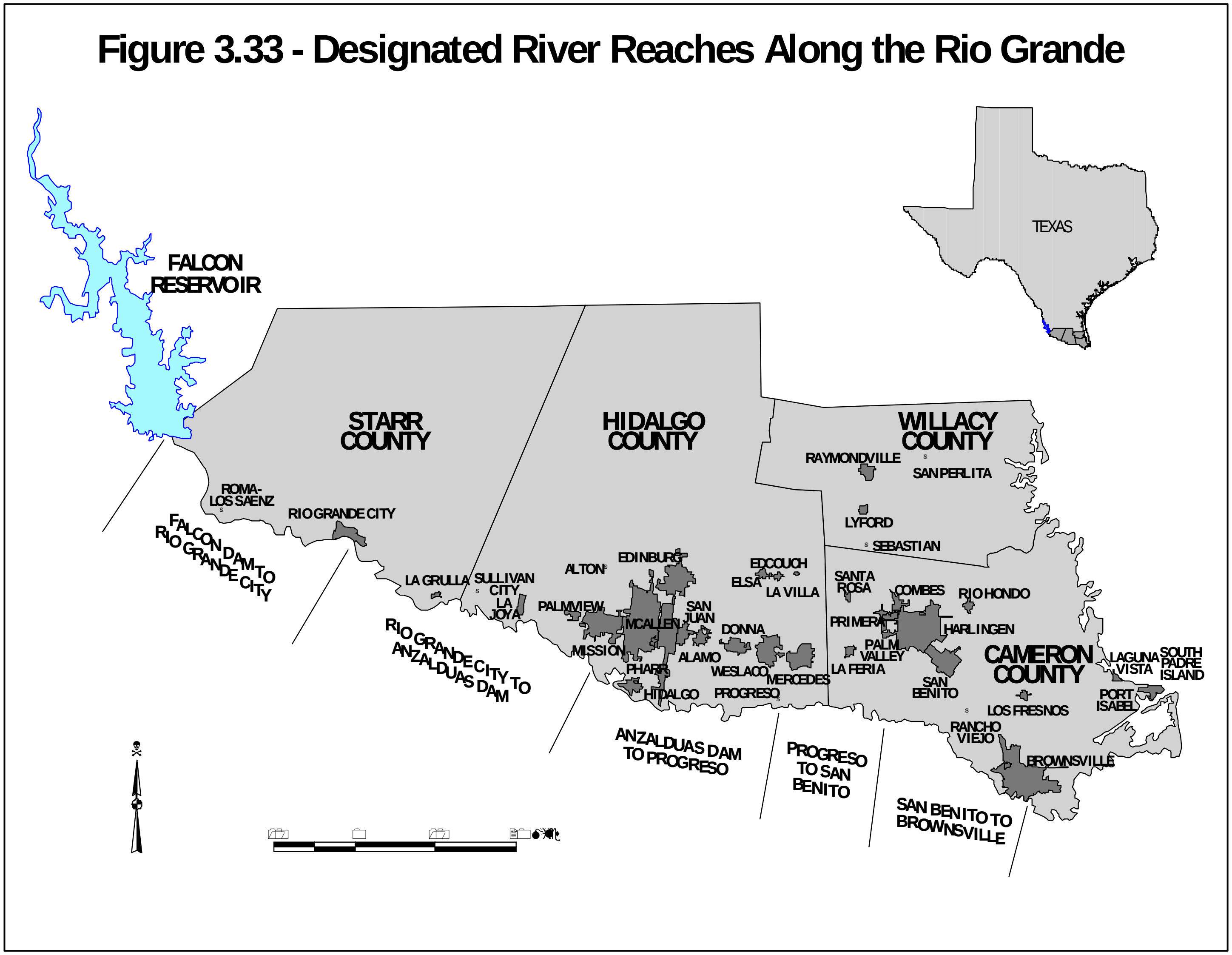


Figure 3.33 - Designated River Reaches Along the Rio Grande
FALCON RESERVOIR
STARR COUNTY
HIDALGO COUNTY
WILLACY COUNTY
CAMERON COUNTY
TEXAS
ROMA-LOS SAENZ
RIO GRANDE CITY
LA GRULLA
SULLIVAN CITY
LA JOYA
PALMVIEW
ALTON
EDINBURG
MISSION
MCALLEN
PHARR
HIDALGO
SAN JUAN
ALAMO
DONNA
WESLACO
MERCEDES
PROGRESO
EDCOUCH
ELSA
LA VILLA
RAYMONDVILLE
SAN PERLITA
LYFORD
SEBASTIAN
SANTA ROSA
COMBES
RIO HONDO
PRIMERA
HARLINGEN
PALM VALLEY
LA FERIA
SAN BENITO
LOS FRESNOS
RANCHO VIEJO
BROWNSVILLE
LAGUNA VISTA
SOUTH PADRE ISLAND
PORT ISABEL
FALCON DAM TO RIO GRANDE CITY
RIO GRANDE CITY TO ANZALDUAS DAM
ANZALDUAS DAM TO PROGRESO
PROGRESO TO SAN BENITO
SAN BENITO TO BROWNSVILLE

Figure 3.34 Expanded Link-Node Network for Amistad-Falcon Reservoir Operations Model

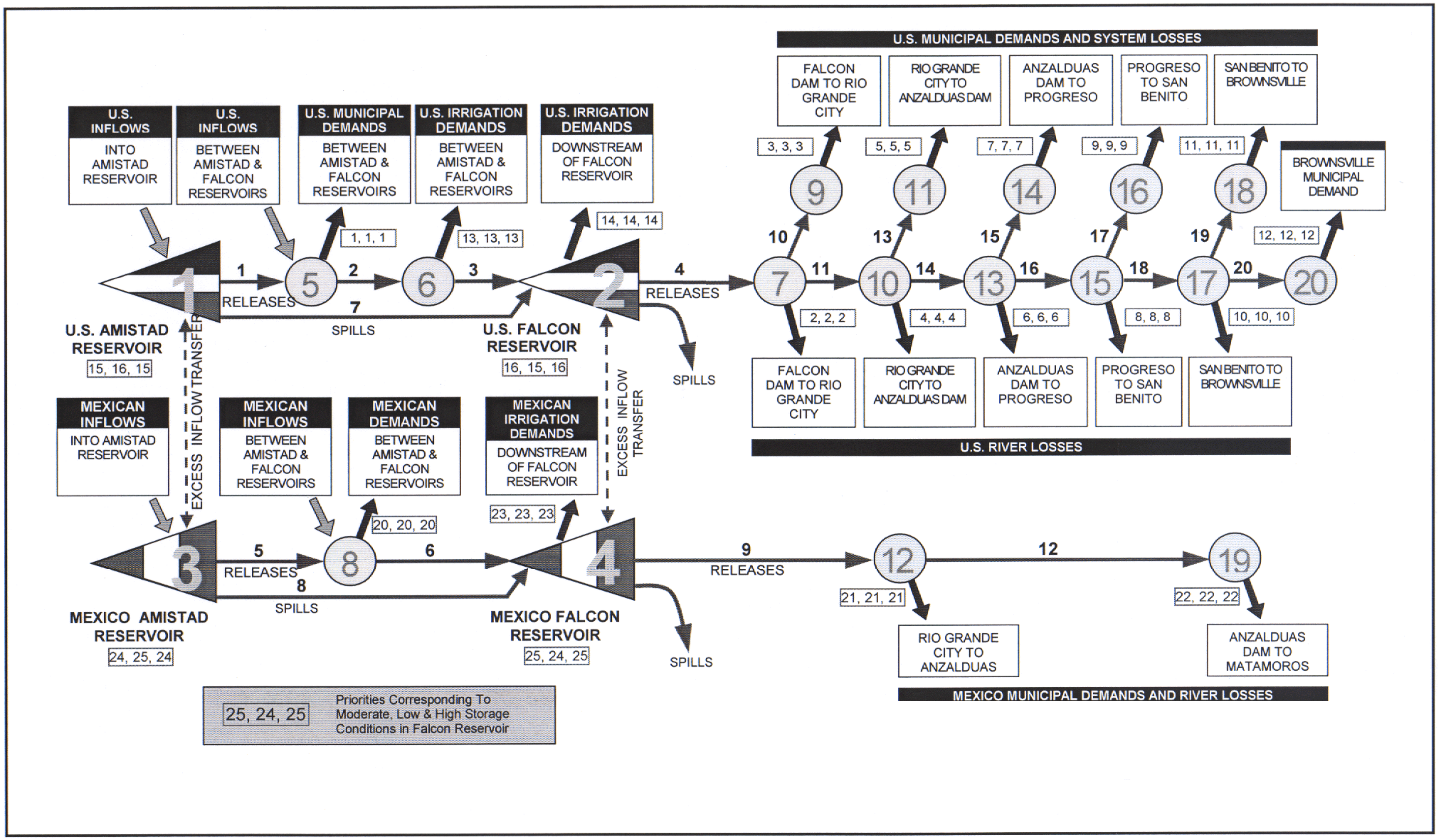


Table 3.22: Distribution of Projected Water Demands and Associated Irrigation District Delivery System Losses Under Severe Drought Conditions

ROM NODE NO.	REACH / NODE DESCRIPTION	PROJECTED YEAR-2000 WATER DEMANDS Acre-Feet	IRRIGATION DISTRICT DELIVERY SYSTEM CONVEYANCE LOSSES		
			15% Acre-Feet	20% Acre-Feet	25% Acre-Feet
9	Falcon Dam to Rio Grande City	5,032	351	469	586
	Rio Grande City*				
	Roma/Los Saenz				
11	Rio Grande City to Anzalduas Dam	47,997	7,200	9,599	11,999
	La Grulla				
	Starr County - Other				
	Sullivan City				
	La Joya				
	Palmview				
	Alton				
	Mission				
	Hidalgo County - Other				
14	Anzalduas Dam to Progreso	55,698	8,355	11,140	13,925
	Hidalgo				
	McAllen				
	Edinburg				
	Pharr				
	San Juan				
	Alamo				
	Donna				
	Elsa				
	Edcouch				
	La Villa				
	Weslaco				
	Progreso				
16	Progreso to San Benito	31,225	4,684	6,245	7,806
	Mercedes				
	San Perlita				
	Raymondville				
	Lyford				
	Sebastion				
	Willacy County - Other				
	La Feria				
	Santa Rosa				
	Palm Valley				
	Primera				
	Combes				
	Harlingen				
	Rio Honda				
	San Benito				

* Since raw water deliveries to Rio Grande City are diverted directly from the Rio Grande, no conveyance losses have been assigned to its projected year-2000 water demand (2,689 ac-ft).

Table 3.22 - Distribution of Projected Water Demands and Associated Irrigation District Delivery System Losses Under Severe Drought Conditions, cont'd.

ROM NODE NO.	REACH / NODE DESCRIPTION	PROJECTED YEAR-2000 WATER DEMANDS Acre-Feet	IRRIGATION DISTRICT DELIVERY SYSTEM CONVEYANCE LOSSES		
			15% Acre-Feet	20% Acre-Feet	25% Acre-Feet
18	San Benito to Brownsville Rancho Viejo Los Fresnos Laguna Vista Port Isabel South Padre Island Cameron County - Other	19,245	2,887	3,849	4,811
20	Brownsville*	27,000	0	0	0
TOTAL UNITED STATES DEMANDS AND SYSTEM LOSSES		186,198	23,476	31,302	39,127
12	Mexico Anzalduas Canal*	230,051	0	0	0
19	Matamoros and Other Users*	43,447	0	0	0
TOTAL MEXICO DEMANDS AND SYSTEM LOSSES		273,498	0	0	0

* Since raw water deliveries to Brownsville, the Anzalduas Canal, and Matamoros are diverted directly from the Rio Grande, no conveyance losses have been assigned to their respective water demands.

The resulting amounts of water losses associated with the conveyance of United States municipal water through the irrigation district delivery systems also are listed in Table 3.22 for each of the nodes in the revised ROM network where the lower Rio Grande municipal water demands are assigned. Three columns of figures are presented corresponding to the three different assumed percentages for conveyance losses (15%, 20%, and 25 %). For those entities that divert water directly from the river (Rio Grande City, Brownsville, Anzalduas Canal, and Matamoros), no conveyance losses are indicated.

An analysis of historical monthly streamflow records for gages located along the lower Rio Grande also was made in an attempt to quantify historical channel losses from the river under flow conditions similar to those that might occur during extreme drought periods when only municipal water deliveries would be made from Falcon Reservoir. For this purpose, historical monthly streamflow and diversion data were examined for the period from 1960 through 2003[33] for each of the river reaches as previously identified on the map of the lower Rio Grande in Figure 3.33. Using these data, months during which the historical flows in the lower Rio Grande were of the same general magnitude as those that might be expected during future periods when only municipal water deliveries would be made from Falcon Reservoir were identified. The general ranges of these flow conditions by reach of the river were inferred based the projected demands and the estimated delivery system conveyance losses listed in Table 3.22. For the selected historical monthly data sets, water balance analyses were performed for each of the reaches to quantify monthly losses or gains. For the water balance analyses, the gaged monthly streamflows at the upstream and downstream ends of each reach and the corresponding gaged incremental tributary inflows and reported diversions were used.

The resulting monthly percentage losses and gains, calculated based on the flow at the upstream end of each reach, were plotted versus the flow at the downstream end of each reach. Plots were prepared for each of the five reaches of the lower Rio Grande. While the data shown on these plots does exhibit considerable variations with flow, the indicated loss percentages, nonetheless, do provide general estimates of the level of losses that might be expected, and these values were used to establish the following average and high percentage loss rates for each of the reaches:

[33] At the time of the studies, this was the last year for which published and unpublished streamflow and diversion records were available from the IBWC.

River Reach	Average Loss Rate	High Loss Rate
Falcon Dam to Rio Grande City	4 %	7 %
Rio Grande City to Anzalduas Dam	5 %	7 %
Anzalduas Dam to Progreso	2 %	4 %
Progreso to San Benito	2 %	7 %
San Benito to Brownsville	8 %	10 %

Six different operations of the modified ROM were made corresponding to the three sets of irrigation district delivery system loss rates (15%, 20%, and 25%) and the two sets of river channel loss rates (average and high). Results from these simulations indicate that between 13 and 21 percent of the municipal water released from the reservoir for the United States during extreme drought periods without any irrigation carrying water potentially could be lost along the river, with Mexico's losses ranging between 11 and 17 percent.

The differences between the river loss rates for the two countries are the result of allocating the total losses in a given reach based on the proportional amount of water that each country has flowing in the reach.

The total amount of water that must be released at any one time from Falcon Reservoir in order to satisfy United States municipal demands in the Lower Rio Grande Valley without the benefit of irrigation carrying water is equal to the sum of the individual demands themselves plus the estimated losses associated with the irrigation district delivery systems plus the estimated losses along the river channel. The resulting total loss rates associated with each of the six combinations of assumed irrigation district delivery system loss rates (15%, 20%, and 25%) and river channel loss rates (average and high) are summarized in Table 3.23 for as percentages of the total municipal demands and as percentages of the corresponding releases from Falcon Reservoir required to meet these demands. These loss rates suggest that between 29 and 52 percent of the total United States municipal demands below Falcon Reservoir can be expected to be lost either along the river channel or through the irrigation district delivery systems, which means that an additional 29 to 52 percent of the municipal demands must be released from Falcon Reservoir in order for the full amount of the municipal demands to be satisfied; i.e., at the water treatment plant headgates. Or stated another way, for every acre-foot of United States water that is released from Falcon Reservoir to meet downstream municipal demands without the benefit of irrigation carrying water, between 22 and 34 percent can be expected to be lost either along the river channel or through the irrigation district delivery systems.

Corresponding results for Mexico based on the ROM simulations also are summarized in Table 3.23. The indicated total loss rates for Mexico (12% to 20% of total demands or 11% to 17% of Falcon releases) are considerably less than those for the United States because they do not reflect any conveyance losses within Mexico's internal water delivery system, for example, along the Anzalduas Canal. These total loss rates reflect only river channel losses. The corresponding river channel loss rates for the United States based on Falcon Reservoir releases are comparable and range between 13 and 21 percent.

3.9.3 Withdrawal Capabilities of Existing Diversion Facilities

Municipal water users in the Lower Rio Grande Valley that rely on irrigation districts to pump and deliver their water from the Rio Grande also have expressed concerns regarding the ability of the districts' pumping facilities on the river to effectively function when flows in the river may become diminished because irrigation water is not being conveyed. As with the loss analysis described in the previous section, under these conditions, it is conceivable that if only municipal water is being released from Falcon Reservoir and conveyed in the river, then the river levels may be so low that the pump intakes could be physically above the level of the river and, therefore, unable to withdraw water from the river.

To investigate this potential problem, the Lower Rio Grande Development Council entered into a Research and Planning Fund Research Grant Contract with the TWDB to assemble data on each irrigation district diversion facility on the lower Rio Grande that delivers water for domestic, municipal, and industrial uses. The objective of the study was to assess the irrigation district diversion facilities on the river to develop an opinion as to whether municipal water supplies could be pumped from the river and delivered under conditions when little or no irrigation water is being used.

To achieve the basic objective of the study, the following specific activities were undertaken:

- Available construction drawings showing the general plan and capacity of each diversion facility, including existing weirs, were assembled;
- A committee of three irrigation district representatives and three municipal representatives was established to review the assembled drawings;
- Each critical diversion facility was reviewed and discussed to evaluate its capabilities for delivering municipal water in the absence of irrigation water in the river; and
- A written summary report was prepared.

Table 3.23 - Summary of Total Losses Associated with Municipal Water Deliveries in the Lower Rio Grande Valley Under Severe Drought Conditions

UNITED STATES WATER DELIVERIES

Irrigation District System Loss and River Loss Condition	Based On Municipal Releases	Based On Falcon Demands
15% Irrigation System Loss, Average River Loss	29 %	22 %
20% Irrigation System Loss, Average River Loss	34 %	25 %
25% Irrigation System Loss, Average River Loss	38 %	28 %
15% Irrigation System Loss, High River Loss	42 %	29 %
20% Irrigation System Loss, High River Loss	47 %	32 %
25% Irrigation System Loss, High River Loss	52 %	34 %

MEXICAN WATER DELIVERIES

River Loss Condition	Based On Total Demands	Based On Falcon Releases
Average River Loss	12 %	11 %
High River Loss	20 %	17 %

Based on past history of operations, it was verified during the study that the irrigation districts can divert, and have diverted, water from the Rio Grande when there is no irrigation water being released from Falcon Reservoir; although, pumping efficiencies are negatively affected and the overall volumes capable of being pumped are limited.

There are documented data from the Rio Grande Watermaster and the IBWC that indicate the historical periods of time when little or no irrigation water was being released from Falcon Reservoir. The water diverted from the river during these periods was only municipal water. Based on this historical data, the study concluded that irrigation districts would be able to physically pump water from the river even if the only water flowing in the Rio Grande is water that has been released from Falcon Reservoir for municipal uses.

The study also noted that the major water diverters (irrigation districts) along lower Rio Grande, below Anzalduas Dam, have weirs constructed across the river downstream of their respective diversion points. These weirs are effective in maintaining a minimum river elevation at the districts pumping facilities and creating a pool of water that facilitates the diversion of water during low flow conditions. Irrigation districts with their river pumping facilities located upstream of Anzalduas Dam utilize the reservoir created by the dam itself; therefore, their ability to divert water for municipal use generally is not affected when there is no irrigation water flowing in the river.

In conclusion, the study made the following recommendations:

> *All cities and/or water purveyors must be required to have control of, or contract to an irrigation district for, raw water storage for at least 20 to 30 days of supply. Raw water storage requirements should meet the maximum daily demand from the water treatment facility. The 20 to 30-day storage requirement should be a firm storage requirement and not be based on total volume of storage. If cities had a requirement to have 20 to 30 days of water storage, it would greatly increase the efficiency in how the irrigation districts divert water. This would be the responsibility of the city and not the district since it would only benefit the city.*
>
> *Several cities rely on the irrigation districts' canal system as their reservoir. This practice places an unnecessary burden on the irrigation districts. Cities should not take into account canals as storage facilities unless there are no taps to the canal prior to the cities' diversion points. In other words, they can use that portion of the canal that serves solely their water treatment facility, if and only if, the irrigation district agrees to the concept. The storage could be contained through weirs or gates to meet that storage requirement. If an irrigation district has a storage structure at the present time, the district might explore to determine if the structure can be reworked to provide more storage, or to determine if there is a way that the city can put its own storage facility into operation. If the district has a storage structure presently, the district could work with the city to fund the needed repairs of the facility.*

In addition, the study also made the following specific recommendations to insure the continued pumping ability of the districts under low flow conditions:

1. *A study should be made on all existing Rio Grande weirs (and future installations) that could determine their positive impact on pumping conditions during low flows. Also, to determine what could be done to increase the positive results of the weirs now in place.*

2. *Further study should be done on the aquatic weed infestation and its impact on low Rio Grande flows.*

3. *The water ordering mechanism now being used between the irrigation districts and the Rio Grande Watermaster needs to be investigated to determine what would best enhance the efficient delivery of water from the Falcon Lake if the situation ever arose where only municipal water was remaining in the reserves.*

4. *Additional measuring or gaging stations along the river could better monitor the river flow and could provide a higher level of operation. Efforts should be made to coordinate the activities of all the agencies to assist in the funding of such a program.*

5. *Negative environmental effects resulting from the low flows, such as potential fish or wildlife damage, need to be addressed by those water right holders (Texas Parks & Wildlife, U.S. Fish and Wildlife, etc.) who have the water reserves that could possibly alleviate these conditions. No other water right allocation holders should use their reserves for this purpose.*

6. *The cities can help themselves by either studying their water supply system themselves or hiring someone to assess their needs and provide an answer for them. Many of the smaller towns have let their treatment and distribution systems and their water supply sources to their system deteriorate for so many years. These cities are in an almost impossible situation money-wise to be able to provide any type of fix to these facilities.*

3.10 FALCON-MATAMOROS AQUEDUCT

In 2001, a project was submitted to Border Environment Cooperation Commission (BECC) detailing an aqueduct to carry water from Falcon Reservoir to Matamoros, Tamaulipas, Mexico. In recent years, this project has been gaining s certain level of notoriety as planning studies proceed.

In a presentation prepared by Comision Nacional del Agua (CONAGUA), an overview of the project was laid forth. The proposed project is to consist of the construction of a 262 km (approx. 163 miles) aqueduct with a total capacity of 182.6 MGD. The diameter of the pipeline ranges from 1.8 to 2.8 meters (71 inches to 110 inches). The project also consists of two pumping plants and two storage tanks. The entire infrastructure is to be located in Mexico, a few miles south of the US border (Rio Grande). The purpose of the project is to maintain drinking water supply for local entities located in the lower reaches of the Rio Grande basin. In addition, water losses caused by evaporation and seepage are expected to be eliminated.

In terms of water planning for the Rio Grande Region (Region M), the proposed pipeline capacity (182.6 MGD) correlates to a maximum yearly flow of 204,674 acre-feet per year. Based on information supplied earlier in this chapter, an average of 1.20 million acre-feet per year of United States water have been released from Falcon Reservoir, while Mexico has released an average of approximately 1.00 million acre-feet per year during the period 1960 through 2003. Combining both the United State's releases and Mexico's releases gives a total annual release of 2.2 million acre-feet per year from Falcon Reservoir. By diverting a maximum of 204,674 acre-feet per year through the proposed pipeline, Mexico will be removing approximately 10% of the total flow in the Rio Grande downstream of Falcon Reservoir. This percentage will fluctuate based on the total amount released from Falcon Reservoir and the total amount of flow through the proposed pipeline.

A 10% reduction in river flows will have an impact on key water supply variables. By removing this water from the Rio Grande, the total quantity of push-water (excess water needed to move a certain quantity of water from point A to point B) available will be decreased. This will require push-water to be made up in other areas and could have an impact on water availability for water users on the US side of the Rio Grande. One of the benefits of this project to Mexico is the near elimination of seepage and evaporation losses. Seepage rate is a function of the wetted perimeter of the transmission channel, in this case the Rio Grande. Should the water levels in the Rio Grande maintain a similar level post aqueduct installation, the gross water loss due to seepage will remain the same. Therefore, it can be assumed that the percentage loss of water due to seepage will increase for the flows remaining in the Rio Grande. This same principal can be applied to evaporation losses. Evaporation is a function of the exposed area of a body of water. Again, should the water level in the Rio Grande remain constant after the installation of the proposed aqueduct, the gross water loss due to evaporation will be the same resulting in an increase in water loss percentage for the remaining water in the Rio Grande.

In order to arrive at a concrete conclusion of the impacts of the proposed aqueduct on Rio Grande water supply, future studies shall be performed. As of now,[34] there is no water supply availability at this time. Even though these studies are outside of the current scope of work for this round of regional water planning, the potential impacts are noted and should be considered when evaluating similar projects in the future.

3.11 MEXICAN WATER DEFICITS UNDER 1944 TREATY

As discussed earlier in this report (see Section 3.2.1.6.1), the 1944 Treaty between the United States and Mexico contains a provision whereby Mexico is to provide the United States with a minimum of 350,000 acre-feet per year, averaged in five-year cycles, of inflows to the Rio Grande from six named tributaries located below Fort Quitman, Texas. The inflows from these tributaries contribute directly to the Amistad-Falcon

[34] Updated on August 2, 2010.

water supply that is extensively relied upon by water users in the RGRWPA. Hence, when these tributary inflows are reduced, the available water supply for the RGRWPA also is reduced.

The IBWC is responsible for measuring the Mexican tributary inflows and performing the necessary water accounting in accordance with the provisions of the 1944 Treaty. Since October 1992, data reported by the IBWC indicate that Mexico has failed to deliver the required minimum inflows to the United States, and, therefore, Mexico accrued a deficit of 1,024,000 acre-feet for the five-year accounting cycle that ended on October 2, 1997. For the five-year accounting cycle that ended on October 2, 2002, the deficit owed by Mexico was 384,100 acre-feet. For the ten years from October 3, 1992 through October 2, 2002, the total amount of the inflow deficit incurred by Mexico on the six named tributaries identified in the 1944 Treaty was 1,408,100 acre-feet. We are on the most current five year cycle which begun March 2008. Mexico's current deficit (as of January 30, 2010) now has been reduced to 187,780 acre-feet.

Because of the substantial amount of the current Mexican water deficits and because agricultural interests in the Lower Rio Grande Valley have been severely impacted during the drought of the 2000's as available water supplies from Amistad and Falcon Reservoirs have diminished, there has been increased concern by all Rio Grande water users regarding the reasons for the deficits and Mexico's ability to repay the deficits in accordance with the terms of the 1944 Treaty and Minute No. 234.

To begin to address these issues, special studies were undertaken as part of the first round of this regional water planning effort for the RGRWPA, and preliminary results pertaining to the Mexican water deficits were presented in a separate report[35]. The United Section of the IBWC also issued a report in April, 2002 that discussed the deficit situation and included much of the data and information previously compiled and presented in the earlier TRC Solutions report[36]. For specific details regarding these findings, these Mexican deficit reports should be consulted.

It should be noted that after February 2000, Mexico transferred approximately 138,000 acre-feet of its water stored in the Amistad-Falcon reservoir system to the United States in an effort to help offset the deficits under the 1944 Treaty. Mexico also agreed to provide to the United States through September 2000, a portion of the inflows to the Rio Grande that Mexico was entitled to under the provisions of the 1944 Treaty. This additional water that Mexico allocated to the United States totaled about 110,000 acre-feet. In June 2002, the IBWC issued Minute 308, which transferred 90,000 acre-feet of Mexican water stored in Amistad and Falcon Reservoirs to the United States. In

[35] TRC Solutions; "Preliminary Analysis of Mexico's Rio Grande Water Deficit Under the 1944 Treaty"; Second Draft Report to the Rio Grande Regional Water Planning Group and the Lower Rio Grande Valley Development Council; Austin, Texas; April 3, 2000.

[36] United States Section, International Boundary and Water Commission; "Deliveries of Waters Allotted to the United States Under Article 4 of the United States – Mexico Water Treaty of 1944; El Paso, Texas; April, 2002.

July 2003, the IBWC issued Minute 309, which ultimately was to result in up to 321,043 acre-feet per year being released from the reservoirs in the Rio Conchos basin to the Rio Grande. To achieve this, Minute 309 required funding from the North American Development Bank (NADBank) for improvements to the irrigation systems of several large irrigation districts in the Rio Conchos basin. The water saved by these improvements was to be released to the Rio Grande, with the United States receiving its share as allocated under the 1944 Treaty. Efforts are still underway to implement Minute 309. No further information has been received on the implementation of Minute 309.

3.12 SURFACE WATER QUALITY

Surface water quality is addressed in this section for portions of two basins - the Rio Grande, which flows directly into the Gulf of Mexico, and the Arroyo Colorado, which discharges into the Laguna Madre and then into the Gulf of Mexico. Surface and sub-surface discharges that arise from both natural processes and the activities of man affect the quality of these water resources. In general, the presence of minerals, which contribute to the total dissolved solids concentration in surface water, arise from natural sources, but can be concentrated as flows travel downstream. Return flows from both irrigation and municipal uses can concentrate dissolved solids, but can also add other elements such as nutrients, sediments, chemicals, and pathogenic organisms.

The new Environmental Flows Allocation Process addresses a contentious issue of long standing in Texas: How to ensure that enough water continues to flow in our rivers and streams and into our coastal bay systems to keep them healthy and productive for current and future generations of the region. The process will address two key issues: determining how much flow is needed to maintain a sound ecological environment, and how to go about ensuring that flow is protected. The time table for the development of the environmental flows program is as followed: the process is anticipated to start for the Rio Grande basin in June 2010; with flow recommendations due by October 2011; flow standards will be adopted by April 2013.

3.12.1 Rio Grande

Water in the Rio Grande normally is of suitable quality for irrigation, treated municipal supplies, livestock, and industrial uses, but salinity, nutrients, and fecal coliform bacteria are concerns identified throughout the basin. Salinity concentrations in the Rio Grande are the result of both human activities and natural conditions: the naturally salty waters of the Pecos River are a major source of the salts that flow into Amistad Reservoir and continue downstream. Untreated or poorly treated discharges from inadequate wastewater treatment facilities, primarily in Mexico, are the principal source for fecal coliform bacteria contamination. A secondary source is from nonpoint source pollution on both sides of the river, including poorly constructed or malfunctioning septic and sewage collection systems and improperly managed animal wastes. Although frequently identified as a concern, nutrient levels do not represent a threat to human health nor have they supported excessive aquatic plant growth and caused widespread depressed dissolved oxygen levels.

Following is a discussion of water quality for each of the following individual river segments:

- Amistad to Falcon Reservoir;
- Falcon Reservoir;
- Below Falcon Reservoir;
- Arroyo Colorado; and,
- Laguna Madre.

Where available, the TCEQ water quality stream segment number corresponding to a particular reach of the river or other stream is noted. In addition, the current water quality standards for each of these stream segments are provided in Table 3.24.

3.12.1.1 Amistad to Falcon Reservoir

In the Rio Grande below Amistad Reservoir (TCEQ Stream Segment No. 2304), the major water quality concern is the occurrence of fecal coliform bacteria (at low-flow conditions) resulting from inadequately treated wastewater discharges. Historically, this has resulted from inadequate wastewater treatment facilities in Mexico, but is also resulting from "Colonia" developments on the United States side of the Rio Grande. Due to the elevated levels of fecal coliform bacteria that have been observed, contact recreation use is not supported. Possible other concerns are nitrogen and phosphorus. This segment of the river was included on prior 303d lists of water quality limited stream segments, and remains on the draft 303d list for 2004. The original basis for listing this segment was the occurrence of sediment toxicity downstream of Laredo and Eagle Pass.

3.12.1.2 Falcon Reservoir

In Falcon Reservoir (TCEQ Stream Segment No. 2303), the elevated total dissolved solids have been identified as a concern. Phosphorus is identified as a possible concern. The average concentrations of chlorides and total dissolved solids exceed the criteria established to safeguard general water quality uses.

3.12.1.3 Below Falcon Reservoir

The Rio Grande below Falcon Reservoir (TCEQ Stream Segment No. 2302) is regulated by releases from Falcon Reservoir. Concerns that have been identified include elevated total dissolved solids and fecal coliform bacteria (at low-flow conditions). Possible concerns are nitrogen and phosphorus. This segment is on the draft 303(d) list for 2004 because of bacteria. Because of elevated levels of fecal coliform bacteria, contact recreation use is not supported. In the lower 25 miles of this reach, bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation. As water levels continue to decline in Amistad and Falcon Reservoirs, the dissolved solids concentrations of the stored water continues to increase. Total dissolved solids concentrations usually range from 400 to 750 mg/L (milligrams per liter), which is considered fresh, but these levels can cause salt accumulation in agricultural soils if excess water is not applied periodically to leach the fields.

Near the mouth of the Rio Grande, which is known as the Rio Grande Tidal segment (TCEQ Classified Stream Segment 2301), the watershed is narrow and flat and extends only a few miles inland on either side of the river. The only significant water quality concern beyond the salinity influence from the Gulf of Mexico is a concern for elevated phosphorus levels.

Table 3.24: Summary of Water Quality Standards for Stream Segments in the Lower Rio Grande Region[i]

		DESIGNATED WATER USES				CRITERIA						
Segment No.	**Segment Name**	**Recreation**	**Aquatic Life**	**Domestic Water Supply**	**Other**	**Cl^{-1} (mg/L)**	**SO_4^{-2} (mg/L)**	**TDS (mg/L)**	**Dissolved Oxygen (mg/L)**	**pH Range (SU)**	**Indicator Bacteria[1] [Fecal Coliform] #/100ml**	**Temperature (°F)**
NUECES-RIO GRANDE COASTAL BASIN												
2201	Arroyo Colorado Tidal	Contact Recreation	High						4.0	6.5-9.0	35/200	95
2202	Arroyo Colorado Above Tidal	Contact Recreation	Inter-mediate			1,200	1,000	4,000	4.0	6.5-9.0	126/200	95
RIO GRANDE BASIN												
2301	Rio Grande Tidal	Contact Recreation	Excep-tional						5.0	6.5-9.0	35/200	95
2302	Rio Grande Below Falcon Reservoir	Contact Recreation	High	Public Supply		270	350	880	5.0	6.5-9.0	126/200	90
2303	International Falcon Reservoir	Contact Recreation	High	Public Supply		200[140]	300	1,000 [700]	5.0	6.5-9.0	126/200	93
2304	Rio Grande Below Amistad Reservoir	Contact Recreation	High	Public Supply		200	300	1,000	5.0	6.5-9.0	126/200	95
2305	International Amistad Reservoir	Contact Recreation	High	Public Supply		150	270	800	5.0	6.5-9.0	126/200	88
BAYS AND ESTUARIES												
2491	Laguna Madre	Contact Recreation	Excep-tional/ Oyster						5.0	6.5-9.0	14	95
2493	South Bay	Contact Recreation	Excep-tional/ Oyster						5.0	5-9.0	14	95
2494	Brownsville Ship Channel	Non-Contact Recreation	Excep-tional						5.0	6.5-9.0	35/200	95

Table 3.24: Summary of Water Quality Standards for Stream Segments in the Lower Rio Grande Region, cont'd.

		DESIGNATED WATER USES				CRITERIA						
Segment No.	Segment Name	Recreation	Aquatic Life	Domestic Water Supply	Other	Cl^{-1} (mg/L)	SO_4^{-2} (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L)	pH Range (SU)	Indicator Bacteria[1] [Fecal Coliform] #/100ml	Temperature (°F)
GULF OF MEXICO												
2501	Gulf of Mexico	Contact Recreation	Excep-tional/ Oyster						5.0	6.5-9.0	14	95

[1] The indicator bacteria for freshwater is *E. coli* and Enterococci for saltwater. Fecal coliform is an alternative indicator.

Stream Segment Descriptions

2201 Arroyo Colorado Tidal - from the confluence with Laguna Madre in Cameron/Willacy County to a point 100 meters (110 yards) downstream of Cemetery Road south of Port Harlingen in Cameron County
2202 Arroyo Colorado Above Tidal - from a point 100 meters (110 yards) downstream of Cemetery Road south of Port Harlingen in Cameron County to FM 2062 in Hidalgo County (includes La Cruz Resaca, Llano Grande Lake, and the Main Floodway)
2301 Rio Grande Tidal - from the confluence with the Gulf of Mexico in Cameron County to a point 10.8 kilometers (6.7 miles) downstream of the International Bridge in Cameron County
2302 Rio Grande Below Falcon Reservoir - from a point 10.8 kilometers (6.7 miles) downstream of the International Bridge in Cameron County to Falcon Dam in Starr County
2303 International Falcon Reservoir - from Falcon Dam in Starr County to the confluence of the Arroyo Salado (Mexico) in Zapata County, up to the normal pool elevation of 301.1 feet (impounds Rio Grande)
2304 Rio Grande Below Amistad Reservoir - from the confluence of the Arroyo Salado (Mexico) in Zapata County to Amistad Dam in Val Verde County
2305 International Amistad Reservoir - from Amistad Dam in Val Verde County to a point 1.8 kilometers (1.1 miles) downstream of the confluence of Ramsey Canyon on the Rio Grande Arm in Val Verde County and to a point 0.7 kilometer (0.4 mile) downstream of the confluence of Painted Canyon on the Pecos River Arm in Val Verde County and to a point 0.6 kilometer (0.4 mile) downstream of the confluence of Little Satan Creek on the Devils River Arm in Val Verde County, up to the normal pool elevation of 1117 feet (impounds Rio Grande)
2491 Laguna Madre *
2493 South Bay *
2494 Brownsville Ship Channel *
2501 Gulf of Mexico * - from the Gulf shoreline to the limit of Texas' jurisdiction between Sabine Pass and Brazos Santiago Pass

* The segment boundaries are considered to be the mean high tide line.
Information provided by TPWD

3.12.2 Arroyo Colorado

The Arroyo Colorado lies in Willacy, Cameron, and Hidalgo counties, and is the major drainageway for approximately two dozen cities in this area, with the notable exception of Brownsville. Almost 500,000 acres in the three counties are irrigated for cotton, citrus, vegetables, grain sorghum, corn, and sugar cane production; and much of the runoff and return flows from these areas are discharged into the Arroyo Colorado. The Arroyo Colorado and the Brownsville Ship Channel both discharge into the Laguna Madre near the northern border of Willacy County.

The Arroyo Colorado includes TCEQ Classified Stream Segment 2201 and 2202. Use of the water in the Arroyo Colorado for municipal, industrial, or irrigation purposes is severely limited because of poor quality conditions. Salinity concentrations in the Arroyo typically exceed the limits considered desirable for human consumption, as well as those acceptable for irrigation of crops. Water quality and fish tissue testing have found that: (1) low dissolved oxygen levels have impaired the fish community and other aquatic life downstream from the Port of Harlingen; (2) elevated levels of pesticides (chlordane, toxaphene, and 1,1-dichloro-2,2-bis(p-chlorophenyl) ethylene—DDE, and PCBs in the Donna Canal) have resulted in a fish consumption advisory upstream from the Port of Harlingen; and (3) bacteria levels are occasionally elevated indicating a potential health risk to people who swim or wade in the Arroyo upstream from the Port of Harlingen. The fish consumption advisory was modified in 2001, lifting restrictions except for one species, small-mouth buffalo. In response to these use impairments, the TCEQ has performed a Total Maximum Daily Load (TMDL) study to assess the specific causes of the observed pesticide and PCB problems and to determine the pollution controls necessary to restore water quality in the Arroyo Colorado. A plan to monitor pollutants is currently being implemented and fish advisories will be lifted as concentrations decline over time.

3.12.3 Laguna Madre

The Lower Laguna Madre (TCEQ Classified Stream Segment 2491), which encompasses the portion of the Laguna Madre south of the land bridge, receives runoff from watersheds in Cameron, Willacy, and Hidalgo counties primarily by way of the Arroyo Colorado. The concerns identified are depressed dissolved oxygen and elevated nitrogen, which results mainly from agricultural runoff and from municipal wastewater discharges. This segment is on the draft 303(d) list for 2004 because of depressed dissolved oxygen. Total dissolved solids concentrations in the range of 35,000 mg/L typically eliminate this water from being considered as a viable source for municipal or industrial uses. However, improvements in technology are continuing to reduce the cost of desalinization, especially where there is a waste heat source available.

Based on Texas Department of Health shellfish maps, 5.2 percent of the Lower Laguna Madre (18.1 square miles near the Arroyo Colorado and along the

Intracoastal Waterway) does not support the oyster water use, and 38.8 percent (134.8 square miles) of the bay fully supports the oyster water use. The remaining 56 percent (194.6 square miles) of the Laguna Madre, from Port Mansfield to Corpus Christi, has not been assessed for oyster use. Non-supporting areas are restricted or prohibited for the growing and harvesting of shellfish for direct marketing due to potential contamination by human pathogens.

3.13 GROUND WATER QUALITY

In general, groundwater from the various aquifers in the region has total dissolved solids concentrations exceeding 1,000 mg/L (slightly saline) and often exceeds 3,000 mg/L (moderately saline). The salinity hazard for groundwater ranges from high to very high[37]. Localized areas of high boron content occur throughout the study area.

3.13.1 Gulf Coast Aquifer

The quality of groundwater found in the Gulf Coast aquifer in Starr, Hidalgo, Willacy, and Cameron counties is reviewed in the TWDB's Report No. 316[38]. Water quality is described from the deepest and oldest or Eocene series (as shown in Table 3.25: Stratigraphy of the Lower Rio Grande Valley) to the shallower and younger Pleistocene series. Wells in western Starr County draw from the Eocene-age strata, which lie below the more commonly known Evangeline aquifer, and provide small quantities of slightly to moderately saline water for domestic and livestock use. In many places water drawn from these strata is too mineralized for domestic use and, in some cases, even for livestock watering. The Miocene-age strata overly the Eocene strata, but are still below the Evangeline aquifer. These strata are characterized as yielding small to moderate quantities of slightly to moderately saline water to wells in the characterized as yielding small to moderate quantities of slightly to moderately saline water to wells in the area of northwestern Hidalgo and eastern Starr counties. (See Figure 3.19 above, Approximate Productive Areas of the Major Sources of Groundwater in the Lower Rio Grande Valley)

The Evangeline and Chicot aquifers lie within the Goliad Formation and the younger, Quaternary-age deposits, respectively. Both aquifers yield moderate to large quantities of fresh to moderately saline water in Cameron, Hidalgo, and Willacy counties. (see Figure 3.35, Chemical Quality of Water in the Evangeline and Chicot Aquifers) However, these aquifers are reported as containing high sodium concentrations.

In addition, water quality analyses for the Chicot have shown chloride, bicarbonate, and sulfate concentrations in roughly equal proportions, with water quality

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[37] Salinity hazard is a measure of the potential for salts to be concentrated in the soil from high salinity groundwater. Accumulation or buildup of salts in the soil can affect the ability of plants to take in water and nutrients from the soil. Salinity hazard is usually expressed in terms of specific conductance in micromhos per centimeter at 25° C.

[38] Evaluation of Ground-Water Resources In the Lower Rio Grande Valley, Texas; T. Wesley McCoy; Texas Water Development Board Report 316; January 1990.

deteriorating with distance from the Rio Grande. Analyses of water from the Evangeline aquifer indicate higher chloride and sulfate concentrations with respect to that of bicarbonate. Within both the Chicot and Evangeline aquifers there are two small areas yielding fresh-quality groundwater (total dissolved solids less than 1,000 mg/L).

One of these areas is located in southeastern Hidalgo and southwestern Cameron counties and occurs in the alluvial and deltaic deposits of the Rio Grande Alluvium, and the other is located in north-central Hidalgo County and occurs in the shallow sediments found between the cities of Linn and Faysville. Scattered throughout the study area, many wells with depths of less than 100 feet have produced water with high nitrate levels. Additionally, wells drawing from the Oakville Sandstone in Starr, Willacy and northern Hidalgo counties can contain levels of sulfate in excess of 300 mg/L.

The TWDB well database was used to complete a more detailed water quality assessment of the Gulf Coast Aquifer. TWDB standard water quality constituent analytical results from wells within the region were compared to primary and secondary drinking water maximum contaminant level (MCL) when the database contained sufficient data. In the case of fluoride, the lower secondary MCL of 2 mg/L was used for comparison purposes. The standard water quality constituents studied were: sulfate, chloride, pH, TDS, nitrate, and fluoride.

TWDB infrequent water quality constituent analytical results were also compared to primary drinking water MCLs. Only constituents with primary drinking water MCLs and representative data records were selected for this effort. Only the most recent data for each well was used. The infrequent water quality constituents studied were: gross alpha, arsenic, barium, cadmium, chromium, copper, lead, and selenium. Organic and other regulated infrequent constituent data was very sparse and were not considered to be representative. Table 3-26 summarizes the results for the Gulf Coast Aquifer.

Table 3.25: Stratigraphy of the Lower Rio Grande Valley

Era	System	Epoch	Stratigraphic Units	Character of Material	Hydrologic Units	Water-Bearing Characteristics*
Cenozoic	Quaternary	Recent	Alluvium	Sand and silt	Chicot Aquifer	Yields moderate to large quantities of fresh to slightly saline water near the Rio Grande in Cameron and Hidalgo Counties.
		Pleistocene	Fluviatile Terrace Deposits	Gravel, and silt, and clay		Yields moderate to large quantities of fresh to moderately saline water.
			Beaumont Formation	Mostly clay with some sand and silt		
			Lissie Formation	Clay, silt, sand, gravel, and caliche		
	Tertiary	Pleistocene or Pliocene	Uvalde Gravel	Chert, occurs as terrace gravel in western Starr County		
		Pliocene	Goliad Formation	Clay, sand, sandstone, marl, caliche, limestone, and conglomerate	Evangeline Aquifer	Yields moderate to large quantities of fresh to slightly saline water.
		Miocene	Miocene Formations Undifferentiated	Mudstone, claystone, sandstone, tuff, and clay		Yields moderate quantities of slightly to moderately saline water in northwestern Hidalgo and eastern Starr Counties
		Eocene	Eocene Formations Undifferentiated	Sandstone and clay		Yields small quantities of slightly to moderately saline water.

* Yields of wells: small = <50 gallons per minute; moderate = 50 to 500 gallons per minute; large = >500 gallons per minute.
Chemical Quality of Water: fresh = <1,000 milligrams per liter (mg/l); slightly saline = 1,000 to 3,000 mg/l; moderately saline = 3,000 to 10,000 mg/l.
*Source TWDB

Figure 3.35: Chemical Quality of Water in the Evangeline and Chicot Aquifers

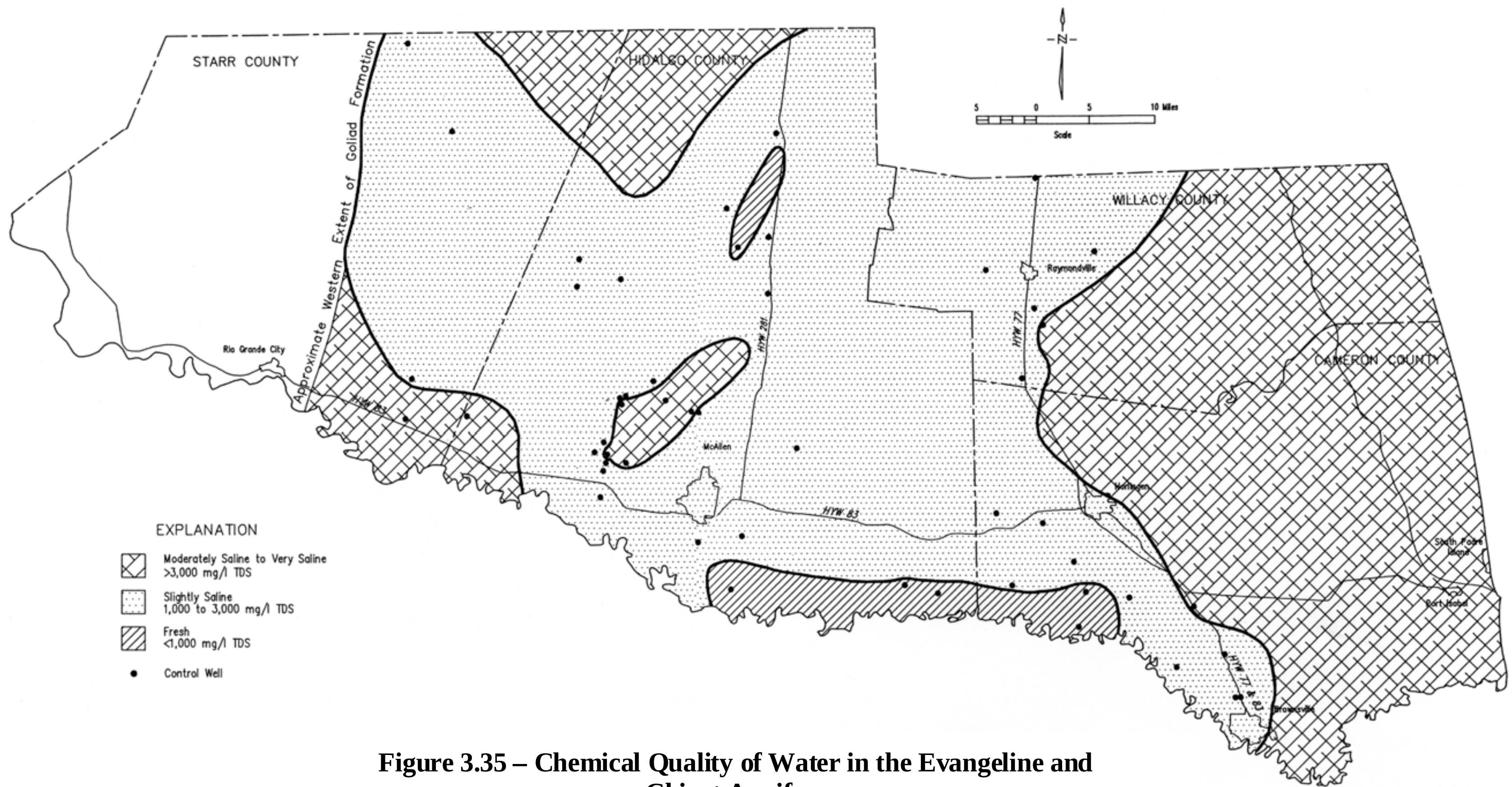

Figure 3.35 – Chemical Quality of Water in the Evangeline and Chicot Aquifers
Source: TWDB

Source: TWDB

Following are summaries of the ground-water quality for specific constituents found in the Gulf Coast Aquifer.

Alpha
Eleven results for dissolved alpha particles exceeded the 15 pCi/L primary MCL in the Carrizo-Wilcox in Region M. Five of these were results from samples collected in the Catahoula Formation: three from wells in Bruni, one from a well in Oilton, and one from a well near Cuevitas. Two results that exceeded the MCL were collected from wells completed in the combined Beaumont Clay, Lissie Formation, and Goliad Sand in southeast Hidalgo County. The remaining four results were collected from wells in the Jasper Formation in Starr County, the Chicot in Cameron County, and the undifferentiated Gulf Coast in Jim Hogg and Cameron Counties. The alpha results are well distributed spatially in the Gulf Coast aquifer group in Region M.

Dissolved alpha particles exceeded the 15 pCi/L primary MCL in the Gulf Coast aquifer group in 17.5% of the results in Region M. The average for all of the results is 10 pCi/L, and the median for all of the results is 6 pCi/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Arsenic
Over one-third of available results for arsenic in the Gulf Coast aquifer group exceeded the 10 mg/L primary MCL. About one-third of the results that exceeded the MCL represented samples collected from wells completed in the Catahoula Formation in Webb, Starr, and Jim Hogg Counties. Several others represented samples collected from wells completed in the alluvium in Starr, Hidalgo, and Cameron Counties.

Samples collected from wells completed in the Lissie Formation, the Goliad Sand, or a combination of the two in Starr, Hidalgo, Willacy, and Jim Hogg Counties accounted for another third of the results that exceeded the secondary MCL for arsenic. The remainder represented groundwater samples from wells in the Chicot (one result), the Evangeline (one result) and the undifferentiated Gulf Coast Aquifer (13 results). All the available results are well distributed spatially in the Gulf Coast aquifer group in Region M.

About 36% of available results for arsenic in the Gulf Coast aquifer group exceeded the 10 µg/L primary MCL. Arsenic was not detected in 32% of the results. The average for all of the results is 17 µg/L, and the median is less than 10 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Table 3-26: Summary of Groundwater Quality for the Gulf Coast Aquifer in the RGWPA

MCL Class	Constituent	Limit(s)	Units	Total Results	% Over Limit	Average	Median	Max	Min
primary	Alpha	15	µg/L	63	17.5%	10	6	74	0.5
primary	Arsenic	10	µg/L	160	36.3%	17	< 10	160	0.5
primary	Barium	2000	µg/L	161	0.0%	54	35	414	4
primary	Cadmium	5	µg/L	100	0.0%	< 1.3	< 1	< 5	< 1
primary	Chromium	100	µg/L	147	0.0%	10	7.4	36.4	< 1
primary	Lead	15	µg/L	119	1.7%	2	< 1	22	< 1
primary	Nitrate (as N)	10	mg/L	788	7.1%	3	0.63	85	0
primary	Selenium	50	µg/L	160	2.5%	12	6	64.7	1.6
secondary[a]	Fluoride	2	mg/L	442	12.4%	1	1	30	0
secondary[a]	Copper	1000	µg/L	160	0.0%	16	10	455	< 1
secondary	Sulfate	300	mg/L	823	56.3%	512	351	6300	6.8
secondary	Chloride	300	mg/L	823	67.6%	702	450	17900	14
secondary	pH	6.5 - 8.5		625	2.6%	7.7	7.6	9.7	6.51
secondary	Total Dissolved Solids	1000	mg/L	822	80.4%	2204	1618	37752	198
secondary	Iron	300	µg/L	218	21.1%	401	51	13600	0
secondary	Manganese	50	µg/L	170	21.2%	97	20	3300	0
advisory[b]	Boron	3750	µg/L	538	19.1%	2520	1700	25200	0

[a]Primary MCLs for fluoride (4 mg/L) and copper (1,300 µg/L) are higher than secondary MCLs.

[b]Advisory level for boron-tolerant crops

Barium

No results for barium exceeded the 2,000 µg/L primary MCL in the Gulf Coast aquifer group in Region M. The available barium results were spatially well distributed within this region and aquifer group. Barium was not detected in any of the results above the 2,000 µg/L primary MCL in the Gulf Coast aquifer group in Region M. Barium was detected in more than 95% of the results, and the average for all of the results is 54 µg/L, and the median is 35 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Cadmium

Cadmium was not detected in any results in the Gulf Coast aquifer group in Region M, and so no results for cadmium exceeded the 5 µg/L primary MCL. The available cadmium results were spatially well distributed within this region and aquifer group.

Most of the cadmium results for Region M were below detection limits, and the indicated color-coded values usually represent the detection limit for the result. There were 46 cadmium results that were below reporting limits that exceeded the current MCL (reporting limits greater than 5 µg/L). These results were not considered useful and were not included the figure or table for this aquifer group in Region M.

Chromium

No results for chromium exceeded the 100 µg/L primary MCL in the Gulf Coast aquifer group in Region M. The available chromium results were spatially well distributed within this region and aquifer group. Chromium was detected in less than 40% of the results, and the average for all of the results is 10 µg/L, and the median is 7.4 µg/L.

Lead
Two results for lead exceeded the 15 µg/L primary MCL in the Gulf Coast aquifer group in Region M. The available lead results were spatially well distributed within this region and aquifer group. There were 40 lead results were below reporting limits that exceeded the current MCL (reporting limits greater than 15 µg/L). These results were not included the figure for this aquifer group in Region M. Lead was detected in only 8% of the results in the Gulf Coast aquifer group in Region M, only two of which exceeded the 15 µg/L primary MCL. The average for all of the results is 2 µg/L, and the median for all of the results is less than 1 µg/L. There were 40 lead results with reporting limits greater than the 15 µg/L primary MCL. These results were not included the statistical calculations.

Nitrate as N
Several formations in the Gulf Coast aquifer group produced samples with nitrate results greater than the 10 mg/L (as N) primary MCL in Region M. These were: the Catahoula in central and northwestern Starr County, the Goliad Sand in northeastern Starr County, the Evangeline in southeastern Starr County, the Lissie and the Goliad Sand in central Hidalgo County near Linn, the generalized Gulf Coast Aquifer in southern Hidalgo County, and the Mercedes-Sebastian Aquifer southwestern Willacy County. With the exceptions of wells completed in the Catahoula and Evangeline formations, most of these results were from samples collected from shallow wells. The nitrate results available from most shallow alluvial wells did not appear elevated, although the most recent results from many of these wells were from samples collected in 1957. The available results were well distributed throughout the Gulf Coast aquifer group in Region M. Nitrate (as N) was detected in 7.1% of the results above the primary MCL of 10 mg/L in the Gulf Coast aquifer group in Region M. The average for all of the results is 3 mg/L, and the median for all of the results is 0.63 mg/L.

Selenium
Four results for lead exceeded the 50 µg/L primary MCL in the Gulf Coast aquifer group in Region M. There was no significant pattern to the results that exceeded the MCL. The available selenium results were spatially well distributed within this region and aquifer group. Selenium was detected above the 100 µg/L primary MCL in 2.5% of the results in the Gulf Coast aquifer group in Region M. Selenium was detected in approximately half of the results, and the average for all of the results is 12 µg/L, and the median is 6 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Copper
No results for copper exceeded the 1,000 μg/L secondary MCL or the 1,300 μg/L primary MCL in the Gulf Coast aquifer group in Region M. The available copper results were spatially well distributed within this region and aquifer group. Copper was detected in approximately half of the results, and the average for all of the results is 16 μg/L, and the median is 10 μg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Fluoride
Most formations in the Gulf Coast aquifer group produced samples with fluoride results greater than the 2 mg/L secondary MCL in the Gulf Coast aquifer group in Region M. These were: the Catahoula, the undifferentiated Gulf Coast Aquifer, Jasper, and Evangeline in central and northwestern Starr County; the Goliad Sand in northeastern Starr County; wells in the alluvium in southeastern Starr County; the Lissie and the Goliad Sand in Hidalgo County; and the undifferentiated Gulf Coast Aquifer in southern Hidalgo and Cameron Counties. There were also 11 results that exceeded the 4 mg/L primary MCL in the Gulf Coast aquifer group. Some extremely high values (11, 22, and 30 mg/L) were collected from wells in the Lissie and Goliad Sand formations in Hidalgo County. Other results exceeding the primary MCL were collected from wells completed in the undifferentiated Gulf Coast Aquifer in Hidalgo and Cameron Counties, and one result from a well completed in the Mercedes-Sebastian Aquifer in southern Willacy County.

Fluoride was detected in 12.4% of the results above the secondary MCL of 2 mg/L in the Gulf Coast aquifer group in Region M. Of these, 2.4% were also above the primary MCL of 4 mg/L. Fluoride was detected in 99% of the results, and the average for all of the results is 1 mg/L, and the median for all of the results is also 1 mg/L.

Chloride
Two-thirds of chloride samples in the Gulf Coast aquifer group in Region M exceeded the 300 mg/L secondary MCL. Two formations produced sample results that were often below the secondary MCL in certain areas: the Catahoula Formation in central Starr County and the undifferentiated Gulf Coast Aquifer in southern Cameron County. The available results were well distributed throughout the Gulf Coast aquifer group in Region M.

Chloride was detected in 67.6% of the results above the secondary MCL of 300 mg/L in the Gulf Coast aquifer group in Region M. The average for all of the results is 702 mg/L, and the median for all of the results is 450 mg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Iron
Approximately 21% of iron results in the Gulf Coast aquifer group in Region M exceeded the 300 μg/L secondary MCL. Formation-area combinations that produced

a significant number of results that exceeded the MCL were those from wells completed in the Rio Grande Alluvium in Hidalgo and Cameron Counties, the undifferentiated Gulf Coast Aquifer in Cameron County, and the Goliad Sand in Willacy County. The available results were well distributed spatially throughout the Gulf Coast aquifer group in Region M.

Iron was detected in 21.1% of the results above the secondary MCL of 300 µg/L in the Gulf Coast aquifer group in Region M. Iron was detected in approximately 65% of the results, and the average for all of the results is 401 µg/L, and the median for all of the results is only 51 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Manganese

Several manganese results exceeded the 50 µg/L secondary MCL in the Gulf Coast aquifer group in Region M. A majority of results from the Rio Grande Alluvium in Hidalgo and Cameron Counties and the undifferentiated Gulf Coast Aquifer in Cameron County exceeded the secondary MCL. The only result available for the Mercedes-Sebastian Aquifer in Willacy County also exceeded the secondary MCL. The available results were well distributed spatially throughout the Gulf Coast aquifer group in Region M.

Manganese was detected in 21.2% of the results above the secondary MCL of 50 µg/L in the Gulf Coast aquifer group in Region M. Manganese was detected in approximately 63% of the results, and the average for all of the results is 97 µg/L, and the median for all of the results is only 20 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

pH

A small number of the available pH results for the Gulf Coast aquifer group in Region M were outside of the 6.5 - 8.5 secondary MCL range. Of these results, all were more alkaline than the 8.5 upper pH limit. Most of these strongly alkaline results were from samples collected from wells completed in the undifferentiated Gulf Coast Aquifer in Cameron County. The available results were well distributed spatially throughout the Gulf Coast aquifer group in Region M. The pH of water samples was outside the secondary MCL range of 6.5 to 8.5 in 2.6% of the results in the Gulf Coast aquifer group in Region M. The range of all of the results was 6.51 to 9.7, and the average is 7.7, and the median is 7.6.

Sulfate

About 56% of sulfate chloride samples in the Gulf Coast aquifer group in Region M exceeded the 300 mg/L secondary MCL. However, several formations produced sample results that were often below the secondary MCL in certain areas: the Catahoula Formation in central Starr County, the Goliad Sand Formation in Jim Hogg and Starr Counties, the Evangeline Aquifer in southeastern Starr County, and the Lissie Formation near Linn in Hidalgo County. The available results were well distributed throughout the Gulf Coast aquifer group in Region M. Sulfate was detected in 56.3% of the results above the secondary MCL of 300 mg/L in the Gulf Coast aquifer group in Region M. The average for all of the results is 512 mg/L, and the median for all of the results is 351 mg/L.

Total Dissolved Solids

Over 80% of TDS results exceeded the 1,000 mg/L secondary MCL in the Gulf Coast aquifer group in Region M. The only formation-county combination in the Gulf Coast-Region M to have a majority of TDS results below the MCL was the Catahoula Formation in Webb County.

The total dissolved solids concentration was above the secondary MCL of 1,000 mg/L in 80.4% of the results in the Gulf Coast aquifer group in Region M. The average for all of the results is 2,204 mg/L, and the median for all of the results is 1,618 mg/L.

Boron

Generally, only wells identified as being completed in the undifferentiated Gulf Coast Aquifer in southern Hidalgo and Cameron Counties had boron concentrations below the 600 µg/L EPA suggested lifetime health advisory level. Most areas and formations also produced samples with boron concentrations above the 1,250 µg/L advisory level for sensitive crops suggested by Leeden, et al. Formation-area combinations that generally produced water above the 3,750 µg/L advisory level for tolerant crops were: the Goliad Sand in Willacy County, the Jasper in Starr County, and the Catahoula in Starr County. The available results were well distributed throughout the Gulf Coast aquifer group in Region M.

Boron was detected in 19.1% of the results above the advisory level for tolerant crops (Leeden et al, 1990) of 3,750 µg/L in the Gulf Coast aquifer group in Region M. The average for all of the results is 2,520 µg/L, and the median for all of the results is 1,700 µg/L.

3.13.2 Carrizo-Wilcox Aquifer

The Carrizo Sand Formation outcrops in a very small area in northwest Webb County and continues north into Dimmit, Zavala, and Maverick counties. It yields moderate to large quantities of fresh to slightly saline water. Groundwater quality and yield decrease with distance from the formation outcrop and are best down gradient of the outcrop in Dimmit and Zavala counties. The water remains fresh into northern Webb County, but yields decline as the formation dips southeastward. In central Webb County, total dissolved solids levels exceed 1,000 mg/L. Water quality and yield data from a few wells in southern and western Webb County suggest that the groundwater becomes more mineralized down-dip as aquifer permeability and yield decline.

The water quality of the Carrizo-Wilcox Aquifer was evaluated using the same approach as was used for the Gulf Coast Aquifer. The results of the detailed analysis are shown in Table 3.27.

Following are summaries of the ground-water quality for specific constituents found in the Carrizo-Wilcox Aquifer.

Alpha

No results for dissolved alpha particles exceeded the 15 pCi/L primary MCL in the Carrizo-Wilcox in Region M. The alpha results available were mostly collected from wells on or near the outcrop of the Carrizo-Wilcox in Region M. The average for all of the results is 6 pCi/L, and the median for all of the results is 4.55 pCi/L.

Arsenic

No results for arsenic exceeded the 10 μg/L primary MCL in the Carrizo-Wilcox in Region M. The arsenic results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Arsenic was detected in only two of the results. The average for all of the results is less than 3 μg/L, and the median is less than 2 μg/L.

Table 3.27: Summary of Groundwater Quality for the Carrizo-Wilcox Aquifer in the RGWPA

MCL Class	Constituent	Limit(s)	Units	Total Results	Results Over Limit	% Over Limit	Average	Median	Max	Min
primary	Arsenic	10	μg/L	13	0	0.0%	< 3	< 2	< 8	1.9
primary	Alpha	15	μg/L	8	0	0.0%	6	4.55	12	< 2
primary	Barium	2000	μg/L	13	0	0.0%	140	79	789	18.3
primary	Cadmium	5	μg/L	12	0	0.0%	< 2	< 1	< 2	< 0.5
primary	Chromium	100	μg/L	13	0	0.0%	13	8.36	98.4	< 1
primary	Lead	15	μg/L	13	0	0.0%	< 3	< 1	< 10	< 1
primary	Nitrate (as N)	10	mg/L	30	0	0.0%	2	0.4	14	0
primary	Selenium	50	μg/L	13	1	7.7%	12	4.01	105	< 4
secondary[a]	Fluoride	2	mg/L	30	1	3.3%	1	0.6	3.5	< 0.05
secondary[a]	Copper	1000	μg/L	14	0	0.0%	19	2.8	216	< 0.05
secondary	Sulfate	300	mg/L	30	4	13.3%	229	157.5	1699	9
secondary	Chloride	300	mg/L	30	5	16.7%	643	128.5	7494	19.1
secondary	pH	6.5 - 8.5		30	3	10.0%	7.7	7.7	8.8	6.31
secondary	Total Dissolved Solids	1000	mg/L	30	5	16.7%	1773	776.5	13596	270
secondary	Iron	300	μg/L	16	1	6.3%	81	50	423	0.09
secondary	Manganese	50	μg/L	14	3	21.4%	35	9.83	212	0.05
advisory[b]	Boron	3750	μg/L	12	1	8.3%	2080	575	19400	135.1

[a]Primary MCLs for fluoride (4 mg/L) and copper (1,300 μg/L) are higher than secondary MCLs.

[b]Advisory level for boron-tolerant crops

Barium
No results for barium exceeded the 2,000 µg/L primary MCL in the Carrizo-Wilcox in Region M. The barium results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Barium was detected in all of the results, and the average for all of the results is 140 µg/L, and the median is 79 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Cadmium
No results for cadmium exceeded the 5 µg/L primary MCL in the Carrizo-Wilcox in Region M. The cadmium results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Most of the cadmium results for Region M were below detection limits, and the indicated color-coded values usually represent the detection limit for the result.

Chromium
No results for chromium exceeded the 100 µg/L primary MCL in the Carrizo-Wilcox in Region M. The chromium results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Chromium was detected in approximately half of the results, and the average for all of the results is 13 µg/L, and the median is 8.36 µg/L.

Lead
No results for lead exceeded the 15 µg/L primary MCL in the Carrizo-Wilcox in Region M. The lead results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M.

Nitrate as N
No results for nitrate exceeded the 10 mg/L (as N) primary MCL in the Carrizo-Wilcox in Region M. The nitrate results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Nitrate (as N) was not detected above the primary MCL of 10 mg/L in any of the results in the Carrizo-Wilcox aquifer in Region M. The average for all of the results is 2 mg/L, and the median for all of the results is 0.4 mg/L.

Selenium
One result for selenium exceeded the 50 µg/L primary MCL in the Carrizo-Wilcox in Region M. This result was from a well in the downdip Carrizo Sand in Webb County. Other results in the Carrizo-Wilcox indicated lower selenium concentrations on the outcrop and shallow downdip areas. Selenium was detected in less than half of the results, and the average for all of the results is 12 µg/L, and the median is 4 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Copper
No results for copper exceeded the 1,000 µg/L secondary MCL or the 1,300 µg/L primary MCL in the Carrizo-Wilcox in Region M. The copper results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. The average for all of the results is 19 µg/L, and the median is 2.8 µg/L, indicating that the average is significantly skewed upward due to the presence of a limited number of high values.

Fluoride
One result for fluoride exceeded the 2 mg/L secondary MCL in the Carrizo-Wilcox in Region M. No results exceeded the 4 mg/L primary MCL for fluoride. The result that exceeded the secondary MCL was from a well in the downdip Carrizo Sand in Webb County. Other results in the Carrizo-Wilcox indicated lower fluoride concentrations on the outcrop and shallow downdip areas.

Chloride
About 17% of available chloride results exceeded the 300 mg/L secondary MCL in the Carrizo-Wilcox in Region M. Most of the results that exceeded the secondary MCL were from samples collected from deep wells completed in the downdip Carrizo Sand. The average for all of the results is 643 mg/L, and the median for all of the results is 128.5 mg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Iron
One iron result exceeded the 300 µg/L secondary MCL in the Carrizo-Wilcox in Region M. This result was from a sample collected from a well in the downdip Carrizo Sand. The iron results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M. Iron was detected in approximately two-thirds of the results, and the average for all of the results is 81 µg/L, and the median for all of the results is only 50 µg/L.

Manganese
Three manganese results from the Carrizo-Wilcox in Region M exceeded the 50 mg/L secondary MCL. No significant pattern was observed in the manganese results. The manganese results available were collected from wells completed in both the outcrop of the Carrizo-Wilcox and downdip in Region M.

Manganese was detected in approximately 80% of the results, and the average for all of the results is 35 µg/L, and the median for all of the results is approximately 10 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

pH
Three pH results were outside of the 6.5 - 8.5 secondary MCL range in Carrizo-Wilcox in Region M. Two of these results were more alkaline than the 8.5 upper limit; one result was more acid than the 6.5 lower limit. The pH results available tended to increase in the downdip wells. The range of all of the results was 6.31 to 8.8, and both the average and median are 7.7.

Sulfate
About 17% of available sulfate results exceeded the 300 mg/L secondary MCL in the Carrizo-Wilcox in Region M. Sulfate results tended to increase in wells located downdip in the Carrizo-Wilcox. The average for all of the results is 229 mg/L, and the median for all of the results is 157.5 mg/L.

Total Dissolved Solids
About 17% of available TDS results exceeded the 1,000 mg/L secondary MCL in the Carrizo-Wilcox in Region M. Like the chloride and sulfate that account for much of Total Dissolved Solis, these results tended to increase in wells located downdip in the Carrizo-Wilcox. The average for all of the results is 1,773 mg/L, and the median for all of the results is 776.5 mg/L.

Boron
Boron concentrations tended to increase with depth in the Carrizo-Wilcox in Region M. All results from the outcrop wells were below the EPA's 600 µg/L suggested lifetime health advisory level for drinking water, while most results from wells in downdip areas exceeded this value. Only one result exceeded either the 1,250 mg/L advisory level for sensitive crops or the 3,750 mg/L advisory level for tolerant crops suggested by Leeden, et al39. The average for all of the results is 2,080 µg/L, and the median for all of the results is 575 µg/L.

3.13.3 Yegua-Jackson Aquifer

The water quality of the Yegua-Jackson aquifer was evaluated using the same approach as was used for the Gulf Coast Aquifer. The results of the detailed analysis are shown in Table 3.28.

Following are summaries of the ground-water quality for specific constituents found in the Yegua-Jackson Aquifer.

Alpha
No results for dissolved alpha particles exceeded the 15 pCi/L primary MCL in the Yegua-Jackson in Region M. The alpha results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Alpha particles were

[39] van der Leeden, F., F.L. Troise and D.K. Todd, 1990, The Water Encyclopedia, Lewis Publishers, 808p.

detected in only one of the results. The average for all of the results is less than 8 pCi/L, and the median for all of the results is less than 4 pCi/L.

Arsenic
One result for arsenic exceeded the 10 μg/L primary MCL in the Yegua-Jackson in Region M. This result was from a sample collected from a well completed in the Jackson Group in southeastern Webb County. The remaining arsenic results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Arsenic was detected in only one result. The average for all of the results is less than 3 μg/L, and the median is less than 2 μg/L.

Barium
No results for barium exceeded the 2,000 μg/L primary MCL in the Yegua-Jackson in Region M. The barium results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Barium was detected in all of the results, and the average for all of the results is 98 μg/L, and the median is 21.85 μg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Cadmium
No results for cadmium exceeded the 5 μg/L primary MCL in the Yegua-Jackson in Region M. The cadmium results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. All of the cadmium results for Region M were below detection limits, and the indicated color-coded values usually represent the detection limit for the result.

Chromium
No results for chromium exceeded the 100 μg/L primary MCL in the Yegua-Jackson in Region M. The chromium results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Chromium was detected in only two of the results. The average for all of the results is less than 6 μg/L, and the median is less than 6 μg/L.

Lead
No results for lead exceeded the 15 μg/L primary MCL in the Yegua-Jackson in Region M, and no lead was detected. The lead results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M.

Table 3.28: Summary of Groundwater Quality for the Yegua-Jackson Aquifer in the RGWPA

MCL Class	Constituent	Limit(s)	Units	Total Results	Results Over Limit	% Over Limit	Average	Median	Max	Min
primary	Arsenic	10	µg/L	9	1	11.1%	< 8	< 4	28.5	< 2
primary	Alpha	15	pg/L	9	0	0.0%	< 4	< 3	5.6	< 2
primary	Barium	2000	µg/L	10	0	0.0%	98	21.85	646	13.2
primary	Cadmium	5	µg/L	10	0	0.0%	< 3	< 2	< 5	< 1
primary	Chromium	100	µg/L	10	0	0.0%	< 6	< 6	10.1	< 1
primary	Lead	15	µg/L	10	0	0.0%	< 4	< 5	< 5	< 1
primary	Nitrate (as N)	10	mg/L	33	2	6.1%	1	0.1	12	0
primary	Selenium	50	µg/L	10	0	0.0%	< 10	< 6	6.9	< 2
secondary[a]	Fluoride	2	mg/L	22	1	4.5%	1	0.44	3.39	< 0.1
secondary[a]	Copper	1000	µg/L	10	0	0.0%	8	7.58	19.8	< 2
secondary	Sulfate	300	mg/L	38	26	68.4%	700	504	2026	1.47
secondary	Chloride	300	mg/L	38	34	89.5%	1477	755	15800	17
secondary	pH	6.5 - 8.5		38	2	5.3%	7.7	7.90	8.8	6.88
secondary	Total Dissolved Solids	1000	mg/L	38	35	92.1%	3746	2607	25930	502
secondary	Iron	300	µg/L	14	4	28.6%	666	159	4240	10
secondary	Manganese	50	µg/L	10	1	10.0%	29	19.95	121	5.01
advisory[b]	Boron	3750	µg/L	26	8	30.8%	4278	2350	15000	0.062

[a]Primary MCLs for fluoride (4 mg/L) and copper (1,300 µg/L) are higher than secondary MCLs.

[b]Advisory level for boron-tolerant crops

Nitrate as N

Two results for nitrate exceeded the 10 mg/L (as N) primary MCL in the Yegua-Jackson in Region M. These results were from samples collected from two shallow wells completed in the Jackson Group in Starr County. Deeper wells in the Jackson Group in this area had much lower nitrate results. The nitrate results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Nitrate (as N) was detected above the primary MCL of 10 mg/L in 6.1% of the results in the Yegua-Jackson aquifer in Region M. The average for all of the results is 1 mg/L, and the median for all of the results is 0.1 mg/L.

Selenium

No results for selenium exceeded the 50 µg/L primary MCL in the Yegua-Jackson in Region M. The selenium results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M.

Selenium was detected in only one of the results. The average for all of the results is less than 10 µg/L, and the median is less than 6 µg/L.

Copper

No results for copper exceeded the 1,000 µg/L secondary MCL or the 1,300 µg/L primary MCL in the Yegua-Jackson in Region M. The copper results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. The average for all of the results is 8 µg/L, and the median is 7.58 µg/L.

Fluoride

One result for fluoride exceeded the 2 mg/L secondary MCL in the Yegua-Jackson in Region M. This result was from a sample collected from a well completed in the Yegua Formation in southeastern Webb County. No fluoride results exceeded the 4 mg/L primary MCL. The remaining fluoride results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Fluoride was detected in only one of the results, and the average for all of the results is 1 mg/L, and the median for all of the results is 0.44 mg/L.

Chloride

Almost all the chloride results exceeded the 300 mg/L secondary MCL in Region M. The results that were less than the secondary MCL tended to be from the few wells less than 200 feet deep. Most of the available results represented the southern Yegua-Jackson in Region M. Chloride was detected in 89.5% of the results above the secondary MCL of 300 mg/L in the Yegua-Jackson aquifer in Region M. The average for all of the results is 1,477 mg/L, and the median for all of the results is 755 mg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Iron

Four results for iron exceeded the 300 µg/L secondary MCL in the Yegua-Jackson in Region M. Approximately half of the results available in both the Yegua Formation and the Jackson Group appear elevated with respect to iron. The iron results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Iron was detected above the secondary MCL of 300 µg/L in 28.6% of the results in the Yegua-Jackson aquifer in Region M. Iron was detected in nearly all of the results, and the average for all of the results is 666 µg/L, and the median for all of the results is 159 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Manganese

One result for manganese exceeded the 50 µg/L secondary MCL in the Yegua-Jackson in Region M. No significant pattern was observed in the manganese results in this aquifer group in Region M. The manganese results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Manganese was detected in 10% of the results above the secondary MCL of 50 µg/L in the Yegua-Jackson aquifer in Region M. Manganese was detected in all of the results, and the average for all of the results is 29 µg/L, and the median for all of the results is 19.95 µg/L.

pH

Two pH results were outside of the secondary MCL range of 6.5 to 8.5 in the Yegua-Jackson in Region M. Both of these were more alkaline than the secondary MCL. No significant pattern was observed in the pH results in this aquifer group in

Region M. The pH results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M.

The pH of water samples was outside the secondary MCL range of 6.5 to 8.5 in 5.3% of the results in the Yegua-Jackson aquifer in Region M. The range of all of the results was 6.88 to 8.8. The average pH was 7.7, and the median pH was 7.90.

Sulfate
Over two-thirds of sulfate results exceeded the 300 mg/L secondary MCL. Almost all samples collected from wells in the Yegua Formation exceeded the MCL, and about half of samples collected from wells in the Jackson Group exceeded the MCL. The results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Sulfate was detected in 68.4% of the results above the secondary MCL of 300 mg/L in the Yegua-Jackson aquifer in Region M. The average for all of the results is 700 mg/L, and the median for all of the results is 504 mg/L.

Total Dissolved Solids
About 92% of TDS results exceeded the 1,000 mg/L secondary MCL. No significant spatial trends were observed in the TDS results. The results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. The total dissolved solids concentration was above the secondary MCL of 1,000 mg/L in 92.1% of the results in the Yegua-Jackson aquifer in Region M. The average for all of the results is 3,746 mg/L, and the median for all of the results is 2,607 mg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

Boron
Almost all Yegua-Jackson boron results were above the 600 µg/L EPA suggested lifetime health advisory level. Most areas and formations also produced samples with boron concentrations above the 1,250 µg/L advisory level for sensitive crops suggested by Leeden, et al. About one-quarter of results were above the 3,750 µg/L advisory level for tolerant crops. No spatial or geological pattern was observed in these results. The results available were mostly collected from wells on the southern end of the Yegua-Jackson in Region M. Boron was detected above the advisory level for tolerant crops (Leeden et al, 1990) of 3,750 µg/L in only one of the results in the Yegua-Jackson aquifer in Region M. The average for all of the results is 4,278 µg/L, and the median for all of the results is 2,350 µg/L, indicating that the average is skewed upward due to the presence of a limited number of high values.

3.13.4 Other Aquifers

The Catahoula Formation has a very narrow outcrop area in southeast Webb County that extends northeast into Duval County. It yields small amounts of highly mineralized water at the outcrop, and moderate quantities of fresh to slightly saline water at confined depths in southeast Webb County. Water quality is a concern in this formation due to the presence of arsenic and other metals in concentrations exceeding the limits for potable water. The Jackson Group has a substantial outcrop area in Webb County, but it is also a minor aquifer. It yields variable amounts of slightly to highly saline water. The Yegua Formation outcrops across Webb and La Salle counties. It is often ferruginous (iron bearing) and yields small to moderate quantities of slightly to moderately saline water.

The Laredo Formation yields small to moderate quantities of fresh to slightly saline water to wells in Webb County and also outcrops across Webb and La Salle counties. The El Pico Clay outcrops in Webb, Dimmit, and Zavala counties, but yields only small amounts of highly mineralized water. The Bigford Formation is a minor aquifer that outcrops in northwestern Webb County and to the north-northeast through Dimmit County. Groundwater from wells in the Bigford Formation is usually highly mineralized.

3.13.4.1 Rio Grande Alluvium

The material composing the Rio Grande alluvium is highly variable from one location to another. The alluvium has generally been divided into three layers or zones: shallow (less than 75 feet), middle (75 to 150 feet), and deep (150 to 225 feet). Yields are generally higher in the deeper zone and closer to the river. Recharge is primarily through interaction with the river, with some surface recharge. Water levels have generally been stable. There is currently additional research being done by the TWDB to further identify the thickness and properties of this groundwater source.

Water quality data is assigned to one of three zones defined by depth: shallow (50-100 feet below the land surface), middle (100 to 300 feet below the land surface) and lower (more than 300 feet below the land surface) for the Lower Rio Grande Valley aquifer (now referred to as the Gulf Coast aquifer).

<u>Shallow Zone</u> - In the area near Mission, the shallow zone is characterized by highly mineralized water that is unsuitable for most uses, except for the southern portion near the Rio Grande. Water samples taken in 1983 from some of the shallow zone wells revealed excessive levels of nitrate. In Cameron County, the shallow zone (depths less than 75 feet) was found to produce limited amounts of very poor quality ground water with dissolved solids ranging from 1,170 to 37,800 mg/L.

<u>Middle Zone</u> - Water samples from the middle zone indicate fresh to slightly saline water, with about 25 percent of the wells sampled also containing excessive nitrate levels in the area near Mission. The middle zone is not considered suitable for irrigation purposes due to its high salinity and sodium (alkali) hazards. Water drawn from this zone has yielded concentrations of

dissolved solids and chlorides that appear to increase to the east and southeast in the range of 1,180 to 13,450 mg/L. Water quality data reported for wells in the area just west of Brownsville suggest that the middle zone may be in direct hydraulic contact with the shallow zone as indicated by high mineral concentrations.

Lower Zone - The lower zone is considered to contain better water quality than the other two zones. Water samples have indicated fresh to slightly saline water with nitrate levels found to be within safe limits (<45 mg/L). Nevertheless, this zone is generally considered not to be suitable for irrigation due to its high salinity and sodium (alkali) hazards. A few deep wells have produced groundwater of relatively good quality in an area north of the City of Brownsville along the Rio Grande. From there, the salinity of ground water produced from the deep zone increases steadily toward the southeast, east, northeast, and north, especially in the concentrations of sodium, sulfate, chloride, and dissolved solids.

3.13.4.2 Laredo Formation

The Laredo formation yields small to moderate quantities of fresh to slightly saline water to wells in Webb County. The total dissolved solids concentrations range from 1,000 to 3,000 mg/L. This formation has been identified as one of the potential alternative groundwater supply sources for the City of Laredo.

ATTACHMENT 3-1

WATER USER GROUP SUPPLIES

WATER USER GROUPS	RIVER BASIN	WATER SOURCE	2010	2020	2030	2040	2050	2060
CAMERON COUNTY								
BROWNSVILLE	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	29,060	29,060	29,060	29,060	29,060	29,060
	NUECES-RIO GRANDE	GULF COAST AQUIFER	7,800	7,800	7,800	7,800	7,800	7,800
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	226	226	226	225	226	225
TOTAL			37,086	37,086	37,086	37,085	37,086	37,085
COMBES	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	430	430	430	430	430	430
TOTAL			430	430	430	430	430	430
COUNTY-OTHER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	13,082	13,069	13,056	13,046	13,037	13,030
	NUECES-RIO GRANDE	GULF COAST AQUIFER	2,519	2,478	2,439	2,396	2,354	2,311
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	8	9	12	13	15	17
	RIO GRANDE	GULF COAST AQUIFER	5	5	4	4	4	4
TOTAL			15,614	15,561	15,511	15,459	15,410	15,362
EAST RIO HONDO WSC	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	5,046	5,046	5,046	5,046	5,046	5,046
TOTAL			5,046	5,046	5,046	5,046	5,046	5,046
EL JARDIN	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,590	1,590	1,590	1,590	1,590	1,590
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	10	10	10	10	10	10
TOTAL			1,600	1,600	1,600	1,600	1,600	1,600
HARLINGEN	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	16,621	16,621	16,621	16,621	16,621	16,621
TOTAL			16,621	16,621	16,621	16,621	16,621	16,621
INDIAN LAKE	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	31	31	31	31	31	31
TOTAL			31	31	31	31	31	31

IRRIGATION	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	212,340	210,224	208,259	206,295	204,330	202,516
	NUECES-RIO GRANDE	GULF COAST AQUIFER	6,673	6,673	6,673	6,673	6,673	6,673
	NUECES-RIO GRANDE	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	2,610	2,610	2,610	2,610	2,610	2,610
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	10,220	10,118	10,023	9,929	9,834	9,747
	RIO GRANDE	DIRECT REUSE	239	239	239	239	239	239
TOTAL			232,082	229,864	227,804	225,746	223,686	221,785
LA FERIA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	2,400	2,400	2,400	2,400	2,400	2,400
TOTAL			2,400	2,400	2,400	2,400	2,400	2,400
LAGUNA MADRE WD	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,948	3,948	3,948	3,948	3,948	3,948
TOTAL			3,948	3,948	3,948	3,948	3,948	3,948
LAGUNA VISTA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,022	1,022	1,022	1,022	1,022	1,022
TOTAL			1,022	1,022	1,022	1,022	1,022	1,022
LIVESTOCK	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,048	1,048	1,048	1,048	1,048	1,048
	RIO GRANDE	GULF COAST AQUIFER	55	55	55	55	55	55
TOTAL			1,103	1,103	1,103	1,103	1,103	1,103
LOS FRESNOS	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,102	1,102	1,102	1,102	1,102	1,102
TOTAL			1,102	1,102	1,102	1,102	1,102	1,102
LOS INDIOS	NUECES-RIO GRANDE	GULF COAST AQUIFER	230	271	311	354	396	439
TOTAL			230	271	311	354	396	439
MANUFACTURING	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	20	20	20	20	20	20
	NUECES-RIO GRANDE	DIRECT REUSE	2,240	2,240	2,240	2,240	2,240	2,240
TOTAL			2,260	2,260	2,260	2,260	2,260	2,260
MILITARY HIGHWAY WSC	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,455	1,610	1,597	1,610	1,561	1,518
	RIO GRANDE	GULF COAST AQUIFER	21	25	29	33	31	29
TOTAL			1,476	1,635	1,626	1,643	1,592	1,547

MINING	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	4	4	4	4	4	4
	NUECES-RIO GRANDE	GULF COAST AQUIFER	8	8	8	8	8	8
TOTAL			12	12	12	12	12	12
OLMITO WSC	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	996	996	996	996	996	996
TOTAL			996	996	996	996	996	996
PALM VALLEY	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	331	331	331	331	331	331
TOTAL			331	331	331	331	331	331
PALM VALLEY ESTATES UD	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	81	94	104	112	119	125
TOTAL			81	94	104	112	119	125
PORT ISABEL	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	756	756	756	756	756	756
TOTAL			756	756	756	756	756	756
PRIMERA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	400	400	400	400	400	400
TOTAL			400	400	400	400	400	400
RANCHO VIEJO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	242	322	408	491	577	659
	NUECES-RIO GRANDE	GULF COAST AQUIFER	355	355	355	355	355	355
TOTAL			597	677	763	846	932	1,014
RIO HONDO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	890	890	890	890	890	890
TOTAL			890	890	890	890	890	890
SAN BENITO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	7,032	7,032	7,032	7,032	7,032	7,032
TOTAL			7,032	7,032	7,032	7,032	7,032	7,032
SANTA ROSA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	900	900	900	900	900	900
TOTAL			900	900	900	900	900	900
SOUTH PADRE ISLAND	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,754	1,754	1,754	1,754	1,754	1,754
TOTAL			1,754	1,754	1,754	1,754	1,754	1,754

STEAM ELECTRIC POWER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	2,400	2,400	2,400	2,400	2,400	2,400
TOTAL			2,400	2,400	2,400	2,400	2,400	2,400
VALLEY MUD #2	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	561	493	420	349	275	204
	NUECES-RIO GRANDE	GULF COAST AQUIFER	302	265	226	188	148	110
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	95	83	70	58	46	35
	RIO GRANDE	GULF COAST AQUIFER	51	45	38	32	25	19
TOTAL			1,009	886	754	627	494	368
CAMERON COUNTY TOTAL			**339,209**	**337,108**	**334,993**	**332,906**	**330,749**	**328,759**
HIDALGO COUNTY								
ALAMO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,917	1,917	1,917	1,917	1,917	1,917
	NUECES-RIO GRANDE	GULF COAST AQUIFER	343	343	343	343	343	343
TOTAL			2,260	2,260	2,260	2,260	2,260	2,260
ALTON	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,346	4,153	2,615	2,637	2,653	2,666
TOTAL			3,346	4,153	2,615	2,637	2,653	2,666
COUNTY-OTHER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	8,780	8,714	8,612	8,515	8,418	8,327
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,589	1,447	1,299	1,131	939	743
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	512	459	453	448	443	438
	RIO GRANDE	GULF COAST AQUIFER	93	86	78	68	57	45
TOTAL			10,974	10,706	10,442	10,162	9,857	9,553
DONNA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	4,190	4,190	4,190	4,190	4,190	4,190
TOTAL			4,190	4,190	4,190	4,190	4,190	4,190

EDCOUCH	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	411	411	411	411	411	411
TOTAL			411	411	411	411	411	411
EDINBURG	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	7,981	7,981	7,981	7,981	7,981	7,981
	NUECES-RIO GRANDE	DIRECT REUSE	7,462	7,462	7,462	7,462	7,462	7,462
TOTAL			15,443	15,443	15,443	15,443	15,443	15,443
ELSA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,840	1,840	1,840	1,840	1,840	1,840
TOTAL			1,840	1,840	1,840	1,840	1,840	1,840
HIDALGO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	13	13	13	13	13	13
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,651	1,651	1,636	1,625	1,625	1,625
	RIO GRANDE	GULF COAST AQUIFER	42	42	57	68	68	68
TOTAL			1,706	1,706	1,706	1,706	1,706	1,706
HIDALGO COUNTY MUD #1	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	573	573	573	573	573	573
TOTAL			573	573	573	573	573	573
IRRIGATION	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	357,532	353,969	350,661	347,353	344,045	340,991
	NUECES-RIO GRANDE	DIRECT REUSE	4,288	4,288	4,288	4,288	4,288	4,288
	NUECES-RIO GRANDE	GULF COAST AQUIFER	19,383	19,383	19,383	19,383	19,383	19,383
	NUECES-RIO GRANDE	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	79	79	79	79	79	79
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	2,905	2,877	2,850	2,823	2,796	2,771
	RIO GRANDE	DIRECT REUSE	4,288	4,288	4,288	4,288	4,288	4,288
	RIO GRANDE	GULF COAST AQUIFER	1,020	1,020	1,020	1,020	1,020	1,020
TOTAL			389,495	385,904	382,569	379,234	375,899	372,820

LA JOYA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	360	360	360	360	360	360
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	152	152	152	152	152	152
TOTAL			512	512	512	512	512	512
LA VILLA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	500	500	500	500	500	500
TOTAL			500	500	500	500	500	500
LIVESTOCK	NUECES-RIO GRANDE	GULF COAST AQUIFER	647	647	647	647	647	647
	RIO GRANDE	GULF COAST AQUIFER	34	34	34	34	34	34
TOTAL			681	681	681	681	681	681
MANUFACTURING	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,240	3,240	3,240	3,240	3,240	3,240
	NUECES-RIO GRANDE	GULF COAST AQUIFER	908	908	908	908	908	908
TOTAL			4,148	4,148	4,148	4,148	4,148	4,148
MCALLEN	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	32,424	32,424	32,424	32,424	32,424	32,424
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	4	4	4	4	4	4
TOTAL			32,428	32,428	32,428	32,428	32,428	32,428
MERCEDES	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,595	3,595	3,595	3,595	3,595	3,595
	NUECES-RIO GRANDE	OTHER AQUIFER	1,691	1,691	1,691	1,691	1,691	1,691
TOTAL			5,286	5,286	5,286	5,286	5,286	5,286
MILITARY HIGHWAY WSC	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,325	1,382	1,309	1,200	1,128	1,063
	RIO GRANDE	GULF COAST AQUIFER	13	15	17	20	19	17
TOTAL			1,338	1,397	1,326	1,220	1,147	1,080
MINING	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	183	182	181	179	177	175
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,291	1,398	1,462	1,526	1,589	1,644
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	23	22	21	21	21	20
	RIO GRANDE	GULF COAST AQUIFER	151	163	171	178	185	192
TOTAL			1,648	1,765	1,835	1,904	1,972	2,031

MISSION	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	9,595	9,595	9,595	9,595	9,595	9,595
TOTAL			9,595	9,595	9,595	9,595	9,595	9,595
NORTH ALAMO WSC	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	19,400	19,520	19,627	19,728	19,831	19,927
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,258	1,265	1,272	1,279	1,286	1,292
TOTAL			20,658	20,785	20,899	21,007	21,117	21,219
PALMHURST	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,157	1,789	2,706	2,967	3,170	3,324
TOTAL			1,157	1,789	2,706	2,967	3,170	3,324
PALMVIEW	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	869	1,199	1,570	1,967	1,967	1,967
TOTAL			869	1,199	1,570	1,967	1,967	1,967
PENITAS	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	162	163	163	164	164	164
TOTAL			162	163	163	164	164	164
PHARR	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	8,676	8,676	8,676	8,676	8,676	8,676
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,120	1,120	1,120	1,120	1,120	1,120
TOTAL			9,796	9,796	9,796	9,796	9,796	9,796
PROGRESO	NUECES-RIO GRANDE	GULF COAST AQUIFER	576	717	867	1,037	1,234	1,436
TOTAL			576	717	867	1,037	1,234	1,436
SAN JUAN	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,023	3,023	3,023	3,023	3,023	3,023
TOTAL			3,023	3,023	3,023	3,023	3,023	3,023
SHARYLAND WSC	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	6,517	5,078	5,698	5,416	5,196	5,030
TOTAL			6,517	5,078	5,698	5,416	5,196	5,030
STEAM ELECTRIC POWER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	5,941	5,941	5,941	5,941	5,941	5,941
	NUECES-RIO GRANDE	DIRECT REUSE	5,040	5,040	5,040	5,040	5,040	5,040
	NUECES-RIO GRANDE	GULF COAST AQUIFER	1,190	1,190	1,190	1,190	1,190	1,190
TOTAL			12,171	12,171	12,171	12,171	12,171	12,171

SULLIVAN CITY	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	685	858	1,029	1,029	1,029	1,029
TOTAL			685	858	1,029	1,029	1,029	1,029
WESLACO	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	5,976	5,976	5,976	5,976	5,976	5,976
	NUECES-RIO GRANDE	GULF COAST AQUIFER	968	968	968	968	968	968
TOTAL			6,944	6,944	6,944	6,944	6,944	6,944
HIDALGO COUNTY TOTAL			**548,932**	**546,021**	**543,226**	**540,251**	**536,912**	**533,826**
JIM HOGG COUNTY								
COUNTY-OTHER	RIO GRANDE	GULF COAST AQUIFER	9	9	9	9	9	9
	NUECES-RIO GRANDE	GULF COAST AQUIFER	77	77	77	77	77	77
TOTAL			86	86	86	86	86	86
HEBBRONVILLE	NUECES-RIO GRANDE	GULF COAST AQUIFER	900	900	900	900	900	900
TOTAL			900	900	900	900	900	900
IRRIGATION	NUECES-RIO GRANDE	GULF COAST AQUIFER	817	817	817	817	817	817
TOTAL			817	817	817	817	817	817
LIVESTOCK	NUECES-RIO GRANDE	GULF COAST AQUIFER	383	383	383	383	383	383
	RIO GRANDE	GULF COAST AQUIFER	135	135	135	135	135	135
TOTAL			518	518	518	518	518	518
MINING	NUECES-RIO GRANDE	GULF COAST AQUIFER	41	41	41	41	41	41
TOTAL			41	41	41	41	41	41
JIM HOGG COUNTY TOTAL			**2,362**	**2,362**	**2,362**	**2,362**	**2,362**	**2,362**

MAVERICK COUNTY								
COUNTY-OTHER	NUECES	CARRIZO-WILCOX AQUIFER	1	1	1	1	1	1
	NUECES	OTHER AQUIFER	44	88	129	165	198	224
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	2,174	2,174	2,174	2,174	2,174	2,174
	RIO GRANDE	CARRIZO-WILCOX AQUIFER	267	267	267	267	267	267
	RIO GRANDE	OTHER AQUIFER	214	170	129	93	60	34
TOTAL			2,700	2,700	2,700	2,700	2,700	2,700
EAGLE PASS	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	7,414	7,414	7,414	7,414	7,414	7,414
TOTAL			7,414	7,414	7,414	7,414	7,414	7,414
EL INDIO WSC	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,253	1,567	1,855	2,108	2,335	2,530
TOTAL			1,253	1,567	1,855	2,108	2,335	2,530
IRRIGATION	NUECES	CARRIZO-WILCOX AQUIFER	729	729	729	729	729	729
	NUECES	OTHER AQUIFER	4,224	4,224	4,224	4,224	4,224	4,224
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	53,755	53,219	52,722	52,224	51,727	51,268
	RIO GRANDE	CARRIZO-WILCOX AQUIFER	635	635	635	635	635	635
	RIO GRANDE	DIRECT REUSE	0	0	0	0	0	0
	RIO GRANDE	OTHER AQUIFER	28	28	28	28	28	28
	RIO GRANDE	RIO GRANDE RUN-OF-RIVER	243	243	243	243	243	243
TOTAL			59,614	59,078	58,581	58,083	57,586	57,127
LIVESTOCK	NUECES	CARRIZO-WILCOX AQUIFER	1	1	1	1	1	1
	NUECES	LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
	NUECES	OTHER AQUIFER	103	103	103	103	103	103
	RIO GRANDE	CARRIZO-WILCOX AQUIFER	80	80	80	80	80	80
	RIO GRANDE	LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
	RIO GRANDE	OTHER AQUIFER	76	76	76	76	76	76
TOTAL			260	260	260	260	260	260
MANUFACTURING	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	114	114	114	114	114	114
TOTAL			114	114	114	114	114	114

MINING	NUECES	CARRIZO-WILCOX AQUIFER	55	57	59	60	61	62
	NUECES	OTHER AQUIFER	53	55	56	57	58	59
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	35	35	34	34	34	33
	RIO GRANDE	CARRIZO-WILCOX AQUIFER	24	26	26	27	27	28
	RIO GRANDE	OTHER AQUIFER	24	25	25	25	26	26
TOTAL			191	198	200	203	206	208
MAVERICK COUNTY TOTAL			**71,546**	**71,331**	**71,124**	**70,882**	**70,615**	**70,353**
STARR COUNTY								
COUNTY-OTHER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	30	30	30	30	30	30
	NUECES-RIO GRANDE	GULF COAST AQUIFER	275	403	533	656	748	748
	NUECES-RIO GRANDE	OTHER AQUIFER	3	3	3	3	3	3
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	751	751	751	751	751	751
	RIO GRANDE	GULF COAST AQUIFER	547	494	401	321	220	144
TOTAL			1,606	1,681	1,718	1,761	1,752	1,676
IRRIGATION	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	15,773	15,616	15,470	15,324	15,178	15,043
	RIO GRANDE	GULF COAST AQUIFER	756	756	756	756	756	756
	RIO GRANDE	OTHER AQUIFER	5,839	5,839	5,839	5,839	5,839	5,839
TOTAL			22,368	22,211	22,065	21,919	21,773	21,638
LA GRULLA	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	522	522	522	522	522	522
TOTAL			522	522	522	522	522	522
LIVESTOCK	NUECES-RIO GRANDE	GULF COAST AQUIFER	224	224	224	224	224	224
	NUECES-RIO GRANDE	OTHER AQUIFER	22	22	22	22	22	22
	RIO GRANDE	GULF COAST AQUIFER	793	793	793	793	793	793
	RIO GRANDE	OTHER AQUIFER	78	78	78	78	78	78
TOTAL			1,117	1,117	1,117	1,117	1,117	1,117

MANUFACTURING	RIO GRANDE	OTHER AQUIFER	28	31	34	37	39	42
TOTAL			28	31	34	37	39	42
MINING	NUECES	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	226	224	222	220	218	216
	NUECES	CARRIZO-WILCOX AQUIFER	360	357	356	356	355	354
	NUECES	GULF COAST AQUIFER	126	124	124	124	124	123
	NUECES	OTHER AQUIFER	60	60	59	59	59	59
	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	311	308	305	302	299	297
	NUECES-RIO GRANDE	GULF COAST AQUIFER	96	95	95	95	95	94
	NUECES-RIO GRANDE	OTHER AQUIFER	46	46	46	45	45	45
	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	110	109	108	107	106	104
	RIO GRANDE	CARRIZO-WILCOX AQUIFER	158	156	156	155	155	154
	RIO GRANDE	GULF COAST AQUIFER	55	54	54	54	54	54
	RIO GRANDE	OTHER AQUIFER	26	26	26	26	26	26
TOTAL			1,574	1,559	1,551	1,543	1,536	1,526
RIO BRAVO	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,234	1,205	1,188	1,177	1,169	1,164
TOTAL			1,234	1,205	1,188	1,177	1,169	1,164
STEAM ELECTRIC POWER	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,645	1,645	1,645	1,645	1,645	1,645
TOTAL			1,645	1,645	1,645	1,645	1,645	1,645
WEBB COUNTY WATER UTILITY	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	197	196	196	196	196	196
TOTAL			197	196	196	196	196	196
WEBB COUNTY TOTAL			**68,437**	**71,267**	**73,480**	**73,953**	**73,850**	**73,757**
WILLACY COUNTY								
COUNTY-OTHER	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	698	579	471	370	267	267
TOTAL			698	579	471	370	267	267

IRRIGATION	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	34,257	33,915	33,598	33,281	32,964	32,672
	NUECES-RIO GRANDE	NUECES-RIO GRANDE RIVER COMBINED RUN-OF-RIVER	899	899	899	899	899	899
TOTAL			35,156	34,814	34,497	34,180	33,863	33,571
LIVESTOCK	NUECES-RIO GRANDE	GULF COAST AQUIFER	151	151	151	151	151	151
TOTAL			151	151	151	151	151	151
LYFORD	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	980	980	980	980	980	980
TOTAL			980	980	980	980	980	980
MINING	NUECES-RIO GRANDE	GULF COAST AQUIFER	6	6	6	6	6	6
TOTAL			6	6	6	6	6	6
NORTH ALAMO WSC	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,217	1,098	991	889	786	690
	NUECES-RIO GRANDE	GULF COAST AQUIFER	79	71	64	58	51	51
TOTAL			1,296	1,169	1,055	947	837	741
RAYMONDVILLE	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	5,670	5,670	5,670	5,670	5,670	5,670
TOTAL			5,670	5,670	5,670	5,670	5,670	5,670
SAN PERLITA	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	120	120	120	120	120	120
TOTAL			120	120	120	120	120	120
SEBASTIAN MUD	NUECES-RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	300	300	300	300	300	300
TOTAL			300	300	300	300	300	300
WILLACY COUNTY TOTAL			**44,377**	**43,789**	**43,250**	**42,724**	**42,194**	**41,806**
ZAPATA COUNTY								
COUNTY-OTHER	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	661	661	661	661	661	661
TOTAL			661	661	661	661	661	661
IRRIGATION	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	3,960	3,920	3,884	3,847	3,810	3,776
TOTAL			3,960	3,920	3,884	3,847	3,810	3,776

LIVESTOCK	RIO GRANDE	OTHER AQUIFER	474	474	474	474	474	474
TOTAL			474	474	474	474	474	474
MINING	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	134	132	131	130	129	127
TOTAL			134	132	131	130	129	127
ZAPATA	RIO GRANDE	AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	1,905	1,905	1,905	1,905	1,905	1,905
TOTAL			1,905	1,905	1,905	1,905	1,905	1,905
ZAPATA COUNTY TOTAL			**7,134**	**7,092**	**7,055**	**7,017**	**6,979**	**6,943**
REGION M TOTAL			**1,114,576**	**1,111,507**	**1,107,936**	**1,102,455**	**1,095,883**	**1,089,835**

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CHAPTER 4.0 : IDENTIFICATION, EVALAUTION, & SELECTION OF WATER MANAGEMENT STRATEGIES BASED ON NEEDS

In accordance with the Regional Planning Guidelines as indicated in Exhibit B 4.2.6, "All potential WMSs shall be included for and those selected as final recommendations should be annotated as such. The Planning Group shall evaluate potentially feasible WMSs for each WUG when future water supply needs are known to exist."

The primary emphasis of the regional water supply planning process established by Senate Bill (SB) 1 is the identification of current and future water needs and the development of strategies for meeting those needs. This chapter presents the results of the evaluation of various water management strategies; a conceptual framework and overview of the water management strategies recommended for implementation within the Rio Grande Region; and specific recommendations to meet the identified water supply shortages of individual water user groups (WUGs).

4.1 TWDB GUIDELINES FOR PREPARATION OF REGIONAL WATER PLANS

By rule, the Texas Water Development Board (TWDB) has set forth specific requirements for the preparation of regional water plans (31 Texas Administrative Code, Chapter 357). With regard to recommendations for meeting identified water supply needs, the regional water plans are to include:

- Specific recommendations for meeting near-terms needs (2010-2040) in sufficient detail to allow the TWDB and the Texas Natural Resource Conservation Commission (TCEQ) to make financial assistance or regulatory decisions with regard to the consistency of the proposed action with approved regional water plan.
- Specific recommendations or alternative scenarios for meeting long-term needs (2040-2060).

It should be noted, however, that TWDB rules provide that a regional water plan may also identify water needs for which no water management strategy is feasible, provided applicable strategies are evaluated and reasons are given as to why no strategies are feasible. For the Rio Grande Region, there are no feasible strategies for meeting a portion of the projected irrigation shortages. This will be explained in detail in subsequent sections of this chapter.

According to TWDB rules, potentially feasible water management strategies are to be evaluated by considering:

- The quantity, reliability, and cost of water delivered and treated for the end user's requirements;
- Environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico;

- Impacts on other water resources of the state, including other water management strategies and groundwater surface water interrelationships;
- Impacts of water management strategies on threats to agricultural and natural resources;
- Any other factors deemed relevant by the regional water planning group, including recreational impacts;
- Equitable comparison and consistent application of all water management strategies the regional water planning group determined to be potentially feasible for each water supply need;
- Consideration of the provisions in Texas Water Code, Section 11.085(k)(1) for interbasin transfers; and
- Consideration of third party social and economic impacts resulting from voluntary redistributions of water.

In January 2000, the Rio Grande RWPG adopted a two-tiered approach to the evaluation of water management strategies. The first tier of criteria focused on the estimated water supply yield, cost, and environmental impact of each water management strategy. According to TWDB guidelines, yield is the quantity of water that is available from a particular strategy under drought-of-record hydrologic conditions. The cost of implementing a strategy includes the estimated capital or construction costs, total annual cost, and the unit cost expressed as dollars per acre-foot of yield. As indicated, cost estimates include the cost of water delivered and treated for end-user requirements. For example, water supplied to a municipal water user would typically include costs for diversion and delivery, as well as capital and O&M costs for treatment to meet current state and federal drinking water standards and distribution to the end user. Cost estimates were prepared in consideration of TWDB guidelines regarding interest rates, debt service, other project costs (e.g., environmental studies, permitting, and mitigation). In addition to environmental considerations that are included in estimates of cost for each strategy, environmental impacts were considered and assessed at a reconnaissance level.

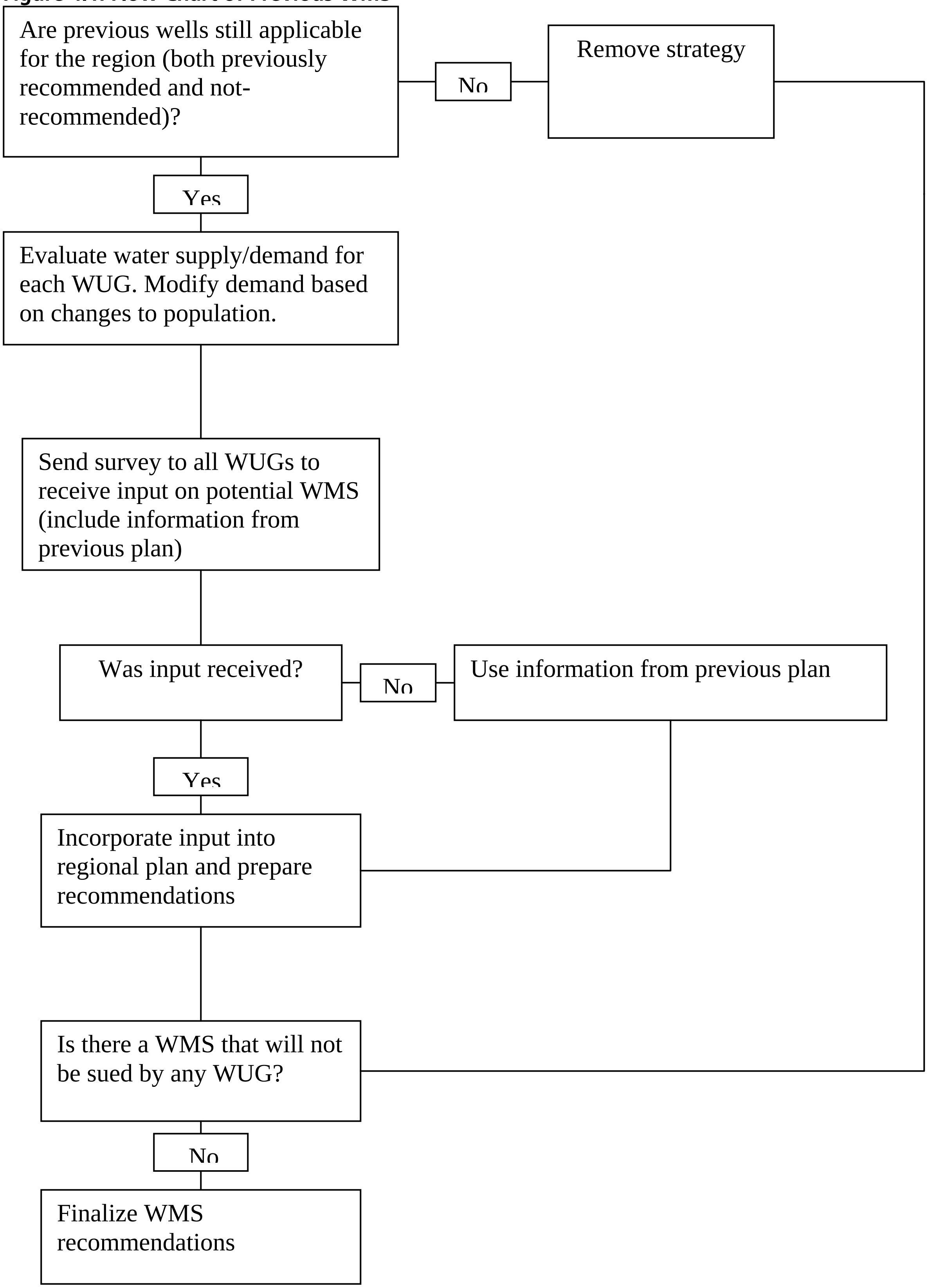
The second tier of evaluation included consideration, as appropriate, of other factors outlined in TWDB rules, for example, impacts on recreation, third-party impacts, impacts on agricultural and natural resources. A step by step flow chart of determining if a previously mentioned WMS shall still be implemented in the next round of regional planning is shown in Figure 4.1.

In the process of developing the regional water plan for Region M, the Rio Grande Regional Water Planning Group has considered several forms of plan development. The RGRWPG has done so by planning to achieve efficient use of existing water supplies and has explored opportunities and benefits of regional water facilities.

Additionally, the RGRWPG has coordinated the actions of local and regional water resource management agencies and provided substantial involvement by the public in the decision-making process; the RGRWPG coordinates a monthly meeting in which representatives from different counties and cities, within Region M, are incorporated into the decision making process in the sense that they are allowed to give presentations and, essentially, lobby for a certain project to be implemented in their area, through the RWPG. For instance, a representative from the City of Elsa recently gave a brief presentation on how to improve water conveyance infrastructure and the proposed incorporation of a new elevated storage tank. Topics which are of importance to the region and certain ongoing events are often discussed during these meetings in order to keep the planning group up to date and, in the process, more competent in making decisions. For example, the Hidalgo County Drainage District informed the Board about potentially incorporating storm water as a direct source of water for a water treatment plant.

The benefits of implementing regional water facilities has also been explored and exploited since the last round of planning. The Southmost Regional Water Authority which supplies potable water to Valley Municipal Utility District 2, Los Fresnos, Indian Lake, Brownsville PUB, and Brownsville Navigation District is one example. The North Alamo Water Supply Corporation supplies potable water to Donna, North Alamo Water Supply Corporation, and San Perlita. The North Cameron Regional Water Authority supplies potable water to East Rio Hondo Water Supply Corporation and North Alamo Water Supply Corporation. These regional water suppliers have been successful in implementing such facilities and help the region produce over 13 million gallons per day combined with using reverse osmosis technologies on brackish groundwater.

Figure 4.1: Flow Chart of Previous WMS



4.2 COMPARISON OF WATER DEMANDS WITH WATER SUPPLIES TO DETERMINE NEEDS

This chapter compares the water demand projections discussed in Chapter 2 with the water supply projections presented in Chapter 3. The objective is to determine which water users within the Rio Grande Region will have more water supplies than they will need during the planning period and which will fall short. As required by the TWDB, this comparison considers each "city, county and portion of a river basin within the regional water planning area for major providers of municipal and manufacturing water, and for categories of water use including municipal, manufacturing, irrigation, steam electric power generation, mining and livestock watering." In this analysis, a water supply "need" means that current or projected demands are greater than supply, producing a water supply "deficit" or shortage. Supply in "excess" of demand, on the other hand, results in a water supply "surplus" for the particular user. It is the water supply deficits and shortages that will require new water supply strategies in order to satisfy future projected demands.

The Rio Grande region faces significant water supply needs, as indicated in Table 4.1, even though there are surpluses of water available for some categories of use in some counties in some years, as indicated in Table 4.2. These tables summarize total water supply needs and excess supplies by category of use for the Rio Grande Region for each decade of the planning period. Following are detailed projections of water needs and excess supplies by each category of use: municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock. Projected demands are also provided for each of the two river basins and the one coastal basin that are encompassed within the Rio Grande Region. A list of the Wholesale Water Providers for the region is located in Table 4.3.

Table 4.1: Water Supply Needs for the Rio Grande Region by Category of Use (acre-feet/year)

Category of Use	2010	2020	2030	2040	2050	2060
Municipal	26,479	64,277	115,719	178,005	252,293	330,,625
Manufacturing	1,921	2,355	2,748	3,137	3,729	4,524
Irrigation	407,522	333,246	239,408	245,896	252,386	258,375
Steam Electric	0	1,980	4,374	7,291	11,214	16,382
Mining	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
TOTAL WATER NEEDS (ac-ft/yr)	**435,922**	**401,858**	**362,249**	**434,329**	**519,622**	**609,906**

Table 4.2: Water Supply Surpluses for the Rio Grande Region by Category of Use (acre-feet/year)

Category of Use	2010	2020	2030	2040	2050	2060
Municipal	66,272	43,847	32,027	22,960	18,355	16,059
Manufacturing	962	634	338	42	34	29
Irrigation	0	0	212	185	158	133
Steam Electric	2,753	1,332	874	315	0	0
Mining	755	747	736	726	717	704
Livestock	0	0	0	0	0	0
TOTAL WATER SURPLUS (ac-ft/yr)	**70,742**	**46,560**	**34,187**	**24,228**	**19,264**	**16,925**

Table 4.3: Wholesale Water Providers Surplus/Deficit Analysis

	2010	2020	2030	2040	2050	2060
Delta Lake Municipal Authority	0	0	0	0	0	0
City of Eagle Pass	0	0	0	0	0	0
Harlingen Waterworks System	0	0	1	0	0	0
Laguna Madre WD	0	0	0	0	0	0
City of McAllen	0	0	0	0	0	0
Sharyland WSC	0	0	0	0	0	0
Southmost Regional Water Authority	-6,888	-6,888	-6,888	-6,888	-6,888	-6,888
Valley MUD#2	0	0	0	1	0	1
North Alamo WSC	0	0	0	0	0	0
Brownsville Irrigation and Drainage District Needs	-34	-34	-34	-34	-34	-34

4.2.1 Municipal Water Needs

Municipal water needs in the Rio Grande Region are projected to increase dramatically over the 50-year planning period, as a growing demand for water outstrips currently available water supplies. As shown in Figure 4.2 below, regional water supply deficiencies for municipal use are projected to increase from approximately 23,936 acre-feet per year (ac-ft/yr) in the year 2010 to more than 321,248 ac-ft/yr in 2060.

Figure 4.2: Municipal Water Needs Summary

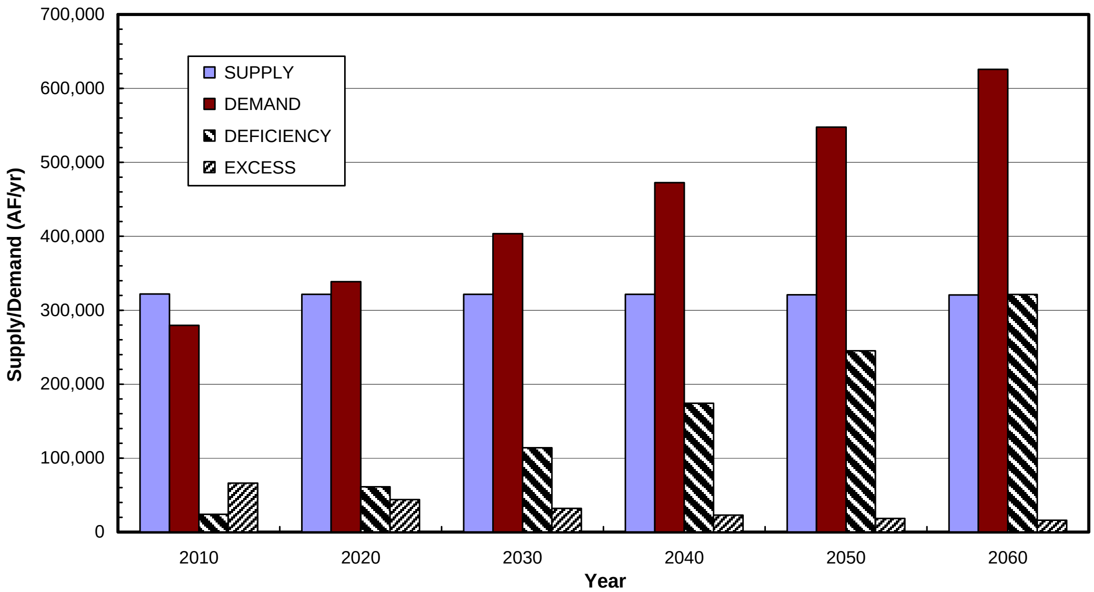


Figure 4.2 shows that total municipal demand will exceed total supplies beginning around the year 2020. However, this regional summary does not reflect the fact that some entities have secured water supplies in excess of projected demand for the entire planning period while others already are facing deficiencies. A county-by-county summary of the region's municipal water needs follows.

4.2.1.1 Cameron County - Municipal Summary

By 2010, nine communities or water supply corporations out of the 23 municipal water supply entities located in Cameron County are expected to experience water supply deficits. By 2030, four additional cities in the county are projected to have deficits, as shown in Table 4.4. A total of 16 of the 23 municipal water supply entities are projected to have deficits by the year 2060.

Table 4.4: Municipal Water Surplus/Needs for Cameron County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr)					
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
Brownsville	Nueces-Rio Grande	-8,103	-16,828	-25,645	-34,844	-43,994	-53,028
Brownsville	Rio Grande	-123	-191	-259	-331	-401	-471
Combes	Nueces-Rio Grande	222	201	174	149	121	89
East Rio Hondo WSC	Nueces-Rio Grande	2,638	1,939	1,184	491	-277	-1,006
El Jardin	Rio Grande	-309	-729	-1,165	-1,608	-2,046	-2,482
El Jardin	Nueces-Rio Grande	-1	-3	-6	-8	-10	-13
Indian Lake	Nueces-Rio Grande	-18	-26	-35	-45	-54	-64
Harlingen	Nueces-Rio Grande	4,826	3,315	1,807	257	-1,377	-3,041
Laguna Madre WD	Nueces-Rio Grande	1,638	562	-568	-1,674	-2,796	-3,864
La Feria	Nueces-Rio Grande	1,545	1,369	1,186	997	813	623
Laguna Vista	Nueces-Rio Grande	693	623	546	468	389	309
Los Fresnos	Nueces-Rio Grande	335	94	-145	-388	-643	-886
Los Indios	Nueces-Rio Grande	0	0	0	0	0	0
Military Highway WSC	Nueces-Rio Grande	-10	-145	-440	-734	-1084	-1433
Military Highway WSC	Rio Grande	0	0	0	-1	-7	-13
Olmita WSC	Nueces-Rio Grande	44	-318	-695	-1,064	-1,448	-1,813
Palm Valley	Nueces-Rio Grande	-81	-76	-69	-62	-58	-56
Palm Valley Estates UD	Nueces-Rio Grande	-4	-14	-28	-43	-61	-78
Port Isabel	Nueces-Rio Grande	-1,889	-2,090	-2,296	-2,498	-2,714	-2,925
Primera	Nueces-Rio Grande	-209	-332	-456	-589	-721	-855
Rancho Viejo	Nueces-Rio Grande	862	871	877	885	887	890
Rio Hondo	Nueces-Rio Grande	461	431	400	370	334	297
San Benito	Nueces-Rio Grande	2,116	1,548	982	402	-209	-831
Santa Rosa	Nueces-Rio Grande	569	524	471	422	369	312
South Padre Island	Nueces-Rio Grande	-750	-1,382	-2,035	-2,689	-3,341	-3,968
Valley Mud 2	Nueces-Rio Grande	129	27	-81	-187	-298	-407
Valley Mud 2	Rio Grande	22	5	-14	-31	-51	-69
County-Other	Nueces-Rio Grande	8,644	7,749	6,802	5,887	4,925	3,938
County-Other	Rio Grande	0	0	0	0	0	0
SUM OF DEFICITS		-11,497	-21,816	-32,434	-43,452	-54,491	-65,386
SUM OF EXCESS SUPPLIES		24,734	19,113	13,989	10,328	7,838	6,458

4.2.1.2 Hidalgo County - Municipal Summary

Five cities in Hidalgo County are projected to have a need for additional water supply in 2010. By 2030, 13 of the county's 25 municipal water suppliers, plus its rural areas, will experience deficits. Water needs for the county are projected to increase more than 50-fold in 50 years, from approximately 3,200 ac-ft/yr in 2010 to more than 139,000 ac-ft/yr in 2060, as shown in Table 4.5.

Table 4.5: Municipal Water Surplus/Needs for Hidalgo County

		Surplus/Deficit (ac-ft/yr)					
Water User Group	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Alamo	Nueces-Rio Grande	-59	-762	-1,548	-2,415	-3,407	-4,424
Alton	Nueces-Rio Grande	0	0	-2,446	-3,419	-4,482	-5,602
Donna	Nueces-Rio Grande	1,729	1,435	1,117	759	347	-103
Edcouch	Nueces-Rio Grande	-129	-188	-255	-332	-420	-516
Edinburg	Nueces-Rio Grande	6,216	3,826	1,029	-1,805	-5,151	-8,580
Elsa	Nueces-Rio Grande	659	603	534	460	364	258
Hidalgo	Nueces-Rio Grande	594	209	-219	-685	-1,206	-1,740
Hidalgo	Rio Grande	-2	-18	-20	-27	-49	-71
Hidalgo County MUD	Nueces-Rio Grande	-1,130	-1,814	-2,588	-3,421	-4,342	-5,287
La Joya	Nueces-Rio Grande	46	-5	-59	-120	-189	-265
La Joya	Rio Grande	19	-2	-25	-51	-80	-113
La Villa	Nueces-Rio Grande	256	258	259	261	261	258
McAllen	Nueces-Rio Grande	2,627	-2,501	-8,474	-14,830	-21,932	-29,453
McAllen	Rio Grande	0	-1	-1	-2	-3	-4
Mercedes	Nueces-Rio Grande	3,231	3,123	2,988	2,846	2,652	2,434
Military Hwy WSC	Nueces-Rio Grande	-8	-143	-422	-780	-1,120	-1,479
Military Hwy WSC	Rio Grande	0	0	0	0	-4	-9
Mission	Nueces-Rio Grande	-1,470	-4,468	-7,824	-11,365	-15,469	-19,674
North Alamo WSC	Nueces-Rio Grande	8,983	5,627	1,853	-2,345	-7,180	-12,150
Palmhurst	Nueces-Rio Grande	0	0	209	-296	-929	-1,633
Palmview	Nueces-Rio Grande	0	0	0	0	-447	-906
Penitas	Nueces-Rio Grande	5	3	2	-1	-7	-16
Pharr	Nueces-Rio Grande	376	-1,754	-4,152	-6,799	-9,649	-12,695
Progresso	Nueces-Rio Grande	0	0	0	0	0	0
San Juan	Nueces-Rio Grande	-478	-1,642	-2,933	-4,361	-6,008	-7,697
Sharyland WSC	Nueces-Rio Grande	1,624	-391	-397	-1,331	-2,296	-3,335
Sullivan City	Rio Grande	159	186	184	13	-197	-411
Weslaco	Nueces-Rio Grande	1,043	286	-579	-1,537	-2,622	-3,787
County-Other	Nueces-Rio Grande	1,028	-2,179	-5,775	-9,722	-14,197	-18,779
County-Other	Rio Grande	60	-187	-409	-652	-927	-1,210
SUM OF DEFICITS		**-3,276**	**-16,055**	**-38,126**	**-66,296**	**-102,313**	**-139,930**
SUM OF EXCESS SUPPLIES		**28,655**	**15,556**	**8,175**	**4,339**	**3,624**	**2,950**

4.2.1.3 Jim Hogg County - Municipal Summary

Jim Hogg County currently indicates no water supply shortages for the only major city located in the region (Hebbronville), as shown in Table 4.6. However, the County-Other water user categories, which incorporate rural demands, show small shortages over the planning period. The total supply shortage for the County-Other category ranges from 67 ac-ft/yr to 81 ac-ft/yr.

Table 4.6: Municipal Water Surplus/Needs for Jim Hogg County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr) 2010	2020	2030	2040	2050	2060
Hebbronville	Nueces-Rio Grande	169	141	120	108	122	152
County-Other	Nueces-Rio Grande	-60	-66	-70	-73	-71	-65
County-Other	Rio Grande	-7	-7	-8	-8	-8	-7
SUM OF DEFICITS		**-67**	**-73**	**-78**	**-81**	**-79**	**-72**
SUM OF EXCESS SUPPLIES		**169**	**141**	**120**	**108**	**122**	**152**

4.2.1.4 Maverick County - Municipal Summary

The most significant municipal water supply need in Maverick County occurs in the Rio Grande basin portion of the County-Other category. This need, estimated to be 67 ac-ft/yr by the year 2010, is projected to increase to over 2,400 ac-ft/yr in 2060. Table 4.7 presents the water surplus or deficit for each city or County-Other area in Maverick County.

Table 4.7: Municipal Water Surplus/Needs for Maverick County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr) 2010	2020	2030	2040	2050	2060
Eagle Pass	Rio Grande	2,065	1,869	1,644	1,462	1,175	862
El Indio WSC	Rio Grande	0	0	0	0	0	0
County-Other	Nueces	253	252	251	250	249	249
County-Other	Rio Grande	-67	-632	-1165	-1641	-2063	-2442
SUM OF DEFICITS		**-67**	**-632**	**-1165**	**-1641**	**-2063**	**-2442**
SUM OF EXCESS SUPPLIES		**2,318**	**2,121**	**1,895**	**1,712**	**1,424**	**1,111**

The City of Eagle Pass now has absorbed the El Indio WSC service area and is now supplying these users with municipal water. While the TWDB-approved demand projections for Eagle Pass and El Indio are not being formally amended at this time, Table 4.7 shows that the demand for El Indio will be met by the City of Eagle Pass throughout the planning horizon.

4.2.1.5 Starr County - Municipal Summary

Total municipal water supply deficits in Starr County are projected to increase from approximately 5,700 ac-ft/yr in 2010 to approximately 18,000 ac-ft/yr in the year 2060. During this period, excess supplies are projected to decrease from about 539 ac-ft/yr down to about 251 ac-ft/yr. Table 4.8 presents the water surplus or deficit for each city or County-Other area in Starr County.

Table 4.8: Municipal Water Surplus/Needs for Starr County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr) 2010	2020	2030	2040	2050	2060
La Grulla	Rio Grande	-345	-397	-454	-516	-582	-653
Rio Grande City	Rio Grande	-483	-755	-1,066	-1,361	-1,692	-2,034
Roma Los-Saenz	Rio Grande	-104	-491	-895	-1,314	-1,743	-2,175
RIO WSC	Rio Grande	-174	-314	-462	-603	-753	-896
County-Other	Nueces-Rio Grande	539	483	426	367	309	251
County-Other	Rio Grande	-4,688	-6,195	-7,746	-9,332	-10,844	-12,276
SUM OF DEFICITS		**-5,794**	**-8,152**	**-10,623**	**-13,126**	**-15,614**	**-18,034**
SUM OF EXCESS SUPPLIES		**539**	**483**	**426**	**367**	**309**	**251**

4.2.1.6 Webb County - Municipal Summary

Webb County has projected water supply needs of approximately 5,500 ac-ft/yr by 2010. By 2060, these needs are projected to reach almost 97,000 ac-ft/yr. The City of Laredo, Webb County WUD and portions of the County-Other water user categories will have shortages over the planning period. Table 4.9 presents the water surplus or deficit for each city or County-Other area in Webb County.

Table 4.9: Municipal Water Surplus/Needs for Webb County

Water User Group	River Basin	Surplus/Defict (ac-ft/yr) 2010	2020	2030	2040	2050	2060
El Cenizo	Rio Grande	209	-59	-376	-725	-1,128	-1,554
Laredo	Rio Grande	-5,293	-18,857	-34,375	-51,672	-70,422	-90,775
Webb County WUD	Rio Grande	-43	-139	-246	-362	-494	-633
Rio Bravo	Rio Grande	144	-285	-737	-1,233	-1,789	-2,375
County-Other	Nueces	-19	-38	-58	-82	-108	-138
County-Other	Nueces-Rio Grande	-30	-57	-88	-122	-162	-207
County-Other	Rio Grande	-148	-289	-448	-627	-832	-1,058
SUM OF DEFICITS		**-5,532**	**-19,724**	**-36,327**	**-54,824**	**-74,934**	**-96,740**
SUM OF EXCESS SUPPLIES		**353**	**0**	**0**	**0**	**0**	**0**

4.2.1.7 Willacy County - Municipal Summary

In Willacy County, water shortages have been identified for the city of Sebastian beginning in 2030. North Alamo WSC and the City of San Perlita are expected to experience shortages in 2040 and 2050 respectively. Table **4.10** presents the water surplus or deficit for each city or County-Other area in Willacy County.

Table 4.10: Municipal Water Surplus/Needs for Willacy County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr) 2010	2020	2030	2040	2050	2060
Lyford	Nueces-Rio Grande	657	647	638	633	621	607
North Alamo WSC	Nueces-Rio Grande	563	317	94	-105	-285	-415
Raymondville	Nueces-Rio Grande	5,625	5,588	5,550	5,511	5,496	5,494
San Perlita	Nueces-Rio Grande	14	8	3	0	-4	-6
Sebastian	Nueces-Rio Grande	44	4	-33	-62	-82	-93
County-Other	Nueces-Rio Grande	483	366	259	159	57	58
SUM OF DEFICITS		**0**	**0**	**-33**	**-167**	**-371**	**-514**
SUM OF EXCESS SUPPLIES		**7,387**	**6,930**	**6,544**	**6,303**	**6,174**	**6,160**

4.2.1.8 Zapata County - Municipal Summary

The City of Zapata has secured adequate water supplies to meet demand throughout the planning period. The total County-Other deficit is projected to increase from about 579 ac-ft/yr in 2010 to more than 1,800 ac-ft/yr in 2060. Table 4.11 presents the water surplus or deficit for each city or County-Other area in Zapata County.

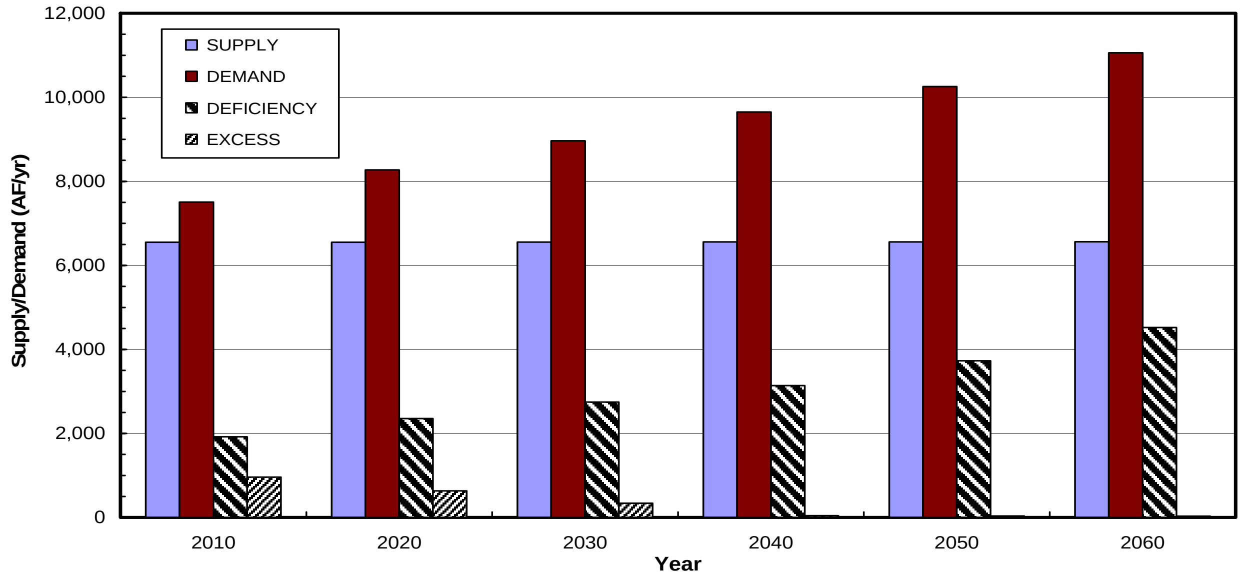
Table 4.11: Municipal Water Surplus/Needs for Zapata County

Water User Group	River Basin	Surplus/Deficit (ac-ft/yr) 2010	2020	2030	2040	2050	2060
Zapata	Rio Grande	872	888	904	920	931	931
County-Other	Rio Grande	-571	-853	-1131	-1387	-1632	-1813
SUM OF DEFICITS		**-571**	**-853**	**-1131**	**-1387**	**-1632**	**-1813**
SUM OF EXCESS SUPPLIES		**872**	**888**	**904**	**920**	**931**	**931**

4.2.2 Manufacturing Water Needs

The Rio Grande Region exhibits a supply shortage over the planning period for manufacturing water demands. Figure 4.33 presents a region-wide summary of manufacturing water supplies as compared to projected demands. The projected water needs (deficiencies) and excess supplies for the region also are indicated on the graph for each decade.

Figure 4.3: Manufacturing Water Needs Summary



The majority of the deficits in manufacturing water supplies are located in Cameron County, with much smaller deficits in Hidalgo and Willacy Counties. Table 4.12 presents manufacturing water surplus/deficit information by county and river basin.

Table 4.12: Manufacturing Water Surplus/Needs for the Rio Grande Region

County	River Basin	Surplus/Deficit (ac-ft/yr) Deficits are shaded					
		2010	2020	2030	2040	2050	2060
Cameron	Nueces-Rio Grande	-1,896	-2,330	-2,723	-3,112	-3,449	-3,905
Cameron	Rio Grande	0	0	0	0	0	0
Hidalgo	Nueces-Rio Grande	912	589	297	5	-255	-594
Hidalgo	Rio Grande	0	0	0	0	0	0
Jim Hogg	Nueces-Rio Grande	0	0	0	0	0	0
Jim Hogg	Rio Grande	0	0	0	0	0	0
Maverick	Nueces	50	45	41	37	34	29
Maverick	Rio Grande	0	0	0	0	0	0
Starr	Nueces-Rio Grande	0	0	0	0	0	0
Starr	Rio Grande	0	0	0	0	0	0
Webb	Nueces	0	0	0	0	0	0
Webb	Nueces-Rio Grande	0	0	0	0	0	0
Webb	Rio Grande	0	0	0	0	0	0
Willacy	Nueces-Rio Grande	-25	-25	-25	-25	-25	-25
Zapata	Rio Grande	0	0	0	0	0	0
SUM OF DEFICITS		**-1,921**	**-2,355**	**-2,748**	**-3,137**	**-3,729**	**-4,524**
SUM OF EXCESS SUPPLIES		**962**	**634**	**338**	**42**	**34**	**29**

4.2.3 Irrigation Water Needs

The Rio Grande Region does not have enough irrigation water supplies to meet projected irrigation water demands. At present, total water supply deficiencies are estimated to be more than 410,000 ac-ft/yr. The overall volumes of these water supply shortages are projected to remain relatively constant over the planning period. It should be noted that these deficits are based on normal levels of projected irrigation demand under drought conditions with adequate water available in storage in Amistad and Falcon Reservoirs to meet the irrigation demands. Figure 4.4 presents a region-wide summary of irrigation water supplies as compared to projected demands, along with water needs (deficiencies) and excess supplies.

Cameron, Hidalgo, Maverick, Starr, Webb, Willacy, and Zapata counties have identified irrigation water supply needs. Table 4.13 presents irrigation water surplus/deficit by county and by river basin.

Figure 4.4: Irrigation Water Needs Summary

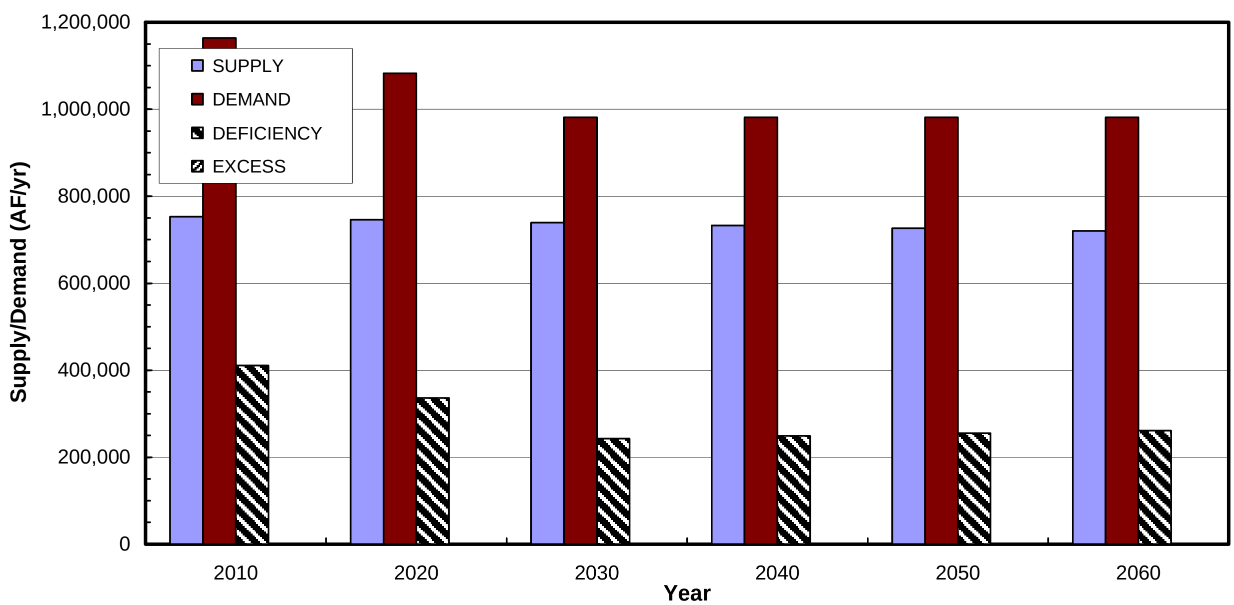


Table 4.13: Irrigation Water Surplus/Needs for the Rio Grande Region[1]

		Surplus/Deficit (ac-ft/yr) Deficits are shaded					
County	**River Basin**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Cameron	Nueces-Rio Grande	-131,084	-114,354	-94,595	-96,559	-98,524	-100,338
Cameron	Rio Grande	-4,238	-3,553	-2,745	-2,839	-2,934	-3,021
Hidalgo	Nueces-Rio Grande	-179,009	-127,739	-61,663	-64,971	-68,279	-71,333
Hidalgo	Rio Grande	-14,526	-12,328	-9,540	-9,567	-9,594	-9,619
Jim Hogg	Nueces-Rio Grande	0	0	0	0	0	0
Maverick	Nueces	1,056	1,193	1,351	1,351	1,351	1,351
Maverick	Rio Grande	-36,482	-33,808	-30,633	-31,131	-31,628	-32,087
Starr	Nueces-Rio Grande	-8,823	-7,897	-7,005	-7,151	-7,297	-7,432
Webb	Rio Grande	-6,831	-5,977	-5,180	-5,277	-5,375	-5,464
Willacy	Nueces-Rio Grande	-24,035	-25,389	-26,126	-26,443	-26,760	-27,052
Zapata	Rio Grande	-2,494	-2,201	-1,921	-1,958	-1,995	-2,029
SUM OF DEFICITS		**-407,522**	**-333,246**	**-239,408**	**-245,896**	**-252,386**	**-258,375**
SUM OF EXCESS SUPPLIES		**1,056**	**1,193**	**1,351**	**1,351**	**1,351**	**1,351**

[1] Irrigation water surplus/needs are the approved TWDB figures.

Table 4.14 Irrigation Districts Surplus/Deficits for the Rio Grande Region[2]

Irrigation District	River Basin	Surplus/Deficit (ac-ft/yr) Defects Are Shaded						
		2000	2010	2020	2030	2040	2050	2060
Cameron								
Adams Garden Irrigation District No. 19	Nueces-Rio Grande	-4,845	-5,051	-5,565	-6,085	-6,151	-6,218	-6,279
Bayview Irrigation District No. 11	Nueces-Rio Grande	-7,105	-5,260	-3,531	-2,021	-2,115	-2,209	-2,296
Brownsville Irrigation District	Nueces-Rio Grande	-40,536	-29,740	-19,533	-12,051	-12,141	-12,230	-12,313
	Rio Grande	-327	-240	-158	-97	-98	-99	-99
Cameron County Irrigation District No. 2	Nueces-Rio Grande	-87,896	-72,366	-57,074	-43,700	-44,280	-44,860	-45,395
Cameron County Irrigation District No. 6	Nueces-Rio Grande	-24,192	-18,749	-13,562	-9,028	-9,280	-9,533	-9,767
Cameron County Water Improvement District No. 16	Nueces-Rio Grande	-2,488	-2,109	-1,727	-1,391	-1,403	-1,415	-1,425
Harlingen Irrigation District-Cameron County No. 1	Nueces-Rio Grande	-19,170	-16,607	-14,536	-12,585	-12,847	-13,110	-13,353
Hidalgo and Cameron Counties Irrigation District No. 9	Nueces-Rio Grande	-2,159	-1,315	-571	111	81	51	25
	Rio Grande	-22	-13	-6	1	1	1	0
La Feria Irrigation District-Cameron County No. 3	Nueces-Rio Grande	-34,939	-28,984	-23,446	-18,432	-18,793	-19,154	-19,488
Santa Maria Irrigation District-Cameron County No. 4	Nueces-Rio Grande	-3,403	-2,982	-2,657	-2,348	-2,395	-2,442	-2,486
	Rio Grande	-179	-157	-140	-124	-126	-129	-131
Valley Acres Irrigation District	Nueces-Rio Grande	-622	-599	-618	-636	-649	-661	-672
Hidalgo								
Delta Lake Irrigation District	Nueces-Rio Grande	-37,562	-34,272	-34,014	-33,645	-34,160	-34,675	-35,150
Donna Irrigation District-Hidalgo County No. 1	Nueces-Rio Grande	-26,998	-22,135	-19,056	-16,163	-16,533	-16,902	-17,244
Engleman Irrigation District	Nueces-Rio Grande	-2,347	-1,738	-1,248	-758	-790	-822	-852
Hidalgo and Cameron Counties Irrigation District No. 9	Nueces-Rio Grande	-54,525	-33,197	-14,430	2,792	2,045	1,297	608
Hidalgo County Irrigation District No. 1	Nueces-Rio Grande	-56,706	-38,352	-21,144	-7,097	-7,359	-7,621	-7,863
Hidalgo County Irrigation District No. 2	Nueces-Rio Grande	-29,526	-12,710	2,008	13,999	13,595	13,190	12,817
	Rio Grande	-7,474	-3,217	508	3,544	3,441	3,339	3,244
Hidalgo County Irrigation District No. 6	Nueces-Rio Grande	-36,482	-15,704	2,481	17,297	16,797	16,298	15,836
	Rio Grande	-518	-223	35	246	239	231	225
Hidalgo County Irrigation District No. 13	Nueces-Rio Grande	-304	88	319	409	405	400	397
Hidalgo County Irrigation District No. 16	Nueces-Rio Grande	-7,747	-5,229	-3,019	-1,214	-1,284	-1,353	-1,416
	Rio Grande	-7,747	-5,229	-3,019	-1,214	-1,284	-1,353	-1,416
Hidalgo County Irrigation District No. 19	Nueces-Rio Grande	-4,536	1,170	4,748	6,260	6,197	6,135	6,078
Hidalgo County Municipal Utility District No. 1	Nueces-Rio Grande	-3,931	-2,988	-2,116	-1,402	-1,420	-1,439	-1,457
Hidalgo County Water Control and Improvement District No. 18	Nueces-Rio Grande	-3,641	-2,780	-1,981	-1,326	-1,343	-1,360	-1,376
Hidalgo County Water Improvement District No. 3	Nueces-Rio Grande	-2,996	-1,940	-962	-165	-182	-199	-214
	Rio Grande	-2,996	-1,940	-962	-165	-182	-199	-214
Hidalgo County Water Improvement District No. 5	Nueces-Rio Grande	-4,312	-3,492	-2,927	-2,338	-2,398	-2,457	-2,511
	Rio Grande	-227	-184	-154	-123	-126	-129	-132
Santa Cruz Irrigation District No. 15	Nueces-Rio Grande	-18,301	-15,364	-13,599	-11,718	-11,968	-12,219	-12,451
United Irrigation District of Hidalgo County	Nueces-Rio Grande	-37,600	-30,108	-22,884	-16,974	-17,080	-17,188	-17,286
	Rio Grande	-11,486	-9,198	-6,991	-5,185	-5,218	-5,250	-5,280
Valley Acres Irrigation District	Nueces-Rio Grande	-4,777	-4,611	-4,758	-4,897	-4,991	-5,085	-5,172
Willacy								
Delta Lake Irrigation District	Nueces-Rio Grande	-16,152	-14,737	-14,626	-14,468	-14,689	-14,911	-15,115
Sum of Deficits		**-606,774**	**-443,520**	**-311,013**	**-227,349**	**-231,283**	**-235,220**	**-238,854**
Sum of Excess Supplies		**0**	**1,258**	**10,099**	**44,659**	**42,801**	**40,942**	**39,230**

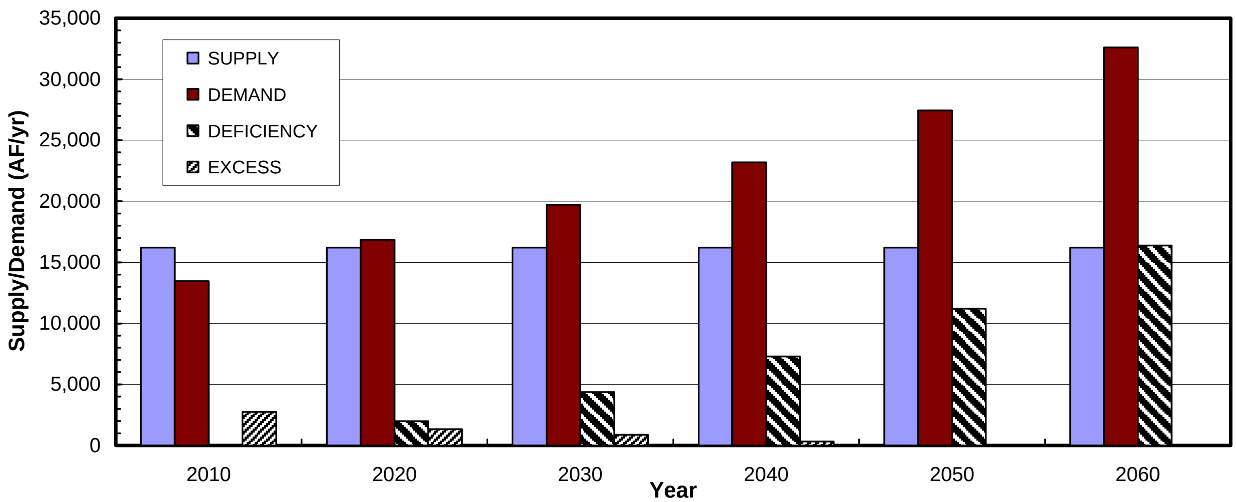
4.2.4 Steam Electric Water Needs

The Rio Grande Region is projected to have steam electric water demands in excess of existing supplies after the year 2010. Relatively large steam electric water supply

[2] This table is based on information in Special Study No. 2: Classify Irrigation Districts as Water User Groups. Special Study No. 2 is located in the appendix.

deficits will occur due to the location of available supply though the year 2060. Figure 4.5 presents a region-wide summary of steam electric water supplies as compared to demand, along with water needs (deficiencies) and excess supplies for the region.

Figure 4.5: Steam Electric Water Needs Summary



Although the Rio Grande Region has no identified steam electric water demand needs in the year 2010, supply shortages are projected beginning in 2020 for Hidalgo County and beginning in 2050 for Cameron and Webb County. Table 4.15 presents steam electric water surplus/deficit by county and by river basin.

Table 4.15: Steam Electric Water Surplus/Needs for the Rio Grande Region

County	River Basin	Surplus/Deficit (ac-ft/yr) Deficits are shaded					
		2010	2020	2030	2040	2050	2060
Cameron	Nueces Rio Grande	784	877	620	306	-77	-544
Cameron	Rio Grande	0	0	0	0	0	0
Hidalgo	Nueces-Rio Grande	1816	-1,980	-4,374	-7,291	-10,847	-15,183
Hidalgo	Rio Grande	0	0	0	0	0	0
Jim Hogg	Nueces-Rio Grande	0	0	0	0	0	0
Jim Hogg	Rio Grande	0	0	0	0	0	0
Maverick	Nueces	0	0	0	0	0	0
Maverick	Rio Grande	0	0	0	0	0	0
Starr	Nueces-Rio Grande	0	0	0	0	0	0
Starr	Rio Grande	0	0	0	0	0	0
Webb	Nueces	0	0	0	0	0	0
Webb	Nueces-Rio Grande	0	0	0	0	0	0
Webb	Rio Grande	153	455	254	9	-290	-655
Willacy	Nueces-Rio Grande	0	0	0	0	0	0
Zapata	Rio Grande	0	0	0	0	0	0
SUM OF DEFICITS		**0**	**-1,980**	**-4,374**	**-7,291**	**-11,214**	**-16,382**
SUM OF EXCESS SUPPLIES		**2,753**	**1,332**	**874**	**315**	**0**	**0**

4.2.5 Mining Water Needs

Total mining water supply is projected to exceed water demand throughout the planning period. Figure 4.6, below, presents a region-wide summary of mining water supplies as compared to demand and water needs (deficiencies) and excess supplies for the region.

Table 4.16 presents mining water surplus/deficit by county and by river basin. This table shows that the largest surpluses are in Hidalgo, Webb, and Zapata counties.

4.2.6 Livestock Water Needs

Projections show no identified livestock water supply shortages in the Rio Grande Region during the next 50 years. Figure 4.7 presents a region-wide summary of livestock water supplies as compared to demand and a summary of water needs (deficiencies) and excess supplies for the region. The following table presents livestock water surplus/deficit by county and by river basin.

Figure 4.6: Mining Water Needs Summary

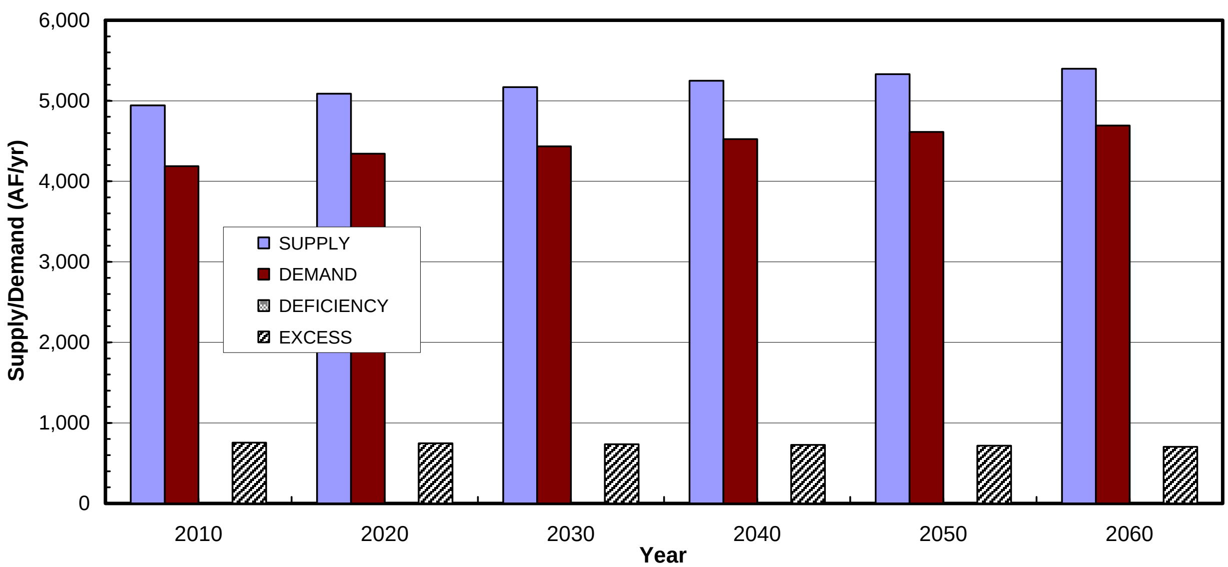


Table 4.16: Mining Water Surplus/Needs for the Rio Grande Region

County	River Basin	Surplus/Deficit (ac-ft/yr) Deficits are shaded					
		2010	2020	2030	2040	2050	2050
Cameron	Nueces-Rio Grande	6	6	6	6	6	6
Cameron	Rio Grande	0	0	0	0	0	0
Hidalgo	Nueces-Rio Grande	183	182	181	179	177	175
Hidalgo	Rio Grande	23	22	21	21	21	20
Jim Hogg	Nueces-Rio Grande	8	5	4	3	1	1
Jim Hogg	Rio Grande	0	0	0	0	0	0
Maverick	Nueces	0	0	0	0	0	0
Maverick	Rio Grande	35	36	34	34	34	33
Starr	Nueces-Rio Grande	11	11	11	11	11	11
Starr	Rio Grande	9	9	9	9	9	8
Webb	Nueces	226	224	222	220	218	216
Webb	Nueces-Rio Grande	34	34	32	29	27	26
Webb	Rio Grande	110	109	108	107	106	104
Willacy	Nueces-Rio Grande	0	0	0	0	0	0
Zapata	Rio Grande	110	109	108	107	106	104
SUM OF DEFICITS		**0**	**0**	**0**	**0**	**0**	**0**
SUM OF EXCESS SUPPLIES		**755**	**747**	**736**	**726**	**716**	**704**

Figure 4.7: Livestock Water Needs Summary

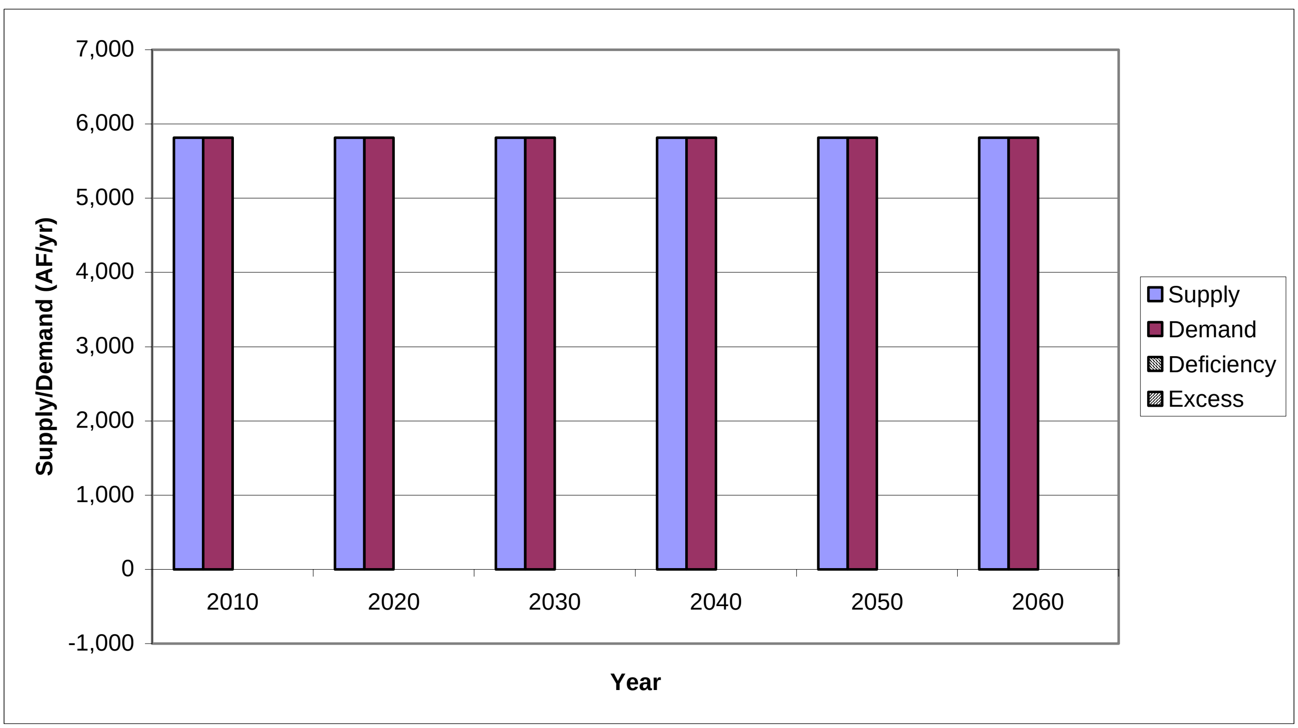


Table 4.17: Livestock Water Surplus/Needs for the Rio Grande Region

County	River Basin	Surplus/Deficit (ac-ft/yr) Deficits are shaded					
		2010	2020	2030	2040	2050	2060
Cameron	Nueces-Rio Grande	0	0	0	0	0	0
Cameron	Rio Grande	0	0	0	0	0	0
Hidalgo	Nueces-Rio Grande	0	0	0	0	0	0
Hidalgo	Rio Grande	0	0	0	0	0	0
Jim Hogg	Nueces-Rio Grande	0	0	0	0	0	0
Jim Hogg	Rio Grande	0	0	0	0	0	0
Maverick	Nueces	0	0	0	0	0	0
Maverick	Rio Grande	0	0	0	0	0	0
Starr	Nueces-Rio Grande	0	0	0	0	0	0
Starr	Rio Grande	0	0	0	0	0	0
Webb	Nueces	0	0	0	0	0	0
Webb	Nueces-Rio Grande	0	0	0	0	0	0
Webb	Rio Grande	0	0	0	0	0	0
Willacy	Nueces-Rio Grande	0	0	0	0	0	0
Zapata	Rio Grande	0	0	0	0	0	0
SUM OF DEFICITS		**0**	**0**	**0**	**0**	**0**	**0**
SUM OF EXCESS SUPPLIES		**0**	**0**	**0**	**0**	**0**	**0**

4.3 OVERVIEW OF RECOMMENDED WATER MANAGEMENT STRATEGIES[3]

The Rio Grande RWPG has adopted five basic goals or "pillars" that underlie this regional water plan. These are:

- Optimize the supply of water available from the Rio Grande;
- Reduce projected municipal water supply needs through expanded water conservation programs;
- Diversify water supply sources for DMI uses through the appropriate development of alternative water sources (e.g., brackish water desalination, seawater desalination, reuse of reclaimed water, groundwater); and
- Minimize irrigation shortages through the implementation of agricultural water conservation measures and other measures; and
- Recognize that the acquisition of existing Rio Grande water supplies will be the preferred strategy of many DMI users for meeting future water supply needs.

Consistent with these goals, the Rio Grande RWPG has adopted recommended water management strategies for each water user group (WUG) with identified water needs during the 50-year planning period. It should be noted that the water management strategies recommended and adopted by the Rio Grande RWPG and presented herein

[3] A table listing all water management strategies by county and WUG is attached to this chapter.

are for the entire 50-year planning period, applicable towards both near-term needs (2010-2040) and long-term needs (2040-2060). The sections that follow present a regional overview of recommended water management strategies for each major category of water use. Information for all of the potentially feasible water management strategies that were considered during the planning process is presented in Section 4.5 for meeting DMI needs in Section 4.9 for reducing irrigation shortages.

A summary of water management strategies is shown in Table 4.18 and Figure 4.8. It is apparent that the most cost effective strategy with the greatest yield is Irrigation Conveyance System Improvements. This strategy is expected to yield in excess of 200,000 acre-feet of water at approximately one-third the cost of most other strategies with the exception of Municipal Water Conservation. Funding for these improvements has been the drawback to implementation and is further described in Chapter 10 and in Chapter 8 as a legislative recommendation.

Figure 4.8: Water Management Strategies

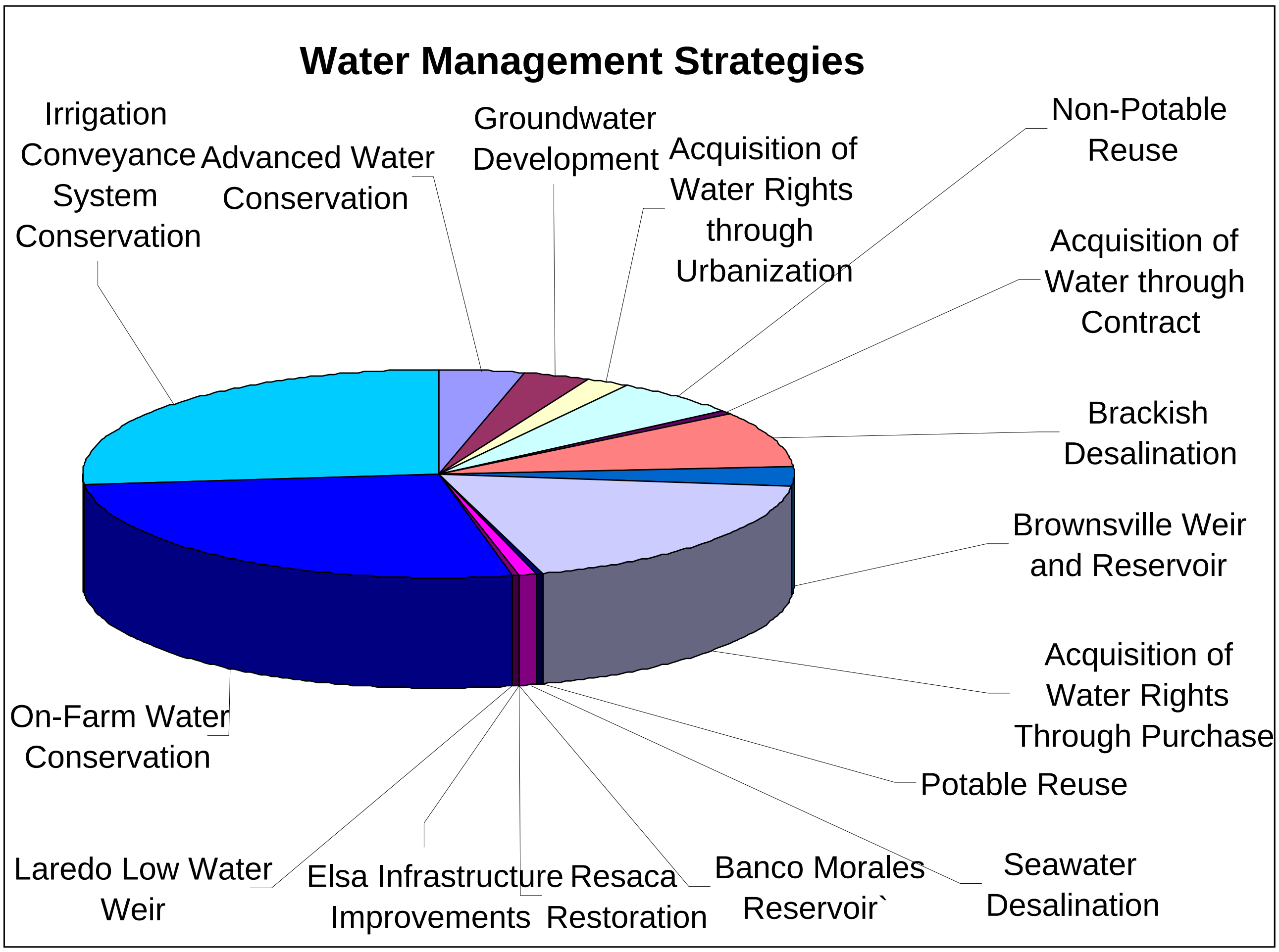


Table 4.18: Recommended Water Management Strategies Capital Cost and Water Supply

Strategy	Total Capital Cost	Water Supplies Per Decade					
		2010	2020	2030	2040	2050	2060
Advanced Water Conservation	$22,583,710	2,917	6,339	11,986	16,512	24,867	32,793
Groundwater Development	$27,474,302	3,772	8,572	17,139	20,492	22,284	24,520
Acquisition of Water Rights through Urbanization	$56,167,089	299	3,433	6,467	9,496	12,868	16,406
Non-Potable Reuse	$173,803,091	2,417	9,444	12,378	20,137	29,810	46,382
Acquisition of Water through Contract	$16,263,877	312	738	1,665	2,352	3,198	4,671
Brackish Desalination	$263,599,392	38,364	44,627	48,309	54,472	66,696	71,700
Brownsville Weir and Reservoir	$98,411,077	20,643	20,643	20,643	20,643	20,643	23,643
Acquisition of Water Rights Through Purchase	$631,081,709	9,611	19,461	41,602	70,944	110,913	151,237
Potable Reuse	$7,519,850	1,120	1,120	1,120	1,120	1,120	1,120
Seawater Desalination	$185,940,937	125	125	143	6,049	6,421	7,902
Elsa Infrastructure Improvements	$8,325,386	105	105	105	105	105	105
Banco Morales Reservoir`	$25,790,900	238	238	238	238	238	238
Resaca Restoration	$52,000,000	877	877	877	877	877	877
Laredo Low Water Weir	$294,400,000	0	0	0	0	0	0
Irrigation							
On-Farm Water Conservation	$194,417,692	36,528	73,085	109,614	146,144	182,698	219,228
Irrigation Conveyance System Conservation	$130,757,978	91,160	182,313	191,435	200,551	209,667	218,783
TOTAL	**$2,188,536,991**	**208,488**	**371,120**	**463,721**	**570,132**	**692,405**	**819,605**

It should be noted, however, that irrigation yields less than municipal rights by a factor of two to one when comparing irrigation Class A rights to the of municipal rights. With the acquisition of water rights accounting for over 40% of the municipal strategies, the Rio Grande will remain the dominant source of water for the Region.

Alternate sources of water will also play an important part in providing the needs for the area. Brackish Groundwater Desalination will provide an alternate source of water not previously used and planned in the previous Rio Grande Regional Plan. Over 22% of the supplies will be from brackish desalination. The remaining strategies are shown below.

4.3.1 Recommended Strategies for Meeting Municipal Water Needs[4]

Table 4.19: Municipal Demand by County (ac-ft/year)

County Name	Year 2010	Year 2020	Year 2030	Year 2040	Year 2050	Year 2060
CAMERON	88,690	104,850	121,342	138,190	155,290	172,211
HIDALGO	109,745	134,676	162,904	193,339	227,928	264,012
JIM HOGG	884	918	944	959	943	906
MAVERICK	9,409	10,559	11,666	12,649	13,601	14,476
STARR	13,487	15,773	18,171	20,610	23,064	25,542
WEBB	54,855	69,401	86,001	104,503	124,614	146,420
WILLACY	3,323	3,527	3,706	3,844	3,966	4,039
ZAPATA	2,265	2,531	2,793	3,033	3,267	3,448
TOTAL	**282,658**	**342,235**	**407,527**	**477,127**	**552,673**	**631,054**

All projections referenced from TWDB approved data.

According to the data provided by the TWDB municipal water demands are projected to almost triple by 2060. With the factor of urbanization and the loss of acreage used for irrigation needs, the growth of municipal water demand is inevitable. TWDB rules specify that the regional water plans are to include the evaluation of all water management strategies the RWPG determines to be potentially feasible. For the Rio Grande Region, an initial determination of potentially feasible strategies was made by the Rio Grande RWPG and was incorporated into the approved scope-of-work for preparation of the regional water plan. Additional strategies were added over the course of the planning process.

For DMI users, the strategies that were further evaluated according to TWDB standards for this plan are:

- Municipal Water Conservation
- Non-Potable Reuse of Reclaimed Water
- Acquisition of Additional Rio Grande Water Through Water Rights Purchase, Urbanization & Contract
- Desalination of Brackish Groundwater
- Desalination of Seawater
- Groundwater Development
- Dams, Weir and Storage
  - Brownsville Weir and Reservoir
  - Banco Morales Reservoir
  - Resaca Restoration
  - Laredo Low Water Weir
- Water Infrastructure and Distribution
  - Proposed Elsa Tank

It should be noted that a given WUG may implement any combination and/or order of the above mentioned recommended strategies for DMI shortages to meet its

[4] A table listing all municipal supply/demand deficits and recommended water management strategies by county and WUG is attached at the end of this chapter.

specific needs. A municipal water supply/demand analysis has been performed for each WUG. This information can be viewed in the appendix in the decision documents.

The strategies selected for meeting DMI needs generally will not result in adverse impacts to other water resources of the state, will not threaten other natural resources (see Chapter 1), and will not result in significant adverse socio-economic impacts to third parties from voluntary redistributions of water (e.g., contractual water sales).

Because a portion of future DMI needs will be met through the acquisition of additional supply from the Rio Grande, reallocation of water from agricultural to DMI uses will be required, which will have the effect of reducing the availability of water for agricultural use.

However, instead of aggravating this "threat to agricultural resources" (see Chapter 1), significant opportunities exist for constructive partnerships between DMI users and agricultural water users that will further the interests of both groups, and the region as a whole.

Desalination of Brackish Groundwater as a technology was evaluated and an amendment made to the previously adopted Regional Plan. There is an increased consideration of desalination water plants for DMI use when the cost efficiencies and environmental issues were economically addressed. Desalination of Brackish Groundwater is a recommended strategy in specific local areas where it already is cost-effective.

The Rio Grande RWPG considers groundwater as a viable alternative to augment supplies in some areas. This is a current practice that is likely to continue.

In addition, the Rio Grande RWPG recognizes that surface water uses that will not have significant impact on the region's water supply may be required above and beyond the recommended strategies even though they are not specifically recommended in the plan. Additionally, the region may also face the need to develop water supply projects that do not involve the development of or connection to a new water source even though such projects are not specifically recommended in the plan.

4.3.1.1 Implementation of Recommended WMS Currently Using Amistad-Falcon Reservoir

As previously mentioned in Chapter 3, in accordance with the water allocation priorities set forth in TCEQ's Rio Grande operating regulations, water stored in Amistad-Falcon Reservoir is available for irrigation uses only after the demands for domestic, municipal, and industrial (including manufacturing and steam electric) uses have been supplied. For purposes of water supply planning in accordance with TWDB guidelines, this represents the availability of water supply from Amistad-Falcon Reservoirs for irrigation uses which is represented by the balance of the firm annual yield of the reservoir system after the domestic, municipal, and industrial (including manufacturing and steam electric) water demands have been satisfied and after the DMI pool and the operating reserve in the reservoirs have been fully restored. With this being said, the current water supply of Amistad-Falcon Reservoir fully satisfies the region except for irrigation demands. But as the region grows, it exploits for the entities around. In effect, the region must implement new water management strategies (listed previously in this chapter) in order to meet these rising demands. When implementing these strategies, it takes away from the current firm yield of Amistad-Falcon and therefore creates an overallocation of water effect. As affirmed in the section above, this reduces the supply of irrigation water rights in the region as the water rights are converted from irrigation use to municipal use.

Without implementing any water management strategies, the current supply of Amistad-Falcon in 2010 is 1,011,976 ac-ft. When all WMS attached to Amistad-Falcon for municipal use are implemented in the year 2010 (the WMS that are directly associated to Amistad-Falcon are Acquisition of Water Rights through Purchase, Contract or Urbanization; Brownsville Weir and Reservoir; Banco Morales Reservoir; Laredo Low Water Weir; Proposed Elsa Infrastructure; and Resaca Restoration), it will exceed the current supply of Amistad-Falcon by 24,724 ac-ft in 2010 and 191,586 ac-ft in 2060. Table 4.20 describes the volume of water by which Amistad-Falcon is overallocated in each decade when implementing the water management strategies.

Table 4.20: Overallocation of Amistad-Falcon by Implementing WMS

2010	2020	2030	2040	2050	2060
-24,724	-38,717	-65,434	-98,941	-143,151	-191,586

As mentioned in this section, to resolve the overallocation of Amistad-Falcon when implementing these strategies, there will be voluntary redistribution of water rights between irrigation and municipal users. DMI users have first priority of water in a drought of record condition. In order for municipal users to be satisfied fully in the future during a drought, municipal needs are entirely met through converting irrigation water rights to municipal water rights. Figure 4.9 shows the amount of reallocation of Amistad-Falcon Reservoir supply that must be transferred to or from users to implement the recommended WMS. The remaining unallocated water from Amistad-Falcon and the irrigation water rights which are being transferred to municipal use are shown in this figure. Figure 4.9 and Table 4.21 are strictly based on the amount of yield that is produced from implementing the recommended WMS and where the water is redistributed from. This figure does not take into effect the conversion of irrigation water rights to municipal use. The information in Figure 4.9 directly relates to the information in Table 4.21.

Figure 4.9: Reallocation of Amistad-Falcon Reservoir

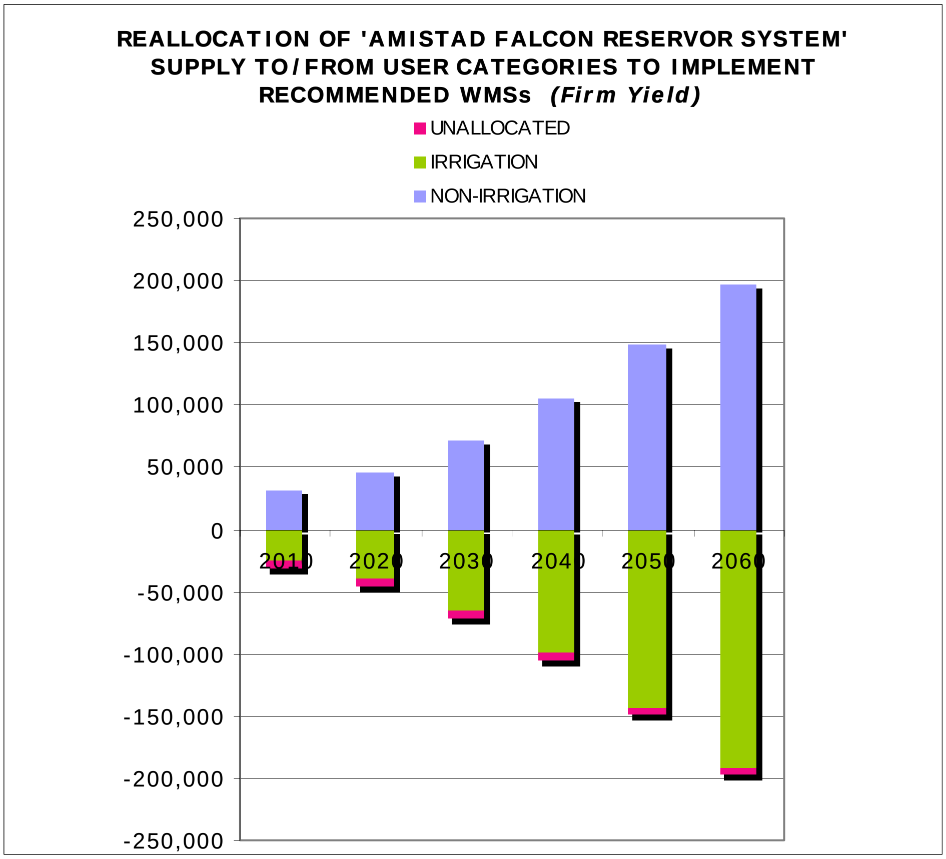


Table 4.21: Reallocation Amounts for Graph (Firm Yield)

2010	2020	2030	2040	2050	2060	
32,085	45,495	71,597	104,655	148,842	197,177	**NON-IRRIGATION**
-24,724	-38,717	-65,434	-98,941	-143,151	-191,586	**IRRIGATION**
-7,361	-6,778	-6,163	-5,714	-5,691	-5,591	**UNALLOCATED**
0	0	0	0	0	0	**CHECK: Total equals zero (overallocation resolved)**

4.3.1.2 Transferring Class A and B Irrigation Water Rights to Municipal Use

As mentioned in the previous section and in Chapter 3, a large part of implementing WMS and supplying for future demands for municipal, manufacturing, and steam electric uses in the RGRWPA, will be supplied through the conversion of irrigation water rights that utilize water from Amistad-Falcon Reservoir. As urbanization continues to encroach into agricultural areas and as the overall agricultural economy is potentially diminished, the available supplies of irrigation water are likely to be reduced as demands for municipal, manufacturing, and steam electric water increase and begin to be satisfied with converted irrigation water rights from Amistad-Falcon reservoir system.

Figure 4.10 shows the amount of irrigation water rights that must be converted to municipal use in order to meet the municipal demand and implement the recommended WMS. As mentioned before, irrigation water rights are broken down into two different categories Class A and Class B. Based on information received from Rio Grande Watermaster, roughly 90.048% of all Class A and B water rights are Class A. The other 9.952% is Class B water rights. Based on this information and factoring in the conversion ratios for Class A (2:1) and B (2.5:1) water rights it would take 50,678 acre-feet of irrigation water in 2010 to convert to 24,724 municipal water rights and implement the recommended WMS. In 2060 it would take 392,705 acre-feet of irrigation water rights to convert into the necessary 191,586 acre-feet of municipal water to implement the WMS.

By transferring irrigation water rights to municipal water rights for implementation of the recommended water management strategies, irrigation supply takes a major hit. Irrigation is designed to have unmet needs throughout each decade. By transferring the existing water rights to municipal water rights it's going to create bigger unmet needs in the region. Table 4.23 below shows unmet needs before the transfer of water rights to municipal water rights and also after irrigation water rights have been transferred. The table shows that unmet needs in 2060 more than doubles when the WMS have been implemented.

Figure 4.10: Estimated Quantity of Class A and B Irrigation Water Rights Reallocated in Order to Implement Recommended WMSs

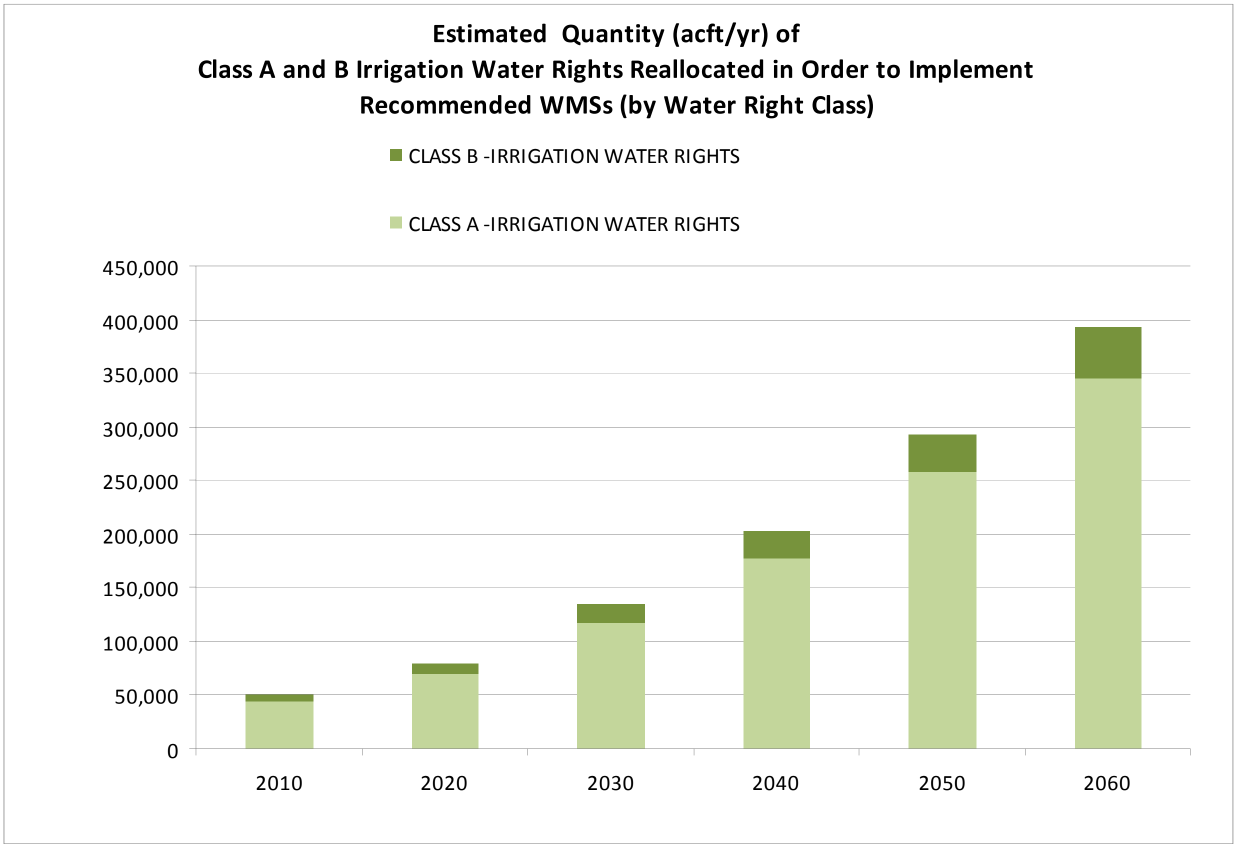


Table 4.22: Converted Irrigation Water Rights to Municipal Rights

SHARE OF IRRIGATION RIGHTS	VOLUME OF WATER OUT OF 'AMISTAD-FALCON RESERVOIR SYSTEM' ***FIRM***							ESTIMATED QUANTITY OF CONVERTED IRRIGATION WATER RIGHTS REALLOCATED					
CLASS A=90.048% CLASS B=9.952%	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**CONVERSION RATIO**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
SUBTOTAL - CLASS A	**22,263**	**34,864**	**58,922**	**89,094**	**128,905**	**172,519**	***2.0***	**44,527**	**69,728**	**117,844**	**178,189**	**257,809**	**345,039**
SUBTOTAL - CLASS B	**2,461**	**3,853**	**6,512**	**9,847**	**14,246**	**19,067**	***2.5***	**6,151**	**9,633**	**16,280**	**24,617**	**35,616**	**47,667**
Total	*24,724*	*38,717*	*65,434*	*98,941*	*143,151*	*191,586*	***2.05***	*50,678*	*79,361*	*134,124*	*202,805*	*293,425*	*392,705*

Table 4.23: Unmet Irrigation Needs Before and After Implementation of Water Management Strategies

UNMET IRRIGATION NEEDS BEFORE AND AFTER IMPLEMENTATION OF WATER MANAGEMENT STRATEGIES						
	2010	2020	2030	2040	2050	2060
Unmet Irrigation Needs Before Implementation of WMS	-407,522	-333,246	-239,408	-245,896	-252,386	-258,375
Unmet Irrigation Needs After Implemenentation of WMS	-458,200	-412,607	-373,532	-448,701	-545,811	-651,080

4.3.1.3 Third Party Social and Economic Impacts from Redistribution of Water

There are several conditions that can cause water to be redistributed from rural to municipal and domestic uses.

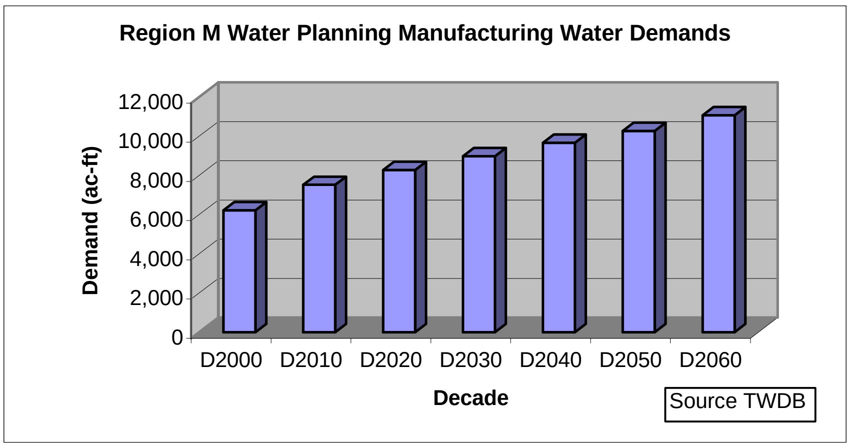
1. Agricultural land near municipal and industrial areas becomes too valuable an asset for agricultural uses and farmers are enticed by economic reasons to sell their land for profit and which then provides cities and industry with land needed to service their growing populations of the RGRWPA. The water rights attached to the agricultural land is then converted to municipal use.

2. Crops that use a large amount of water such as sugar cane and citrus crops will be converted to less water intense crops as the cost and availability of water becomes scarcer. The economics of transferring the necessary crop to a low maintenance water crop will encourage the farmer to make this decision. A drought of record will only accelerate these decisions. The change from higher income producing crops per acre to lower income producing crops per acre will force the trend to larger farms and using fewer workers in the agricultural area. After this change is made it is a short transition to the next step in the redistribution of land use to urban and municipal uses stated in Scenario No.1

The impacts to society of these redistributions of water resources will continue to accelerate the change of the labor force from an agrarian to an urban society. These changes have been increasing in speed over the last one hundred years. It is recommended that local and state leaders need to plan a method to conserve and produce more water resources so the RGRWPA has time to plan and change at a manageable rate. This will also give the agricultural industry time to develop more efficient and effective means of production for future generations. The RGRWPA rural area and all rural areas of this country are witnessing this trend. This trend will move more families from the rural setting to an urban lifestyle with more dependence on city services with higher costs. These changes also change the manufacturing demand from agricultural tools and needs to urban needs of society. The demand for tractors and farm implements will decline and the demand for urban needs will increase. The loss of the agricultural base to the RGRPA would be a very significant blow to the local economy. Without a replacement for this economic base, the area could go into significant decline without some form of economic growth to replace these jobs and income to the local region.

4.3.2 Recommended Strategies for Meeting Projected Manufacturing Needs[5]

Figure 4.11: Water Planning Manufacturing Water Demands

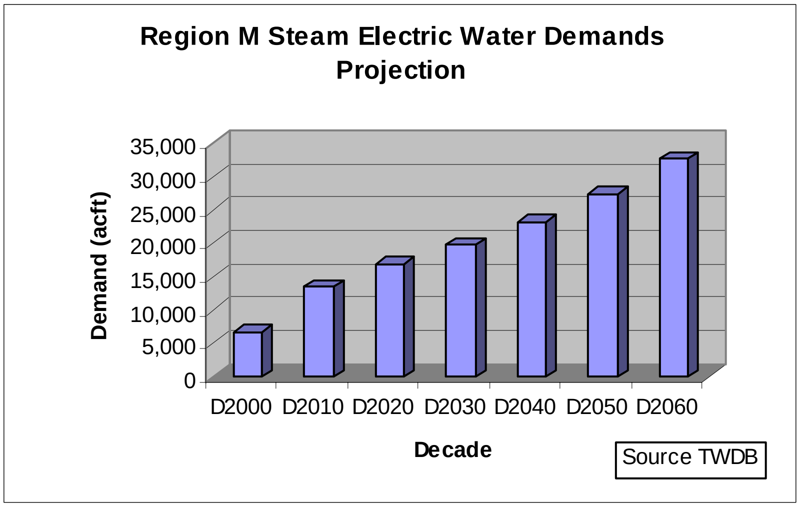


Manufacturing deficits exist in Cameron, Hidalgo, and Willacy Counties. These deficits are expected to be supplied with a combination of Additional Groundwater, Non-Potable Reuse, and Water Rights Purchase. Manufacturing needs are projected to double by 2060. There will be a steady increase in this demand according to the data provide by the TWDB. The manufacturing water supply/demand analysis for each county can be viewed in the appendix.

[5] A table listing all manufacturing supply/demand deficits and recommended water management strategies by county is attached at the end of this chapter.

4.3.3 Recommended Strategies for Meeting Projected Steam Electric Needs[6]

Figure 4.12: Steam Electric Water Demands Projection



Combined, the county-level steam electric power generation WUGs in the region are expected to have a deficit of 649 acre-feet in 2020 increasing to 16,383 acre-feet in 2060. Water management strategies considered potentially applicable to this need include Acquisition of Additional Rio Grande Supplies and Non-Potable Reuse. It is recommended that all of the projected steam electric demands be met through a combination of these strategies. The steam electric water supply/demand analysis for each county can be viewed in the appendix.

4.3.4 Recommended Strategies for Meeting Projected Mining Needs

There are not projected to be any mining water supply shortages throughout the extent of this planning study. The mining water supply/demand analysis for each county can be viewed in the appendix.

4.3.5 Recommended Strategies for Meeting Projected Livestock Needs

There are not projected to be any livestock water supply shortages throughout the extent of this planning study. The livestock water supply/demand analysis for each county can be viewed in the appendix.

[6] A table listing all steam electric supply/demand deficits and recommended water management strategies by county is attached at the end of this chapter.

4.3.6 Recommended Strategies for Reducing Projected Irrigation Needs[7]

The economics of the agriculture industry are such that water management strategies considered feasible for the Rio Grande Region are not sufficient to satisfy the projected deficits in their entirety. Consequently, development of new water supply sources for irrigated agriculture – whether surface or groundwater – is not seen as a viable strategy. There nevertheless are strategies that could significantly reduce irrigation demand or increase the available supply of water for irrigation.

For irrigation users, the water management strategies considered for this plan are:

- Agricultural Water Conservation (conveyance systems)
- On-Farm Water Use Efficiency

In addition, because of assumptions made in estimated irrigation water availability during drought-of-record hydrologic conditions, additional irrigation supplies are projected to be available as a consequence of recommended strategies for DMI users that will lessen the need for DMI users to acquire additional Rio Grande supplies than would otherwise be the case. In essence, strategies such as municipal water conservation, desalination, and reuse of reclaimed water for DMI purposes are strategies for reducing the magnitude of projected irrigation shortages.

At the regional level, irrigation shortages of 407,522 acre-feet per year in 2010 and 258,375 acre-feet per year in 2060 are projected under normal conditions. The irrigation water supply/demand analysis for each county can be viewed in the appendix. Additionally, a table analyzing the resulting irrigation supply/demand, once after the irrigation water management strategies are implemented, is displayed below.

Table 4.24: Irrigation With Water Management Strategies

IRRIGATION WITH WATER MANAGEMENT STRATEGIES						
DESCRIPTION	2010	2020	2030	2040	2050	2060
IRRIGATION	-407522	-333246	-239408	-245896	-252386	-258375
WMS						
ON-FARM	36528	73085	109614	146144	182698	219228
CONVEYANCE	91160	182313	191435	200551	209667	218783
TOTAL WMS	127688	255398	301049	346695	392365	438011
IRRIGATION WITH WMS	-279834	-77848	61641	100799	139979	179636

The Rio Grande RWPG believes that investment in agricultural water efficiency is one of the cornerstones of the region's near-term water management plan. Accordingly, the Rio Grande RWPG recommends that there be a comprehensive effort by local, state, and federal agencies to "capture" the maximum amount of

[7] A table listing all irrigation supply/demand deficits and recommended water management strategies by county is attached at the end of this chapter.

water savings from irrigated agriculture over the 50-year planning period. The Rio Grande RWPG recommended the following water management strategies for reducing irrigation shortages:

- Conveyance System Improvements
- On-Farm Water Use Efficiency

4.4 REGIONAL DROUGHT PREPAREDNESS

Chapter Six of this Regional Water Plan deals with water conservation and drought preparedness. Overall, the Rio Grande Region is well prepared for drought, as evidenced by the manner in which the region was able to cope with the previous drought. The legal system under which Rio Grande water rights are administered acts like a regional drought contingency plan. DMI users have an assured annual supply of water from the Amistad-Falcon Reservoir System equal to their authorized annual water right. The DMI user, however, must be concerned during times of drought for irrigation districts' ability to deliver water when they are unable to deliver irrigation water as a carrier. Irrigation and mining water rights accounts, as the "residual" users of water from the reservoir system, bear the entire brunt of water supply shortages during drought as those users only receive new allocations of water when inflows to the reservoir system are in excess of that required to satisfy municipal demands and offset system losses.

In effect, the existing TCEQ rules and regulations for operating the Amistad-Falcon Reservoir System provide the means for initiating a drought response. As the storage in the reservoirs falls during dry periods in response to decreased inflows, the existing rules automatically reduce the available supply of water in the irrigation and mining accounts. This action serves to protect the available supply for DMI users. In essence, this system functions as a drought contingency plan. Every DMI user that has a drought contingency plan in place utilizes the reservoir system levels as a trigger for drought plan implementation.

Additionally, many irrigation districts have adopted district-level water allocation policies, which provide a market-based mechanism for minimizing the economic impacts of irrigation shortages. Specifically, during periods of shortage, some districts "go on allocation" and allow individual irrigators to sell all or a portion of their water allocations to other irrigators within the district and, in some cases, to irrigators outside the district. The benefit of these agriculture-to-agriculture water transfers is that the producers of higher value and more water-intensive crops, such as citrus and sugar cane, can gain access to additional water over and above their allocations from an irrigation district. The entire region benefits to the extent that these transactions minimize the economic impacts of irrigation shortages by allowing limited water supplies to move from lower to higher value uses.

While DMI water users in the Rio Grande Region are generally afforded a very high degree of water supply reliability during drought, there are circumstances under which drought preparedness is somewhat deficient. One situation that has arisen during the drought of the late 1990's and early 2000's is the potential for interruption of DMI water deliveries by irrigation districts when irrigation water rights accounts are depleted. In many cases in the Lower Rio Grande Valley, DMI water deliveries are dependent upon adequate supplies of irrigation "push water." If irrigation supplies are exhausted, DMI water rights accounts or the reserves may have to be tapped to maintain adequate water flows in the conveyance facilities that deliver DMI water. One potential solution to this problem is to develop more conveyance/distribution interconnections between DMI users and irrigation districts and between DMI users and other DMI users. With state technical and financial assistance, efforts are currently underway to identify and implement such interconnections.

Based on current TCEQ records, it also appears that all municipal water suppliers have not complied with state requirements to prepare drought contingency plans. While such plans may not be necessary for responding to water supply shortages, there are other conditions, which may from time to time require voluntary or mandatory curtailment of non-essential municipal water uses. For example, local drought can result in elevated peak water demands, which may strain limited water treatment and distribution capacity.

Also, it is not uncommon for water utilities to experience outages caused by major equipment failures and natural disasters. Such situations should be addressed in local drought contingency plans.

4.5 STRATEGIES FOR MEETING DOMESTIC, MUNICIPAL, AND INDUSTRIAL WATER NEEDS[8]

Opportunities for the development of additional water supplies for municipal use are limited in the Rio Grande Region, both because of the hydrologic characteristics of the region and by economics. As previously noted, there are few opportunities to increase the water supply yield of the Rio Grande. However, a number of strategies for augmenting municipal water supplies have been examined as part of this planning effort. These include: Advanced Municipal Water Conservation; Banco Morales Reservoir; Laredo Low Water Weir; Resaca Restoration; Infrastructure Improvements for City of Elsa; Brownsville Weir and Reservoir; Reuse of Reclaimed Water; Optimizing Surface Water Supply from the Rio Grande; Groundwater Development; Brackish and Seawater Desalination; and Acquisition of Additional Rio Grande Supplies for domestic-municipal-industrial (DMI) uses. The evaluations of these strategies are presented in the sections that follow. More detailed back-up information is provided in the appendix and in technical appendices to this plan.

[8] Water Management Strategies for Water User Groups can be found in the Decision Documents in the appendix.

4.5.1 Acquisition of Rio Grande Water Rights

4.5.1.1 Strategy Description

Water rights for the Lower Rio Grande were 100% adjudicated by the courts in the late 1960's to domestic, municipal, industrial, and agricultural users. In 1971, there were approximately 155,000 acre-feet of adjudicated water rights for DMI use. Currently there are approximately 390,000 acre-feet of DMI rights in the region. This increase in the quantity of DMI water rights is the result of the gradual, incremental conversion of irrigation and mining water rights to DMI use through voluntary, market-based transfers. This trend is expected to continue for the foreseeable future.

Because of the unique nature of the water rights system for the middle and lower Rio Grande, the Rio Grande Region enjoys one of the most active and robust water markets in the world. Because a water right is considered private property in Texas, it can be bought and sold or otherwise transferred subject to state administrative review and approval. Irrigation districts may sell Class A and B water rights to other irrigation users, or they may sell and convert those rights for municipal, industrial, or domestic use. In the middle and lower Rio Grande, such transfers have been common since the adjudication of water rights. Because of the nature of the water rights system for the Rio Grande, state administrative review is relatively simple and inexpensive.

Another common means of converting irrigation use rights to municipal urban use rights is the conversion of irrigation rights in conjunction with the "exclusion" of non-irrigable land, or land that is urban in nature, from a district's boundary. An irrigation district may, through an arrangement with a municipal supplier (a city, municipal utility district, or water supply corporation), convert all or a portion of the water previously used to irrigate the excluded land to municipal use, or the district may retain all or a portion of such water for irrigation use depending upon what is in the best interest of the district. One exclusion statute, § 49.314 of the Texas Water Code, provides that if land is excluded pursuant to this statute, a municipal supplier can petition an irrigation district to convert and reallocate the irrigation rights associated with land "excluded" to a non-irrigation use on terms agreeable to the parties, preference shall be given to the Water Right Conversion Bill. This is the process by which irrigation rights may be converted to municipal use. However, the specific terms of the water supply transfer is left to the parties' agreement.

In the past, some irrigation districts have converted some or all of their irrigation water rights associated with excluded lands to DMI rights. The DMI water is then supplied to a city or a water supply corporation on a contractual basis. Usually, this involves the district diverting and delivering the water supply for a city or water supply corporation for a specified charge based on the quantity of water delivered, or if delivered by another district, a specified charge for the water supply provided. These types of contracts are typically open-ended and provide a pre-determined amount of water. However, contractual water right sales must comply with the following:

- Sales can only be approved between the same type use of water (i.e. DMI water can only be sold to another DMI water user).
- Accounts with existing contract balances cannot sell water from that account until such time as all contract water has been diverted and used.
- Purchased water cannot exceed the total storage amount allowed under the water right.
- Purchased irrigation water is valid only for a 12-month period.
- Purchased municipal water expires the last Saturday of each year.

In summary, there are three methods for obtaining Additional Water Supplies through the Acquisition of Rio Grande Water Rights: purchase, exclusion through urbanization, and contract. Each method involves the conversion of irrigation water rights into DMI water rights. However, since all circumstances surrounding the transfer of water rights are not similar, it is difficult to predict which acquisition method would be best suited for all interested parties.

4.5.1.2 Water Supply Yield

A significant quantity of water can be expected to become available for DMI use as a consequence of further urbanization of irrigated lands throughout the region. Table 4.25 shows the reduction in irrigation demands through 2060.

Table 4.25: Region M Irrigation Demands

	2010	2020	2030	2040	2050	2060
Irrigation Demand (ac-ft/yr)	1,163,634	1,082,232	981,748	981,748	981,748	981,748

The numbers shown in Table 4.25 are a direct result of discussions with various irrigation districts. By looking at annual rainfall and reservoir levels, the planning group used a base year demand of 1.2 million acre-feet or water for irrigation. The decrease in irrigation demand is directly related to the effects of urbanization, among other factors. As land is transformed from agricultural use to urban use, the water rights associated with that land are often converted to DMI use. Irrigation water rights are converted to municipal water rights on a 2-to-1 basis. In other words, 2 acre-feet of irrigation water can be converted to 1 acre-foot of DMI water. As can be seen in Table 4.25, there will be a reduction in irrigation demand of 227,898 ac-ft of water by year 2060. Should all of that supply be fully converted to DMI use, a potential DMI supply of 113,949 would result. Also, as described later in this chapter, there are significant opportunities for reducing irrigation water demands through measures to improve water conveyance system efficiency and on-farm water use efficiency. By looking at the

Irrigation Summary WUG table in the appendix, one will notice a projected additional supply of over 430,000 acre-feet of water for irrigation use in 2060. To the extent that DMI users might help finance agricultural water conservation measures, additional irrigation rights might also become available for conversion to DMI use. Outright purchase of water rights from irrigation districts for DMI use will be required to help irrigation districts implement water conservation strategies. In some cases, it may be in the best interest of both the irrigation district and the WUG to acquire water through exclusions due to urbanization or long-term contracts. WUG tables are shown in the appendix. These tables give a breakdown of which water management strategy is most feasible for each WUG.

After considering the contributions to be made by all other water management strategies, the amount of additional Rio Grande supply that will be needed to meet the remaining municipal water needs is shown in Table 4.26. This information is a summary of the information shown in the Municipal WUG tables located in the appendix.

Table 4.26: Water Yield for Acquisition of Rio Grande Water Rights

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Purchase (ac-ft)	15,121	65,663	7	2,226	11,149	55,060	198	1,813
Urbanization (ac-ft)	0	16,406	0	0	0	0	0	0
Contract (ac-ft)	892	2,201	0	0	235	1,338	5	0
Total:	16,013	84,270	7	2,226	11,384	56,398	203	1,813

4.5.1.3 Cost

As indicated, it is not possible to predict when or how individual transactions will be structured by DMI users needing to acquire additional Rio Grande water supplies. It is also not possible to predict the exact cost of either future water rights purchases or the price of water provided to DMI users under contract. The specific terms of such transactions will be determined by the parties willing buyers and willing sellers, which will also dictate the specific components required to implement this strategy[9]. However, for this planning process it is

[9] The new Water Rights Conversion Bill statute provides that if the water rights are conveyed to the municipal water supplier, that the amount paid to the water district is equivalent to 68% of the prevailing market value of water rights sold in the Lower and Middle Rio Grande, which are determined by the Rio Grande Regional Water Authority (RGRWA) based upon the price paid in the last three sales transactions of 100 acre feet or more from the previous year. If the water is to be delivered on a contractual basis, the law provides for a formula to determine the delivery charge to be paid by the municipal supplier to the water district on an annual basis.

necessary to provide cost estimates for acquisition of additional Rio Grande water supplies for DMI use. A water right value of $2300/ac-ft was used. This is a significant increase of approximately $700/acre-foot charged only a decade ago. For long-term contract of water, the up-front cost for water right acquisition was assumed to be $1,000/ac-ft. Acquisition of water rights through urbanization does not have an associated up-front cost for acquisition. These costs include full water rights and responsibilities over one acre-foot. The cost estimate per acre-foot of water after delivery, treatment, distribution, and plant operations costs are taken into consideration. This analysis can be seen in the appendix. A summary of these costs can be seen below.

Table 4.27: WMS Strategy Cost Summary (Acquisition of Water Rights Through Purchase)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Acquisition of Water Rights Through Purchase	$ 430.12	$ 1.32	A of Cost Analysis Appendix

Table 4.28: WMS Strategy Cost Summary (Acquisition of Water Rights Through Urbanization)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Acquisition of Water Rights Through Urbanization	$ 430.12	$ 1.32	B of Cost Analysis Appendix

Table 4.29: WMS Strategy Cost Summary (Acquisition of Water Rights Through Contract)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Acquisition of Water Rights Through Contract	$ 430.12	$ 1.32	C of Cost Analysis Appendix

4.5.1.4 Environmental Impact

When this water management strategy is put into motion there will be temporary and permanent impacts associated with implementation of this strategy. The temporary environmental impacts would probably be evident with the construction activities associated with infrastructure improvements needed to facilitate additional municipal water. The construction activities dealing with this WMS would include a decrease in air and noise quality. The intensity of these construction-related impacts would be minimal due to dust and noise measures to be implemented during construction, applicable permit conditions, and stipulations for the protection of air and water quality, and temporary localized nature of the effects. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts. Permanent environmental impacts due to construction and operation of the WMS would be a decrease in air quality due to the maintenance activities required for this WMS. The permanent decrease in air quality would not be significant, as maintenance activities are periodic in nature and duration.

Since the majority of municipal water is delivered by irrigation districts, the transfer of water rights from irrigation use to municipal use will have a minimal effect on existing plant and animal habitat associated with the irrigation district conveyance system. However, an increase in DMI use will directly result in an increase in wastewater flows. Currently, excess irrigation results in water runoff. With the reduction in irrigable acres, these runoff flows will be reduced. Therefore, water supplied to irrigation drainage and seep ditches will be reduced. This effect will be somewhat offset with increased wastewater flows. However, the loss of agricultural land will have a negative impact on terrestrial wildlife and wetlands. Also, given that irrigation use is seasonally based and DMI demand would be continuous, there likely will be changes in the pattern of use of the Rio Grande water that may impact the environment.

Since the Acquisition of Additional Rio Grande Water, either through purchase, exclusion, or contract, involves changes in the type, location, or owner of water rights, TCEQ handles it as a routine administrative process and does not require a detailed evaluation for proposed amendments to Rio Grande water rights.

4.5.1.5 Implementation Issues

As indicated, acquisition of additional Rio Grande water supplies for DMI use can be accomplished through outright purchase of water rights, through exclusions of irrigable land due to urbanization, or through contractual arrangements between a water right holder and a DMI user. The process for amending Rio Grande water rights to change the ownership, type of use, or place of use requires approval by TCEQ. However, because water rights amendments generally do not affect instream flows or other water rights holders, approval of amendments is accomplished administratively by the TCEQ's executive director. A second issue is the lack of a standard methodology and contractual obligation for implementing the exclusion process except as provided for in Section 1(1), Chapter 707, Acts of the 69th Legislature, Regular Session, 1985 (Article 973c, Vernon's Texas Civil Statutes). Although the process is defined by statute, the timeframes and terms under which the exclusion occurs vary considerably.

4.5.1.6 Recommendation

It is recommended that any remaining DMI water supply needs, after considering the effects of other recommended strategies for meeting DMI needs, be met through the Acquisition of Additional Rio Grande Water Supplies through purchase of water rights, exclusions due to urbanization, or water supply contracts.

4.5.2 Non-Potable Water Reuse

4.5.2.1 Strategy Description

As a water management strategy, Direct Reuse of Reclaimed Water provides a water supply benefit when reclaimed water is used as a substitute or as supplemental water source. Non-potable Direct Reuse is defined as the application of wastewater effluent directly from the waste treatment plant to the point of use without co-mingling with state waters.

Recycled water is most commonly used for non-potable (not for drinking) purposes, such as agriculture, landscape, public parks, and golf course irrigation. Other non-potable applications include cooling water for power plants and oil refineries, industrial process water for such facilities as paper mills, carpet dyers, toilet flushing, dust control, construction activities, concrete mixing, and artificial lakes. In addition, there are potential opportunities for non-potable reuse of reclaimed water for existing and projected manufacturing and stream electric demands.

One negative aspect of non-potable reuse is the accumulation of byproducts over time in the irrigated soil. Since recycled wastewater normally contains higher levels of salts or other minerals, and those minerals may accumulate over time where the water is applied. Usually physical and biological processes in the soil offset this concern, unless the concentration of a pollutant is unusually high.

Another negative effect is the potential consumer confusion between potable and non-potable water piping. Mixing up potable and non-potable water pipes is a concern when users of recycled water include ordinary residences. Industrial users typically do not suffer such problems, but small children may drink from a home faucet that is intended solely for irrigation water. Because treated wastewater could contain harmful substances, the consequences of ingestion can be significant.

This WMS can be feasible if several factors are taken into consideration: 1) the location of wastewater treatment facilities relative to the locations of potential users of reclaimed water, 2) the level of treatment and quality of the reclaimed water, 3) the water quality requirements of particular users, and 4) the public acceptance of reuse.

These and other factors determine whether reuse of reclaimed water is economically feasible for specific uses. For example, the distance one has to convey reclaimed water from the source (i.e., a wastewater treatment plant) to a user (e.g., a golf course or power plant) is a significant cost factor and determinant of feasibility. Similarly, the water quality requirements of potential users may mean that additional treatment would be necessary. Also, state regulatory requirements for non-potable reuse of reclaimed water place constraints on both the types of uses considered acceptable and the manner in which reclaimed water is managed and used. Public acceptance of water reuse is also an important factor. Perceptions, or misperceptions, about the public health or environmental risks of non-potable reuse can make or break a water reclamation project.

4.5.2.2 Water Supply Yield

Theoretically, it is technically feasible to beneficially reuse all of the reclaimed water produced from municipal wastewater treatment plants for non-potable municipal and industrial uses. Achieving very high levels of water reuse requires the development of costly dual water systems capable of delivering water on demand to both large and small users over a large area. While extensive dual water systems have been developed in a handful of communities in California, Florida, and Texas, generally the costs of such systems are prohibitive, particularly in already developed communities. In most settings, cost considerations limit reclaimed water distribution systems to delivery of relatively large volumes of reclaimed water to a relatively small number of large non-potable water users. As such, the current realistically achievable reuse potential within a typical municipal water utility service area is generally a tenth of total water demand.

For this planning effort, a water supply and demand analysis was performed for each Water User Group (WUG). In this analysis, total water demand was compared to total water supply over the extent of the planning study. Many of the WUGs projected a water supply deficit. It is in these cases that non-potable reuse could provide relief to the supply shortage. The following WUGs expressed interest in Non-Potable Reuse: Brownsville, Harlingen, Laguna Madre Water District, Alamo, Edinburg, McAllen, Mission, Pharr, Rio Grande City, and Laredo. Table 4.30 shows the proposed non-potable water supply yield for each county in the region. For a city-by-city breakdown, please reference the decision documents in the appendix.

Table 4.30: Water Supply Yield for Non-Potable Reuse

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft)	3,755	29,964	0	0	125	12,523	15	0

Each of these WUGs has the potential to perform non-potable reuse since they are served by central wastewater collection and treatment systems. Experience suggests that reuse potential is limited in smaller communities due to lack of relatively large non-potable water users in proximity to treatment facilities. In rural areas that lack central wastewater collection and treatment systems, reuse potential is limited except at a small scale through individual on-site systems, neighborhood scale cluster systems, or local golf course and landscape irrigation.

4.5.2.3 Cost

The cost of a non-potable municipal reuse system can vary widely, primarily because of distribution system costs. It was beyond the scope of the regional planning process to evaluate the water reuse potential and develop cost estimates for each of the municipal entities. However, cost estimates developed for other systems in the state are considered representative. Brownsville (Robindale Wastewater Treatment Plant) performed a reuse study and evaluated cost based on three treatment alternatives: no treatment, ultra filtration, and a combination of ultra filtration and reverse osmosis. Table 4.31 shows the cost breakdown of each of these alternatives. The numbers are based on annual debt service of 6% for 20 years.

Table 4.31: Cost Breakdown for Brownsville PUB Reuse Facility

Formal Name	Project Description	Total Annual Cost	Cost per acre-foot	Capacity (MGD)
Wastewater Recovery and Reuse Facility – Brownsville PUB	No Additional Treatment	$153,893	$228.96	.6
	Ultra Filtration	$1,146,072	$243.59	4.2
	Ultra Filtration/Reverse Osmosis	$1,882,291	$420.07	4

The Rio Grande RWPG also obtained cost-related information for other reuse facilities. Harlingen formerly had a reuse agreement with Fruit of the Loom, with a cost of $296 per acre-foot per year (ac-ft/yr) (30 years at 6%) being reported in the last round of regional planning. McAllen has a reuse agreement with the Calpine Electric Generation Plant for cooling water, but the cost was shared between the City and Calpine, and the total cost is not available. The cities of Austin and San Antonio have dual-water systems. The Rio Grande RWPG had discussions with operators at the Austin and San Antonio plants, and based on 20 year debt service at 6% per year, costs of $643/ac-ft/yr (Austin plant) and $500/ac-ft/yr (San Antonio plant) were reported. The Lakeway MUD in Travis County has a small reuse system and charges $1.80/1,000 gallons ($587/ac-ft), which they believe is approximately their cost.

Based on the range of costs from the Brownsville study ($228.96/ac-ft/yr for no treatment to $420.07/ac-ft/yr for ultra filtration/reverse osmosis), the total estimated annual costs for the total projected reuse amounts would be approximately $49,000 to $90,000 in 2010, increasing to $6.3 million to $11.5 million in 2060. The range is based on the difference in treating the water by ultra filtration/ reverse osmosis and not treating it at all. Due to wide range or wastewater quality in the region, ultra filtration/ reverse osmosis construction costs from this feasibility study were referenced when calculating a new cost for Non-Potable Reuse which is shown below. Reference the appendix for a detailed breakdown.

Table 4.32: WMS Strategy Cost Summary (Non-Potable Reuse)

Water Management Strategy Cost Summary			
	Cost		
WMS	**$/Acre-ft**	**$/1000 gallons**	**Appendix**
Non-Potable Reuse	$ 150.45	$ 0.46	**D of Cost Analysis Appendix**

*This is based off a feasibility study done for City of Brownsville "Robindale Wastewater Recovery and Reuse Facility Project" done through the Border Environment Cooperation Commission. The costs were derived from here but formulated through TWDB standards of costs for each WMS which includes interest during construction and various other factors. The cost is also brought to present cost since the derived cost was estimated in 2001.

4.5.2.4 Environmental Impact

When this water management strategy is put into motion there will be temporary and permanent impacts associated with implementation of this strategy. The temporary environmental impacts would probably be evident with the construction activities needed to make infrastructure improvements. The construction activities dealing with this WMS would include a decrease in air and noise quality. The intensity of these construction related impacts would be minimal due to dust and noise measures to be implemented during construction, applicable permit conditions, and stipulations for the protection of air and water quality, and temporary localized nature of the effects. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts.

Permanent environmental impacts due to construction and operation of the WMS would be a decrease in air quality due to the maintenance activities required for this WMS. The permanent decrease in air quality would not be significant, as maintenance activities are periodic in nature and duration.

One negative aspect of non-potable reuse for irrigation usage is the accumulation of byproducts over time in the irrigated soil. Since recycled wastewater normally contains higher levels of salts or other minerals, and those minerals may accumulate over time where the water is applied. Usually physical and biological processes in the soil offset this concern, unless the concentration of a pollutant is unusually high.

Mixing up potable and non-potable water pipes is a concern when users of recycled water include ordinary residences. Industrial users typically do not suffer such problems, but small children may drink from a home faucet that is intended solely for irrigation water. Because treated wastewater could contain harmful substances, the consequences of ingestion can be significant.

Bar the effects of urbanization, non-potable reuse will increase environmental water quality by reducing wastewater flows resulting in lower organic levels in receiving streams.

4.5.2.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act, if any threatened or endangered species is impacted. The widespread implementation of reuse programs would require detailed utility and site-specific assessments to identify feasible reuse applications. Generally, direct non-potable reuse is economically feasible where there are central wastewater collection and treatment systems and where there are large demands for non-potable water within relatively close proximity to the supply source. However, some potential does exist in rural areas through the direct reuse of household gray water and through non-potable reuse in proximity to small wastewater systems and other types of alternative wastewater management systems. Consequently, there may be reuse potential for some WUGs in the Rio Grande Region that were excluded from the analysis summarized above. Similarly, some municipal water users included in the analysis may exceed goals for reuse while others may fall short.

In any case, it is recommended that all municipal water suppliers with central wastewater collection and treatment systems undertake an assessment to identify and develop cost-effective reuse opportunities. This should include evaluation of opportunities to use reclaimed water as a substitute supply for municipal, manufacturing, steam electric, and agricultural uses.

The largest potential impact on cultural resources associated with this option comes from pipeline construction and operation. Therefore, pipelines should follow existing and shared rights-of-way whenever possible to minimize the area of disturbance.

4.5.2.6 Recommendations

The Rio Grande RWPG recommends that direct Non-Potable Water Reuse be considered a water management strategy for the following WUGs: Brownsville, Alamo, Edinburg, McAllen, Mission, Pharr, and Laredo.

It is further recommended that the Non-Potable Use of Reclaimed Water be adopted as a strategy for meeting a portion of projected municipal water needs, as well as a portion of the projected steam electric power generation needs. It is also recommended that funding be provided by TWDB and from other sources for the purpose of conducting a more thorough assessment of non-potable reuse opportunities within the municipal, manufacturing, and steam electric water use categories. This assessment should be completed on a schedule that will allow the results to be incorporated into a future update of this regional water plan.

4.5.3 Potable Reuse

4.5.3.1 Strategy Description

There are two types of Potable Reuse, indirect and direct. Potable reuse of reclaimed water refers to the intentional reuse of highly treated wastewater effluent as a supplemental source of water supply for potable uses. While it is technically feasible to produce potable quality water from municipal wastewater effluent, direct potable reuse has not gained either regulatory or public acceptance. By contrast, indirect potable reuse is currently practiced elsewhere in Texas where surface water supplies are deliberately augmented with wastewater effluent or reclaimed water.

For this planning effort, a 1977 study that investigated the feasibility of indirect potable reuse in the McAllen-Edinburg area was reviewed.

Based on the results of the pilot study, a potable reuse option was evaluated that would involve modification of existing wastewater treatment plants for biological nutrient removal, microfiltration, reverse osmosis, and ultraviolet disinfection. The reclaimed water would then be blended with raw water from the Rio Grande in a raw water storage reservoir from which the blended supply would be treated by existing water treatment plant processes, disinfected with ozone, and then sent to the potable water distribution system after adding chlorine. To more accurately assess the feasibility of potable reuse for the City of McAllen, a pilot study was performed as a separate project to assess the use of an integrated bioreactor and reverse osmosis treatment train to reclaim municipal wastewater for potable reuse. The results of the pilot study indicated that reverse osmosis filtration is capable of producing reclaimed water that meets all state and federal drinking water and reuse standards.

With indirect potable reuse, highly treated recycled water is returned to the natural environment and mixes with other waters for an extended period of time. The blended water is then diverted to a water treatment plant for sedimentation, filtration, and disinfection before it is distributed. The mixing and travel time through the natural environment provides several benefits: (1) sufficient time to ensure that the treatment system has performed as designed with no failures, (2) opportunity for additional treatment through natural processes such as sunlight and filtration through soil, and (3) increased public confidence that the water source is safe. Unplanned indirect potable reuse is occurring in virtually every major river system in the United States today.[10]

A national example can be found in Virginia. The Upper Occoquan Sewage Authority (UOSA) Regional Water Reclamation Plant has been discharging to the Occoquan Reservoir, a principal water supply source for approximately one million people in northern Virginia. Because of the plant's reliable, state-of-the-art performance and the high-quality of water produced, regulatory authorities have endorsed UOSA plant expansion over the years to increase the safe yield of the reservoir. UOSA recycled water is now an integral part of the water supply plans for the Washington metropolitan area. Other major projects with proven track records are in Los Angeles County and Orange County, California, and in El Paso, Texas. After decades of research, pilot studies, and demonstration, the City of San Diego is designing a 20-MGD indirect potable reuse project.

The option of direct potable reuse is technically demanding and socially contentious. In direct potable reuse, the effluent of a wastewater treatment plant is routed directly to the intake of a drinking-water treatment plant. Because of the seemingly closed-loop cycle this process achieves, it is often called "toilet-to-tap." In other words, this is the use of recycled water for drinking purposes directly after treatment.

There are several reasons that prevent the adoption of this type of water treatment. The first reason is that direct potable reuse is technically demanding because wastewater requires extensive treatment prior to re-introduction in the drinking water plant. Typically, wastewater is discharged to receiving bodies of water such as lakes and rivers. This is directly cycling the wastewater back into drinking water that requires physical and chemical treatment surpassing that necessary for surface water discharge.

The second reason is that direct potable reuse is socially contentious because of the negative associations of wastewater. Although many communities already practice indirect potable reuse because their drinking water lies downstream of another municipality's wastewater plant, the idea of direct reuse is often more upsetting. Citizen group reactions in areas where direct potable reuse has been proposed tend to be strongly negative.

While some of the initial issues with direct reuse can be attributed to general ignorance of the realities of water treatment, direct potable reuse does suffer some serious questions regarding health and hygiene. The dilution of pollutants by receiving bodies of water in traditional water plays a significant role in cleaning the water. A system that loops back a large quantity of its water volume has the risk of concentrating pollutants over time. While EPA-limited pollutants and pathogens are closely monitored, there are other potential

[10] National Academy of Science, "Issues in Potable Reuse: The Viability of Augmenting Potable Water Supplies With Reclaimed Water," 1998.

problem chemicals whose effects are unknown. For example, many medications are excreted from the body and are detectable in wastewater. Such chemicals are not on the list of monitored pollutants, but would certainly be present in recycled wastewater.

4.5.3.2 Water Supply Yield

Conceptually, the amount of water that could be provided through indirect potable reuse of reclaimed water would be equal to the total amount of municipal wastewater discharges. However, economic and regulatory constraints, as well as public perceptions of the potential health risks associated with potable reuse, would likely represent major impediments to widespread implementation of potable reuse.

For this planning effort, a water supply and demand analysis was performed for each Water User Group (WUG). In this analysis, total water demand was compared to total water supply over the extent of the planning study. Many of the WUGs projected a water supply deficit. It is in these cases that potable reuse could provide relief to the supply shortage. Currently, only the City of Weslaco is interested in pursuing indirect potable water reuse. By 2010, their goal is to use 1 million gallons/day (1,120 ac-ft/yr) of reuse water to facilitate potable water demand by blending it with raw water before it enters a treatment facility. This quantity would be available to Weslaco for the extent of the planning study. The WUG supply and demand table for Weslaco can be viewed in the appendix.

4.5.3.3 Cost

The cost estimates developed for the full-scale potable reuse system evaluated for the City of McAllen were reviewed for this planning effort. In 2000 dollars, capital costs of the project would be approximately $17.8 million. The total annual cost, which includes debt service (6% for 20 years) and operations and maintenance costs, are estimated to be $3.9 million per year. On an annualized basis, the unit cost of the additional water supply would be $535 per acre-foot per year. However, it should be noted that these estimates do not include the costs associated with conventional treatment of the blended raw/reclaimed water supply. Table 4.33 shows a breakdown of these costs. These numbers were referenced from the previous regional plan and are based on the McAllen, TX – Demonstration of ZenoGem and RO for Indirect Potable Reuse Pilot Study performed by CH2M Hill.

Table 4.33: Cost Breakdown for McAllen Indirect Reuse Plant

Project Name	Total Annual Cost	Cost per acre-foot	Capacity (MGD)
City of McAllen Indirect Potable Reuse Plant	$3,871,172	$535	6.8

Table 4.34: WMS Strategy Cost Summary (Potable Reuse)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Potable Reuse	$ 150.45	$ 0.46	E of Cost Analysis Appendix

4.5.3.4 Environmental Impacts

When this water management strategy is put into motion there will be temporary and permanent impacts associated with implementation of this strategy. The temporary environmental impacts would probably be evident with the construction activities associated with infrastructure improvements. The construction activities dealing with this WMS would include a decrease in air and noise quality. The intensity of these construction related impacts would be minimal due to dust and noise measures to be implemented during construction, applicable permit conditions, and stipulations for the protection of air and water quality, and temporary localized nature of the effects. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts. Permanent environmental impacts due to construction and operation of the WMS would be a decrease in air quality due to the maintenance activities required for this WMS. The permanent decrease in air quality would not be significant, as maintenance activities are periodic in nature and duration.

Barring the effects of urbanization, potable reuse will increase environmental water quality by reducing wastewater flows, resulting in lower organic levels in receiving streams.

4.5.3.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, the project may need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act if any threatened and endangered species are impacted. The key issue associated with the implementation of non-potable reuse of reclaimed water is public acceptance of the strategy. While opinion surveys indicate that the public is generally supportive of strategies that involve the use of reclaimed water for non-potable purposes, public acceptance of indirect potable reuse is questionable no matter what degree of public health safeguards are provided. Also, while indirect non-potable use has been implemented elsewhere in Texas, the practice involves blending relatively small quantities of reclaimed water with very large volumes of raw water in a large surface water reservoir.

While the potable reuse option evaluated for McAllen would meet current state and federal drinking water standards, permitting of such a project could be in doubt, particularly if there is significant public opposition to such a project.

The largest potential impact on cultural resources associated with this option comes from pipeline construction and operation. Therefore, pipelines should follow existing and shared rights-of-way whenever possible to minimize the area of disturbance.

4.5.3.6 Recommendations

The Rio Grande RWPG recommends Indirect Potable Water Reuse as a water management strategy for the City of Weslaco. It is also recommended that funding be provided by TWDB and from other sources for the purpose of conducting a more thorough assessment of potable reuse opportunities within the municipal water use category. This assessment should be completed on a schedule that will allow the results to be incorporated into a future update of this regional water plan.

4.5.4 Advanced Water Conservation

Past regional water planning studies included estimated water savings due to water conservation in the overall demand figure for each Water User Group (WUG). In this round of regional planning, the TWDB has determined that "reductions due to the installation of water-efficient plumbing fixtures in new construction, as well as from the replacement of older fixtures, will be included in the Regional Water Plans based on data provided by the TWDB." These measures are treated as a requirement for each municipal WUG thereby reducing per-capita water demand throughout the extent of the planning study. Any additional conservation measures will be treated as Advanced Water Conservation.

4.5.4.1 Strategy Description

Advanced water conservation methods were analyzed and evaluated based on the best management strategies developed by the Water Conservation Implementation Task Force. As defined in the Best Management Strategies Guide[11], strategies for municipal water users included residential clothes washer incentive program, school education, public information, landscape irrigation conservation and incentives, and water wise landscape design and conversion programs, among others.

After conversations with various municipal water users in the region, it was determined that the most feasible advanced conservation methods were public

[11] Texas Water Development Board Water Conservation Implementation Task Force; Report 362, "Water Conservation Best Management Practices Guide," November 2004.

information, school education, and the installation of higher efficiency residential clothes washers.

Public Information/School Education
Advanced water conservation through public information and school education is both a short-term and long-term conservation measure. In the short-term, individuals may realize the benefit of water conservation themselves, resulting in increased water savings. In the long-term, the affected individual may encourage additional water conservation among peers and family alike. This strategy is especially effective when combined with another conservation measure.

Residential Clothes Washers
In 2001, the Unites States Department of Energy (DOE) adopted a two-step phase-in of higher efficiency standards for residential clothes washers. In 2004, all clothes washers manufactured were required to be 20 percent more efficient than the previous standard. In 2007, all clothes washers manufactured were required to be 35 percent more efficient than the previous standard. Water conservation will be a direct result of increased efficiency.

4.5.4.2 Water Supply Yield

The goal and effect of implementing additional or advanced municipal water conservation measures is to reduce projected municipal water demands and thereby reduce future needs for additional supply. In a real sense, water demand management through properly designed and funded water conservation programs can be viewed as providing an additional source of water equivalent to new supply development and other supply acquisition strategies.

It is estimated that the conversion from an old clothes washer to a new, higher efficiency clothes washer can save 5.6 gallons per-capita per day. The DOE's mandate has been in effect since 2007. With this being said, it was assumed that all new washing machines purchased in 2010 and extending until the end of the planning study would incorporate a higher efficiency design and save 5.6 gallons per-capita per day. In order to model this scenario, the Regional Planning Group applied the washing machine water conservation figure as a function of increased population over the base year population. For instance, the year 2000 population of the entire region is 1,236,246. The year 2010 projected population is 1,628,278.

Therefore, the difference in year 2000 population and year 2010 population is modeled as conserving 5.6 gallons per-person per day (392,032 people x 5.6 gallons per person = 1,960,160 gallons conserved daily). Similarly, in the year 2060, expected water conservation is calculated by multiplying the difference in year 2000 base population and year 2060 projected population by 5.6 gallons per-person per day. The following table represents a county-by-county breakdown of the water supply yield associated with washing machine conservation.

Table 4.35: Washing Machine Conservation

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Water Supply Yield (AF/yr)	3,150	8,723	8	289	505	3,315	66	72

Public information and school education measures have the potential to conserve a considerable amount of water over the span of the planning study. However, according to the Best Management Practices Guide, "Water savings for school education programs are difficult to quantify and therefore estimated savings are not included in this BMP." The same scenario exists for Public Information. Most of the available water savings data associated with these methods includes other BMPs. For instance, if a retrofit kit is provided along with education, water savings can be calculated according to the Residential Retrofit BMP. In this region, public information and school education are stand alone water conservation measures. Therefore, the Regional Planning Group estimated potential savings to accrue at a rate of 1 gallon per-capita per day. Another issue facing the planning group is determining the extent of water savings. The method adopted by the Regional Planning Group is similar to that of the Washing Machine Installation Advanced Water Conservation Measure. By taking the projected increase in population over the base 2000 year population and multiplying it by the projected water savings associated with this conservation method (1 gallon per-capita per day), a reasonable conclusion is derived. The following table represents the Water Supply Yield associated with Public Information and School Education.

Table 4.36: Public Information/School Education Savings

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Water Supply Yield (AF/yr)	563	1,558	1	52	91	592	12	13

Combined water savings associated with Public Information, School Education, and Washing Machine Installation are shown in the following table. These findings represent the total water savings associated with Advanced Water Conservation.

Table 4.37: Advanced Water Conservation Savings

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Water Supply Yield (AF/yr)	4,810	17,373	7	341	810	3,906	79	85

Using this method, Cameron County was assigned a yield of 3,713 acre-ft for advanced conservation. Hidalgo County was assigned a yield of 10,281 acre-ft which is the largest yield for the region. Webb County was assigned a yield of 3,907 acre-ft. Starr County was assigned a yield of 595 acre-ft. Maverick County was assigned a yield of 341 acre-ft. Zapata (85), Willacy (78), and Jim Hogg (9) counties were assigned a yield less than 100 acre-ft. The supply distribution was based on the population in the each county. The supply yield was determined for Advanced Water Conservation by finding the percentage of the WUG population to the total county population, and then multiplying that percentage by the available supply for the respective county. Individual Water User Group Advanced Water Conservation figures can be seen in the appendix.

4.5.4.3 Cost

To achieve the estimated water savings associated with the advanced municipal water conservation scenario, a significant commitment of funding and other resources to implement the measures will be required. Cost elements of a program to achieve the estimated savings include funding for educational and public awareness activities and staff to manage and implement the various programs. It is important to note that the investment in municipal water conservation requires substantial front-end funding at the outset and for the duration of the planning period. Because the effects of conservation are incremental and build over time, the initial costs on a unit basis are relatively high at the outset and then decline significantly over time.

The cost for Advanced Conservation will take into consideration the population of the region multiplied by the cost proposed for public education & school education by Best Management Practices Guide provided by TWDB which is estimated to be $5/person. The annual cost for public education was calculated by using the population projected for 2010 by the TWDB which is 1,628,278. The population for the region was then multiplied by the cost of conservation education (Cost of Public Education @$5 per person). The cost for public education was estimated to be $6,999,989..

The annual cost for school education was calculated by using the population of school age children based on the 2008/ US Census which was calculated to be 349,008. This population was multiplied by the cost of school conservation education (Cost of Public Education @$5 per person). The cost for school education was estimated to be $1,793,256.

The total costs of school education and public education are $8,793,245. Then the other capital outlays cost was calculated taking interest, engineering, mitigation, and environmental costs, which was calculated to be $3,824,755. Finally, the total capital cost of the project is set to $12,618,000. There is no annual cost for this project based on the guidelines set by TWDB.

4.5.4.4 Environmental Impacts

Since this strategy deals specifically with conserving municipal water, there are no adverse effects to the environmental needs of the region.

4.5.4.5 Implementation Issues

In this round of regional planning, only three methods are being recognized as feasible: public information, school education, and residential clothes washer installation. In order to realize the full potential of advanced water conservation, additional strategies must be implemented. However, there are many factors hampering the willingness of municipal WUGs to apply such strategies.

Region-wide implementation of advanced municipal water conservation measures will require a commitment of funding and other resources by nearly all public water suppliers in the Rio Grande Region. In addition to funding, many public water suppliers in the region, particularly small systems, lack the staff resources to devote to the development and implementation of water conservation programs. Perhaps the most fundamental problem with implementation of this strategy is the number of small water systems with a large number of small diameter lines that prevent the opportunity to cost effectively save water. This could be addressed through the development of regional approaches to implementation of conservation measures including regionalization of the water transmission and distribution network. For example, larger municipal water suppliers might allow smaller neighboring suppliers to participate in the implementation of certain programs (e.g., rebates for plumbing fixture replacement).

4.5.4.6 Recommendations

The Rio Grande RWPG recommends region-wide implementation of municipal water conservation programs that incorporate the elements of public information, school education, and residential clothes washer installation as defined by the Water Implementation Conservation Task Force, which has now been abolished since January 1, 2005. It is further recommended that all municipal water users with projected shortages implement additional water conservation programs that will reduce projected water demands.

4.5.5 Seawater Desalination

On April 29, 2002, Governor Rick Perry directed the Texas Water Development Board (TWDB) to develop a recommendation for a demonstration seawater desalination project as one step toward securing an abundant water supply to meet Texas' future water supply needs. In December 2004, TWDB released a Biennial Report on Seawater Desalination: "The Future of Desalination in Texas" Volume I & II. Proposals were received from several areas around the state. In Region M, Brownsville submitted a proposal to provide seawater desalination as a strategy to meet future demands of the area.

The available water supply would be from the Gulf of Mexico via the Port of Brownsville Ship Channel. The quantity of supply would not be problem in quantities proposed for 25 MGD seawater plant. This would require a 45 MGD intake with discharge of approximately 20 MGD concentrate. Other potential intakes could be closer to the Gulf of Mexico.

4.5.5.1 Strategy Description

There are several types of desalination methods to treat seawater. Such methods include thermal processes such as multistage flash distillation, multiple-effect distillation, and vapor compression. These energy intensive processes are more common in the Middle East where fuels are more abundant.

Membrane technologies are more prevalent today using reverse osmosis (RO). This process is also energy intensive where semi permeable membranes are used. For higher total dissolved solids (TDS) found in seawater, high pressures are used to separate the seawater into fresh water and a concentrated by-product. The RO process is the most common form of desalination of seawater. A typical pressure for seawater with 35,000 mg/l could be in excess of 1000 psi. That compares to less than 200 psi for 3,000 mg/l TDS groundwater. The higher TDS plants yield less than 50% of the water supplied. The remaining 50% is the concentrated by-product. This compares to approximately 80% with the lower brackish water facilities. Surface water intakes will require additional pretreatment of suspended solids prior to the RO treatment.

Seawater desalination still remains one of the higher cost water management strategies, but cost is expected to continue to decline in the coming years as technology advances. Cost for seawater desalination is site dependant. It is expected that a seawater desalination facility would range in cost from $820 to over $1,300 per acre-foot. When placed in conjunction with power generation facilities, power costs can be lower and a combined water intake and discharge will lower capital costs. Assessing the actual cost should be included in a feasibility analysis.

The TWDB recommends that feasibility studies for these projects be completed. These projects should be of a regional nature. Other TWDB recommendations include: assessment of combined uses of seawater and brackish groundwater sources as a means of enhancing the cost-competitiveness of a desalination project; identification and assessment of regional partnerships inclusive of local entities experienced in desalination research; identification and assessment of water transfers resulting from net new water created by a desalination project that could enhance the benefits of the project to other large water users/municipalities in the Coastal, Lower Rio Grande, South Central and Lower

Colorado planning regions, including approaches to structuring such transfers and draft agreements that would be required to secure their implementation; identification and assessment of likely power sources and expected cost over the life of the project and, if from a co-located facility, description of the impact of current and proposed regulations on use of this source, plus costs; and assessment of project funding and development alternatives.

Desalination of seawater was evaluated as a potential strategy for meeting DMI water demands within the Rio Grande Region. The evaluation was based on a study entitled "Seawater Desalination Feasibility Study in the Laguna Madre Area" that was completed in December 1997. This study provided background information, and described a reverse osmosis pilot study performed to assess the feasibility of using seawater as a water source. The study also determined key design parameters and estimated costs that would be associated with a full-scale seawater desalination facility.

Additionally, the feasibility of seawater desalination was also evaluated in a report prepared for the TWDB entitled, *Desalination for Texas Water Supply*. This study included water supply yield and cost estimates for a full-scale desalination facility located in the vicinity of Port Isabel. During the past 20 years, membrane technology has advanced significantly, resulting in more efficient and relatively lower cost membranes. Globally, desalination capacity has been increasing at approximately 12 percent a year and currently is estimated to be about 7 billion gallons per day (BGD).[12] There are more than 8,600 desalination plants installed globally, approximately 20 percent of which are in the U.S.A.[13]

As a potential water supply strategy for the Rio Grande Region, seawater desalination would involve the development of a full-scale facility in the vicinity of the Port of Brownsville and/or South Padre Island. This project would be sponsored by the Southmost Regional Water Authority to initially serve southeast Cameron County but could grow to other cities in the lower and mid valley area including Cameron and Hidalgo Counties. The Laguna Madre Water District is planning an initial 1.0 MGD seawater plant in the near term to supplement their current supply. The plant is proposed on South Padre Island. Currently on South Padre Island, Laguna Madre is running a seawater desalination pilot plant.

[12] U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center. Desalting Handbook for Planners, 3rd Edition, 2002.
[13] Ibid.

Table 4.38: Technical Characteristics

Technical Characteristics			
	Brownsville (25 MGD)	**Corpus Christi (25 MGD)**	**Freeport (10 MGD)**
Source Water	Brownsville Ship Channel	Gulf of Mexico	Gulf Coast Seawater or Brazos River Water
Intake	Screened Intake at Brownsville Ship Channel	Open sea intake: 8.2 miles of 72-inch pipeline	Existing Dow Chemical Seawater & Brazos River Intake System
Treatment Capacity	25 MGD expandable to 100 MGD by 2040	25 MGD	10 MGD
Concentrate Disposal	Open sea discharge with diffuser array: 15 miles of 36-inch concentrate transmission pipeline	Open sea discharge with diffuser array: 8.2 miles of 54-inch concentrate transmission pipeline	Existing Permitted Dow Freeport discharge canals and outfall

***Referenced Costs from the TWDB's Biennial Report on Seawater Desalination: "The Future of Desalination in Texas Volume 1**

4.5.5.2 Water Supply Yield

The water supply yield of a seawater desalination facility is variable. The facility considered in the Port of Brownsville would provide 25 MGD. A Laguna Madre study indicated to provide 1.0 MGD (1,120 ac-ft/yr) of water supply assuming 100 percent utilization of the facility. For the purpose of this plan, 5 MGD capacity is projected for Brownsville and roughly 1 MGD for the Laguna Madre Water District.

Table 4.39: Water Supply Yield for Seawater Desalination

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft)	7,902	0	0	0	0	0	0	0

4.5.5.3 Cost

Cost estimates were developed for a 1 mgd desalination facility near Port Isabel in 1996. Estimated total project costs are $170 billion, with total annual costs of nearly $65.7 billion. Based on an estimated firm yield of 1,120 acre-feet per year, the cost estimate per acre-foot is $1,300. During a presentation the project team for the Port of Brownsville project indicated a capital cost of $120 million with a combined debt service and operation cost of $4.06/1000 gallons or $1322.96 per acre–foot.[14] This indicates that a larger facility is more cost effective due to economies of scale. It is also site specific where placed in conjunction with power generation facilities will lower power costs and provide a combined water intake. It should be noted that this presentation is only conceptual in nature. Assessing the actual cost should be included in the

[14] The Future of Desalination in Texas Workshop, Austin, Texas 2003, Concept Paper Presented by Dannenbaum Engineering Co. and URS Company.

feasibility analysis. The following data was provided by the TWDB. It shows the costs for three feasible seawater desalination plants located along the Texas coast.

Table 4.40: Seawater Plants Cost Breakdown

	Brownsville 25 MGD	Corpus Christi 25 MGD	Freeport 10 MGD
$/1,000 gallons	3.22	3.51	3.37
$/ acre-ft	1,050	1,133	1,088

*Referenced Costs from the TWDB's Biennial Report on Seawater Desalination: "The Future of Desalination in Texas Volume 1

Table 4.41: Cost of Treated Desalinated Water Delivered to the Distribution System

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Seawater Desalination	$ 1,050.61	$ 3.22	G of Cost Analysis Appendix

*Referenced Costs from the TWDB's Biennial Report on Seawater Desalination: "The Future of Desalination in Texas Volume 1

Table 4.42: WMS Strategy Cost Summary (Seawater Desalination)

	Brownsville (25 MGD)	Corpus Christi (25 MGD)	Freeport (10 MGD)
Capital Cost	$ 170,000,000.00	$ 196,600,000.00	$ 93,183,000.00
Annual Cost of O&M	$ 65,000,000.00	$ 17,515,000.00	$ 7,364,100.00
Annual Potential Cost Off-sets to O&M	$2,372,500/yr (Sale/Lease of water rights)	$5,000,000/yr (Sale of raw water to San Antonio)	NONE

4.5.5.4 Environmental Impacts

Major environmental issues associated with a large-scale seawater desalination facility include disposal of the brine concentrate produced from the membrane filtration process, energy consumption associated with operation of the facility, and land and environmental resource impacts associated with the construction and operation of the facility and the construction of a treated water transmission pipeline. The impacts of concentrate disposal would be minimal with dispersion into seawater at an offshore location. Land and environmental resource impacts could be avoided or minimized through careful location planning.

The need for education in this area exists at all levels, including water utilities staff and officials, consultants, TCEQ, funding agencies, the public, environmental agencies, and environmentalists. The experience of each one of these groups in dealing with membrane technology and membrane concentrate disposal is somewhat different. Each one of these groups forms their own perspective related to these topics based on their particular experience. All these groups need to be educated about the permitting process related to membrane concentrate disposal, and the nature of membrane processes and the membrane concentrate.

The TCEQ will need to develop permit applications more relevant to membrane concentrate applications. The existing permit applications could be modified by removal and addition of sections that apply to membrane concentrate and tailored to meet the information needs peculiar to membrane processes. It will become necessary for the TCEQ to provide permit applicants with a clearer understanding of the needed information, guidelines, and procedures for the permitting process.

The label applied to the membrane concentrate as an "industrial" discharge could be misleading and creates some misunderstanding in the public eye. The permit process chart indicates that anything not a domestic waste is automatically an industrial waste. Membrane concentrate is, therefore, considered an industrial waste. The label of industrial discharge applied to the membrane concentrate can be construed as a discharge of a toxic or hazardous nature. The greatest concern is then public perception. This public perception can, in turn, affect the decisions of decision makers on how drinking water needs are to be met. It is necessary to communicate and interact with the public to provide a clear understanding of the membrane concentrate rather than avoiding short-term unpleasant confrontations which can typically lead to long-term problems.

The goal should be to increase our understanding of any environmental concerns for the protection of environmental resources. This understanding will allow for a more effective way of dealing with concentrate disposal based on a sound knowledge of the nature of membrane concentrate. The planning and implementation of a reverse osmosis facility will require the processing of a membrane concentrate disposal permit. It is important for the utility to have the confidence that the given permit will be allowed to be renewed after the expiration date. Therefore, it is necessary to push for well established regulations for evaluation of membrane concentrate permits.

4.5.5.5 Implementation Issues

A major implementation issue for a large-scale desalination facility is whether there are users that are willing to finance and implement such a project. Brownsville currently holds rights and contracts to Rio Grande water supplies sufficient to meet current demands. The City of Brownsville Public Utilities Board has also indicated that it intends to develop the Brownsville Weir and Reservoir, local groundwater supplies, and non-potable reuse of reclaimed water to meets its future water supply needs. Brownsville's local water supply plan does now include seawater desalination if proven feasible by further study in conjunction with power generation facilities.

Costs could be further reduced with grant proceeds to assist in financing this option. There also exists a possibility that a large scale facility could serve other areas in the lower and mid-Valley area. A seawater desalination project could become a more feasible water supply strategy for Brownsville if it were to sell all or a large portion of its existing Rio Grande water rights to other DMI users. This could have the benefit of providing a revenue source to offset a portion of the costs of a desalination project while also making DMI water rights available to meet the future needs of other DMI water users in the region.

The permits for a seawater desalination project, although not insignificant, do not appear to place unreasonable requirements on such a project. The first seawater desalination project to go through the permit phase shall nevertheless be closely monitored to identify specific areas in which permitting processes might need to be adjusted to facilitate future seawater desalination projects in Texas.[15]

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved and with the Endangered Species Act if any threatened and endangered species is impacted. Regulatory permitting of a large-scale desalination facility in the vicinity of Port Isabel would require extensive coordination with numerous federal, state, and local agencies. Land acquisition for the desalination facility and acquisition of right-of-way for construction of the concentrate disposal pipeline and treated water pipeline would also be major implementation issues. The treatment facility should be located to minimize cultural resource impacts. Also, pipelines should follow existing and shared ROWs whenever possible to minimize the area of cultural disturbance.

4.5.5.6 Recommendation

Seawater Desalination still remains one of the higher cost water management strategies but cost is expected to continue to decline in the coming years as technology advances. The large DMI demand centers in relative proximity to the Gulf of Mexico (e.g., Brownsville) have expressed an interest in pursuing seawater desalination as a future water supply strategy through the Governor's initiative. It is recommended that this be a recommended strategy to provide desalinated seawater to the southeast Cameron County area through the year 2010. A total of 5 MGD is allowed for this strategy at this time for Brownsville and 1 MGD for Laguna Madre Water District.

[15] Texas Water Development Board, 2003

4.5.6 Brackish Water Desalination

4.5.6.1 Strategy Description

Desalination of Brackish Groundwater is most commonly accomplished through reverse osmosis (RO). A full scale RO system to treat brackish groundwater would require pretreatment, which would include a cartridge filtration system to remove minimal suspended solids. Acid and a silica scale inhibitor would also be added to prevent scale formation. A full-scale system would be expected to have a membrane life of approximately five years. Chemical cleaning of the membrane would be required approximately one to four times per year. Concentrate from the RO system must be disposed of in an environmentally acceptable manner. Most of the current or proposed systems will utilize drainage ditch discharge, which ultimately will discharge into the Laguna Madre or the Gulf of Mexico. Other options include disposal to a sewer system and deep well injection.

Recent awareness of the cost effectiveness of RO treatment of brackish water has made this a supply source of greater importance. The availability of brackish groundwater from the aquifer is moderate. There are large volumes of brackish water available from the Gulf Coast aquifer throughout Region M, however, the aquifer is significantly less productive than in other regions along the Gulf Coast. Even though the area where brackish water is found increases, the availability is only considered average due to the decreased productivity.

4.5.6.2 Water Supply Yield

Table 4.43: Brackish Desalination Project Capacities

Brackish Desalination Project Capacities			
Formal Name	**Projects**	**Size**	**Location**
Valley Municipal Utilities District #2	VMUD#2 (Rancho Viejo)	0.25 MGD	Cameron County
Reverse Osmosis Facility North Alamo Water Supply Corporation-La Sara Site	La Sara (NAWSC)	1 MGD	Willacy County
North Regional Water Project	North Cameron (NAWSC & ERWSC)	2 MGD	Cameron County
Reverse Osmosis Facility North Alamo Water Supply Corporation- Owassa Site #4	Owassa Site #4 (NAWSC)	3 MGD	Hidalgo County
Reverse Osmosis Facility North Alamo Water Supply Corporation-Dolittle Site #1	Dolittle Site #1 (NAWSC)	3 MGD	Hidalgo County
Southmost Regional Water Authority	SRWA	7.5 MGD	Cameron County

The total amount of water supply that could be made available from the Gulf Coast aquifer with advanced water treatment technology is estimated to be

262,330 acre-ft in 2010. It is projected that the Carrizo Aquifer has a water availability of 19,150 acre-ft in 2010. As indicated, the various desalination plants constructed or under construction in this region range from .25 MGD to 7.5 MGD being pumped from a wellfield.

Table 4.44 gives a county-by-county breakdown of proposed Brackish Water Desalination water supplies. The net sum of all counties is 69,832 acre-feet, well below the available water supply of 262,330 acre-feet.

Table 4.44: Water Supply Yield for Brackish Water Desalination

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft)	25,069	23,066	0	641	1,498	10,100	11,326	0

4.5.6.3 Cost

The annual cost per acre-ft for this strategy to be implemented in this region was estimated to be $465.10. The sizes of the brackish desalination plants in this region range from .25 MGD to 7.5 MGD[16]. Further cost data updated to include current projects completed or in the planning and design stage are summarized in the Appendix of this plan. Costs include Well Field, Well Field Collection and Treatment Facilities. It does not include pumping and distribution costs. A major factor not included in these figures is the cost of water rights. The latest cost to purchase water rights is approximately $2,300/acre-foot. If financed for 20 years at 6% interest, the annual cost per acre foot would be $542.74. This could be deducted from the following costs as the capital cost includes the development of the groundwater source. Costs vary due to plant size, location, and water source salinity.

Table 4.45: WMS Strategy Cost Summary (Brackish Water Desalination)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Brackish Water Desalination	$ 465.10	$ 1.43	H of Cost Analysis Appendix

4.5.6.4 Environmental Impact

The use of membrane systems for potable water production in the Region M area is expected to increase dramatically in the next ten years. The primary environmental issue associated with the development of brackish groundwater supplies is the disposal of the concentrate produced from the membrane process. Reverse osmosis (RO) concentrate disposal must be dealt with by utilizing environmentally sound and cost effective methods developed to support membrane technology growth in this area. We know that membrane processes

[16] Data Provided By NRS Consulting Engineers

are technically and economically well suited to produce drinking water, however, the disposal of concentrate can be more difficult and more expensive.

The need for education in this area exists at all levels, including water utilities staff and officials, consultants, TCEQ, funding agencies, the public, environmental agencies, and environmentalists. The experience of each one of these groups in dealing with membrane technology and membrane concentrate disposal is somewhat different. Each one of these groups forms their own perspective related to these topics based on their particular experience. All these groups need to be educated about the permitting process related to membrane concentrate disposal, and the nature of membrane processes and the membrane concentrate.

The TCEQ will need to develop permit applications more relevant to membrane concentrate applications. The existing permit applications could be modified by removal and addition of sections that apply to membrane concentrate and tailored to meet the information needs peculiar to membrane processes.

It will become necessary for the TCEQ to provide permit applicants with a clearer understanding of the needed information, guidelines, and procedures for the permitting process. TCEQ should also include protective measures regarding mineral content of RO discharges.

The label applied to the membrane concentrate as an "industrial" discharge could be misleading and creates some misunderstanding on the public eye. The permit process chart indicates that anything not a domestic waste is automatically an industrial waste. Membrane concentrate is, therefore, considered an industrial waste. The label of industrial discharge applied to the membrane concentrate can be construed as a discharge of a toxic or hazardous nature. The greatest concern is then public perception. This public perception can, in turn, affect the decisions of decision makers on how drinking water needs are to be met. It is necessary to communicate and interact with the public to provide a clear understanding of the membrane concentrate rather than avoiding short-term unpleasant confrontations which can typically lead to long-term problems.

The goal should be to increase our understanding of any environmental concerns for the protection of environmental resources. This understanding will allow for a more effective way of dealing with concentrate disposal based on a sound knowledge of the nature of membrane concentrate. Also, the ability of receiving streams to receive desalination effluent should be evaluated. If the receiving stream system would be negatively affected in a manner that would cause severe and permanent damage, alternate receiving waters should be evaluated. The planning and implementation of a reverse osmosis facility will require the processing of a membrane concentrate disposal permit. It is important for the utility to have the confidence that the given permit will be allowed to be renewed after the expiration date. Therefore, it is necessary to push for well-established regulations for evaluation of membrane concentrate permits.

There are data provided by cooperating agencies to address and reference the impacts to aquifer levels due to the removal groundwater supplies. A 100 ft/50yrs draw down is estimated through the projections calculated in Chapter 3. There are potential impacts associated with groundwater removal, but due to a lack of region-specific studies performed in this regard, an accurate description of these impacts cannot be quantified. Simulations with available GAMs indicate that drawdown from proposed groundwater strategies will have very little impact on streamflow in Region M. Most of the groundwater from the Gulf Coast aquifer is produced from aquifer storage (Chowdhury and Mace, 2003). Groundwater production from the downdip portion of the Carrizo-Wilcox aquifer would also remove water mainly from confined storage within the aquifer.

4.5.6.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, projects may need to comply with the National Environmental Policy Act, if federal funding is involved, and with either Section 7 or Section 10 Consultation under the Endangered Species Act if any threatened and endangered species is impacted. Potential impacts on cultural resources may result from pipeline construction and operation. Therefore, pipelines should follow existing and shared ROWs whenever possible to minimize the area of disturbance. The small area disturbed due to well construction and operation is not expected to have a large impact on cultural resources. There are no other significant implementation issues associated with this strategy. However, additional technical information is required on the availability, quality, and cost of developing groundwater as a supply source for DMI uses. Also, consideration should be given to converting some DMI users entirely from surface to groundwater.

4.5.6.6 Recommendations

Based on the success of previous pilot studies and implementation of the VMUD, SRWA, and North Alamo WSC projects, and their potential for water supply, it is recommended that Brackish Groundwater Treatment be a water management strategy for DMI users. Much testing continues to take place to determine site-specific water availability and areas for concentrate disposal for many planned projects in the Region.

Additional study should continue to take place to more fully assess both the availability and cost of groundwater supplies from the Gulf Coast aquifer in Cameron, Hidalgo, Jim Hogg, Webb, and Willacy counties. The development of a groundwater model for this portion of the Gulf Coast aquifer will aid in determining how much groundwater could be withdrawn from the aquifer for municipal use on a sustainable basis. Once these data and analytical tools are available, it is recommended that a comprehensive assessment be conducted to identify areas most promising for groundwater development. Additional opportunities for developing brackish groundwater as a substitute for current municipal supplies from the Rio Grande should be thoroughly explored.

4.5.7 Groundwater: Wellfield in Gulf Coast Aquifer

4.5.7.1 Strategy Description

The Gulf Coast Aquifer contains fresh and brackish groundwater. The southern Gulf Coast GAM indicates that groundwater is available from the aquifer in this area. Well production estimates range from 200 to 600 gal/min. The quality of the groundwater is expected to meet most standards for public water supplies and require minimal treatment. If required, the groundwater may be mixed with treated surface water to improve water quality.

About 80% of 822 wells containing total dissolved solids (TDS) measurements exceeded the 1,000 mg/L. The average for all of the results is 2,204 mg/L, and the median for all of the results is 1,618 mg/L. Although there may be some local trends regarding water quality, the TDS data for the Gulf Coast aquifer in Region M do not appear to show trends at the regional level. In other words, there are wells containing relatively low TDS water between wells that have relatively high TDS water. Based on the groundwater quality assessment completed for the Gulf Coast aquifer, it is expected that about 20% of the wells in Region M would contain fresh water and about 80% would contain brackish water. The GAM does not estimate the volume of brackish groundwater in storage. Therefore, it is assumed that the 80% of the available groundwater supplies will be brackish (>1000 mg/L TDS) and about 20% would be fresh water (<1000 mg/L TDS).

4.5.7.2 Water Supply Yield

The Gulf Coast Aquifer is projected to have a water supply of 262,330 acre-ft in 2010 through 2060. Out of the 262,330 acre-ft of water supply in the aquifer, 52,466 acre-ft is estimated to be a freshwater source. The rest of the 80% is brackish. The fresh groundwater water yield amount falls under the projected supply for this aquifer. The wellfield project is expected to provide an estimated yield of 29,824 acre-feet per year of additional supply for this region if utilized as a strategy. Table 4.46 gives a county-by-county breakdown of potential water supply yields for groundwater.

Table 4.46: Groundwater Supply Yield

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft/yr)	2,947	9,147	65	0	4,188	7,918	0	0

4.5.7.3 Cost

The estimated construction cost of the wellfield is about $26,952,429 (2009 dollars). The estimated construction cost for the wells (assuming depth and production rate for each well of 300 feet and 7.5 MGD). Annual operation and maintenance costs for the wellfield are estimated at $2,287,458.

TWDB guidelines require an annualized cost to construct the project and deliver water to the end user based on yield assumptions. Consequently, the estimated unit cost of firm water supply from the wellfield is approximately $214.96 per acre-foot per year (see appendix). Of this amount, approximately $136.65 per acre-foot is for development of the water and the balance is for treatment and transfer of the water.

Table 4.47: WMS Strategy Cost Summary (Groundwater)

Water Management Strategy Cost Summary			
	Cost		
WMS	**$/Acre-ft**	**$/1000 gallons**	**Appendix**
Groundwater	$ 214.96	$ 0.66	**I of Cost Ananlysis Appendix**

4.5.7.4 Environmental Impact

No negative environmental effects are anticipated. There may be a water level decline in the deeper zones of the Gulf Coast Aquifer, but this is not expected to impact surface water resources or wetlands. Water level declines are not expected to be high enough to cause appreciable land subsidence. Increased groundwater production will impact the small springs located in the region. The small springs provide water to wildlife and livestock. Water source or loss of water source is discussed in Chapter Three.

Simulations with available GAMs indicate that drawdown from proposed groundwater strategies will have very little impact on streamflow in Region M. Most of the groundwater from the Gulf Coast aquifer is produced from aquifer storage.[17] Groundwater production from the downdip portion of the Carrizo-Wilcox aquifer would also remove water mainly from confined storage within the aquifer.

[17] Chowdhury, A.H., R.E. Mace, 2003. A Groundwater Availability Model of the Gulf Coast Aquifer in Lower Rio Grande Valley, Texas: Numerical Simulations Through 2050.

4.5.7.5 Implementation Issues

Potential implementation issues include the uncertainty of the aquifer production capacity and the water quality of produced water. Because there are a limited number of large production wells in the area, it may take some exploration and multiple borings to determine the best location for wells and the wellfield. These implementation issues may add to the overall project cost.

In addition, if the aquifer production capacity is good, but the water quality is not as good as expected, additional water treatment costs may be incurred, which would also increase the cost of the water.

4.5.7.6 Recommendations

The Wellfield Project is a recommended WMS for this region. It will be a valuable component of the overall water supply for this regional area. The project adds to the overall water supply for Region M by developing additional water that has not been historically used.

4.5.8 Dams, Weirs, and Storage

This Water Management Strategy is actually a combination of four individual strategies: Brownsville Weir and Reservoir, Resaca Restoration, Laredo Low Water Weir, and Banco Morales Reservoir. Due to the uniqueness of each individual project, the analysis of each in terms of strategy description, water supply yield, cost, environmental impact, implementation issues, and recommendations were evaluated separately. However, there are common themes that each strategy shares. The main intent of each project is to increase the volume of available raw water storage for the end user. This could be the result of constructing an on-channel weir and reservoir, removing sediment from existing storage, or constructing an off-channel reservoir. Each individual strategy is analyzed in more detail below.

4.5.8.1 Brownsville Weir and Reservoir

4.5.8.1.1 Strategy Description

The Brownsville Weir and Reservoir Project is being proposed by the Brownsville Public Utilities Board (BPUB) as a surface water development project on the Lower Rio Grande in Cameron County. The proposed project is intended to provide additional dependable water supplies for municipal and industrial use by capturing and diverting "excess" flows of United States waters in the Rio Grande that would flow past Brownsville and discharge to the Gulf of Mexico. The proposed project consists of a weir structure across the channel of the Rio Grande approximately eight miles downstream of the Gateway Bridge at Brownsville. Under normal operating conditions the reservoir created by the proposed weir will have a maximum surface area of

600 acres and store approximately 6,000 acre-feet of water. The reservoir would extend 42 river miles upstream of the proposed weir.

4.5.8.1.2 Water Supply Yield

In addition to other water rights, BPUB currently has authorization to divert up to 40,000 acre-feet per year of “excess flows” from the Rio Grande under TCEQ Permit No. 1838. Excess flows are defined as all U.S. waters passing the Brownsville stream flow gauging station above a base flow rate of 25 cfs. Excess U.S. River flows will be impounded in the Brownsville Reservoir under BPUB’s TCEQ water rights Permit No. 5259. According to hydrologic studies preformed for the project sponsors, the proposed project would allow the diversion of the full 40,000 acre-feet per year authorized under the existing permit approximately 70 percent of the time. However, the firm yield of the project (based on hydrologic analysis for the period from 1960 to 1997) is estimated to be 20,643 acre-feet per year.

4.5.8.1.3 Cost

Based on information supplied in the last regional plan, the cost estimate to construct the Brownsville Weir and Reservoir is $96,541,766. This cost is at present cost compared to the $25.9 million it was projected to be in the first round of planning. TWDB guidelines require an annualized cost to construct the project to deliver water to meet end user based on firm yield requirements. Assuming the firm yield from the diversion is used as the basis for providing treated water for DMI use, the following determination of unit cost was developed. Using TWDB cost estimation guidelines, the inflation adjusted annualized cost to construct, operate, and maintain the project, and provide required treatment, is approximately $11.09 million dollars per year.

Consequently, the unit cost of firm water supply from the project is approximately $182.90 per acre-foot (see WMS Cost Analysis report in Appendix). Of this amount, approximately $1183 per acre foot is used to develop the water and the balance is used to treat and transfer the water.

Table 4.48: WMS Strategy Cost Summary (Brownsville Weir)

Water Management Strategy Cost Summary			
	Cost		
WMS	**$/Acre-ft**	**$/1000 gallons**	**Appendix**
Brownsvillle Weir	$ 182.90	$ 1.78	**J of Cost Analysis Appendix**

4.5.8.1.4 Environmental Impact

Several environmental issues have been raised concerning the proposed Brownsville Weir and Reservoir. These include impacts on water quality (i.e., increased salinity) within and downstream of the reservoir; impacts to aquatic and riparian habitat as a result of changes in downstream flow and salinity patterns; potential impacts to habitat from reservoir construction and inundation; potential adverse impacts to the Audubon Society's Sabal Palm Sanctuary; and increased risk of flooding. Although data isn't available to determine the exact impacts, maintaining environmental flows downstream of the river should be a major concern. The project sponsors have indicated their intent to operate the proposed project in such a manner as to completely avoid or largely mitigate these concerns; resource advocates remain concerned about these issues.

A water right permit for the Brownsville Weir and Reservoir (BWR) Project was issued by the TCEQ on September 29, 2000. This permit authorizes on behalf of the State of Texas the construction of the Brownsville Weir on the Rio Grande and the impoundment of 6,000 acre-feet of Rio Grande water in the Brownsville Reservoir. Special conditions included in this permit require the BPUB to: (1) pass a minimum flow of 25-cfs whenever water is being impounded in the reservoir; (2) pass sufficient water through the reservoir to satisfy the demands of downstream water rights holders as directed by the Rio Grande Watermaster; (3) monitor salinity in the Rio Grande downstream of the weir near the riverine/estuarine interface (23.6 river miles upstream from the mouth of the river) and only impound water in the reservoir when the measured salinity is less than an established near-fresh (low salinity) condition; and (4) consult with the TCEQ, Texas Parks and Wildlife Department (TPWD), U.S. Fish and Wildlife Service (USFWS), and other appropriate agencies to develop and implement an acceptable mitigation plan for the overall BWR Project.

The requirements in the TCEQ permit for the 25-cfs minimum stream flow and for the maximum salinity level at the riverine/estuarine interface are directed toward assuring that the BWR Project will not cause significant changes in estuarine habitat conditions so as to adversely impact existing aquatic resources, such as shrimp and finfish. In order to identify potential impacts of the Project on estuarine aquatic resources, the BPUB will fund a six-year monitoring study that is to be undertaken by the TPWD after the Project has been constructed and in operation.

The required mitigation plan for the Project will be developed and finalized through the Section 404/10 Federal permitting process that is now underway under the authority of the Galveston District of the Corps of Engineers (Corps). Although the mitigation plan will include a variety of measures dealing with the Project's environmental impacts, it will focus on protecting and/or re-establishing riparian habitat along the reservoir reach of the Rio Grande for two endangered species of cats, the ocelot and the jaguarundi. Other issues to be addressed as part of the mitigation plan will include runoff and pollution control strategies during construction activities, bank erosion control measures, temporarily and permanently impacted vegetation, wetland habitat impacts, passage facilities for supporting the upstream and downstream migration of aquatic species through the weir structure, and identification of potential impacts of the Project to federal, state and private environmental preserves and cultural/historical resources in the region. BPUB currently is engaged in Section 7 Consultation of the ESA with the USFWS, Corps and other agencies regarding the Project's potential impacts on endangered species and the development of appropriate mitigation measures. Also, the Corps is evaluating public comments regarding the BWR Project and comments received from the various federal and state resource agencies to determine whether or not a full environmental impact statement needs to be prepared for the Project.

In summary, all of the environmental issues that have been raised regarding the BWR Project will have to be satisfactorily addressed through the Section 404/10 Federal permitting process and through the IBWC project approval process in order for the necessary authorizations for the Project to be issued by the various agencies. Otherwise, the Project cannot be constructed and operated. This also will include authorization for the Project from Mexico. The IBWC will be the lead agency for all discussions and dealings with Mexico, and these discussions and dealings will not be undertaken until after the Section 404/10 permit has been issued by the Corps.

4.5.8.1.5 Implementation Issues

In addition to environmental issues, there is significant concern about the effect that construction and operation of the project could have on the Rio Grande water rights system and, in particular, the effect on "no-charge pumping." According to the 1994 Hydrology Report and as amended in 1999 "… the existence of the Brownsville Weir and Reservoir should not impact no-charge pumping conditions since these proposed facilities will be located near the lower end of the Rio Grande below where any excess flows might enter the river …". The report also states that when the Watermaster designates excess flow conditions below Anzalduas Dam, water right holders are notified in consecutive river order going downstream. These diverters are then allocated water until the available no-charge pumping supply is exhausted. Diverters downstream of this point do not receive any of the available excess flows. Since the proposed project is downstream of most of these diverters, the project should not affect no-charge pumping. In addition, BPUB has agreed to pass any available no-charge water through the proposed weir if it is requested by existing downstream water rights holders. Nonetheless, some irrigation districts continue to express concerns that the project would reduce the amount of "free water" available during no-charge periods it could affect accounting of water under the 1944 Treaty.

A comprehensive cultural resources evaluation will be undertaken as part of the Section 404/10 permitting process for the BWR Project. Field surveys will be conducted for the purpose of identifying existing archeological and/or historical resources of significance that potentially may be impacted by the Project. Working with the Texas Historical Commission, procedures for avoiding or minimizing these impacts will be developed and incorporated into the mitigation plan for the Project.

The issue of flooding impacts associated with the BWR Project also is being addressed by the BPUB. Under the current regulations of the IBWC, the proposed BWR Project cannot cause any increase in flood levels along the Rio Grande for the design flood condition. This condition corresponds to a flood flow of 20,000 cfs in the river at Brownsville. Currently, the BPUB is evaluating the flooding impacts of the Project using a state-of-the-art hydraulic computer model of the reach of the river from the weir upstream to the Gateway Bridge. The IBWC has reviewed preliminary modeling results and has suggested revisions, which now are being incorporated into the analysis. The objective of these studies is to develop a design for the weir structure that will be satisfactory to the IBWC and that will not cause any increase in design flood levels along the river.

This work also is important because of an existing agreement between the IBWC and the USFWS that authorizes maintenance of only certain portions of the floodway between the levees along the Rio Grande in the vicinity of Brownsville so as to preserve minimum habitat areas for the endangered species of cats.

Concerns have also been expressed that a new structure at Brownsville could be designated as the new final water accounting point under the treaty dividing Rio Grande waters between the U.S. and Mexico. At present, the final accounting point is designated as the Anzalduas Dam located approximately 120 river miles upstream of the proposed Brownsville Weir. The concern is that a change in the physical point in accounting could in some manner alter the availability of water for Texas diverters. The project sponsors have stated that under their proposal "no identifiable harm" will occur if the IBWC chooses to move the accounting point from Anzalduas Dam to the proposed Brownsville Weir. IBWC staff has indicated that the only treaty implication associated with the proposed project is that Mexico could request, under terms of the treaty, to participate in the project and use it to capture excess river flows owned by Mexico. Conceivably, Mexican participation in the project could reduce the yield associated with capturing excess U.S. flows by decreasing the amount of U.S. storage capacity in the proposed reservoir and affect water supply to other water right holders because the changes in water accounting or river operations by the IBWC. However, Mexico's involvement in the project could offset the initial and operating costs of the weir.

4.5.8.1.6 Recommendations

Based on the criteria established for the final recommendations for meeting the DMI shortages, Brownsville Weir and Reservoir was recommended by the Rio Grande RWPG as a water management strategy toward meeting Brownsville's future needs.

4.5.8.2 Resaca Restoration

4.5.8.2.1 Strategy Description

Resacas and reservoirs are used by a number of municipalities and irrigation districts in the region as a form of storing surface water. Preliminary discussions with many of these entities have allowed the planning group to ascertain that dredging and other forms [i.e. refurbishing of earthen liner, removal of plant material and debris, etc.] of restoration have the potential to: 1) provide additional water storage capacity; and 2) reduce the overall percentage of water lost due to seepage and evaporation as a function of storage capacity. In addition, as water rights are transferred from one user to another, there is the potential that storage capacity could also be transferred.

Resacas are former channels of the Rio Grande. Due to the damming of the Rio Grande (e.g. Amistad and Falcon Reservoirs), resacas are no longer natural waterways. Instead, resacas are naturally cut off from the Rio Grande, and they have no natural inlet or outlet. Before the Amistad and Falcon Reservoirs were built, resacas were filled through the natural flooding of the Rio Grande. In the early 1900's, the use of resacas for water storage, primarily for irrigation usage, began. Now, many resacas are filled through pumping. These resacas are used not only by irrigation users but also domestic-industrial users. Due to the terrain of the area, these small storage reservoirs are very shallow in nature, often being less than 10 feet deep. Due to the natural physics of storage reservoirs, siltation occurs when the flow of water is less than the sedimentation velocity of particles in the water. Therefore, over time, sedimentation causes a reduction in storage capacity.

The Brownsville Public Utilities Board (BPUB) is actively pursuing the dredging of resacas to return storage capacity to previous levels (prior to sedimentation).

4.5.8.2.2 Water Supply Yield

One of the most significant benefits of this project will be to provide additional capacity for storing raw water. This additional quantity of water will help to supplement available water supply during periods of shortages. Approximately 1,700 acre-feet of additional storage capacity can be created within the 3,500 acre Resaca system by removing bottom sediments and some of the underlying clay material. This is equivalent to about 2.7 million cubic yards. Using a combination of excess flows in the river, TCEQ permit No. 1838 water, and existing water supplies, it is anticipated that the diversion of the full 1,700 acre-feet of water will be available approximately 70% of the time. However, the firm yield is estimated to be 877 acre-feet per year.

4.5.8.2.3 Cost

The capital cost of the project, including engineering, is estimated to be $52,000,000. TWDB guidelines require an annualized cost to construct the project which is based on firm yield requirements. The firm yield was calculated from the combined construction project costs, regulatory, water rights and land acquisition expenses. The operation and maintenance of this project is estimated to be $25,000 annually. The unit cost of firm water supply from the project is approximately $2,542 per acre-foot.

Table 4.49: WMS Strategy Cost Summary (Resaca Restoration)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Resaca Restoration	$ 2,542	$ 7.79	K of Cost Analysis Appendix

4.5.8.2.4 Environmental Impact

The environmental impact of this strategy will be predominantly related to water quality and disposal of solids during dredging activities. Solids generated during the process are either organic or non-organic in nature. Often, the disposal method of choice entails drying of removed solids with either mechanical dewatering or evaporative methods. Once the solids are of a certain quality, the material is then hauled to a landfill. Impacts to aquatic and riparian habitat are limited. In terms of water quality, a temporary decrease in water quality due to dredging activities will occur. In particular, total organic carbon (TOC) and total suspended solids (TSS) will increase temporarily.

In terms of the construction activity itself, a temporary increase in noise and air pollution will result. The construction will also have little to no direct impact to aquatic and riparian habitat of the resacas. In fact, dredging activities will help to return resacas to their original status thereby increasing the amount of water stored. This, in turn, will increase the available water habitat for a variety of species.

For this project, Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), U.S. Fish and Wildlife Service

(USFWS), and any other appropriate agencies will assist in developing and implementing an acceptable mitigation plan for the project. Further, this project will most likely need to obtain a 404 Corps of Engineers' Permit with subsequent coordination with other agencies and land owners. Approval would be required for fuel storage.

During the dredging activities, special care should be taken to minimize the on-site storage of sediment. By developing a system of dredging concurrent with drying and removal of solids, the short term storage of dredging byproducts should be minimized.

Chapter 1 of the Regional Plan lists critically endangered species of plants, animals, fish, and amphibians. Construction activities are not anticipated to harm any of these species. However, a detailed evaluation of potential impacts should be completed prior to beginning any construction activities.

4.5.8.2.5 Implementation Issues

Obtaining funding for these activities is typically the main hurdle for implementation. Equipment purchase is often expensive, and having knowledgeable staff to operate the machinery is critical.

The location for temporary disposal of the solids removed from the storage reservoir is also an item that must be overcome. Typically, the solids have a distinct smell that may be offensive to some. By developing a system of dredging concurrent with drying and removal or solids, the short term storage of dredging byproducts should be minimized. In addition to the smell, special care must be taken to prevent stormwater runoff of the solids during rain. A Storm Water Pollution Prevention Plan should be prepared to take this item into consideration.

Developing an engineering solution for such an activity should be given special consideration. Typical dredging activities include the short term storage of wet solids in adjacent areas. As previously described, this activity should be minimized to reduce potential environmental and social concerns.

Additional storage capacity could lead to the short term decrease in water quality due to evaporation and seepage. However, usage of the water in the resacas, thereby increasing flow turnover in the system, would eliminate this concern.

Due to the nature of the resaca system as former flood channels of the Rio Grande, there is minimal concern associated with flooding due to damaged levees. Therefore, it is not anticipated that an Emergency Action Plan (EAP) will be needed.

Permits for the short term dredging activities will need to be acquired through the State (typically the TCEQ). However, proper engineering and construction planning will assist in acquiring the needed permits. Early and continuous dialogue with environmental agencies will further aid the permitting process.

4.5.8.2.6 Recommendations

It is recommended that Resaca Restoration be included as a Water Management Strategy for the Rio Grande (Region M) Region. This strategy will aid in securing water for future uses.

4.5.8.3 Laredo Low Water Weir Project

4.5.8.3.1 Strategy Description

The Dos Laredos Low Water Weir is being proposed by Laredo, TX and Nuevo Laredo, Mexico. The proposed weir would create higher water elevations for the Rio Grande River downstream as well as help Nuevo Laredo and City of Laredo future water treatment plants upstream of the weir. This project will also help improve the raw water quality of the area. The production and sale of hydropower is also another component of the project and will help supply the new water treatment plants and the cities power. The proposed project consists of a weir structure across the channel of the Rio Grande approximately 200 feet downstream of the existing La Bota site. Under normal operating conditions, the reservoir created by the proposed weir will have a maximum surface area of 4,956 acres and store approximately 66,007 acre-feet of water.

4.5.8.3.2 Water Supply Yield

The operating assumptions for obtaining the U.S. impoundment goal will depend on the acquisition of short term and long term water rights. Municipal water rights, which are held by the City of Laredo, are used for consumptive use. One possible avenue to be explored is the lease of water rights for the duration of the reservoir to be filled. While the reservoir is being filled the weir operation would allow the passage of the natural river flow and any other water releases from Amistad Dam. This would enable it to only store the water that was leased by the City of Laredo. Laredo's fulfillment of the weir would be on a schedule determined by the TCEQ Watermaster.

The U.S. would have short-term flexibility by leasing water rights and would help impound the water necessary to accomplish recreational and hydropower goals without purchasing water rights. A permit would have to be applied for from TCEQ by the City of Laredo in order to store the volume necessary. It would be specified that the water right would be multi-use for non-consumptive/recreational use.

4.5.8.3.3 Cost

Based on information in the ***Draft Final Report Preliminary Analysis: Dos Laredos Low Water Weir***, the cost estimate to construct the Dos Laredos Low Water Weir is $294.4 million. TWDB guidelines require an annualized cost to construct the project which is based on firm yield requirements. The firm yield was calculated from the combined construction project costs, regulatory, water rights and land acquisition expenses. The operation and maintenance of this project is $205,000 annually. The unit cost of firm water supply from the project is approximately $4,460 per acre-foot.

Table 4.50: WMS Strategy Cost Summary (Laredo Low Water Weir Project)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Dos Laredos Low Water Weir	$ 4,460	$ 13.69	L of Cost Analysis Appendix

4.5.8.3.4 Environmental Impact

Several environmental issues have been raised concerning the proposed Dos Laredos Low Water Weir. These issues include impacts on water quality (i.e., increased salinity) within and downstream of the reservoir; impacts to aquatic and riparian habitat as a result of changes in downstream flow; potential impacts to habitat from reservoir construction and inundation; and increased risk of flooding. Although data isn't available to determine the exact impacts, maintaining environmental flows downstream of the river should be a major concern.

It is expected that the associated wetlands and potentially excavated ponds close to the banks of the Rio Grande would be considered U.S. waters. Impacts to these features would require permitting under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Although the mitigation plans will include a variety of measures dealing with the project's environmental impacts, it will focus on protecting and/or re-establishing riparian habitat along the reservoir reach of the Rio Grande. Other issues that have been established and need to addressed as part of the mitigation plan will include runoff and pollution control strategies during peak construction activities; bank erosion control measures; temporarily and permanently impacted vegetation; wetland habitat impacts; passage facilities for supporting the upstream and downstream migration of the aquatic species through the weir structure; identification of potential impacts; and cultural/historical resources in the region.

In Webb County, six species are federally listed as endangered species. These include the ocelot, jaguarundi, interior least tern, Rio Grande silvery minnow, ashy dogweed, and Johnston's frankenia (Attachment 1-1 Rare, Threatened, and Endangered Species Lists).

At the time of the study, no ocelot, jaguarundi or their habitat were identified in the project area. The interior least tern and Johnston's frankenia has no real potential habitat in the current project area. The ashy dogweed has been identified as having potential habitat, but at the time of the study no individuals or populations of the plant were found and observed. Although no impacts to federally-listed species are to be affected during this project, further consideration would have to be given for the final inundation zone once the weir is constructed and reservoir volume is filled.

4.5.8.3.5 Implementation Issues

Due to the construction of the weir, many permits and/or consultations are generally required for projects. Potentially these affect waterways, natural habitats, and historical sites. Many of the permits may share comparable elements and criteria. Their filing requirements may have different consultations, but at their base they all require consideration of the weir development's potential environmental and implementation impacts.

For all new border crossings, as well as for all substantial modifications of existing border crossings, a Presidential Permit is required. While the weir project does not qualify as a conventional bridge crossing (port of entry) along the Rio Grande, the Department of State may consult with relevant federal, state, and local agencies, and invites public comment to assure the project would comply with all pertinent federal, state and local requirements.

A permit is required to construct a facility on the U.S. and Mexico Section of the International Boundary and Water Commission (IBWC) rights-of-way. It is required due to the weir project construction and inundation footprint along the international boundary and right-of-way. Before any work is to begin, the permit must be authorized by each respective Commissioner of the International Boundary and Water Commission.

The Clean Water Act Section 404 establishes a program to regulate the discharge of dredge and fill material into waters of the United States, including wetlands. Enforcing and administering Section 404 is shared by the responsibility of U.S. Army Corps of Engineers (USACE) and Environmental Protection Agency (EPA).

The Endangered Species Act (ESA) of 1973 applies to any project that affects or potentially affects endangered species or their habitat. Whenever an action, such as construction of a weir, (anything authorized, funded, or carried out) "may affect" a listed species, the agency, organization, or individual taking the action should consult the United States Fish and Wildlife Services (USFWS) and Texas Parks and Wildlife Department (TWDB).

4.5.8.3.6 Recommendations

Based on the criteria provided for the final recommendations for meeting the shortages of the area, the Dos Laredos Low Water Weir is recommended by the Rio Grande RWPG as a water management strategy. This water management strategy will help meet the needs of Laredo's future needs and the regions.

4.5.8.4 Banco Morales Reservoir

4.5.8.4.1 Strategy Description

The Banco Morales Reservoir is being proposed by the Brownsville Public Utilities Board (BPUB) as a surface water development project on the Lower Rio Grande in Cameron County. This project is proposed to provide additional dependable water supply for municipal and industrial use for the city of Brownsville, by capturing and diverting "excess" flows of United States waters in the Rio Grande as well as storing the City's existing water rights. As it stands now, the excess water is currently allowed to flow through Brownsville and into the Gulf of Mexico. It will now have a chance to be captured and stored and pumped to future users. This Project is proposed to meet the future municipal and industrial water needs of the BPUB and the Region. Existing municipal and industrial water supply sources for BPUB cannot currently satisfy the anticipated future water needs for the region.

The proposed reservoir would provide a pool of water from which the city can pump water and could capture the excess flows on the lower Rio Grande for municipal use. Currently, the water released from Falcon Dam has no opportunity to impound water at a downstream location in the event of rain or changed conditions. In addition, the proposed reservoir will also be used for additional storage of BPUB's existing surface water rights.

4.5.8.4.2 Water Supply Yield

The Project will impound both surplus water and current water supplies from the Lower Rio Grande in an off-channel raw water storage reservoir. Current off-channel storage capacity for the BPUB is 216 million gallons, and the proposed project will add an additional 150 million gallons of storage capacity. Using a combination of excess flows in the river, TCEQ Permit No. 1838 water, and existing water supplies, it is anticipated that the diversion of the full 150 million gallons (460 acre-feet) of water will be available approximately 70% of the time. However, the firm yield is estimated to be 238 acre-feet per year.

4.5.8.4.3 Cost

The capital cost of the project is expected to be $25,790,900 as indicated in studies performed by the Brownsville PUB. TWDB guidelines require an annualized cost to construct the project which is based on firm yield requirements. The firm yield was calculated from the combined construction project costs, regulatory, water rights and land acquisition expenses. The operation and maintenance of this project is estimated to be $55,000 annually. The unit cost of firm water supply from the project is approximately $4,825 per acre-foot.

Table 4.51: WMS Strategy Cost Summary (Banco Morales Reservoir)

Water Management Strategy Cost Summary			
	Cost		
WMS	$/Acre-ft	$/1000 gallons	Appendix
Banco-Morales	$ 4,825	$ 14.78	M

4.5.8.4.4 Environmental Impact

Banco Morales Reservoir has several environmental issues that have been raised as concerns. Most notable include impacts on water quality (i.e., increased salinity) within the reservoir due to evaporative losses, increased risk of flooding, and potential impacts to habitat from reservoir construction and inundation. Although data isn't available to determine the exact impacts, maintaining environmental flows downstream of the reservoir should be a major concern. These concerns could be mitigated by preparing an Emergency Action Plan (EAP) through the TCEQ. The EAP will be used to evaluate and analyze the potential for downstream flooding by evaluating inundation areas and flows from a breach.

A required mitigation plan will be developed for this project. This will be finalized through the Section 404/10 Federal permitting process. The mitigation plan will include a variety of measures dealing with the project's environmental impacts. Its main focus will be on protecting and/or re-establishing riparian habitat along the reservoir for endangered species, specifically the jaguarondi and ocelot (Attachment 1-1 Rare, Threatened, and Endangered Species List). The mitigation plan will also include information on runoff and pollution control strategies during construction activities, bank erosion control measures, temporarily and permanently impacted vegetation, wetland habitat impacts, passage facilities for supporting the upstream and downstream migration of aquatic species through the weir structure, identification of potential impacts of the project to federal, state, and private environmental preserves, and cultural/historical resources in the region.

In summary, all of the environmental issues that have been raised regarding the Banco Morales Reservoir will have to be addressed through the Section 404/10 Federal permitting process.

4.5.8.4.5 Implementation Issues

As with any project of this magnitude, implementation issues such as design feasibility, constructability, and funding will need to be addressed prior to achieving successful completion of the project. Should these issues be resolved, there are not anticipated to be an additional implementation issues associated with the Banco Morales Reservoir.

There is a concern regarding the effect of construction and operation of the Banco Morales Reservoir Project on the Rio Grande water rights system, in particular the "no-charge pumping." The existence of the reservoir should not impact no-charge pumping conditions since these proposed facilities will be located near the lower end of the Rio Grande below where any excess flows might enter the river

Under Section 404/10 of the permitting process for Banco Morales Reservoir, a comprehensive cultural resources evaluation will be undertaken. Field surveys will be conducted for identifying existing archeological and/or historical resources of significance that potentially be impacted by the project. The Texas Historical Commission will be developing and incorporating procedures for avoiding or minimizing these impacts into the mitigation plan.

BPUB will be addressing the flooding impacts associated with the Banco Morales Reservoir. An Emergency Action Plan (EMP) will be developed by the BPUB and submitted to the TCEQ. This plan will incorporate the potential inundation areas that would be impacted by a breach in the levee. The unique situation with the Banco Morales Reservoir is that the reservoir is in close proximity to existing reservoir storage of the BPUB. Therefore, there are not anticipated to be any implementation issues that have not been previously addressed by the BPUB.

4.5.8.4.6 Recommendations

It is recommended by the Rio Grande RWPG to include the Banco Morales Reservoir as a Water Management Strategy for the Rio Grande (Region M) Region to help reduce the DMI shortages.

4.5.9 Improving Water Infrastructure and Distribution

The improvements of pumping, diverting, transporting, storing, and delivering are all ways to improve the distribution of water to end users in the region. By increasing the efficiency of distribution, and subsequently water delivery infrastructure, the efficiency of delivery is increased. By increasing efficiency, water yield should also increase due to improvements to infrastructure. In more specific terms, improvements to water infrastructure and distribution could consist of improvements to high service pumping (pumping water from the treatment facility to the distribution system), improvements to diversion structures (raw water diversion points, interconnect delivery locations, etc.), improvements to raw water transportation infrastructure, and/or improvements to the distribution system (pipelines, flow meters, etc.). Specific projects in this region include:

4.5.9.1 Proposed Elevated Storage Tank and Infrastructure Improvements for the City of Elsa

4.5.9.1.1 Strategy Description

The City of Elsa water distribution system currently has insufficient capabilities due to damages from Hurricane Dolly in 2008. The heavy rainfall and poor drainage within the City of Elsa during the hurricane had an impact on the deterioration of the water distribution system. Currently, any rainfall within the City produces leakages through the current water distribution system. There are approximately 1,775 water and wastewater connections in Elsa's city limits and that is expected to grow in the near future. Elsa also expects to extend the city limits north and south of the current limits.

To help alleviate the problems that were exposed during Hurricane Dolly, the City of Elsa has proposed the following improved infrastructure to help maximize the distribution efficiency.

- New 0.5 million gallons a day (MGD) elevated storage tank along with two high service pumps and 16-inch shut off valves installed along the proposed 16-inch water line project.

- The removal and replacement of approximately 3,500 linear feet of a 8-inch water line to be replaced by a 16-inch water line that would serve the north end of the City of Elsa. This water line will feed the proposed elevated storage tank.

- The removal and replacement of approximate 20,000 linear feet of existing wastewater clay pipe along with upgrading and/or adding approximately 20 lift service stations, which sustained severe damage due to flooding during Hurricane Dolly (2008).

- Upgrading approximately 10,000 linear feet of various existing water lines that sustained damage during Hurricane Dolly.

- Providing approximately 7000 and 9000 linear feet of water and sewer services, respectively for the areas north and south of the city that are in the process of being incorporated.

4.5.9.1.2 Water Supply Yield

The water supply yield from the City of Elsa Improvements Project is equal to the reduction in unaccounted for water. During normal operation of any water distribution system, the amount of water produced at the water treatment facility is slightly higher than metered sales. This unaccounted water normally results from distribution system leaks, inaccurate or un-registered meters, unauthorized connections, and un-metered municipal uses such as fire fighting, hydrant flushing or park irrigation. Table 4.1 compares the amount of treated water `produced by the City of Elsa with the water sales each year. On average, approximately 25% of the water produced by the City of Elsa is not accounted for in water sales.

As noted in the Strategy Description section, the improvements are aimed at replacing an existing damaged water main with a new main as well as constructing a new elevated storage tank to address storage deficiencies. The proposed improvements are aimed at increasing the system's efficiency and reducing the volume of water loss. This reduction in water loss or water supply yield was computed based on the reduction in water loss once the water management strategies proposed is implemented. The system can expect a 10 to 12% water loss in lieu of the current 25% loss. Table 4.2 shows the water yield as result of the water management strategy.

Table 4.52: City of Elsa Treated Water Production Versus Metered Sales

City of Elsa
Treated Water Production Versus
Metered Sales (Check Appendix N for
Analysis)

Year	Water Production (ac-ft)	Water Sold (ac-ft)	Water Loss (ac-ft)	Unaccounted for Water (ac-ft)
2006	771	593	177	23%
2007	695	515	181	26%
2008	598	471	127	21%
2009	593	496	217	30%

City of Elsa
Water Yield

Year	Water Production (ac-ft)	Water Sold (ac-ft)	Water Loss (ac-ft)	Unaccounted for Water (ac-ft)
2011	694	625	70	10%
2011	694	519	175	25%
	Water Yield/Year		105	

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4.5.9.1.3 Cost

The estimated capital cost for this project is $8,325,386. This includes all capital outlays such as costs for engineering, contingencies, financial, legal, administration, environmental permitting and mitigation, land, and interest during construction. The $8,325,386 also includes the construction costs for this project. This takes into consideration the following: improved and/or new pump stations, pipelines, water intakes, storage facilities, and relocation of infrastructure such as roads and utilities.

4.5.9.1.4 Environmental Impact

When this water management strategy is put into action there will be temporary and permanent impacts associated with implementation of this strategy. The temporary impacts associated with this project would be evident with the construction activities needed to make infrastructure improvements. The construction activities dealing with this WMS would include an increase in air and noise quality. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species. These should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts.

4.5.9.1.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, this project may need to comply with the National Environmental Policy Act if federal funding is involved and with either Section 7 or Section 10 Consultation under the Endangered Species Act if any threatened and endangered species is impacted. Potential impacts on cultural resources may result from pipeline construction and operation. Therefore, pipelines should follow existing and shared rights-of-way (ROW) whenever possible to minimize the area of disturbance. The small area disturbed due to construction and operation is not expected to have a large impact on cultural resources. There are no other significant implementation issues associated with this strategy.

4.5.9.1.6 Recommendations

Based on the damage sustained during Hurricane Dolly, it is vital to make the necessary improvements to the water and wastewater distribution system as described in the above mentioned projects. Furthermore, these infrastructure improvements would enhance the quality of life not only for the current citizens of Elsa but also for the people living in the colonias that are going to be incorporated within the new city limits.

4.6 WATER MANAGEMENT STRATEGIES FOR WHOLESALE WATER PROVIDERS

Texas Water Development Board guidelines in Exhibit B state that a Wholesale Water Provider (WWP) is any person or entity, including river authorities, that has contracts to sell more than 1,000 acre-ft of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. Table 4.3 indicates the water providers that follow the TWDB guidelines to designate them as Wholesale Water Providers for this region. This table also shows the projected water surplus/deficit for each WWP.

Out of the nine Wholesale Water Providers there are two that have a deficit in this region. They are Southmost Regional Water Authority (SRWA) and North Alamo Water Supply Corporation. SRWA has a deficit of 11,844 acre-ft from 2010 to 2060. SRWA has Brackish Desalination as a water management strategy to alleviate the deficit from the Nueces-Rio Grande Basin and Rio Grande Basin. North Alamo Water Supply Corporation has a deficit of 2,345 acre-ft starting in the decade 2040 and growing to 12,150 acre-ft in 2060. The two water management strategies are being recommended to alleviate the deficit on the Nueces-Rio Grande Basin are Brackish Desalination and the Acquisition of Water Rights through Purchase. Since WWPs supply water to WUGs, numerical comparisons of WMS Yields needed to overcome a deficit can be seen by looking at each applicable WUG in the decision documents located in the appendix.

4.7 QUANTITATIVE ENVIRONMENTAL ANALYSIS

Based on the recommendations of each Water User Group (WUG) in the Rio Grande Region, water supply yields have been developed for each Water Management Strategy (WMS). Based on these yields, the Regional Planning Group has developed a quantitative environmental analysis that allows for a direct comparison of environmental impacts to land and stream flows associated with each WMS.

As was previously discussed, 392,705 acre-feet of irrigation water rights are proposed to be converted into DMI water rights. The current Rio Grande water right structure requires the conversion of irrigation Class A water rights to DMI water rights to occur at a 2-to-1 ratio. Class B water rights conversion is 2.5-to-1 ratio.

As population increases, irrigation acreage is lost and converted to urban use. Based on data provided by the Rio Grande Watermaster as well as a number of Irrigation District Managers, the current Irrigation Water Duty (acre-feet of irrigation water rights per irrigation acre) is 2.5. Dividing the number of irrigation water rights to be converted to DMI use (327,532 acre-feet) by the Irrigation Water Duty (2.5 acre-feet/acre) gives the total number of irrigable acres lost to urbanization by this conversion (131,013 acres). The following table represents these findings.

Table 4.53: Irrigation Acres Lost

Acquisition of Rio Grande Water Rights	Water Yield (acre-feet)	Converted Water Rights (acre-feet)	Irrigation Water Duty (acre-feet/acre)	Irrigation Acreage Lost
Purchase	151,237	287,888	2.5	115,155
Urbanization	16,406	30,490	2.5	12,196
Contract	4,671	9,154	2.5	3,662
Totals:	172,314	327,532	2.5	131,013

Since this method takes into consideration the direct conversion of irrigation water rights, it cannot be applied to the other WMSs. Therefore, another method must be used to determine the effect of each WMS on non-urbanized land.

Table 4.49 is a breakdown of the each WMS that has been affected by the conversion of irrigation water rights. It gives the firm yield of the WMS directly related to Amistad-Falcon and the amount the WMS receives after the irrigation water rights have been converted. An explanation of ‘Other’ is displayed in the chart and has been grouped together for the purpose of this table. A percentage breakdown of the total firm yield of Amistad-Falcon has also been inserted; this was converted to irrigation water rights to municipal water rights and is displayed in this graph with respect to their associative WMS.

Table 4.54: Breakdown of Firm Yield of WMS Directly Correlated to Amistad-Falcon

TOTAL	32,085	45,495	71,597	104,655	148,842	197,177		100%	100%	100%	100%	100%	100%
ACQUISITION - PURCHASE WR (permanent)	9,611	19,461	41,602	70,944	110,913	151,237		30%	43%	58%	68%	75%	77%
ACQUISITION - CONTRACT WR (temporary)	312	738	1,665	2,352	3,198	4,671		1%	2%	2%	2%	2%	2%
ACQUISITION - URBANIZATION (permanent)	299	3,433	6,467	9,496	12,868	16,406		1%	8%	9%	9%	9%	8%
OTHER (permanent)	21,863	21,863	21,863	21,863	21,863	24,863		68%	48%	31%	21%	15%	13%

"Other" = BANCO MORALES RESERVOIR, BROWNSVILLE WEIR & RESERVOIR, RESACA RESTORATION, LAREDO LOW WATER WEIR, PROPOSED EST & INFRASTRUCTURE IMPROVEMENTS FOR CITY OF ELSA

Chapter 2 of this report described the TWDB's population and water demand projections for this region. The population density (people per acre) of the region in 2010 was .175 people/acre. In 2060, the projected population density of the region is .557 people/acre. The city with the highest projected population density in 2060 is Laredo (12.77 people per acre). Since the City of Laredo has the highest population density in the region in 2060, it is assumed to be 100% urbanized. Percent urbanized is a relative term describing an area's population density in terms of the maximum regional population density. For the purpose of this text, urbanized land is defined as any such land parcel that serves as housing, industry, or any such relation of the two. As described earlier, the year 2010 population density of the region was .175 people per acre. By dividing this term by the maximum population density in the region (City of Laredo: 12.77 people per acre), the region was assumed to be 1.37% urbanized in 2010. Multiplying this figure (.0137) by the overall land area of the region (7,081,600 acres) gives the number of urbanized acres (97,017.92 acres). Similarly, the region is projected to be 4.23% urbanized in 2060. This correlates to 299,410.05 urbanized acres. Therefore, the difference in year 2060 urbanized acres and year 2010 urbanized acres (202,392 acres) represents the region wide increase in urban land.

As population grows, land must be converted from non-urban to urban. Consequently, as population grows, water use increases. It can therefore be assumed that land conversion is directly related to an increase in water use. As described earlier in Chapter 4, Water Management Strategies (WMS) were developed to serve these rising populations.

It is estimated that 70% of all potable municipal water returns to the wastewater collection system. Further, 90% of flows entering a wastewater treatment plant are discharged into receiving bodies of water. Due to the increased demand of municipal water, wastewater receiving streams will see increased flows. It should be noted that source water for Non-potable Water Reuse and Potable Water Reuse comes from wastewater effluent. Therefore, these strategies actually decrease the amount of wastewater entering receiving streams. Advanced water conservation also reduces the amount of wastewater entering receiving streams.

The following table represents the overall increase/decrease in water flows in both the irrigation distribution network and wastewater receiving streams.

In summary, the Purchase of Rio Grande Water Rights is going to be responsible for the largest conversion of land to urban use, followed by Brackish Desalination, Non-Potable Reuse, Additional Groundwater, Brownsville Weir, Advanced Water Conservation, Acquisition of Water Rights through Urbanization, Seawater Desalination, Acquisition of Water Rights through Contract, and Potable Reuse, in order. As a Water Management Strategy, the Purchase of Rio Grande Water Rights will account for the largest amount of wastewater discharge, followed by Brackish Desalination, Non-Potable Reuse, Additional Groundwater, Brownsville Weir, Acquisition of Water Rights through Urbanization, Seawater Desalination, Acquisition of Water Rights through Contract, and Potable Reuse, in order. Implementation of Advanced Water Conservation will actually decrease the quantity of wastewater discharge.

In Figure 4.23 is a bar chart detailing Amistad-Falcon Reservoir total water supply after all recommended WMS have been implemented. This has also taken into consideration the transferring of irrigation water rights to municipal water rights. As can be seen, there is a steady increase in supply for municipal use in each decade. Table 4.50 breaks down Amistad-Falcon water supply and details the figures for the development of Figure 4.23. Irrigation supply out of Amistad-Falcon significantly decreases when the WMS have been implemented. Before implementation, Amistad-Falcon irrigation supply in 2060 was 668,818 ac-ft that now decreased to 477,232 ac-ft.

Figure 4.13: 'Total Supplies' by Use Category from the 'Amistad Falcon Reservoir System' After Recommended WMS Implementation

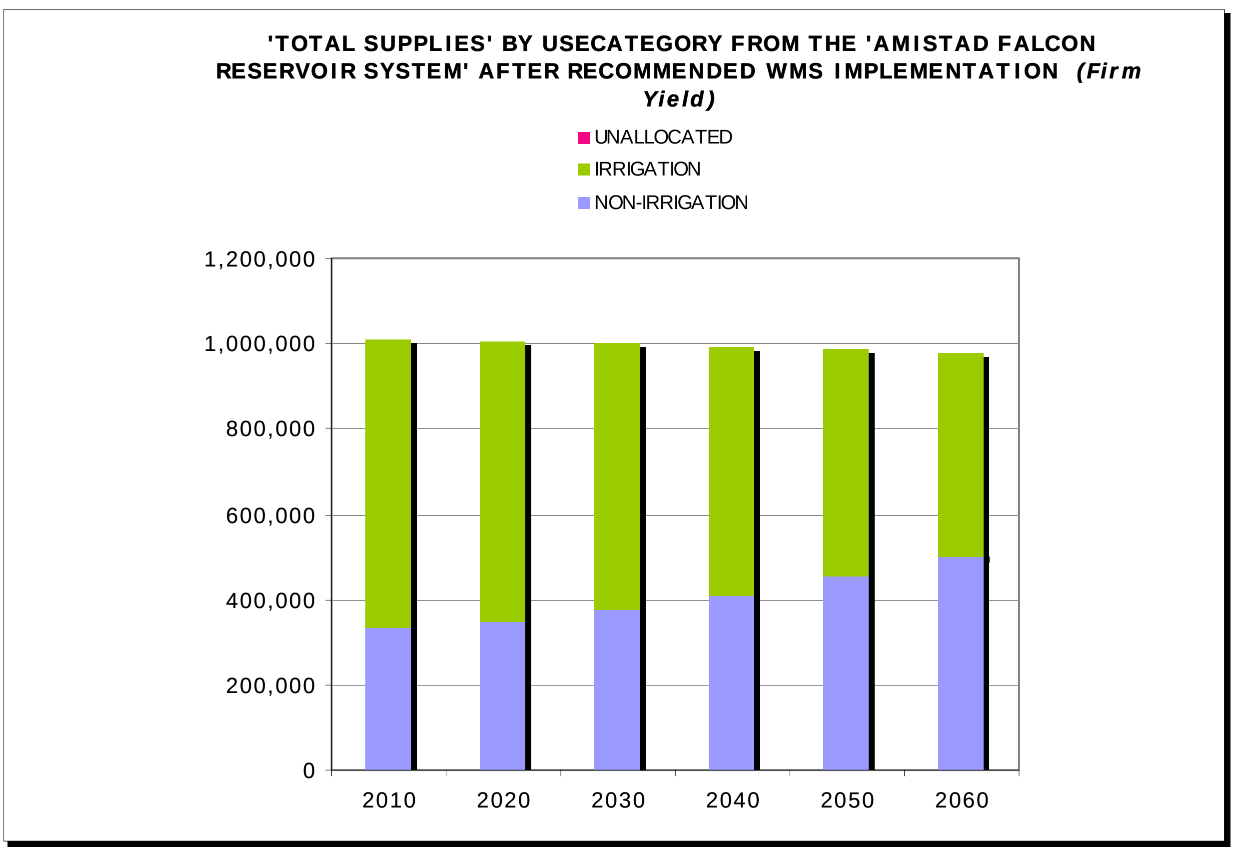

Table 4.55: Total Supplies After WMS Implementation for Graph (Firm Yield)

2010	2020	2030	2040	2050	2060	
335,438	349,420	376,125	409,620	453,820	502,244	**NON-IRRIGATION**
676,538	655,556	622,351	582,356	531,656	477,232	**IRRIGATION**
0	0	0	0	0	0	**UNALLOCATED**
1,011,976	1,004,976	998,476	991,976	985,476	979,476	**CHECK: Total equals firm yield**

4.8 WATER MANAGEMENT STRATEGIES NOT REEVALUATED FROM THE PREVIOUS PLAN AND NOT RECOMMENDED

In addition to the strategies that were evaluated for this round of regional planning, there are several strategies in the last plan that were not reevaluated due to implementation reasons. A discussion of these specific strategies is presented below. Their descriptions were taken from the previous plan and their water yields and costs were not updated. Although specific water supply benefits for these strategies were not quantified in this plan, these strategies are believed to be of general benefit to all water users in this region. For example, the City of Laredo will be implementing inter-basin transfer as a groundwater source. Although this strategy was considered it was not confirmed, no information was afforded the Rio Grande RWPG in order to evaluate it as a recommended strategy.

4.8.1 Groundwater Supply Alternatives for the City of Laredo

The City of Laredo has been actively evaluating various groundwater supply alternatives. The results of these evaluations are presented in a report entitled, Groundwater Source Study Alternatives Evaluation: Final Report (November 1999), and are summarized below.

4.8.1.1 Strategy Description

A total of 13 groundwater supply alternatives were initially identified and subjected to a preliminary screening analysis. From this analysis, five alternatives were considered potential feasible and were evaluated in greater detail. The five alternatives are:

Alternative 1-Carrizo aquifer in northwest Webb County with conveyance to Laredo via pipeline;

Alternative 2-Carrizo aquifer in northwest Webb County with bed and banks conveyance to Laredo via the Rio Grande;

Alternative 3-Laredo/Carrizo aquifers within 10 miles of Laredo;

Alternative 4-Edwards/Trinity aquifers in Kinney County with bed and banks conveyance via the Rio Grande;

Alternative 5-Carrizo aquifer in Dimmit County

A key engineering assumption used in the analysis was that each option would be capable of producing 5.0 MGD of sustainable groundwater supply over the 30-year operating life of the projects. Additionally, for the two alternatives that involve bed and banks conveyance of supply via the Rio Grande, required water treatment would be provided at the City's existing water treatment plants.

4.8.1.2 Water Supply Yield

Each of the alternatives evaluated would provide 5,600 acre-feet per year of municipal water supply over a 30-year period. However, the long-term sustainability of each alternative is not certain and will require additional evaluation prior to implementation. Also, the potential to increase groundwater withdrawals beyond 5.0 MGD is moderate to poor for all of the alternatives. For low-yield aquifers such as the Laredo Formation and the Carrizo aquifer in southwest and south-central Webb County, increased production is limited by the length of the aquifer outcrop area as well as the prevalence of existing users of groundwater. For the higher yielding formations, such as the Edwards aquifer and the Carrizo in northwest Webb and Dimmit counties, the potential for increased groundwater production is limited by current competition and future increases in demand by other users.

4.8.1.3 Cost

Cost estimates for each of the alternatives were prepared which included capital and operations and maintenance costs for wellfields, conveyance facilities, and water treatment.

The cost to develop groundwater varies significantly depending upon the groundwater source, well completion, and many other variables. The updated cost for this strategy would be the same as the groundwater costs found in the appendix. The cost for groundwater is $432.71; this includes the treatment of water. Groundwater development is site-specific so a range of $580 to $1,000 per acre-foot is reasonable still at present cost.

4.8.1.4 Environmental Impact

The potential environmental impacts associated with the groundwater development options evaluated for Laredo include impacts to other existing water users, wetlands, and stream flow due to a lowering of water levels. In addition, construction and operation of well fields and transmission pipelines could adversely impact sensitive environmental resources (e.g., native brush clearing) and should be evaluated in detail prior to project implementation.

4.8.1.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water

Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with either Section 7 or Section 10 Consultation under the Endangered Species Act if any threatened and endangered species is impacted. Each of the groundwater supply alternatives considered for Laredo will require regulatory approvals by the TCEQ Public Drinking Water Program. In addition, regulatory controls on groundwater withdrawal are in place for those alternatives that fall within the jurisdiction of the Winter Garden Water Management District. It is uncertain, however, whether the district's regulations would be effective in limiting withdrawals in excess of the recharge rate over the 30-year lifespan of the projects. The only fail-safe method for managing withdrawals is to control a sufficiently large land area that includes the contributing portion of the aquifer recharge zone. This can be accomplished through direct ownership, lease agreements, or other contractual arrangements.

Potential impacts on cultural resources may result from those conveyance options requiring pipeline construction and use. Therefore, pipelines should follow existing and shared ROWs whenever possible to minimize the area of disturbance. Conveyance via bed-and-banks will minimize the need for pipelines, consequently reducing the risk to cultural resources.

4.8.2 Gulf Coast Aquifer

4.8.2.1 Strategy Description

The use of brackish groundwater as a potable water source has been previously evaluated in the Brownsville area. The study, completed in November 1996, included a groundwater assessment, evaluation of treatment alternatives, reverse osmosis pilot study, and cost projections. The groundwater assessment in the Brownsville area indicated that it would be possible to develop a well field to produce 10.5 MGD of water supply.

The Brownsville study considered two methods for groundwater treatment – Reverse Osmosis (RO) and Electrodialysis (EDR). The analysis indicated that RO would be the least expensive option, so an RO pilot plant was constructed. This pilot scale system was used to determine the basic design parameters of a full scale RO system. A full scale RO system to treat 8 -10 MGD of brackish groundwater would require pretreatment, which would include a desander to remove suspended material followed by a cartridge filtration system. Acid and a silica scale inhibitor would also be added to prevent scale formation. Based on the pilot testing, a full-scale system would be expected to have a membrane life of approximately five years. Chemical cleaning of the membrane would be required approximately four times per year. The results of the Brownsville pilot study imply that a full-scale RO system to treat brackish groundwater could successfully meet all state and federal primary and secondary drinking water standards

Concentrate from the RO system must be disposed of in an environmentally acceptable manner. Three options were proposed for a full-scale system including disposal to a brackish surface body, disposal to a sewer system, and deep well injection. Of these, disposal to a brackish surface via a drainage ditch that ultimately discharges into the Brownsville Ship Channel and then to the Gulf of Mexico was the lowest cost.

4.8.2.2 Water Supply Yield

The total amount of water supply that could be made available from the Gulf Coast aquifer with advanced water treatment technology has not been determined. However, it is known that large quantities of poor quality groundwater occur throughout the Lower Rio Grande Valley. As indicated, the Brownsville study determined that it would be feasible to develop a groundwater well field capable of producing 8 -10 MGD of groundwater supply (8,961 to 11,201 acre-feet per year).

4.8.2.3 Cost

The estimated capital cost to develop an 8.5 MGD groundwater supply project with advanced desalination treatment technology is approximately $21 million. This strategy is being implemented by the Southmost Regional Water Authority's Brackish Desalination Plant located in Cameron County. The cost is estimated to be $505.51 taking into consideration power costs, treatment costs, and interest accrued during construction.

4.8.2.4 Environmental Impact

The primary environmental issue associated with the development of brackish groundwater supplies is the disposal of the concentrated brine produced from the membrane filtration process. Disposal options include discharge to a surface water body, preferably one of similar or greater salinity, discharge to a sewer system, and deep well injection into a suitable underground formation. For most potential applications in the Lower Rio Grande Valley, a method of concentrate disposal would likely be through discharge to the Arroyo Colorado. However, this method would increase the salinity of this already impaired water body. Another environmental concern relates to the energy requirements of the desalination process. Also, there would be disturbance and potential environmental impacts in the immediate vicinity of the well fields during drilling and other construction activities.

4.8.2.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with either Section 7 or Section 10 Consultation under the Endangered Species Act if any threatened and endangered species is impacted. Potential impacts on cultural resources may result from pipeline construction and operation. Therefore, pipelines should follow existing and shared ROWs whenever possible to minimize the area of disturbance. The small area disturbed due to well construction and operation is not expected to have a large impact on cultural resources. There are no other significant implementation issues associated with this strategy. However, additional technical information is required on the availability, quality, and cost of developing groundwater as a supply source for DMI uses. Also, consideration should be given to converting some DMI users entirely from surface to groundwater.

4.8.3 Additional Water Supply Reservoirs on the Rio Grande

4.8.3.1 Strategy Description

Article 5 of the 1944 Water Treaty between the United States and Mexico allows, but does not require, construction of a third dam along the Rio Grande River between Eagle Pass and Laredo. However, previous studies indicate that Falcon and Amistad reservoirs alone are sufficient to capture flood flows and provide for the maximum beneficial use of the waters of the Rio Grande. Since 1986, the issue of developing a third reservoir on the Rio Grande has been revisited. In 1986, the United States section of the IBWC completed a preliminary feasibility study of three dam sites between Eagle Pass and Laredo for the generation of hydroelectric power and recreational benefit. Results of the study indicated that the dam would not provide additional conservation or flood control storage but that it might be feasible based on benefits derived from the generation and sale of hydroelectric power.

4.8.3.2 Water Supply Yield

As indicated, Falcon and Amistad reservoirs currently provide adequate water storage to capture flood flows in the Rio Grande. It has been determined from previous studies that the construction of a third dam would provide a significant increase in system firm yield relative the costs of developing the additional storage capacity.

4.8.3.3 Cost

Detailed cost estimates for the low-water dam and reservoir project proposed by Webb County have not been developed at this time. Webb County has indicated that it intends to proceed with more detailed engineering feasibility and environmental impact studies in the near future.

4.8.3.4 Environmental Impacts

The major environmental consequences of constructing a third reservoir include the potential loss of important riverine and riparian habitat, impacts to any endangered species that might occur in the project area, and impacts to downstream wetlands due to changes in the flood plains. The project may also impact water quality of the Rio Grande in Zapata County and in the lower Rio Grande Valley.

4.8.3.5 Implementation Issues

Proponents of the development of a third reservoir near Laredo cite potential water quality benefits as a result of project. The reservoir would also provide a pool from which to divert water to a proposed new regional water treatment plant to be built by Webb County. The reservoir could also provide recreational and aesthetic benefits to the community. Opponents of the project contend that the reservoir will reduce downstream flows and will reduce water quality in Zapata County and the lower Rio Grande Valley. As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, the project may need to comply with the National Environmental Policy Act if federal funding is involved and with the Endangered Species Act if any threatened and endangered species is impacted. Potential impact on cultural resources may result from reservoir construction. Additionally, coordination with Mexico will be necessary. This was expected to be the 3rd reservoir from the 1944 Treaty and not the Laredo Weir Project.

4.8.4 Capture and Use of Local Runoff in the LRGV

4.8.4.1 Strategy Description

Below Falcon Dam, the terrain along the Lower Rio Grande is characterized as coastal plain, with some rolling hills and numerous isolated low areas and depressions. Much of the area toward the Gulf once formed a broad, fan-shaped delta at the river's mouth that was dissected by multiple meandering channels. These channels carried river flows with heavy sediment loads through the delta to the Gulf. Today, these abandoned deltaic channels form finger lakes, which are called "resacas."

One of the possibilities for developing additional supplies of surface water in the Lower Rio Grande Basin would be to collect stormwater in the isolated low areas, depressions and resacas that are scattered throughout the area, primarily in Cameron and Hidalgo counties. Such water could be made available for local use, provided that the stormwater captured is not already appropriated to existing water rights. For stormwater to be considered unappropriated, it would have to drain into isolated low areas or water bodies which are not the source of supply for any existing water rights. Hence, any stormwater that eventually could flow into the Rio Grande would be considered to be appropriated and unavailable for development.

Similarly, any stormwater flowing in the tributaries or the mainstem of the Arroyo Colorado also would likely be considered to be appropriated because of existing water rights located on this watercourse.

Cameron and Hidalgo counties cover an area of approximately 2,860 square miles. The Arroyo Colorado extends eastward for about 90 miles from near the city of Mission through southern Hidalgo County to the city of Harlingen in Cameron County, eventually discharging into the Laguna Madre near the Cameron-Willacy county line. The watershed of the Arroyo Colorado drains approximately 700 square miles. Excluding the watershed of the Arroyo Colorado because of potential conflicts with existing water rights, the remaining drainage area of Cameron and Hidalgo counties that potentially could be considered for collection of stormwater encompasses about 2,160 square miles. A general inspection of available topographic maps, county road maps, and aerial photographs indicates that no more than about 25 percent of this area would likely contribute stormwater flows into water bodies that are not subject to diversions by existing water rights such that the stormwater flows could be considered to be unappropriated. Hence, there appears to be no more than a total of about 700 square miles of drainage area within Cameron and Hidalgo counties from which stormwater flows could be collected and made available for water supply.

Annual rainfall in Cameron and Hidalgo counties averages about 25 inches according to data presented in the "Climatic Atlas of Texas" (Texas Department of Water Resources, LP 192, 1983). Assuming that approximately five percent of this annual rainfall actually occurs as runoff, which is reasonable for the coastal areas of lower Texas, the total volume of stormwater that could be potentially collected and made available for water supply in Cameron and Hidalgo counties would average approximately 50,000 acre-feet per year. Of course, depending on rainfall, this could range from only about 20,000 acre-feet during dry years (10 inches of rainfall) up to possibly 90,000 acre-feet in a very wet year (45 inches of rainfall).

Although as noted above, a significant quantity of stormwater potentially could be available for use on an annual basis, one of the major disadvantages with trying to develop stormwater as a source of supply is that it would not be dependable at a particular location because of the variable nature of rainfall, both spatially and temporally. Without a substantial amount of storage capacity in a low area, depression or resaca to hold the stormwater over extended periods of several months, the only supply of stormwater that might be available at any given location would be that which occurs as runoff during a single rainfall event. This, of course, would be of little value as a dependable water supply, but it could be useful as a short-term supplemental supply.

The use of such stormwater on a short-term basis would reduce the need for releases from Falcon Reservoir and thereby extend the more permanent supply of water stored in the reservoir for later use.

Another issue regarding the stormwater supply option relates to the geographical area within which the stormwater could be effectively used as a water supply. Because of the relatively small amount of water that likely could be accumulated in a given low area, depression or resaca during a rainfall event, the subsequent use of the water probably would have to be limited to the immediate vicinity of the low area, depression or resaca. It is unlikely that it would be cost effective to design and install an extensive system of canals and/or pipes to transport and distribute the limited quantities of stormwater over a wide area. What would also complicate the distribution and use of such water would relate to who actually would own the water. Some type of agreement or institutional arrangement would have to be implemented whereby the ownership of the stormwater and the users of the water would be defined, together with their duties and responsibilities. These arrangements could vary widely depending on local circumstances regarding where a particular low area, depression or resaca is located and who owns it, which water users are to be supplied the associated stormwater, and who is to pay for development of the water supply project.

4.8.4.2 Water Supply Yield

As discussed above, the water supply yield from developing the stormwater option in Cameron and Hidalgo counties could potentially average about 50,000 acre-feet per year. Because of the variable nature of rainfall both spatially and temporally, the available water supply would not be dependable on a localized basis and could range between 20,000 acre-feet per year up to 90,000 acre-feet per year for the two-county region depending on annual rainfall conditions. These water supply yield amounts would be refined based on the results from the recommended pilot studies.

4.8.4.3 Cost

The costs of developing local stormwater runoff for use as a water supply source would be highly dependent upon site-specific factors including the amount of yield available at a given site and the sites proximity to potential users. It was beyond the scope of this planning effort to investigate the costs of this strategy for a specific site. It is recommended, however, that a study be conducted to develop water supply yield, cost, and environmental impact information for five localized areas.

4.8.4.4 Environmental Impact

The potential environmental impacts associated with this water supply strategy would be primarily localized in nature and related mostly to any disturbances of the existing environment resulting from modification of low areas, depressions or resacas to enhance their storage capabilities or from installation of water transport and distribution facilities. Such impacts would need to be minimized to the extent possible and mitigated where necessary.

4.8.4.5 Implementation Issues

The implementation issues that potentially could be factors affecting development of the stormwater supply strategy include the following:

Identification of low areas, depressions or resacas with stormwater inflows not subject to appropriation by existing water rights;

Definition of the reliability and dependability of water supplies developed using localized stormwater because of the spatial and temporal variability of rainfall;

Availability of adequate storage capacities to provide short-term stormwater supplies that can effectively supplement permanent Falcon Reservoir water;

Availability of local water users within the immediate vicinity of low areas, depressions or resacas where stormwater could be stored;

Cost of water transport and distribution facilities to serve local water users;

Ownership of stormwater and relationship to water users and cost of water distribution facilities; and

Financing of project costs.

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with either Section 7 or Section 10 Consultation under the Endangered Species Act if any threatened and endangered species is impacted.

4.8.5 Conveyance of Rio Grande Water Supply - Pipeline from Falcon Reservoir to the LRGV

4.8.5.1 Strategy Description

Currently, both municipal and irrigation water supplies for Cameron, Hidalgo, and Willacy counties are released from Falcon Dam and conveyed down the Rio Grande where it is diverted for use. In most cases irrigation districts divert both irrigation and municipal water supplies through canal systems to delivery locations. For municipal water users, major disadvantages of the current water delivery system include relatively poor water quality, reliability and the large transmission losses in the process. With regard to the latter, many municipal water users in the Lower Rio Grande Valley are assessed a 25 percent loss factor, or more, on delivery of their water supplies by an irrigation district. This loss factor effectively reduces the amount of water that is available for actual municipal water use. Also, during the current on-going drought, there has been concern that municipal water deliveries could be interrupted if irrigation supplies are exhausted. For many municipal water users in the region, delivery of water supplies requires that there be adequate irrigation "push" water.

As an alternative to the current system for the delivery of municipal water supplies, the feasibility of a water transmission pipeline from Falcon Reservoir to the lower Rio Grande Valley was evaluated in 1999 as part of the Integrated Water Resource Plan – Phase II.[18] The pipeline would be designed to convey an amount of water equivalent to the projected increases in municipal water demands from Falcon Reservoir to four delivery points in the Lower Rio Grande Valley. Use of a pipeline for transport would increase the efficiency of water delivery by eliminating channel losses. An update of that study, published in March 2000, confined the proposed activity to municipal supplies in Hidalgo and Starr counties.[19] Current municipal water demands would continue to be conveyed by the Rio Grande and through canals to existing water treatment and distribution facilities. Since the pipeline would convey more water as demand increases, the initial phase of the project would be sized to convey only half of the projected increase in municipal demands over a 50-year period. Initially, water treatment capacity would be provided for only about 20 percent of the ultimate water delivery capacity. These facilities would be expanded as needed to meet increasing demand.

4.8.5.2 Water Supply Yield

According to the analyses presented in the Falcon Reservoir Water Treatment Plant and Pipeline System for Hidalgo and Starr Counties, Texas and Northern Mexico, domestic water transportation losses through the existing irrigation canal system below Falcon Reservoir are between 29 to 52 percent. While the proposed water transmission pipeline, would not affect the firm yield available from the Falcon Reservoir, it would eliminate much of the transportation losses associated with the portion of future municipal diversions that would be conveyed by the pipeline. The effect of reduced transportation losses would be felt proportionately with the increase in the amount of water conveyed in the pipeline. It is estimated that the transportation losses that would be prevented

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[18] Route A, as discussed in the *Integrated Water Resources Plan*, is along a utility easement that extends from the hydropower facility at Falcon Dam toward Moore field.
[19] Falcon Reservoir Water Treatment Plant and Pipeline System for Hidalgo and Starr Counties, Texas and Northern Mexico, March 2000.

with the full development of the pipeline system would be 19,000 acre-feet per year.

4.8.5.3 Cost

The previous evaluation of the feasibility of the water transmission pipeline was preliminary with several alternatives considered. These alternatives include three identified pipeline routes, delivery of treated or raw water, system size, and four delivery points. The cost information presented in this section focuses on the costs for the system to deliver 100 million gallons of treated water per day from Falcon Reservoir to Hidalgo and Starr Counties. The annualized cost to construct the entire project is estimated to be approximately $24 million dollars. When compared to the maximum net water savings at full utilization of the project, the annualized unit cost per acre-foot of recovered municipal water supply is $1,025. The cost to deliver the total amount of treated water approximates $275 per acre foot. At present cost (2005) is estimated to be 29 million with the annualized unit cost per acre-foot of recovered municipal water supply now being at is $1,474.

4.8.5.4 Environmental Impacts

Construction of a pipeline from Falcon Reservoir to the Lower Rio Grande Valley would have environmental impacts as a result of both the construction and operation of the project. Construction impacts would be predominately contained in the pipeline right-of-way (ROW) and could include disturbance to cultural resources, threatened and endangered species, wetlands, stream crossings, and prime farmland soils. Wildlife and migratory birds that depend on drinking water provided by the open canals will have a negative impact due to loss of canal areas.

4.8.5.5 Implementation Issues

In addition to reducing water transmission losses, the proposed pipeline project would have other potential benefits. For example, the pipeline would likely deliver higher quality water than the existing river and canal system and the pipeline project would facilitate the development of regional water treatment plants and perhaps induce further regionalization of water and wastewater utility services in the Lower Rio Grande Valley. A treated water transmission line routed through the northern portion of the Lower Rio Grande Valley could also provide important benefits in terms of providing water utility services in currently undeveloped areas. However, a project of this nature would likely face significant institutional hurdles, for example, obtaining a high degree of regional participation by a large number of independent municipal water suppliers. Such participation would be required in order to finance a project of this magnitude. In addition, a project of this type could significantly alter existing relationships between municipal water users and the irrigation districts that deliver water and in many cases provide increasing amounts of water for municipal use.

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act if any threatened and endangered species is impacted. Potential impacts on cultural resources may result from pipeline construction and operation. Therefore, pipelines should follow existing and shared ROWs whenever possible to minimize the area of disturbance. Lane easements for pipeline construction might be required. The existing Certificates of Adjudication (approximately 900) might need to be amended if there is a change in the diversion point.

4.8.6 Conveyance of Rio Grande Water Supply - Gravity Canal

4.8.6.1 Strategy Description

In the late 1940s and early 1950s, the Lower Rio Grande Authority spearheaded an unsuccessful attempt to build a project that would divert water from Anzalduas Diversion Dam through a gravity canal that would supply downstream irrigation districts and other water users in Hidalgo and Cameron counties. The project was proposed largely in response to a similar diversion canal that was constructed in Mexico and in an attempt to increase the efficiency of water delivery to downstream irrigators.

Projected benefits from the proposed project included the elimination of the need for existing river pumping stations, reduced sedimentation in the existing irrigation canal systems, and an increase in the reliability and rate of water deliveries to irrigators.

The gravity canal project was proposed to flow in a southeasterly direction, roughly parallel the Rio Grande. The first seven miles of the canal were to be unlined, with a bottom width of 160 feet. This section would act as a settling basin for sediments, with silt removal by means of a floating dredge. The remainder of the canal was to be concrete-lined in order to minimize water losses. The canal was to be sized large enough to convey the entire United States portion of releases from Falcon Reservoir. Feasibility studies completed in 1952 concluded that, at that time, the gravity canal project was feasible.

4.8.6.2 Water Supply Yield

The development of the project could increase the effective supply of water available for irrigation by reducing river channel and irrigation canal losses. Estimates of such savings were not previously developed. However, to the extent that minimum releases would likely be required from Anzalduas Diversion Dam to maintain downstream aquatic and riparian habitat, all or a portion of the water conservation benefits would be negated.

4.8.6.3 Cost

In 1952 the Gravity Canal Project was projected to cost approximately $18.32 million, with annual operation and maintenance costs of approximately $154,000. When these cost estimates are adjusted to1999 conditions, the Gravity Canal Project would cost over $193 million, with annual operation and maintenance costs of over $1.6 million. However, it should be noted that the original cost estimates likely do not account for such factors as permitting and mitigation of environmental impacts. At present cost conditions, the project is projected to cost approximately $20.51 million with annual operation and maintenance costs of approximately $197,450.

4.8.6.4 Environmental Impacts

When this project was originally proposed and evaluated, current state and federal environmental regulations were not in effect. During that era, feasibility was defined almost exclusively in terms of economic feasibility. By today's environmental standards, the proposed project would likely be closely scrutinized due to its potential adverse effects on the Rio Grande River downstream of Anzalduas Diversion Dam. Operation of such a canal as originally proposed would have the effect of significantly dewatering the Rio Grande downstream of Anzalduas Diversion Dam. It would be likely that minimum releases would be required to preserve downstream aquatic and riparian habitat, which, as noted above, could negate much of the water supply benefit of such a project. Wildlife that are dependent on water from the existing canal system may be impacted. There would also likely be extensive environmental and socioeconomic impacts along the canal route and the canal itself could create a barrier to migration of indigenous threatened and endangered animals.

4.8.6.5 Implementation Issues

The development of a gravity canal to deliver water to irrigation and DMI users in Cameron and Hidalgo counties would face significant institutional impediments. The major issue would be the likely difficulty of gaining the very high degree of cooperation among the large number of DMI and irrigation users that would benefit from such a project. Such cooperation would be essential in securing financing. It could be expected that some water suppliers would be resistance to abandoning existing water diversion and delivery infrastructure.

As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act if any threatened and endangered species is impacted. Potential impact on cultural resources may result from the canal development project.

4.8.7 Importation of Surface Water

Surface water importation (i.e., interbasin transfers) was evaluated at a reconnaissance-level, as a potentially feasible strategy for meeting DMI needs in the Rio Grande Region. A summary of the results of this analysis is provided below. Additional details are presented in a technical memorandum entitled, Interbasin Transfer Water Supply Options (January 2001).

4.8.7.1 Strategy Description

Three surface water importation options were evaluated, two involving delivery of additional water supply to the City of Laredo and one involving the delivery of additional water supply to DMI users in the Lower Rio Grande Valley. These options are:

Lavaca Basin Supply to Laredo: This option would involve the supply of 20 MGD (22,403 acre-feet per year) of raw water from the Lavaca River Basin to the City of Laredo. The diversion would be located near the town of Edna, Texas and a 36-inch diameter transmission pipeline approximately 220 miles long would generally follow the right-of-way of U.S. Highway 59. For the purposes of this analysis, it was assumed that the water supply would be available through a long-term water purchase contract with the Lavaca-Navidad River Authority.

Nueces Basin Supply to Laredo: This option would involve the supply of 20 MGD of raw water from the Nueces River to the City of Laredo. The diversion would be located downstream of the Choke Canyon reservoir in the vicinity of the town of George West, Texas. A 36-inch diameter transmission pipeline approximately 110 miles in length would follow the right-of-way of the U.S. Highway 59. It is assumed that the water supply would be available through a long-term water purchase contract with the City of Corpus Christi.

Nueces Basin Supply to the Lower Rio Grande Valley: This option would involve the supply of 17 MGD (19,042 acre-feet per year) of raw water from the Corpus Christi regional water system to the Lower Rio Grande Valley by extending the existing 42-inch “Sarita Pipeline” from Kingsville to Harlingen. The pipeline extension would be 33-inches in diameter, approximately 98 miles long, and would follow the U.S. Highway 77 right-of-way. As with the other options, it was assumed that the water supply would be available through a long-term water supply contract.

4.8.7.2 Water Supply Yield

As indicated, the two surface water importation options evaluated for Laredo would supply 22,403 acre-feet of additional water supply for DMI use. The water importation option examined for the Lower Rio Grande Valley would supply 19,042 acre-feet of additional DMI water supply.

4.8.7.3 Cost

Cost estimates for the three surface water importation options are presented in Table 4.56.

Table 4.56: Summary of Costs Associated with Surface Water Importation Options

	Lavaca Basin to Laredo	Nueces Basin to Laredo	Nueces Basin to LRGV
Supply	27,570	27,570	22,240
Unit Cost ($/ac-ft/yr)	$1,931	$1,374	$720

4.8.7.4 Environmental Impact

Large-scale interbasin transfers of surface water have potentially far-reaching environmental impacts. Of particular concern are the potential adverse effects of trans-basin diversions on instream flows and bay and estuary inflows. In addition, significant disturbance of land and environmental resources could occur from construction and operation of water transmission pipelines. Of particular concern would be the impacts on wetlands and riparian and aquatic habitat associated with pipeline stream crossings and native brush clearing. However, many of these potential impacts could be at least partially avoided by following existing highway right-of-ways.

4.8.7.5 Implementation Issues

There are a number of key issues associated with large-scale interbasin transfers of surface water. As with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, a project may need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act if any threatened and endangered species is impacted.

Other key issues include current state laws, which restrict new interbasin transfers by establishing a junior priority date to new or amended water rights involved in an interbasin transfer. Additionally, current state law includes provisions (Texas Water Code, Section 11.085) requiring the TCEQ to weigh the benefits of a proposed new interbasin transfer to the receiving basin against the detriments to the basin supplying the water. The criteria established in statute to be used by the TCEQ in the evaluation of proposed interbasin transfers are:

The need for the water in the basin-of-origin and in the receiving basin;

Factors identified in the applicable regional water plan(s);

The amount and purposes of use in the receiving basin;

Any feasible and practicable alternative supplies in the receiving basin;

Water conservation and drought contingency measures proposed in the receiving basin;

The projected economic impact that is expected to occur in each basin;

The projected impacts on existing water rights, instream uses, water quality, aquatic and riparian habitat, and bays and estuaries; and

Proposed mitigation and compensation to the basin-of-origin.

In addition to statutory and regulatory impediments to new interbasin transfers, public and political opposition in the basin-of-origin has become the norm throughout Texas.

Potential impacts on cultural resources may result from pipeline construction and operation. Therefore, pipelines should follow existing and shared ROWs whenever possible to minimize the area of disturbance.

4.8.8 Reallocation of Storage in the Amistad-Falcon Reservoir System

Approximately one-third of the controlled storage capacity in Amistad International Reservoir is below the top of the spillway gates and is the designated flood control pool. About 16 percent of the controlled storage capacity in Falcon International Reservoir is for flood control. The flood pool of each reservoir remains empty except during and following a flood event. As part of the Phase II Integrated Water Resources Plan for the Lower Rio Grande Valley, permanent and seasonal reallocation of a portion of the flood control storage capacity was investigated as a strategy for increasing the water supply yield of the reservoir system.

4.8.8.1 Strategy Description

Permanent or seasonal reallocation of the flood control storage capacity of the Amistad-Falcon Reservoir System could be implemented simply by raising the designated elevation of the top of the conservation pool. Increasing the conservation storage capacity of the reservoirs would allow additional inflows to be held in the reservoirs thereby increasing the firm yield of the system. Current reservoir operating procedures of the IBWC allow for storage of water in the flood control pool during the period from November through April when the threat of flooding, particularly related to tropical storm systems, is minimal. However, there are no set rules for this seasonal storage reallocation. Historically, the amount of water held in the flood control pool for water supply storage has ranged from zero to approximately 100,000 acre-feet in each reservoir.

A total of six alternative reservoir storage reallocation plans were evaluated for the Phase II Integrated Water Resources Plan.

These included baseline scenarios for the current operating procedures with occasional seasonal storage in the flood pool, current-operating procedures without seasonal reallocation, and several scenarios for permanent reallocation of storage.

4.8.8.2 Water Supply Yield

The effects of alternative reservoir storage reallocation plans were estimated by simulating reservoir operations using the Reservoir Operations Model for the Amistad-Falcon reservoir System. Impacts were measured in terms of reducing diversion shortages, which represent failures to fully meet the water demands specified in the model. The results indicated that only relatively minor reductions in diversion shortages would occur with implementation of the alternative reallocation plans, except for the “extreme” scenario of reallocating most of the flood control storage in the two reservoirs to water supply. Furthermore, some shortages still occur even under the extreme reallocation scenario.

4.8.8.3 Cost

Previous studies did not assess whether implementation of flood storage reallocation would require modifications to the dams or control works of Amistad and Falcon reservoirs. It is implied in the study that modifications would not be required. There also would be no increase in reservoir system operations and maintenance costs.

4.8.8.4 Environmental Impacts

The previous study did not address potential environmental impacts associated with reallocation of flood storage in the Amistad-Falcon Reservoir System. However, it is not likely that there would be any significant environmental impacts.

4.8.8.5 Implementation Issues

Implementation of changes to IBWC reservoir operations policies and procedures to allow water supply storage in the flood control pools of the reservoirs would require the concurrence of Mexico. Also, any significant change in current procedures could generate public opposition if it is perceived that the change could increase the risks of flooding.

4.9 STRATEGIES CONSIDERED BUT NOT FULLY EVALUATED

Section 4.9 discusses various projects that are in the process of being fully analyzed by the Region. In order to be recommended as a Water Management Strategy to meet future demands, each WMS must be evaluated in terms of water supply yield, cost, environmental impact, and implementation issues. Due to significant components of each of the following projects still pending and lack of information, they can not be fully recommended as Water Management Strategies. The projects are listed below:

- Hidalgo County Drainage District No. 1 Project
- Proposed Pipeline in Dimmit County, Texas into Region
- Ethanol Production Plants

4.9.1 Hidalgo County Drainage District No. 1 Project

4.9.1.1 Strategy Description

The Hidalgo County Water Supply Project is being proposed by the Hidalgo County Drainage District as a new source of water for the region in the Lower Rio Grande in Hidalgo County. The proposed project is intended to provide additional dependable water supplies to water users by using the extensive drainage network in Hidalgo County and the existing drainage/flood control systems to collect rainfall runoff and shallow groundwater and use and treat the water and eventually serve to water users. The proposed project is to help meet the demands of water for the future. It is to comprise 10% of the water in Hidalgo County in the year 2050.

4.9.1.2 Water Supply Yield

No firm information on water supply yield is available at this time.

4.9.1.3 Cost

No firm information on cost is available at this time.

4.9.1.4 Environmental Impact

The potential impacts associated with the Hidalgo County Water Supply development include construction and operation of transmission pipelines and a conventional water treatment plant and or reverse osmosis plant which could impact sensitive environmental resources (e.g., native brush clearing) and such streams and resacas.

4.9.1.5 Implementation Issues

The main implementation issue for Hidalgo County collection system and future water treatment plant would be funding for the project. Another issue as with any project, necessary state and federal permits must be obtained before construction can begin, potentially including a Section 404, Clean Water Act Permit. Additionally, the project may need to comply with the National

Environmental Policy Act if federal funding is involved and with the Endangered Species Act if any threatened and endangered species are impacted.

The largest potential impact on cultural resources associated with this option comes from pipeline construction and operation. Therefore, pipelines should follow existing and shared rights-of-way whenever possible to minimize the area of disturbance.

4.9.1.6 Recommendations

Due to a lack of information detailing cost and water availability, the Rio Grande RWPG cannot recommend the Hidalgo County Water Supply project as a water management strategy for Hidalgo County users. Should final determinations be made in regards to water supply, cost, and potential end users, future water planning efforts could potentially include the project as a recommended water management strategy.

4.9.2 Proposed Pipeline from Dimmit County, Texas into Region

4.9.2.1 Strategy Description

Rio Grande Regional Water Planning Group (Region M) is proposing a pipeline from Dimmit County into the City of Laredo and various other WUGs in the area. Various studies by hydrology firms have confirmed that the Carrizo Wilcox Aquifer within Dimmit County has tens of millions of acre-feet of water stored within the county. This major aquifer is not dependent on recharge, in fact according to many groundwater availability models that were used in this study; all of the conclusions were similar. Water is available with a sufficient safety factor, meaning over a 50 year period pumping 40 MGD the reduction of water storage in the aquifer was less than 1%.

4.9.2.2 Water Supply Yield

The development of the project could increase the effective supply of water to the City of Laredo and other entities throughout Region M. The proposal for the project suggests pumping 10 MGD by June 2010 and 40 MGD by 2060 for DMI use.

4.9.2.3 Cost

No firm information on cost is available at this time.

4.9.2.4 Environmental Impact

The potential impacts of installing a pipeline from Dimmit County into the region include construction and operation of the transmission pipelines and well drilling involved. This could impact sensitive environmental resources (native brush clearing, etc.) and such streams and resacas.

4.9.2.5 Implementation Issues

An implementation issue for this project is the funding. Funding for this project comes mostly from bonds. An area of concern for a project of this magnitude is going over the dollar amount of the budget. Another issue, as with any project, necessary state and federal permits must be obtained before construction can begin.

The largest potential impact on cultural resources associated with this option comes from pipeline construction and operation. Therefore, pipelines should follow existing and shared rights-of-way whenever possible to minimize the area of disturbance.

4.9.2.6 Recommendations

Due to the lack of information available for costs and the lack of a perceived end user, this strategy cannot be recommended as a regional water management strategy. However, should additional information be made available, it would be in the best interests of the planning group to evaluate this strategy in more detail.

4.9.3 Ethanol Production Plants

4.9.3.1 Strategies for Ethanol Production Facilities

As previously described in Chapters 1 and 2, the potential implementation of ethanol production facilities in the Region will have a direct impact on available water supplies for all users. At this time, specific ethanol facilities are not anticipated for the Region. However, this should not serve as a lack of action. Rather, specific strategies for developing potential water supplies for these facilities should be identified. Using previously defined Water Management Strategies for the Region, the following strategies would help offset additional water demands of such facilities:

- Additional Groundwater
  - Through the use of fresh water wells, water supply for Ethanol Production Facilities could be provided. Depending on the quantity of water needed, special care should be taken regarding quantity and its impact on managed available groundwater.
- Reuse
  - The planning group has identified two types of reuse: non-potable and potable. In terms of Ethanol production, non-potable reuse should be considered. An agreement with a municipality currently

treating wastewater would be required as Ethanol facilities typically wouldn't have enough wastewater production to warrant the installation and operation of its own WWTP. Further, the potential amount of water needed would exceed the wastewater production of such a facility.

- Acquisition of Water Rights
  - The use of surface water for Ethanol production is most likely the most cost effective method for providing water for production purposes. The finished water quality required for operations typically is less than that of municipal supplies and would therefore require less treatment.

    Most surface water treatment facilities for potable supply utilize the conventional method of treatment: rapid mix, flocculation, clarification/sedimentation, and filtration. Ethanol production facilities would most likely only require preliminary flocculation to remove organic carbon, suspended solids, and turbidity thereby reducing treatment costs.
- Desalination
  - The planning group has identified two types of desalination: brackish and seawater. Having a higher unit cost of water, seawater desalination is most likely not a recommended strategy for Ethanol production. However, in certain cases, the use of brackish groundwater could provide high quality water at a relatively low cost. The removal of dissolved solids (TDS) from the groundwater must be achieved prior to utilization in an Ethanol production facility.

4.9.3.2 Water Supply Yield

There is no firm water supply yield information at this time.

4.9.3.3 Cost

There is no firm cost information at this time.

4.9.3.4 Environmental Impacts

The environmental impacts to install Ethanol Production Plants in the region could be very costly to the water supply. It has been studied that for every 1 gallon of ethanol produced it takes up to 3 gallons of water. This could have a tremendous impact on the local water supply in the region. Other potential environmental impacts include the disposal of contaminated wastewater from the production of the ethanol and the discharge stream into the environment. These are all questions that will need to be answered when a further evaluation of Ethanol Productions Plants becomes available.

4.9.3.5 Implementation Issues

As with any project, necessary state and federal permits must be obtained before construction can begin. Additionally, the project will need to comply with the National Environmental Policy Act if federal funding is involved, and with the Endangered Species Act if any threatened or endangered species is impacted. Many environmental analyses will need to be conducted in order for this particular project to be implemented.

4.9.3.6 Recommendations

Due to the lack of information available for costs and the lack of details specific to this region, this strategy cannot be recommended as a regional water management strategy. However, it would be ideal for the planning group to evaluate this strategy in more detail if any additional information could be made available.

4.10 ALTERNATIVE STRATEGIES

Alternative strategies are non-recommended strategies which are strictly intended for contingency planning; they are for entities whose recommended water management strategies may become infeasible at one time or another due to implementation reasons or external factors. For example, an implementation issue could consist of contractual obligations of the project or the lack of required permits in order to begin construction. Some external factors acting on a project could be any outside element that affects the project such as the invasion of aquatic weeds (e.g. salt cedar); aquatic weeds reduce the region's flow of water in the river. Other external factors could include Mexico's non compliance with the 1944 Treaty and the delivery of its share of water. Below is a list of previously mentioned water management strategies. These are also considered alternative strategies. If an entity's water management strategy becomes impracticable, they may incorporate an alternative strategy.

- Municipal Water Conservation;
- Non-Potable Reuse of Reclaimed Water;
- Acquisition of Additional Rio Grande Water through Water Rights Purchase, Urbanization, and Contract;
- Desalination of Brackish Groundwater;
- Desalination of Seawater;
- Groundwater Development;
- Dams, Weirs, and Storage
    - Brownsville Weir Reservoir
    - Banco Morales Reservoir
    - Resaca Restoration
    - Laredo Low Water Weir
- Improving Water Infrastructure and Distribution
    - Proposed Elsa Tank

4.11 STRATEGIES FOR REDUCING IRRIGATION SHORTAGES

4.11.1 On-Farm Water Conservation

4.11.1.1 Strategy Description

The Irrigation Technology Center (ITC) of Texas A&M University was responsible for providing data for this round of regional planning. The data was gathered by investigating both the effects of on-farm conservation in this region and the extent to which irrigation demands could be reduced through adoption of on-farm water conservation measures. These measures include farm-level water measurement and metering, replacement of field ditches with poly pipe, and adoption of improved water management practices and irrigation technologies. It should be noted that the investigation conducted by Texas A&M University provides documentation that 54% of agricultural water delivered within the region is measured or metered on a farm-level. Also, 36% of the agricultural water applied in the region is through poly or gated pipe and 30% is applied using advanced water management practices and/or improved irrigation technology. The ITC report can be referenced in the appendix.

On-farm water conservation offers a large potential to reduce the volume of water used for irrigation in agriculture. Technologies and methods currently available for on-farm water conservation include: 1) plastic pipe, 2) low energy precision application, 3) irrigation scheduling using an evapotranspiration network, 4) drip, 5) metering, 6) unit pricing of water, 7) water efficient crops, and 8) other options.

Water savings estimates were prepared for two scenarios: on-farm water savings without improvements to irrigation conveyance and distribution facilities and on-farm savings with such improvements. The amount of water that reaches the field turnout is partially dependent upon conveyance efficiency, which also influences the type of on-farm water conservation measures that can be applied. For example, insufficient "head" at the delivery point can make it difficult to deliver irrigation water evenly over the span of a field, no matter what irrigation methods or technologies are used. Approximately 50% of the area experiences insufficient head. Similarly, certain irrigation technologies, such as drip and micro-irrigation, require near continuous delivery of relatively small amounts of water. Most existing irrigation conveyance and distribution systems were designed to deliver large volumes of water over relatively short time periods.

4.11.1.2 Water Supply Yield

Three methods/practices were analyzed for this WMS: farm-level water measurement and metering, replacement of field ditches with poly/gated pipe, and adoption of improved water management practices and irrigation technologies. As detailed in the ITC report, 46% of the region still needs to be equipped with water measurement/metering devices, 54% of the region remains to be outfitted with poly/gated pipe, and 60% of the region needs improved management and irrigation technologies.

Two water supply conditions were evaluated for this WMS: normal and drought. Normal conditions were based on the average irrigation diversions for the highest 5 years during the period from 1986 to 2004. Drought conditions were based on the 2010 projected drought supply as detailed in Chapter 3. For the purpose of this plan, only the estimated savings under normal conditions will be evaluated. As was explained earlier, on-farm water savings are detailed for two cases: with and without improvements to irrigation conveyance and distribution facilities. Table 4.52 shows a county-by-county breakdown of achievable on-farm water savings with conveyance system improvements and normal water supply conditions. Table 4.53 shows savings without conveyance system improvements and with normal water supply conditions.

No significant on-farm water savings are expected in Jim Hogg, Webb, or Zapata counties.

Table 4.57: On-Farm Water Savings with Conveyance Efficiency Improvements for Normal Water Supply Conditions (ac-ft/yr)

	Cameron	Hidalgo	Maverick	Starr	Willacy	Total
Measurement	12,714	25,809	0	0	0	38,523
Poly/Gated Pipe	18,795	38,153	1,438	0	2,927	61,313
Improved Mgmt./Tech.	45,938	98,823	14,709	7,894	6,833	174,197
Total	77,447	162,785	16,147	7,894	9,760	274,033

Table 4.58: On-Farm Water Savings without Conveyance Efficiency Improvements for Normal Water Supply Conditions (ac-ft/yr)

	Cameron	Hidalgo	Maverick	Starr	Willacy	Total
Measurement	4,700	8,700	0	0	0	13,400
Poly/Gated Pipe	8,500	16,000	1,100	0	2,000	17,600
Improved Mgmt./Tech.	15,400	50,800	6,000	7,894	4,100	84,194
Total	28,600	75,500	7,100	7,894	6,100	125,194

One can see that significantly more water can be conserved using on-farm techniques in conjunction with conveyance system improvements than can be conserved without conveyance improvements. Conveyance efficiency determines how much water reaches the field turnout. As improvements are made to the conveyance system, more water can be delivered to the turnouts and the full potential of on-farm improvements can be realized. For this report, the Rio Grande RWPG assumes that conveyance system improvements are being done in conjunction with on-farm improvements.

The Rio Grande RWPG will use an implementation scenario for on-farm water conservation measures based on implementation of the conveyance and distribution improvements previously described and in which investments in on-farm water conservation measures and the resultant water savings are to be "ramped up" or phased in over the 50-year planning period. This is in recognition that the implementation of on-farm water conservation measures requires acceptance and adoption by individual agricultural producers. The rate of implementation of on-farm water conservation measures is 13.3 percent of the estimated achievable on-farm water savings per decade, resulting in 80 percent of the estimated achievable on-farm savings being "captured" in decade 2060.

This implementation schedule also allows for conveyance system improvements to take place before on-farm improvements are implemented thereby maximizing on-farm conservation. Therefore, our evaluation of on-farm savings uses data shown in Table 4.52: On-farm Water Savings with Conveyance Efficiency Improvements for Normal Water Supply Conditions. Table 4.54 shows on-farm savings throughout the extent of this planning study. Water savings are represented as a sum of the three conservation methods: farm-level water measurement and metering, replacement of field ditches with poly pipe, and adoption of improved water management practices and irrigation technologies. For a more detailed analysis, the ITC report can be viewed in the appendix.

Table 4.59: Projected Region M On-Farm Water Savings with Conveyance Efficiency Improvements and Normal Water Supply Conditions (ac-ft/yr)

	D2010	D2020	D2030	D2040	D2050	D2060
Cameron (ac-ft/yr)	27,306	54,613	57,343	60,074	62,805	65,535
Hidalgo (ac-ft/yr)	49,566	99,132	104,089	109,045	114,002	118,959
Maverick (ac-ft/yr)	10,394	20,781	21,826	22,866	23,905	24,944
Starr (ac-ft/yr)	0	0	0	0	0	0
Willacy (ac-ft/yr)	3,894	7,787	8,177	8,566	8,955	9,345
Total (ac-ft/yr)	91,160	182,313	191,435	200,551	209,667	218,783

4.11.1.3 Cost

Economists from the Texas Agricultural Experiment Station (TAES) performed a cost analysis for the implementation of on-farm improvements in the region. Their report was based on data collected for the last round of regional planning. It was assumed by the Rio Grande RWPG that on-farm implementation rates have remained consistent throughout the valley on a county-by-county basis. Therefore, the report completed by TAES is still accurate. However, the potential on-farm water savings have been updated, as was described earlier.

In the report done by TAES for the last round of regional planning, capital and O&M costs were reported in terms of water conserved due to volumetric measurement, poly or gated pipe, and improved management and technology. These values were then represented in terms of $/acre-foot. Since each county is in a different state of on-farm improvement implementation, current on-farm potential water savings were extrapolated using TAES's $/acre-foot analysis on a county-by county basis.

These values were then combined to arrive at a general $/acre-foot value for the entire region. This value is representative of what it would take to implement general on-farm improvements throughout the region.

Table 4.60: WMS Cost Summary (On-Farm Conservation)

Water Management Strategy Cost Summary			
WMS	Cost		Appendix
	$/acre-foot	$/1000 gallons	
On-Farm Conservation	$253.38	$.78	O of Cost Analysis Appendix

Table 4.55 gives the resultant Region M annual unit cost analysis based on the aforementioned implementation rate of conserving 13.3 percent of the estimated achievable on-farm savings per decade, resulting in 80 percent of achievable savings being realized in 2060.

Table 4.61: Cameron County and Their Allotted On-Farm Conservation per Irrigation District[20]

On Farm Water Conservation						
	Additional Supply by Decade					
Cameron County Irrigation Districts	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Adams Garden Irrigation District No. 19	312	770	1,195	1,935	2,413	2,889
Bayview Irrigation District No. 11	257	481	556	905	1,134	1,364
Brownsville Irrigation District	838	1,277	1,151	1,868	2,334	2,801
Cameron County Water Improvement District No. 16	59	112	132	214	268	321
Cameron County Irrigation District No. 2	2,024	3,702	4,140	6,757	8,493	10,242
Cameron County Irrigation District No. 6	524	880	855	1,416	1,805	2,204

[20] Table 4.56 is a breakdown of On-Farm Conservation per Irrigation District. This would be implemented as a subset of the Irrigation WUG. This information is based on Special Study No. 2. Classify Irrigation Districts as Water User Groups.

Harlingen Irrigation District-Cameron County No. 1	1,535	3,299	4,459	7,224	9,012	10,794
Hidalgo and Cameron County Irrigation Districts No. 9	44	51	6	14	24	34
La Feria Irrigation District-Cameron County No. 3	811	1,521	1,746	2,868	3,626	4,397
Santa Maria Irrigation District-Cameron County No. 4	88	181	234	385	487	590
Valley Acres Water District	17	40	60	99	125	152
County-Other	3,816	8,339	16,444	17,618	21,913	26,171
TOTALS	**10,324**	**20,655**	**30,979**	**41,302**	**51,634**	**61,958**

Table 4.62 Hidalgo County and Their allotted On-Farm Conservation per Irrigation District[21]

Hidalgo County Irrigation Districts	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Delta Lake Irrigation District	4,261	11,351	22,162	29,309	36,349	43,302
Donna Irrigation District-Hidalgo County No. 1	2,246	5,382	9,403	12,547	15,696	18,847
Engleman Irrigation District	917	2,169	3,702	4,889	6,054	7,201
Hidalgo County Irrigation District No. 1	2,483	3,678	2,434	3,323	4,248	5,200
Hidalgo County Irrigation District No. 2	1,553	607	0	0	0	0
Hidalgo and Cameron County Irrigation Districts No. 9	2,463	3,307	532	1,025	1,665	2,413
Hidalgo County Irrigation District No. 6	0	0	0	0	0	0
Hidalgo County Irrigation District No. 13	131	92	0	0	0	0
Hidalgo County Irrigation District No. 16	677	1,050	833	1,159	1,508	1,873
Hidalgo County Irrigation District No. 19	0	0	0	0	0	0
Hidalgo County Municipal Utility District No. 1	193	368	481	641	802	964
Hidalgo County Water Control and Improvement District No. 18	180	345	455	606	758	910
Hidalgo County Water Improvement District No. 5	238	536	844	1,140	1,442	1,748
Hidalgo County Water Improvement District No. 3	251	335	113	164	221	283

[21] Table 4.57 is a breakdown of On-Farm Conservation per Irrigation District. This would be implemented as a subset of the Irrigation WUG. This information is based on Special Study No. 2. Classify Irrigation Districts as Water User Groups.

Santa Cruz Irrigation District No. 15	3,302	8,279	15,092	19,982	24,810	29,587
United Irrigation District of Hidalgo County	2,545	5,196	7,600	10,068	12,508	14,924
Valley Acres Water District	260	720	1,461	1,961	2,466	2,976
County-Other	0	2,182	2,705	3,623	4,550	5,483
TOTALS	**21,699**	**45,597**	**67,819**	**90,436**	**113,079**	**135,711**

Table 4.63 Willacy County and Their Allotted On-Farm Conservation per Irrigation District[22]

Willacy County Irrigation Districts	2010	2020	2030	2040	2050	2060
Delta Lake Irrigation District	1,096	2,136	3,151	4,197	5,244	6,288
County-Other	205	467	753	1,008	1,263	1,520
TOTALS	**1,301**	**2,603**	**3,904**	**5,205**	**6,507**	**7,808**

Table 4.64: Implementation Rate

	Implementation Rate					
	13.3%	26.7%	40.0%	53.3%	66.7%	80.0%
Annual Cost of Water	$9,255,616	$18,518,176	$27,773,793	$37,029,409	$46,291,969	$55,547,585

4.11.1.4 Environmental Impact

When this water management strategy is put into motion there will be temporary and permanent impacts associated with on-farm improvements. The temporary environmental impacts would probably be evident with the construction activities. The construction activities dealing with this WMS would include a decrease in air and noise quality. The intensity of these construction related impacts would be minimal due to dust and noise measures to be implemented during construction, applicable permit conditions, stipulations for the protection of air and water quality, and the temporary localized nature of the effects. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts.

Permanent environmental impacts due to construction and operation of the WMS would be a decrease in air quality due to the maintenance activities required for this WMS. The permanent decrease in air quality would not be

[22] Table 4.58 is a breakdown of On-Farm Conservation per Irrigation District. This would be implemented as a subset of the Irrigation WUG. This information is based on Special Study No. 2. Classify Irrigation Districts as Water User Groups.

significant, as maintenance activities are periodic in nature and duration. These on-farm improvements could also result in impacts to temporary wetlands and other habitats that occur in areas where over-watering contributed to the temporary water supply. Conversion of open ditches to poly or gated pipe would eliminate open water areas where vegetation is allowed to grow, albeit temporary, and allows for habitat when present. For the most part, many districts allow for the re-vegetation of native grasses where improvements have been made. Tail water would be minimized by undertaking this strategy. With this being the case, sediment/chemical runoff will be reduced thereby increasing drainage ditch water quality. There should be an investigation into these environmental impacts before any construction takes place.

4.11.1.5 Implementation Issues

In looking to the future and adoption of on-farm water conservation strategies, there are several factors that impact the rate of adoption. A major factor relates to water rights being held by the irrigation district. In the absence of an incentive structure for the producer, the investment in distribution technologies cannot be justified. The value of water savings needs to be shared with the agricultural producer.

Irrigation scheduling is being practiced across the U.S. and other regions of Texas. This technology requires an evaporation-transpiration network as well as specific crop water coefficients. Typically neither the network or crop coefficients are available for South Texas. This can be addressed by research and education but takes time and investment.

Metering and per unit pricing are typically resisted in regions where they are not used. Metering requires an initial investment by either the producer or the irrigation district, suggests bureaucracy, and imposes a cost for excessive water use. Plastic pipe is somewhat impacted by the initial investment and potential impact on labor requirements for irrigation.

Often, water efficient crops or breeding programs to reduce crop water requirements are proposed to save on-farm water use. Unfortunately, the lowest water-using crop is often the lowest value crop. Hence, economics and farm profitability become driving forces in farmer crop selections. Using plant breeding programs and biotechnology offer an opportunity to reduce plant water dependency. However, this requires sophisticated and expensive science as well as significant time.

Therefore, there are no quick fixes to dramatically reduce on-farm water use. Texas has a low interest loan program for agriculture which can be used to purchase water conserving distribution systems. However, the producer still must repay the loan. Without an incentive program to benefit producers who adopt reduced water use techniques, this has the potential to be a very slow process. The constraints to on-farm water conservation can be summarized as:

1) water rights do not always reward producers for conservation, 2) investment requirements and disconnect of benefits to the producers, and 3) limitations of science on crop water requirements and time to develop new cultivars.

Implementation of on-farm water conservation measures will require individual agricultural producers to adopt new irrigation technologies and management practices. As noted previously, there has already been a significant degree of adoption of on-farm water conservation measures by producers in the Rio Grande Region. However, to achieve the recommended rates of implementation, it will be important to expand state and federal technical assistance programs, provide incentives (e.g., cost-sharing), and/or financial assistance (e.g., low-interest loans). Also previously noted, the degree to which on-farm water savings can be achieved is partially dependent upon improved efficiencies of irrigation conveyance and distribution facilities. To some extent, such improvements are required in advance of adoption of on-farm water conservation measures. It is therefore essential that the required technical assistance and financial resources be brought to bear on irrigation conveyance and distribution improvements as soon as possible.

4.11.1.6 Recommendations

The Rio Grande RWPG recommends the following on-farm improvements: farm-level water measurement and metering, replacement of field ditches with poly/gated pipe, and adoption of improved water management practices and irrigation technologies. Many technologies and methods are currently available including, but not limited to, plastic pipe, low energy precision application, irrigation scheduling using an evapotranspiration network, drip irrigation, metering, unit pricing of water, and planting water efficient crops.

Each irrigation district should perform an evaluation of their district to determine the most feasible and cost effective method for increasing on-farm efficiency. Key aspects in determining when and where these improvements should take place will be dependent on existing rate schedules, urbanization rates, and applicable on-farm technologies.

4.11.2 Conveyance System Conservation

4.11.2.1 Strategy Description

Water used for irrigation constitutes the largest portion of overall water demand in the region. Currently, 83% of the overall demand is used for irrigation purposes. However, by the year 2060, the projected irrigation demand will be reduced to 59% due to urbanization and other like factors. There are twenty-nine irrigation districts located in the United States below the International

Falcon-Amistad Reservoir System, which supplies nearly 95 percent of their water needs[23].

Several studies and projects have proven that raw water delivered by irrigation districts can be conserved if more efficient distribution systems are put into place. The Irrigation Technology Center (ITC) of Texas A&M University developed and evaluated water savings for a comprehensive program to rehabilitate and improve the management of irrigation conveyance and distribution facilities in four of the five subject counties. Their study is the most recent data pertaining to irrigation districts. Cameron, Hidalgo, Maverick, and Willacy Counties were the only counties in the region evaluated because no irrigation districts operate in the other counties.

The proposed conveyance efficiency program consists of six principal components, and they are as follows: installation of no-leak gates, installation of additional water measurement weirs, conversion of smaller concrete canals that are in poor condition to pipeline, lining of smaller earthen canals previously constructed of more porous soils, and implementation of a verification program to monitor and measure the effectiveness of the efficiency improvements.

Each proposed improvement conserves water in a number of different ways.

- Installation of no-leak gates: Canal gates are used to hold water in a canal upstream of the gate. If leaks are present in the gate structures, irrigation water cannot be effectively stored in portions of the canal where there is a high demand. Water lost in this manner is typically lost to either evaporation or seepage.
- Water measurement weirs: By installing water measurement weirs, irrigation districts can obtain an accurate description of water levels in their canals. Telemetry can also be used in this application. By allowing the district to view canal levels from a remote location, overflows will be significantly reduced, thereby conserving water. In the 2004 ITC study, there were at least 34 major spill sites in the region. A representative sample of four spill and recovery sites was monitored. Of these four, spill rates ranged from 28 ac-ft/yr to 4684 ac-ft/yr.
- Converting canals to pipeline: With an annual evaporation rate of approximately 67.2 inches per year, significant irrigation water is lost to evaporation. By converting open canals to pipelines, water is conserved by eliminating evaporation and seepage. However, there are currently a number of mortar joint concrete pipelines located in the region. The joints associated with this type of pipeline are generally inflexible and crack over time, causing seepage. New materials and methods of pipeline construction reduce, if not eliminate, this problem.

[23] U.S. Bureau of Reclamation Canal Rehabilitation Project Report. Cameron County Irrigation District No. 2. August 2003.

- Lining canals: The majority of canals in the region are constructed of earthen materials. Seepage rates in earthen canals found in the region range from 0.15 to 13.85 gal/sf/day. Seepage is also significant in concrete lined canals where rates ranging from 0.57 gal/sf/day to 8.82 gal/sf/day were reported throughout the region. There are four major types of canal lining systems: buried membrane linings, earth linings, soil sealants, and exposed linings. A study conducted by the U.S. Bureau of Reclamation concluded that a lining system consisting of a buried geomembrane liner with a concrete cover is 95% effective in eliminating seepage.
- Implementation of a verification program: In the initial implementation of this strategy, verifying water savings on improved canals will allow for an accurate description of overall savings, thereby giving detailed information regarding region specific conditions.

4.11.2.2 Water Supply Yield

ITC estimates that irrigation district conveyance and distribution losses could be reduced by 154,393 acre-feet per year during drought conditions and by 243,092 acre-feet per year under average conditions. The lower water savings estimates for drought conditions are based on lower overall water demands due to water availability constraints.

Table 4.60 summarizes the estimated water savings from conveyance and distribution efficiency improvements for the four counties evaluated. These estimates are based on improving the average conveyance/distribution efficiency from present levels, which average 69.7 percent, to an average of 90 percent. Conveyance efficiency is calculated from the total amount of water delivered in order to supply the demand. Transportation losses, accounting losses, and operational losses are the three main components of conveyance efficiency. Transportation losses consist of evaporation and seepage/leakage in lined and unlined canals as well as pipelines. Leaking gates and valves also make up a significant portion of transportation losses.

Accounting losses depend on accuracy of field-level deliveries, unauthorized use, metering at main pumping plant, and the water rights accounting system. Operation losses involve charging empty pipelines and canals, spills, and partial use of water in dead-end lines. For the purpose of this report, normal water conditions were used.

Table 4.65: Conveyance Data Table

County	Average Conveyance Efficiency (%)	Water Savings Potential (ac-ft/yr)	
		Normal	Drought
Cameron	68.0	72,817	50,191
Hidalgo	71.0	132,176	83,419
Maverick	67.0	27,716	13,770
Willacy	70.0	10,383	7,013
Region M	**69.7**	**243,092**	**154,393**

Realistically, the amount of water savings that can be achieved through distribution system improvements is likely to be less than the estimates show. This is due to the fact that not all conveyance improvements are economically attractive under current conditions, and other factors will likely limit the degree to which efficiency improvements are implemented. For example, investments in conveyance and distribution improvements would best be targeted at areas where urbanization will have a minimal effect on irrigated lands, and their irrigation water distribution facilities are likely to be in service for the long-term. Also, the limited financial capacity of irrigation districts, and limited sources of outside financial assistance, will likely affect the rate and degree to which savings are realized.

This plan will use an implementation scenario in which 37.5 percent of potential water savings from conveyance system improvements would be realized in decade 2010, and 75 percent of the potential water savings would be realized in decade 2020. The implementation rate would then increase at 3.75 percent per decade for the remainder of the planning period. Therefore, 90 percent of potential conveyance system improvements will be realized in decade 2060. Table 4.61 reflects the water savings under this scenario with normal water supply conditions.

Table 4.66: Water Savings (in ac-ft/yr)

	D2010	D2020	D2030	D2040	D2050	D2060
Cameron	27,306	54,613	57,343	60,074	62,805	65,535
Hidalgo	49,566	99,132	104,089	109,045	114,002	118,958
Maverick	10,394	20,781	21,826	22,866	23,905	24,944
Willacy	3,894	7,787	8,177	8,566	8,955	9,345
Total	**91,160**	**182,313**	**191,435**	**200,551**	**209,667**	**218,782**

4.11.2.3 Cost

Cost estimates for this Water Management Strategy were derived based on information assembled by the United States Bureau of Reclamation. In their Canal Rehabilitation Project Report for Cameron County Irrigation District No. 2 (CCID2) submitted in August of 2003, 10 canal lining projects and 26 pipeline projects were evaluated based on construction costs and water savings. NRS

Consulting Engineers also provided costs and water savings for one lining project and 5 pipeline projects for CCID2. Total capital costs for these 42 projects totaled $28,229,114 to conserve 23,605 acre-feet of water. This would bring the District up to an estimated 90% efficiency.

Under the assumption that CCID2 is a typical district in the region, total capital costs to conserve 243,092 acre-feet of water under normal conditions, as described previously by Texas A&M, can be extrapolated using project costs and expected water savings of the CCID2 projects. If 23,605 acre-feet of water can be conserved with $28,229,114 in capital costs, then it is expected that a capital cost of $290,716,949 will be needed to conserve 243,092 acre-feet throughout the region. Previous studies have indicated lower capital costs, based on available information. These revised figures are believed to be more accurate taking available information from the projects completed and proposed by CCID2.

Listed below are the cost components that were taken into consideration when developing this WMS.

- Excavation for embankment
- Compacted embankment
- Furnish and install concrete lining
- PVC lining
- Subgrade preparation for lining
- Structural concrete
- Structural removal
- Box culverts

The comprehensive financial analysis performed by the United States Bureau of Reclamation takes into consideration the project component's initial construction cost, how many years the components will be useful and save water, the impact of inflation and time, the impact of changes in O&M costs, and the expected changes in energy costs, etc.

Table 4.67: Economic Data

Water Management Strategy Cost Summary			
	Cost		
WMS	**$/Acre-ft**	**$/1000 gallons**	**Appendix**
Conveyance System	$ 120.68	$ 0.37	**N of Cost Ananlysis Appendix**

Table 4.68: Cameron County Conveyance System Allotment per Irrigation District[24]

	Additional Supply by Decade					
Cameron County Irrigation Districts	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Adams Garden Irrigation District No. 19	824	2,036	2,212	2,814	2,935	3,056
Bayview Irrigation District No. 11	679	1,272	1,029	1,316	1,379	1,442
Brownsville Irrigation District	2,218	3,378	2,130	2,717	2,839	2,962
Cameron County Water Improvement District No. 16	156	296	244	311	326	340
Cameron County Irrigation District No. 2	5,353	9,789	7,663	9,828	10,331	10,833
Cameron County Irrigation District No. 6	1,387	2,326	1,583	2,060	2,195	2,331
Harlingen Irrigation District-Cameron County No. 1	4,059	8,723	8,255	10,507	10,962	11,417
Hidalgo and Cameron County Irrigation Districts No. 9	117	136	11	21	29	36
La Feria Irrigation District-Cameron County No. 3	2,144	4,021	3,232	4,171	4,411	4,651
Santa Maria Irrigation District-Cameron County No. 4	232	480	433	560	592	625
Valley Acres Water District	44	106	112	144	152	160
County-Other	10,093	22,049	30,439	25,626	26,653	27,682
TOTALS	**27,306**	**54,613**	**57,343**	**60,074**	**62,805**	**65,535**

Table 4.69: Hidalgo County Conveyance System Allotment per Irrigation District

Hidalgo County Irrigation Districts	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Delta Lake Irrigation District	4,261	11,351	22,162	29,309	36,349	43,302
Donna Irrigation District-Hidalgo County No. 1	5,131	12,289	15,032	15,760	16,488	17,216
Engleman Irrigation District	2,094	4,953	5,919	6,141	6,359	6,578
Hidalgo County Irrigation District No. 1	5,672	8,397	3,891	4,174	4,463	4,750
Hidalgo County Irrigation District No. 2	3,548	1,386	0	0	0	0

[24] Table 4.68 is a breakdown of Cameron County irrigation districts' conveyance system improvements. It is based off of the irrigation districts in Special Study 2 and are subsets of irrigation WUGs.

Hidalgo and Cameron County Irrigation Districts No. 9	5,626	7,551	851	1,287	1,749	2,204
Hidalgo County Irrigation District No. 6	0	0	0	0	0	0
Hidalgo County Irrigation District No. 13	298	210	0	0	0	0
Hidalgo County Irrigation District No. 16	1,547	2,398	1,331	1,456	1,584	1,711
Hidalgo County Irrigation District No. 19	0	0	0	0	0	0
Hidalgo County Municipal Utility District No. 1	442	840	769	805	843	880
Hidalgo County Water Control and Improvement District No. 18	411	787	727	762	796	831
Hidalgo County Water Improvement District No. 5	544	1,224	1,349	1,432	1,514	1,597
Hidalgo County Water Improvement District No. 3	574	764	180	206	232	259
Santa Cruz Irrigation District No. 15	7,542	18,904	24,126	25,099	26,061	27,026
United Irrigation District of Hidalgo County	5,813	11,865	12,149	12,647	13,139	13,632
Valley Acres Water District	593	1,644	2,336	2,463	2,591	2,718
County-Other	5,472	0	12,715	7,193	1,756	0
TOTALS	**49,566**	**84,564**	**103,538**	**108,732**	**113,925**	**122,706**

Table 4.70: Willacy County Conveyance System Allotment per Irrigation District

Willacy County Irrigation Districts	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Delta Lake Irrigation District	3,279	6,390	6,599	6,908	7,217	7,526
County-Other	614	1,397	1,578	1,658	1,738	1,819
TOTALS	**3,894**	**7,787**	**8,177**	**8,566**	**8,955**	**9,345**

When analyzing the costs associated with implementing the previously described irrigation strategies, it is important to realize that every irrigation conveyance system is unique and that no two individual canals are identical. With this in mind, implementation costs fluctuate depending on the size and type of no-leak gates to be installed, the size and type of water measurement weirs to be installed, the current and proposed layout of canals to be refurbished, the proposed flow of delivered water, and the type of lining system to be installed.

4.11.2.4 Environmental Impact

When this water management strategy is put into motion there will be temporary and permanent impacts associated with implementation of irrigation conveyance and distribution improvements itself. The temporary environmental impacts would probably be evident with the construction activities. The construction activities dealing with this WMS would include a decrease in air and noise quality. The intensity of these construction related impacts would be minimal due to dust and noise measures to be implemented during construction, applicable permit conditions, and stipulations for the protection of air and water quality, and temporary localized nature of the effects. The construction activities could impact ecological and cultural resources to the extent that such resources occur in areas targeted for improvements. Specifically, areas in proximity to the known habitat of threatened and endangered species should be identified prior to construction activities and appropriate measures should be taken to minimize any adverse impacts. Permanent environmental impacts due to construction and operation of the WMS would be a decrease in air quality due to the maintenance activities required for this WMS. The permanent decrease in air quality would not be significant, as maintenance activities are periodic in nature and duration. These improvements to irrigation conveyance and distribution facilities could also result in impacts to wetlands and other habitat that occur in areas where canal seepage indirectly contributes to the water supply. Conversion of canal systems to pipeline systems would eliminate open water areas where vegetation is allowed to grow, albeit temporary, allowing for habitat when present.

For the most part, many districts allow for the re-vegetation of native grasses where improvements have been made. There should be an investigation into these environmental impacts before any construction takes place.

4.11.2.5 Implementation Issues

There are several impediments to the implementation of large-scale canal rehabilitation projects and other types of conveyance efficiency improvements. These include inadequate information at the irrigation district level about specific capital improvements, the potential impacts of urbanization on rehabilitation planning, and access to financing for capital improvements.

The information generated by the investigations undertaken for this planning effort fall short of what is required for large-scale investments to occur in conveyance and distribution efficiency improvements. Ideally, each irrigation district should undergo a systematic hydrologic and engineering evaluation of its water delivery facilities and management policies to identify cost-effective water efficiency improvements.

In developing a canal rehabilitation or capital improvement plan, most irrigation districts need to pay particular attention to identifying those portions of their distribution systems that should be targeted for improvements. For example, investments should generally be directed to areas where water distribution facilities are likely to stay in service for an extended period. Also, in areas that are experiencing rapid urbanization (e.g., western Hidalgo County), the evaluation of water efficiency improvements might best be done on a cooperative basis involving several districts. This would facilitate the identification and evaluation of strategies for the consolidation of district facilities. For example, significant water savings might occur if an isolated block of irrigated acreage were served by an adjoining irrigation district, thereby allowing retirement of under-utilized and inefficient water distribution facilities.

Despite the importance of further planning and engineering evaluations, irrigation districts may lack the financial and/or technical resources to undertake such planning on their own and may therefore require outside assistance. This could include technical assistance from state or federal agencies, such as the Texas Water Development Board (TWDB), the Texas Agricultural Extension Service (TAES), the USDA Natural Resources Conservation Service (NRCS), and the U.S. Bureau of Reclamation. Also, the costs of front-end project planning could be included in loans from the TWDB for agricultural water conservation projects.

Another option is to "internalize" the costs of front-end planning as part of the overall costs of transactions involving the sale of "conserved" water to DMI users. For example, the buyer of conserved water might provide up-front funding for project planning and engineering with agreement that such costs would be credited to the purchase price for the water rights.

A lack of funding is often cited as the primary impediment to the implementation of irrigation conveyance and distribution improvements. A common view is that many irrigation districts lack the capacity to finance major capital improvements on their own. Districts often cite concerns about the ability of agricultural producers to absorb increases in either flat rate assessments or water delivery charges that might result from major capital improvement projects. Nonetheless, there are several options for self-financing of improvements by irrigation districts as well as for third party financing. These options are discussed below.

Options for self-financing of water efficiency improvements by irrigation districts include:

- Pay-as-you-go funding from operating revenues;
- Loans through commercial lending institutions; and
- Loans from the Texas Water Development Board.

Pay-as-you-go funding of improvements from operating revenues would lend itself to a long-term system rehabilitation program whereby improvements are implemented in phases that are matched to revenue availability. For example, a district might budget a set amount annually from operating revenues for capital improvements. This approach has the advantage of avoiding the interest costs associated with debt financing. However, current water users would bear the full costs of such improvements through their flat rate assessments and/or water delivery charges. One way to minimize rate impacts on irrigators would be to dedicate a portion of any revenues derived from DMI water sales, or from DMI water deliveries, to fund capital improvements. If structured appropriately, this approach could provide an on-going source of revenue to fund improvements. Revenues from DMI water sales would be used for improvements that free-up additional water for conversion and sale to DMI use, which would generate additional revenues and so forth.

Under state law, irrigation districts have the authority to finance capital improvements through the issuance of general revenue bonds backed by tax revenues, through the issuance of revenue bonds, or through loans from commercial or public lending institutions, such as the TWDB.

Irrigation districts also have the authority to impose special assessments for improvements made to a portion of their water conveyance and distribution system. Such assessments are made only on the users that benefit directly from the improvements. Voter approval of tax assessments and special assessments is required.

The feasibility and attractiveness of using debt financing of improvements depends in large measure on the overall financial health of each irrigation district. Some irrigation districts may not be considered credit worthy – due to a lack of credit history or poor fiscal performance – and would therefore find it difficult to attract investors to their revenue bonds or to obtain commercial loans without paying excessively high interest rates.

An advantage of debt financing of water irrigation efficiency improvements is that all of the funds required for a major capital improvement program could be obtained in advance, thus assuring a source of funds for completion of the program. However, as with pay-as-you-go funding, debt financing requires the commitment of a stable revenue stream to service the debt. Debt service could be from revenues derived from flat rate assessments and/or revenues from irrigation water sales. It would also be possible to establish a dedicated stream of revenues based on future DMI water sales. This would likely entail a long-term contractual relationship with one or more DMI users whereby the DMI user(s) would agree to purchase increasing amounts of conserved water as it becomes available on take-or-pay basis.

There are also a number of options for third party financing of irrigation water efficiency improvements. One approach would be for individual irrigation districts and DMI users to enter into partnership arrangements whereby the DMI user provides the funds required for improvements in exchange for access to some portion of the conserved water, either through outright purchase of water rights or through long-term water sale contract.[25] Similarly, a voluntary consortium of DMI users could be formed to finance irrigation efficiency improvements in exchange for access to additional water supplies. Under this arrangement, each DMI user would obtain additional supplies proportionate to their share of the funding of improvements. Another potential approach would be to create a regional water authority for the purpose of financing irrigation efficiency improvements and to distribute DMI water supplies made available from such improvements. Finally, private sector entities could similarly finance efficiency improvements and acquire rights to conserved water for subsequent re-sale to DMI users.

4.11.2.6 Recommendations

The Rio Grande RWPG recommends the following conveyance system improvements: installation of no-leak gates, installation of additional water measurement weirs, conversion of smaller concrete canals that are in poor condition to pipeline, lining of smaller earthen canals previously constructed of more porous soils, and implementation of a verification program to monitor and measure the effectiveness of the efficiency improvements.

Each irrigation district should perform an evaluation of their district to determine the most feasible and cost effective methods to increase delivery efficiency. Identifying areas that will be in service for the life of the project is a key factor in determining feasibility, as is locating funding sources or structuring cash flow to perform the improvements.

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[25] The water district must agree to designate at least 75% of the proceeds from the sale of water rights for capital improvements of the district.

The following table describes ongoing projects in Region M with respect to irrigation districts.

Table 4.71: Valley Irrigation District Projects

Valley Irrigation District Projects

District	Completed BOR Owes	Proposed In Org Leg	Completed In Org Leg	Proposed In Pend Leg	Shared Proj w/other Entities	Proposed w/o Legislation	BOR 2025 Proj	Applied for TWDB TEIP	Applied for USDA NRCS AWEP	TWDB Ag WCG	TWDB WC Demo 10yr	Non Irrigation Projects
Adams Gardens ID				$2,500,000				$3,750,000				
Bayview ID				$1,425,219								
Brownsville ID	$984,227	$2,200,000	$2,200,000	$722,100			$1,210,000					
CCID #2 San Benito	$3,309,453	$13,500,000	$13,500,000	$8,269,576		$900,000	$1,066,195					
CCID#6 Los Fresnos				$6,507,300								
CCWID#10 Los Fresnos												
CCWID#16 San Benito												
Delta Lake	$1,066,138	$7,250,000	$4,012,425	$8,000,000		$375,000						
Donna ID				$2,500,000								
Engleman ID				$2,251,480								
Harlingen ID	$404,898	$3,560,000	$4,200,000	$4,173,950		$1,000,000	$500,000	$6,300,000	$3,900,000	$498,844	$3,800,000	
HCID#1 Edinburg	$1,136,818	$5,400,000	$5,400,000	$5,595,018	$10,800,000	$1,250,000						
HCID#2 San Juan			$3,308,177	$5,312,475		$674,935						
HCWID#3 McAllen						$4,995,375						$4,532,286
HCWID#5 Progreso						$9,085,000						
HCID#6 Mission	$965,688			$3,450,000								
H&CID#9 Mercedes				$8,929,152								
HCID#13 McAllen												
HCID#15 Santa Cruz				$4,609,000								
HDIC#16				$2,800,000								
HCWCID#18 Edinburg												
HCID#19 Mission												
La Feria CCID #3												
United ID	$294,662	$14,965,586	$1,050,000	$6,067,021								
Valley Acres ID				$500,000								
TOTALS	$8,161,884	$46,875,586	$33,670,602	$73,612,291	$10,800,000	$18,280,310	$2,776,195	$10,050,000	$3,900,000	$498,844	$3,800,000	$4,532,286

4.12 NON-PRACTICAL WATER MANAGEMENT STRATEGIES

The following is a table of Water Management Strategies that were not evaluated in this plan. This table states why these strategies may not be practical in this particular region according to Title 31, TAC 357.7(a)(7)(D) and (E).

Table 4.72: Water Management Strategies Not Reevaluated from Previous Plan and Not Recommended

Water Management Strategy	
Systems optimization and conjunctive use of resources	Due to the current dependency on the Rio Grande by all water users in the region, the Regional Water Planning Group evaluated the conjunctive use of this source in all Water Management Strategies dealing with the Rio Grande. Systems optimization is also addressed as an irrigation WMS. Since many municipalities obtain their raw water via irrigation canals, improving conveyance efficiency directly benefits these users.
Reallocation of reservoir storage to new uses	Reservoir reallocation was analyzed. However, due to the large quantity and relatively small storage volume of the reservoirs in the region, this strategy is not a feasible option for overall consideration.
Voluntary Redistribution of Water Resources including contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements	Voluntary redistribution of water resources through contracts, sales, and options were evaluated as WMSs. Rio Grande Water Right acquisition by water marketing, water banks, leases, subordination agreements, and financing agreements have the possibility of being feasible WMSs. However, a lack of key information makes these strategies impossible to thoroughly evaluate.
Conversion of existing water rights through voluntary agreements	Municipalities, Water Supply Corporations, and Irrigators are currently in the midst of discussions regarding the voluntary redistribution of water resources. In the past year, these issues have come to the forefront. The transfer may be either temporary or permanent, and in most instances, will require a permit modification from the Texas Commission on Environmental Quality.
Enhancements of yields of existing sources	The regional planning group evaluated the enhancement of yields of existing sources including groundwater (fresh and brackish) and raw water from the Rio Grande. Groundwater yields were thoroughly evaluated and included as a WMS. However, due to the water rights system currently in place for the Rio Grande, enhancing the raw water yield is not a feasible WMS.

Improvement of water quality including control of naturally occurring chlorides	Water quality was researched as part of the Regional Water Plan. The difficulty in including water quality as a WMS lies in Region M's close proximity to Mexico. Untreated or poorly treated discharges from inadequate wastewater treatment facilities, primarily in Mexico, are the principal source for fecal coliform bacteria contamination. Without knowing the extent of Mexico's contribution to water quality in the Rio Grande, a region specific water quality WMS cannot be developed. However, WMSs for reducing irrigation shortages through conservation will have a direct effect on water quality. By reducing non-precipitation irrigation runoff, water quality (predominantly in the Arroyo Colorado) will improve.

ATTACHMENT 4-1

WATER USER GROUPS AND THEIR WATER MANAGEMENT STRATEGIES

COUNTY WUG NAME WATER MANAGEMENT STRATEGY	2010	2020	2030	2040	2050	2060
CAMERON						
BROWNSVILLE						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	0	129
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	0	1,923
ADVANCED WATER CONSERVATION	253	521	798	1,074	1,350	2,162
BRACKISH WATER DESALINATION	8,414	8,417	8,420	8,424	16,828	17,129
BROWNSVILLE WEIR & RESERVOIR	20,643	20,643	20,643	20,643	20,643	23,643
EXPAND EXISTING GROUNDWATER WELLS	0	1,000	1,000	1,000	1,000	1,000
NON-POTABLE REUSE	0	500	500	500	500	500
SEAWATER DESALINATION	0	0	0	5,600	5,600	7,013
RESACA RESTORATION	877	877	877	877	877	877
BANCO MORALES RESERVOIR	238	238	238	238	238	238
COMBES						
ADVANCED WATER CONSERVATION	4	8	12	17	21	25
BRACKISH WATER DESALINATION	0	25	25	25	25	25
COUNTY-OTHER						
ADVANCED WATER CONSERVATION	46	95	145	195	245	293
EAST RIO HONDO WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	5	5
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	95	95
ADVANCED WATER CONSERVATION	0	46	94	144	193	243
BRACKISH WATER DESALINATION	100	100	100	100	177	906
EL JARDIN						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	15	37	59	81	103	125
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	294	696	1,112	1,535	1,953	2,370
ADVANCED WATER CONSERVATION	19	38	59	79	99	119
HARLINGEN						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	75	125
ADVANCED WATER CONSERVATION	68	141	215	290	691	968
BRACKISH WATER DESALINATION	0	25	25	25	586	1,923
NON-POTABLE REUSE	0	0	0	0	25	25
INDIAN LAKE						
ADVANCED WATER CONSERVATION	1	2	4	5	6	7
BRACKISH WATER DESALINATION	18	27	36	46	54	64
IRRIGATION						
IRRIGATION CONVEYANCE SYSTEM CONSERVATION	27,306	54,613	57,343	60,074	62,805	65,535
ON- FARM WATER CONSERVATION	10,324	20,655	30,979	41,303	51,634	61,958
LA FERIA						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	100	100	100	100	100
ADVANCED WATER CONSERVATION	14	18	33	48	62	77
BRACKISH WATER DESALINATION	0	180	180	180	180	180
EXPAND EXISTING GROUNDWATER WELLS	0	10	10	10	10	10
LAGUNA MADRE WD						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	2	12	25	50
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	48	188	425	900
ADVANCED WATER CONSERVATION	26	53	81	109	137	164
BRACKISH WATER DESALINATION	100	100	400	1,000	1,500	2,000
NON-POTABLE REUSE	50	50	50	50	25	25
SEAWATER DESALINATION	100	100	118	424	796	864

LAGUNA VISTA						
ADVANCED WATER CONSERVATION	4	8	12	16	20	24
SEAWATER DESALINATION	25	25	25	25	25	25
LOS FRESNOS						
ADVANCED WATER CONSERVATION	16	32	50	67	84	101
BRACKISH WATER DESALINATION	0	0	206	474	740	997
LOS INDIOS						
ADVANCED WATER CONSERVATION	2	4	6	8	11	13
MANUFACTURING						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	100	100	100	100	100	100
EXPAND EXISTING GROUNDWATER WELLS	1,000	1,000	1,000	1,000	1,000	1,000
NON-POTABLE REUSE	796	1,230	1,623	2,012	2,349	2,805
MILITARY HIGHWAY WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	10	20	40	60
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	150	300	500	700
ADVANCED WATER CONSERVATION	10	20	30	40	51	61
EXPAND EXISTING GROUNDWATER WELLS	0	125	250	375	500	625
OLMITO WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	16	35	53	72	91
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	303	661	1,011	1,376	1,723
ADVANCED WATER CONSERVATION	21	42	65	87	110	131
PALM VALLEY						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	4	6	8	10	12	13
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	78	116	151	185	220	255
ADVANCED WATER CONSERVATION	1	1	1	1	1	1
PALM VALLEY ESTATES UD						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	2	1	2	3	4
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	3	12	27	41	57	75
ADVANCED WATER CONSERVATION	1	1	2	3	4	4
PORT ISABEL						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	47	52	57	62	68	73
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	897	993	1,091	1,187	1,289	1,389
ADVANCED WATER CONSERVATION	3	6	10	13	16	20
BRACKISH WATER DESALINATION	944	1,045	1,149	1,249	1,357	1,463
PRIMERA						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	16	40	60	82	85
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	31	68	95	123	211	339
ADVANCED WATER CONSERVATION	57	88	107	137	147	150
BRACKISH WATER DESALINATION	51	70	95	111	124	113
EXPAND EXISTING GROUNDWATER WELLS	70	90	120	158	158	168
RANCHO VIEJO						
ADVANCED WATER CONSERVATION	4	4	5	5	6	6
RIO HONDO						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	200	200	200	200	200	200
ADVANCED WATER CONSERVATION	2	4	5	7	8	10
SAN BENITO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	11	42
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	200	789
ADVANCED WATER CONSERVATION	26	53	81	109	137	164

SANTA ROSA						
ADVANCED WATER CONSERVATION	5	10	15	20	25	30
SOUTH PADRE ISLAND						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	38	69	102	134	167	198
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	713	1,312	1,933	2,555	3,174	3,769
ADVANCED WATER CONSERVATION	6	12	18	24	31	37
STEAM ELECTRIC POWER						
EXPAND EXISTING GROUNDWATER WELLS	0	0	0	0	27	144
NON-POTABLE REUSE	0	0	0	0	50	400
VALLEY MUD #2						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	6	8	11	14	17
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	268	269	269	269	269
BRACKISH WATER DESALINATION	0	268	269	269	269	269
CAMERON COUNTY TOTAL	74,065	116,992	133,788	156,929	184,403	212,747
HIDALGO COUNTY						
ALAMO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	5	10	14	19	24
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	100	200	277	381	471
ACQUISITION OF WATER RIGHTS THROUGH URBANIZATION	0	400	800	1,330	1,700	2,100
ADVANCED WATER CONSERVATION	25	25	25	25	125	225
BRACKISH WATER DESALINATION	0	83	288	469	882	1,304
NON-POTABLE REUSE	34	150	225	300	400	500
ALTON						
ADVANCED WATER CONSERVATION	59	82	2,446	3,419	4,482	5,602
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	1,277	4,297	6,512	11,026	15,600
ADVANCED WATER CONSERVATION	144	357	595	854	1,136	1,425
EXPAND EXISTING GROUNDWATER WELLS	0	1,089	1,887	3,861	4,098	4,389
DONNA						
ADVANCED WATER CONSERVATION	15	32	51	72	95	118
BRACKISH WATER DESALINATION	0	50	50	50	50	50
EXPAND EXISTING GROUNDWATER WELLS	0	25	25	25	25	25
EDCOUCH						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	65	118	175	246	299	360
ADVANCED WATER CONSERVATION	65	70	81	86	121	156
EDINBURG						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	1,631	3,114	4,591	6,619
ADVANCED WATER CONSERVATION	74	328	500	686	889	1,097
NON-POTABLE REUSE	0	0	500	1,500	3,000	4,000
ELSA						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	50	50
ADVANCED WATER CONSERVATION	2	5	7	10	14	17
BRACKISH WATER DESALINATION	0	100	100	100	100	100
INFRASTRUCTURE IMPROVEMENTS	105	105	105	105	105	105
HIDALGO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	8	29	51
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	154	558	973
ADVANCED WATER CONSERVATION	32	66	104	145	189	235
EXPAND EXISTING GROUNDWATER WELLS	112	253	354	454	555	656
HIDALGO COUNTY MUD #1						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	66	100	139	181	227	274
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	1,051	1,684	2,401	3,173	4,026	4,901
ADVANCED WATER CONSERVATION	14	30	48	68	89	112

IRRIGATION						
IRRIGATION CONVEYANCE SYSTEM CONSERVATION	49,566	99,132	104,089	109,045	114,002	118,959
ON- FARM WATER CONSERVATION	21,699	43,416	65,114	86,815	108,529	130,229
LA JOYA						
ACQUISITION OF WATER RIGHTS THROUGH URBANIZATION	0	0	0	2	87	185
ADVANCED WATER CONSERVATION	7	14	21	49	62	73
BRACKISH WATER DESALINATION	50	50	100	120	120	120
LA VILLA						
ADVANCED WATER CONSERVATION	0	1	1	1	1	1
MANUFACTURING						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	55	194
EXPAND EXISTING GROUNDWATER WELLS	0	0	0	0	100	200
NON-POTABLE REUSE	0	0	0	0	100	200
MCALLEN						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	225	329	393	432
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	1	999	4,085	5,721	7,345
ADVANCED WATER CONSERVATION	191	382	925	1,250	2,177	3,423
BRACKISH WATER DESALINATION	3,360	3,360	6,139	6,600	8,121	8,821
EXPAND EXISTING GROUNDWATER WELLS	0	0	487	619	945	1,543
NON-POTABLE REUSE	0	0	0	2,349	5,578	9,893
MERCEDES						
ADVANCED WATER CONSERVATION	7	14	23	32	43	53
BRACKISH WATER DESALINATION	560	560	560	560	560	560
EXPAND EXISTING GROUNDWATER WELLS	0	560	560	560	560	560
MILITARY HIGHWAY WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	5	14	16	18
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	139	353	561	789
ADVANCED WATER CONSERVATION	8	18	28	38	47	56
EXPAND EXISTING GROUNDWATER WELLS	0	125	250	375	500	625
MISSION						
ACQUISITION OF WATER RIGHTS THROUGH URBANIZATION	299	2,633	4,901	7,236	10,014	12,118
ADVANCED WATER CONSERVATION	260	637	598	789	1,394	2,135
BRACKISH WATER DESALINATION	560	560	560	560	560	560
NON-POTABLE REUSE	352	839	1,765	2,780	3,909	5,321
NORTH ALAMO WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	0	48
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	0	902
ADVANCED WATER CONSERVATION	248	538	863	1,215	3,098	4,000
BRACKISH WATER DESALINATION	11,201	11,201	11,201	11,201	11,201	11,201
PALMHURST						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	15	46	82
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	281	883	1,551
ADVANCED WATER CONSERVATION	32	68	110	155	203	254
PALMVIEW						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	22	45
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	425	860
ADVANCED WATER CONSERVATION	16	34	55	78	102	128
PENITAS						
ADVANCED WATER CONSERVATION	1	1	2	2	7	16

PHARR						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	89	205	311	423	554
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	698	2,478	4,721	7,086	8,895
ACQUISITION OF WATER RIGHTS THROUGH URBANIZATION	0	400	766	928	1,067	2,003
ADVANCED WATER CONSERVATION	143	392	478	589	798	943
EXPAND EXISTING GROUNDWATER WELLS	100	150	175	200	225	250
NON-POTABLE REUSE	50	50	50	50	50	50
PROGRESO						
ADVANCED WATER CONSERVATION	11	24	38	54	71	89
SAN JUAN						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	24	82	147	218	300	385
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	454	1,560	2,786	4,143	5,708	7,312
ADVANCED WATER CONSERVATION	95	206	330	465	612	762
SHARYLAND WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	20	20	67	115	167
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	372	377	1,264	2,181	3,168
ADVANCED WATER CONSERVATION	29	62	100	141	186	231
STEAM ELECTRIC POWER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	980	2,374	3,291	3,847	5,183
NON-POTABLE REUSE	0	1,000	2,000	4,000	7,000	10,000
SULLIVAN CITY						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	10	21
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	186	390
ADVANCED WATER CONSERVATION	11	25	39	55	73	91
WESLACO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	0	0	0	100
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	0	0	0	100
ADVANCED WATER CONSERVATION	44	82	124	217	793	1,048
BRACKISH WATER DESALINATION	100	100	100	100	250	350
EXPAND EXISTING GROUNDWATER WELLS	0	0	0	100	429	899
POTABLE REUSE	1,120	1,120	1,120	1,120	1,300	1,540
HIDALGO COUNTY TOTAL	92,461	178,085	230,461	286,766	351,944	419,296
JIM HOGG						
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	7	7	8	8	8	7
ADVANCED WATER CONSERVATION	0	1	1	1	1	1
EXPAND EXISTING GROUNDWATER WELLS	60	66	70	73	71	65
HEBBRONVILLE						
ADVANCED WATER CONSERVATION	2	4	6	8	7	6
JIM HOGG TOTAL	69	78	85	90	87	79
MAVERICK						
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	27	549	1,042	1,483	1,873	2,226
ADVANCED WATER CONSERVATION	40	83	123	158	190	216
EAGLE PASS						
ADVANCED WATER CONSERVATION	10	21	31	40	48	55
BRACKISH WATER DESALINATION	0	260	260	260	272	641
EL INDIO WSC						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	1	1	0	0	0	0
ADVANCED WATER CONSERVATION	13	27	40	51	61	70

IRRIGATION						
IRRIGATION CONVEYANCE SYSTEM CONSERVATION	10,394	20,781	21,826	22,866	23,905	24,944
ON- FARM WATER CONSERVATION	2,152	4,306	6,459	8,611	10,765	12,918
MAVERICK TOTAL	12,637	26,028	29,781	33,469	37,114	41,070
STARR						
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	3,041	2,786	4,553	5,334	6,512	7,886
ADVANCED WATER CONSERVATION	67	139	212	286	360	430
EXPAND EXISTING GROUNDWATER WELLS	1,580	3,195	2,869	3,557	3,826	3,890
IRRIGATION						
ON- FARM WATER CONSERVATION	1,052	2,105	3,158	4,210	5,263	6,315
LA GRULLA						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	32	45	54	56	88	102
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	243	252	259	270	279	304
ADVANCED WATER CONSERVATION	20	25	30	35	56	64
EXPAND EXISTING GROUNDWATER WELLS	50	75	112	155	159	183
RIO GRANDE CITY						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	5	14	24	50	84	141
ADVANCED WATER CONSERVATION	23	35	48	78	120	155
BRACKISH WATER DESALINATION	560	1,120	1,120	1,123	1,314	1,498
EXPAND EXISTING GROUNDWATER WELLS	0	10	50	50	87	115
NON-POTABLE REUSE	0	10	50	60	87	125
RIO WSC						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	9	16	23	30	38	45
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	166	298	439	573	715	851
ADVANCED WATER CONSERVATION	6	13	20	27	34	41
ROMA CITY						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	20	36	51	75	88
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	65	410	784	1,183	1,564	1,967
ADVANCED WATER CONSERVATION	39	61	75	80	104	120
STARR TOTAL	6,958	10,629	13,916	17,208	20,765	24,320
WEBB						
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	123	240	370	518	686	874
ADVANCED WATER CONSERVATION	8	17	27	39	51	64
EL CENIZO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	3	19	36	56	78
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	56	357	689	1,072	1,476
ADVANCED WATER CONSERVATION	18	38	62	87	115	144
LAREDO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	75	133	409	494	621	1,109
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	1,425	2,524	7,766	18,367	36,313	49,863
ADVANCED WATER CONSERVATION	428	930	1,493	2,111	2,788	3,502
BRACKISH WATER DESALINATION	1,120	5,600	5,600	10,100	10,100	10,100
EXPAND EXISTING GROUNDWATER WELLS	800	799	7,920	7,920	7,919	7,918
LAREDO LOW WATER WEIR	0	0	0	0	0	0
NON-POTABLE REUSE	1,120	5,600	5,600	5,600	5,600	11,200
RIO BRAVO						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	14	37	62	89	119
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	271	700	1,171	1,700	2,256
ADVANCED WATER CONSERVATION	20	44	71	101	133	167
STEAM ELECTRIC POWER						
NON-POTABLE REUSE	0	0	0	0	200	400

WEBB COUNTY WATER UTILITY						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	2	7	12	18	25	32
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	41	132	234	334	459	591
ADVANCED WATER CONSERVATION	4	8	12	17	23	29
WEBB TOTAL	5,184	16,416	30,689	47,664	67,950	89,922
WILLACY						
IRRIGATION						
IRRIGATION CONVEYANCE SYSTEM CONSERVATION	3,894	7,787	8,177	8,566	8,955	9,345
ON- FARM WATER CONSERVATION	1,301	2,603	3,904	5,205	6,507	7,808
LYFORD						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	100	100	100	100	100
ADVANCED WATER CONSERVATION	1	2	3	3	4	4
MANUFACTURING						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	10	10	10	10	10	10
NON-POTABLE REUSE	15	15	15	15	15	15
NORTH ALAMO WSC						
ADVANCED WATER CONSERVATION	11	22	32	40	45	48
BRACKISH WATER DESALINATION	11,201	11,201	11,201	11,201	11,201	11,201
RAYMONDVILLE						
ADVANCED WATER CONSERVATION	2	5	7	9	10	11
BRACKISH WATER DESALINATION	0	100	100	100	100	100
SAN PERLITA						
ADVANCED WATER CONSERVATION	0	1	1	2	2	2
BRACKISH WATER DESALINATION	25	25	25	25	25	25
SEBASTIAN MUD						
ACQUISITION OF WATER RIGHTS THROUGH CONTRACT	0	0	2	3	4	5
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	0	0	31	59	78	88
ADVANCED WATER CONSERVATION	3	6	9	11	13	14
WILLACY TOTAL	16,463	21,877	23,617	25,349	27,069	28,776
ZAPATA						
COUNTY-OTHER						
ACQUISITION OF WATER RIGHTS THROUGH PURCHASE	571	853	1,131	1,387	1,632	1,813
ADVANCED WATER CONSERVATION	14	30	46	61	75	85
ZAPATA TOTAL	585	883	1,177	1,448	1,707	1,898
REGION M TOTAL	207,202	369,773	462,304	567,717	689,988	817,162

UNMET MUNICIPAL WATER NEEDS WITH THE IMPLEMENTATION OF WMS							
COUNTY WUG	AMOUNT DESCRIPTION	2010	2020	2030	2040	2050	2060
CAMERON							
BROWNSVILLE	DEFICIT	-8226	-17019	-25904	-35175	-44395	-53499
	WMS	30425	32196	32476	38356	47036	54614
	TOTAL	**22199**	**15177**	**6572**	**3181**	**2641**	**1115**
EAST RIO HONDO WSC	DEFICIT	2638	1939	1184	491	-277	-1006
	WMS	100	146	194	244	470	1249
	TOTAL	**2738**	**2085**	**1378**	**735**	**193**	**243**
EL JARDIN	DEFICIT	-310	-732	-1171	-1616	-2056	-2495
	WMS	328	771	1230	1695	2155	2614
	TOTAL	**18**	**39**	**59**	**79**	**99**	**119**
HARLINGEN	DEFICIT	4826	3315	1807	257	-1377	-3041
	WMS	68	166	240	315	1377	3041
	TOTAL	**4894**	**3481**	**2047**	**572**	**0**	**0**
INDIAN LAKE	DEFICIT	-18	-26	-35	-45	-54	-64
	WMS	19	29	40	51	60	71
	TOTAL	**1**	**3**	**5**	**6**	**6**	**7**
LAGUNA MADRE WD	DEFICIT	1638	562	-568	-1674	-2796	-3864
	WMS	276	303	699	1783	2908	4003
	TOTAL	**1914**	**865**	**131**	**109**	**112**	**139**
LOS FRESNOS	DEFICIT	335	94	-145	-388	-643	-886
	WMS	16	32	256	541	824	1098
	TOTAL	**351**	**126**	**111**	**153**	**181**	**212**
MILITARY HIGHWAY WSC	DEFICIT	-10	-145	-440	-735	-1091	-1446
	WMS	10	145	440	735	1091	1446
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
OLMITO WSC	DEFICIT	44	-318	-695	-1064	-1448	-1813
	WMS	21	361	761	1151	1558	1945
	TOTAL	**65**	**43**	**66**	**87**	**110**	**132**
PALM VALLEY	DEFICIT	-81	-76	-69	-62	-58	-56
	WMS	83	123	160	196	233	269
	TOTAL	**2**	**47**	**91**	**134**	**175**	**213**
PALM VALLEY ESTATES UD	DEFICIT	-4	-14	-28	-43	-61	-78
	WMS	4	15	30	46	64	83
	TOTAL	**0**	**1**	**2**	**3**	**3**	**5**
PORT ISABEL	DEFICIT	-1889	-2090	-2296	-2498	-2714	-2925
	WMS	1,891	2,096	2,307	2,511	2,730	2,945
	TOTAL	**2**	**6**	**11**	**13**	**16**	**20**
PRIMERA	DEFICIT	-209	-332	-456	-589	-721	-855
	WMS	209	332	457	589	722	855
	TOTAL	**0**	**0**	**1**	**0**	**1**	**0**

SAN BENITO	DEFICIT	2116	1548	982	402	-209	-831
	WMS	26	53	81	109	348	995
	TOTAL	**2142**	**1601**	**1063**	**511**	**139**	**164**
SOUTH PADRE ISLAND	DEFICIT	-750	-1382	-2035	-2689	-3341	-3968
	WMS	757	1393	2053	2713	3372	4004
	TOTAL	**7**	**11**	**18**	**24**	**31**	**36**
VALLEY MUD #2	DEFICIT	151	32	-95	-218	-350	-475
	WMS	0	542	546	549	552	555
	TOTAL	**151**	**574**	**451**	**331**	**202**	**80**
HIDALGO							
ALAMO	DEFICIT	-59	-762	-1548	-2415	-3407	-4424
	WMS	59	763	1548	2415	3507	4624
	TOTAL	**0**	**1**	**0**	**0**	**100**	**200**
ALTON	DEFICIT	0	0	-2446	-3419	-4482	-5602
	WMS	59	82	2,446	3,419	4,482	5,602
	TOTAL	**59**	**82**	**0**	**0**	**0**	**0**
COUNTY-OTHER	DEFICIT	1088	-2366	-6184	-10374	-15124	-19989
	WMS	144	2723	6779	11227	16260	21414
	TOTAL	**1232**	**357**	**595**	**853**	**1136**	**1425**
DONNA	DEFICIT	1729	1435	1117	759	347	-103
	WMS	15	107	126	147	170	193
	TOTAL	**1744**	**1542**	**1243**	**906**	**517**	**90**
EDCOUCH	DEFICIT	-129	-188	-255	-332	-420	-516
	WMS	130	188	256	332	420	516
	TOTAL	**1**	**0**	**1**	**0**	**0**	**0**
EDINBURG	DEFICIT	6216	3826	1029	-1805	-5151	-8580
	WMS	74	328	2631	5300	8480	11716
	TOTAL	**6290**	**4154**	**3660**	**3495**	**3329**	**3136**
HIDALGO	DEFICIT	592	191	-239	-712	-1255	-1811
	WMS	144	319	458	761	1331	1915
	TOTAL	**736**	**510**	**219**	**49**	**76**	**104**
HIDALGO COUNTY MUD #1	DEFICIT	-1130	-1814	-2588	-3421	-4342	-5287
	WMS	1131	1814	2588	3422	4342	5287
	TOTAL	**1**	**0**	**0**	**1**	**0**	**0**
LA JOYA	DEFICIT	65	-7	-84	-171	-269	-378
	WMS	57	64	121	171	269	378
	TOTAL	**122**	**57**	**37**	**0**	**0**	**0**
MCALLEN	DEFICIT	2627	-2502	-8475	-14832	-21935	-29457
	WMS	3551	3743	8775	15232	22935	31457
	TOTAL	**6178**	**1241**	**300**	**400**	**1000**	**2000**
MILITARY HIGHWAY WSC	DEFICIT	-8	-143	-422	-780	-1124	-1488
	WMS	8	143	422	780	1124	1488
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
MISSION	DEFICIT	-1470	-4468	-7824	-11365	-15469	-19674
	WMS	1471	4669	7824	11365	15877	20134
	TOTAL	**1**	**201**	**0**	**0**	**408**	**460**

NORTH ALAMO WSC	DEFICIT	8983	5627	1853	-2345	-7180	-12150
	WMS	11449	11739	12064	12416	14299	16151
	TOTAL	**20432**	**17366**	**13917**	**10071**	**7119**	**4001**
PALMHURST	DEFICIT	0	0	209	-296	-929	-1633
	WMS	32	68	110	451	1132	1887
	TOTAL	**32**	**68**	**319**	**155**	**203**	**254**
PALMVIEW	DEFICIT	0	0	0	0	-447	-906
	WMS	16	34	55	78	549	1033
	TOTAL	**16**	**34**	**55**	**78**	**102**	**127**
PENITAS	DEFICIT	5	3	2	-1	-7	-16
	WMS	1	1	2	2	7	16
	TOTAL	**6**	**4**	**4**	**1**	**0**	**0**
PHARR	DEFICIT	376	-1754	-4152	-6799	-9649	-12695
	WMS	293	1779	4152	6799	9649	12695
	TOTAL	**669**	**25**	**0**	**0**	**0**	**0**
SAN JUAN	DEFICIT	-478	-1642	-2933	-4361	-6008	-7697
	WMS	573	1848	3263	4826	6620	8459
	TOTAL	**95**	**206**	**330**	**465**	**612**	**762**
SHARYLAND WSC	DEFICIT	1624	-391	-397	-1331	-2296	-3335
	WMS	29	454	497	1472	2482	3566
	TOTAL	**1653**	**63**	**100**	**141**	**186**	**231**
SULLIVAN CITY	DEFICIT	159	186	184	13	-197	-411
	WMS	11	25	39	55	269	502
	TOTAL	**170**	**211**	**223**	**68**	**72**	**91**
WESLACO	DEFICIT	3148	2391	1526	568	-517	-1682
	WMS	1264	1302	1344	1537	2772	4037
	TOTAL	**4412**	**3693**	**2870**	**2105**	**2255**	**2355**
JIM HOGG							
COUNTY-OTHER	DEFICIT	-67	-73	-78	-81	-79	-72
	WMS	67	74	79	82	80	73
	TOTAL	**0**	**1**	**1**	**1**	**1**	**1**
MAVERICK							
COUNTY-OTHER	DEFICIT	-67	-632	-1165	-1641	-2063	-2442
	WMS	67	632	1,165	1,641	2063	2442
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
STARR							
COUNTY-OTHER	DEFICIT	-4622	-6057	-7535	-9057	-10535	-12025
	WMS	4688	6120	7634	9177	10698	12206
	TOTAL	**66**	**63**	**99**	**120**	**163**	**181**
LA GRULLA	DEFICIT	-345	-397	-454	-516	-582	-653
	WMS	345	397	455	516	582	653
	TOTAL	**0**	**0**	**1**	**0**	**0**	**0**
RIO GRANDE CITY	DEFICIT	-483	-755	-1066	-1361	-1692	-2034
	WMS	588	1189	1292	1361	1692	2034
	TOTAL	**105**	**434**	**226**	**0**	**0**	**0**

RIO WSC	DEFICIT	-174	-314	-462	-603	-753	-896
	WMS	181	327	482	630	787	937
	TOTAL	**7**	**13**	**20**	**27**	**34**	**41**
ROMA CITY	DEFICIT	-104	-491	-895	-1314	-1743	-2175
	WMS	104	491	895	1314	1743	2175
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
WEBB							
COUNTY-OTHER	DEFICIT	-197	-384	-594	-831	-1102	-1403
	WMS	197	384	594	831	1102	1403
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
EL CENIZO	DEFICIT	209	-58	-375	-726	-1128	-1554
	WMS	18	97	438	812	1243	1698
	TOTAL	**227**	**39**	**63**	**86**	**115**	**144**
LAREDO	DEFICIT	-4968	-15586	-28788	-45513	-64263	-84615
	WMS	4968	15586	28788	45513	64263	84615
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
RIO BRAVO	DEFICIT	144	-285	-736	-1232	-1789	-2374
	WMS	20	329	808	1334	1922	2542
	TOTAL	**164**	**44**	**72**	**102**	**133**	**168**
WEBB COUNTY WATER UTILITY	DEFICIT	-42	-140	-245	-363	-494	-633
	WMS	47	147	258	369	507	652
	TOTAL	**5**	**7**	**13**	**6**	**13**	**19**
WILLACY							
NORTH ALAMO WSC	DEFICIT	563	316	94	-105	-285	-415
	WMS	11212	11223	11233	11241	11246	11249
	TOTAL	**11775**	**11539**	**11327**	**11136**	**10961**	**10834**
SAN PERLITA	DEFICIT	15	8	3	0	-4	-6
	WMS	25	26	26	27	27	27
	TOTAL	**40**	**34**	**29**	**27**	**23**	**21**
SEBASTIAN MUD	DEFICIT	44	3	-33	-62	-82	-93
	WMS	3	6	42	73	95	107
	TOTAL	**47**	**9**	**9**	**11**	**13**	**14**
ZAPATA							
COUNTY-OTHER	DEFICIT	-571	-853	-1131	-1387	-1632	-1813
	WMS	585	883	1177	1448	1707	1898
	TOTAL	**14**	**30**	**46**	**61**	**75**	**85**

UNMET IRRIGATION WATER NEEDS WITH THE IMPLEMENTATION OF WMS							
COUNTY	AMOUNT DESCRIPTION	2010	2020	2030	2040	2050	2060
CAMERON	DEFICIT	-135322	-117907	-97340	-99398	-101458	-103359
	WMS	37630	75268	88322	101377	114439	127493
	TOTAL	**-97692**	**-42639**	**-9018**	**1979**	**12981**	**24134**
HIDALGO	DEFICIT	-193535	-140067	-71203	-74538	-77873	-80952
	WMS	71265	142548	169203	195860	222531	249188
	TOTAL	**-122270**	**2481**	**98000**	**121322**	**144658**	**168236**
MAVERICK	DEFICIT	-36482	-33808	-30633	-31131	-31628	-32087
	WMS	12546	25087	28285	31477	34670	37862
	TOTAL	**-23936**	**-8721**	**-2348**	**346**	**3042**	**5775**
STARR	DEFICIT	-8823	-7897	-7005	-7151	-7297	-7432
	WMS	1,052	2,105	3,158	4,210	5,263	6,315
	TOTAL	**-7771**	**-5792**	**-3847**	**-2941**	**-2034**	**-1117**
WEBB	DEFICIT	-6831	-5977	-5180	-5277	-5375	-5464
	WMS	0	0	0	0	0	0
	TOTAL	**-6831**	**-5977**	**-5180**	**-5277**	**-5375**	**-5464**
WILLACY	DEFICIT	-24035	-25389	-26126	-26443	-26760	-27052
	WMS	5195	10390	12081	13771	15462	17153
	TOTAL	**-18840**	**-14999**	**-14045**	**-12672**	**-11298**	**-9899**
ZAPATA	DEFICIT	-2494	-2201	-1921	-1958	-1995	-2029
	WMS	0	0	0	0	0	0
	TOTAL	**-2494**	**-2201**	**-1921**	**-1958**	**-1995**	**-2029**

UNMET MANUFACTURING WATER NEEDS WITH THE IMPLEMENTATION OF WMS							
COUNTY	AMOUNT DESCRIPTION	2010	2020	2030	2040	2050	2060
CAMERON	DEFICIT	-1896	-2330	-2723	-3112	-3449	-3905
	WMS	1896	2330	2723	3112	3449	3905
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**
HIDALGO	DEFICIT	912	589	297	5	-255	-594
	WMS	0	0	0	0	255	594
	TOTAL	**912**	**589**	**297**	**5**	**0**	**0**
WILLACY	DEFICIT	-25	-25	-25	-25	-25	-25
	WMS	25	25	25	25	25	25
	TOTAL	**0**	**0**	**0**	**0**	**0**	**0**

UNMET STEAM ELECTRIC POWER WATER NEEDS WITH THE IMPLEMENTATION OF WMS							
COUNTY	AMOUNT DESCRIPTION	2010	2020	2030	2040	2050	2060
CAMERON	DEFICIT	784	877	620	306	-77	-544
	WMS	0	0	0	0	77	544
	TOTAL	**784**	**877**	**620**	**306**	**0**	**0**
HIDALGO	DEFICIT	1816	-1980	-4374	-7291	-10847	-15183
	WMS	0	1980	4374	7291	10847	15183
	TOTAL	**1816**	**0**	**0**	**0**	**0**	**0**
WEBB	DEFICIT	153	455	254	9	-290	-655
	WMS	0	0	0	0	290	655
	TOTAL	**153**	**455**	**254**	**9**	**0**	**0**

ATTACHMENT 4-2

MINIMUM REQUIREMENTS FOR EVALUATION OF A WATER MANAGMEMENT STRATEGY

Minimum Requirements for Evaluating a Water Management Strategy

A Water Management Strategy (WMS) is developed to help alleviate potential water deficits in the future for the region.

There are six components in constructing a water management strategy and they are:

- Strategy Description
- Water Supply Yield
- Cost
- Environmental Issues
- Implementation Issues
- Recommendations

Strategy Description

The strategy description is a summary describing the main purpose of the project.

Water Supply Yield

Water supply yield is the quantity of water that is available from a particular strategy under drought-of-record hydrologic conditions. This section comes in summary form with information describing how the yield was developed.

Cost

Costs evaluations for new water management strategies will include capital costs, annual operating and maintenance expenses, and a unit cost expressed as dollars per acre-foot of yield.

- Capital Costs- consist of construction funds and other capital outlays such as engineering costs, contingencies, financial, legal, administration, environmental permitting and mitigation, land, and interest during construction.
- Annual Operating and Maintenance Costs-these figures are based on the quantity of water supplies.

Environmental Impacts

This section includes a quantitative report describing how the water management strategy could affect environmental and cultural resources. For example, it should include information on impacts to environmental water needs, wildlife habitats, cultural resources, and the effects of upstream development on the bays, estuaries, and arms of the Gulf of Mexico. Environmental issues may vary depending on the type of project.

Implementation Issues

This section includes any issues that might occur before or during the construction process of the project. Implementation issues might consist of obtaining permits from state and federal entities, obtaining the proper funding for the project, or any similar implications that might occur before, during, or after the implementation of the strategy.

Recommendations

This section includes final recommendations from the Regional Board as well as from the entity or entities recommending the strategy.

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CHAPTER 5.0 : IMPACTS OF WATER MANAGEMENT STRATEGIES ON KEY PARAMETERS OF WATER QUALITY AND IMPACTS OF MOVING WATER FROM RURAL AND AGRICULTURAL AREAS

5.1 WATER QUALITY IMPACTS

All Water Management Strategies (WMS) explained in Chapter 4, except Advanced Water Conservation, Conveyance Improvements, and On-farm Improvements, involve transferring water or water rights from rural land to urban. This process is known as urbanization; as the region's population expands, irrigable land is lost. In order to make up the projected shortfall of water for municipal use, ten WMS were developed; additional groundwater, advanced water conservation, non-potable reuse, potable reuse, Brownsville weir and storage, water rights purchase, water rights acquisition by long-term contract, water rights acquisition through urbanization, brackish desalination, and seawater desalination. Advanced water conservation is aimed at reducing the amount of water used per capita, thereby reducing overall municipal demand.

Since municipal water has the highest priority in the Amistad/Falcon system, irrigation water is in a constant state of shortage. Accordingly, conveyance and on-farm improvements are needed to reduce the impact of irrigation shortages. Municipal water management strategies are not cost-effective when applied to irrigation use.

Chapter 4 gives an in-depth look at each of these WMS.

The following table breaks out the water quality impacts, both positive and negative, associated with each WMS. Note that the majority of WMS deal similarly with urbanization's effects; in other words, as rural land is urbanized, water quality impacts are consistent from WMS to WMS. Pollutants in agricultural runoff include eroded soil particles (sediments), nutrients, pesticides, salts, bacteria, viruses, and organic matter.[1] Sediment and chemical runoff associated with rural land are eliminated when that land becomes urbanized. On the flip side, urban runoff will increase as reduced porous surface areas prevent rainwater from soaking into the ground. Urban runoff pollutants include sediment from construction sites, oil and gas, fertilizers, pesticides, and household chemicals.[2] Also, as municipal water use increases, wastewater production increases—both inevitable effects of rising populations.

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[1] Lowrance, R., Smith, M., & Vellidis, G. (2003). Impact and Control of Agricultural Runoff. *Stormwater, The Journal for Surface Water Quality Professionals*. Retrieved May 26, 2005 from World Wide Web. http://www.forester.net/sw_0305_impact.html

[2] United States Environmental Protection Agency. (1995, September). Economic Benefits of Runoff Control. Retrieved May 26, 2005 from World Wide Web. http://www.epa.gov/owow/nps/runoff.html

Table 5.1: Water Quality Impacts by Water Management Strategy (Municipal Use)

Water Management Strategy	Positive Impacts	Negative Impacts
Additional Groundwater	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased urban runoff during storm event
Advanced Water Conservation	• Decreased wastewater flows	• Increases concentration of organic matter in wastewater
Non-potable Reuse	• Reduced wastewater flows • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation • Decreased wastewater flows, resulting in lower organic levels in receiving streams	• Increased urban runoff during storm event
Potable Reuse	• Reduced wastewater flows • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation • Decreased wastewater flows result in lower organic levels in receiving streams	• Increased urban runoff during storm event
Dams, Weirs, and Storage • Brownsville Weir and Reservoir • Laredo Low Water Weir • Resaca Restoration • Banco Morales Reservoir	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows resulting in higher organic levels in receiving stream

Purchase of Water Rights	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Acquisition of Water Rights by Urbanization	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Acquisition of Water Rights by Long-term Contracts	• Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels
Brackish Desalination	• Improved water quality in wastewater effluent • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased levels of TDS in receiving streams due to concentrate discharge
Seawater Desalination	• Improve water quality in wastewater effluent • Decreased sediment and/or agricultural chemical runoff due to storm events or excessive irrigation	• Increased urban runoff during storm event • Increased wastewater flows to receiving streams, i.e. higher organic levels • Increased levels of TDS in receiving streams due to concentrate discharge

Improving Water Infrastructure and Distribution	• Increase distribution efficiency • Increase storage capacity	• none

Table 5.2 Water Quality Impacts by Water Management Strategy (Irrigation Use)

Water Management Strategy	Positive Impacts	Negative Impacts
Conveyance Improvements	• None	• None
On-farm Improvements	• Decreased sediment and/or agricultural chemical runoff due to increased management and metering	• None

5.2 IMPACTS OF MOVING WATER FROM RURAL AND AGRICULTURAL AREAS

As part of *Special Study #2: Classifying Irrigation Districts as Water User Groups*, information was gathered detailing the raw water conveyance systems of each Irrigation District in the Region. Often, Irrigation District conveyance systems are used to pump and transport municipal water from the Rio Grande to municipal users. This role of the Irrigation Districts is in addition to their function of delivering irrigation water to agricultural users as well as other water deliveries including steam-electric, mining, and livestock.

Each Irrigation District supports and maintains their own respective conveyance infrastructure, and each District's infrastructure is composed of varying miles of open canals, lined canals, and pipelines. On average throughout the region, there is approximately 15.2 miles of open canal for each mile of pipeline.

In terms of conveyance efficiencies, open canals typically experience higher losses when compared to pipelines. This is primarily due to two natural occurring reasons: seepage and evaporation. It has previously been established that pipeline efficiencies are approximately 95%, with 5% losses occurring due to leaky joints and subsequent seepage. Generally speaking, pipelines do not experience losses due to evaporation. The lining of canals is an effective way at reducing losses due to seepage, but evaporation is still an element of loss that remains in any open canal. Often, financial considerations come into play when considering whether to line an existing canal or convert it to a pipeline. For canals that carry a large amount of water, the diameter of pipeline needed to convey the water within acceptable limits of pressure loss results in a relatively large diameter pipe which can be costly.

As land is converted from agricultural and rural uses to urban uses, the water rights attributed to that land may be converted. The Water Right Conversion Bill, as detailed earlier in the report, is a method of conversion that is unique to this Region. Regardless of the method of conversion, urbanization plays a critical role in the delivery of raw water. For Class A Irrigation Water Rights, the conversion ratio required to convert that right to a municipal right is 2 to 1. Therefore, it takes 2 acre-feet of Class A water rights to convert to 1 acre-foot of municipal rights. For Class B water rights it is 2.5 acre-feet of water rights to convert to 1 acre-foot of municipal rights. Therefore, as land becomes urbanized and water rights are converted from agriculture to municipal, the total amount of water available for use is decreased. Table 5.3 shows the volume of water that would be shifted from agricultural areas to municipal use if WMS are implemented. This table takes into affect the necessary conversion factors for Class A and Class B water rights.

Table 5.3 Estimated Quantity of Water Shifted from Irrigation Use to Municipal Use

ESTIMATED QUANTITY OF CONVERTED IRRIGATION WATER RIGHTS REALLOCATED TO SUPPLY RECOMMENDED MUNICIPAL WMSs							VOLUME OF WATER OUT OF 'AMISTAD-FALCON RESERVOIR SYSTEM' *FIRM YIELD* TO BE ALLOCATED TO RECOMMENDED WMSs DURING IMPLEMENTATION					
2010	**2020**	**2030**	**2040**	**2050**	**2060**	**Conversion Ratio**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
44,527	69,728	117,844	178,189	257,809	345,039	**2.0**	22,263	34,864	58,922	89,094	128,905	172,519
6,151	9,633	16,280	24,617	35,616	47,667	**2.5**	2,461	3,853	6,512	9,847	14,246	19,067
50,678	79,361	134,124	202,805	293,425	392,705	**TOTALS**	24,724	38,717	65,434	98,941	143,151	191,586

The result is a direct impact on Irrigation Districts and environmental flows in the Rio Grande. The overall quantity of water diverted has the potential to decrease. This would result in less available push water in the irrigation district conveyance system which in turn would result in lower conveyance efficiencies. In Special Study #2, it was estimated that Irrigation District conveyance efficiencies range from 68% to 71% (using the best available figures for conveyance efficiencies). As push water is reduced, it would be expected that delivery efficiencies would decrease with identical conveyance infrastructure.

The ultimate impact would be a reduction in final water delivery volume with similar infrastructure. Agricultural impacts would also be great. This in turn would have an impact on the types of crops planted and the number of acres of irrigation at any given time. The strongest trend currently is a shift from cotton to grain sorghum. This historical trend is expected to continue due to urbanization and rainfall. The impact of such a paradigm shift impacts irrigation water deliveries due to a change in water requirements for the crops, and vice-versa. Farmers would take a hit directly as crop growth would disintegrate in the region. Livestock farmers are no longer able to feed and supply water to their livestock. A trickle effect takes place as the economy of the region begins to nose dive as a direct correlation to redistributing water from agriculture to municipal use.

As is the case with many Irrigation Districts, small parcels of land are excluded from the District due to urban development. Many times, this parcel of land is surrounded by acreage that continues to be irrigated. In other cases, land that is irrigable may be surrounded completely by urbanized acres thereby reducing the potential for irrigation such land.

In terms of environmental flows in the Rio Grande, a similar dilemma exists with the conversion of water rights from agricultural uses to municipal uses. Again, the amount of push water available is potentially decreased resulting in a decrease in conveyance efficiencies. Therefore, more water must be diverted from the Rio Grande to deliver a similar quantity of water to the end user. There then remains the potential for increased flows from the reservoirs to the diversion point, but a decrease in the amount of excess water available in the system. As information is made available regarding environmental flow requirements in the Rio Grande, this impact would be quantifiable. However, as it exists now, the analysis can only be performed on a preliminary basis.

ATTACHMENT 5-1

SOCIOECONOMIC IMPACT ANALYSIS

Socioeconomic Impacts of Projected Water Shortages for the Rio Grande Regional Water Planning Area (Region M)

Prepared in Support of the 2011 Rio Grande Regional Water Plan

Stuart D. Norvell, Managing Economist
Water Resources Planning Division
Texas Water Development Board
Austin, Texas

S. Doug Shaw, Agricultural Economist
Water Resources Planning Division
Texas Water Development Board
Austin, Texas

June 2010

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Introduction

Water shortages during drought would likely curtail or eliminate economic activity in business and industries reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline, and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on existing businesses and industry, but they could also adversely affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process, and rules direct TWDB staff to provide technical assistance: "*The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs*" [(§357.7 (4)(A)]. Staff of the TWDB's Water Resources Planning Division designed and conducted this report in support of the Rio Grande Regional Water Planning Group (Region M).

This document summarizes the results of our analysis and discusses the methodology used to generate the results. Section 1 outlines the overall methodology and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 2 presents the results for each category where shortages are reported at the regional planning area level and river basin level. Results for individual water user groups are not presented, but are available upon request.

1. Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Economic Impacts of Water Shortages

1.1.1 General Approach

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts or benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. When analyzing the economic impacts of water shortages as defined in Texas water planning, three potential scenarios are possible:

1) Scenario 1 involves situations where there are physical shortages of raw surface or groundwater due to drought of record conditions. For example, City A relies on a reservoir with average conservation storage of 500 acre-feet per year and a firm yield of 100 acre feet. In 2010, the city uses about 50 acre-feet per year, but by 2030 their demands are expected to increase to 200 acre-feet. Thus, in 2030 the reservoir would not have enough water to meet the city's demands, and people would experience a shortage of 100 acre-feet assuming drought of record conditions. Under normal or average climatic conditions, the reservoir would likely be able to provide reliable water supplies well beyond 2030.

2) Scenario 2 is a situation where despite drought of record conditions, water supply sources can meet existing use requirements; however, limitations in water infrastructure would preclude future water user groups from accessing these water supplies. For example, City B relies on a river that can provide 500 acre-feet per year during drought of record conditions and other constraints as dictated by planning assumptions. In 2010, the city is expected to use an estimated 100 acre-feet per year and by 2060 it would require no more than 400 acre-feet. But the intake and pipeline that currently transfers water from the river to the city's treatment plant has a capacity of only 200 acre-feet of water per year. Thus, the city's water supplies are adequate even under the most restrictive planning assumptions, but their conveyance system is too small. This implies that at some point – perhaps around 2030 - infrastructure limitations would constrain future population growth and any associated economic activity or impacts.

3) Scenario 3 involves water user groups that rely primarily on aquifers that are being depleted. In this scenario, projected and in some cases existing demands may be unsustainable as groundwater levels decline. Areas that rely on the Ogallala aquifer are a good example. In some communities in the region, irrigated agriculture forms a major base of the regional economy. With less irrigation water from the Ogallala, population and economic activity in the region could decline significantly assuming there are no offsetting developments.

Assessing the social and economic effects of each of the above scenarios requires various levels and methods of analysis and would generate substantially different results for a number of reasons; the most important of which has to do with the time frame of each scenario. Scenario 1 falls into the general category of static analysis. This means that models would measure impacts for a small interval of time such as a drought. Scenarios 2 and 3, on the other hand imply a dynamic analysis meaning that models are concerned with changes over a much longer time period.

Since administrative rules specify that planning analysis be evaluated under drought of record conditions (a static and random event), socioeconomic impact analysis developed by the TWDB for the state water plan is based on assumptions of Scenario 1. Estimated impacts under scenario 1 are point estimates for years in which needs are reported (2010, 2020, 2030, 2040, 2050 and 2060). They are independent and distinct "what if" scenarios for a particular year and shortages are assumed to be temporary events resulting from drought of record conditions. Estimated impacts measure what would happen if water user groups experience water shortages for a period of one year.

The TWDB recognize that dynamic models may be more appropriate for some water user groups; however, combining approaches on a statewide basis poses several problems. For one, it would require a complex array of analyses and models, and might require developing supply and demand forecasts under "normal" climatic conditions as opposed to drought of record conditions. Equally important is the notion that combining the approaches would produce inconsistent results across regions resulting in a so-called "apples to oranges" comparison.

A variety tools are available to estimate economic impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Since the planning horizon extends through 2060, economic variables in the baseline are adjusted in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Future values for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category.

The following steps outline the overall process.

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[3] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously were estimated for each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industries within a given region;
- **final sales –** sales to end users in a region and exports out of a region**;**
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in constant year 2006 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as “output” in an IO model. Thus, total sales double-count or overstate the true economic value of goods and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user

[3]The IMPLAN database consists of national level technology matrices based on benchmark input-output accounts generated by the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment, and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to national totals using a matrix ratio allocation system and county data are balanced to state totals.

groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. Each IMPLAN sector was assigned to a specific water use category.

Step 2: *Estimate Direct and Indirect Economic Impacts of Water Needs*

Direct impacts are reductions in output by sectors experiencing water shortages. For example, without adequate cooling and process water a refinery would have to curtail or cease operation, car washes may close, or farmers may not be able to irrigate and sales revenues fall. Indirect impacts involve changes in inter-industry transactions as supplying industries respond to decreased demands for their services, and how seemingly non-related businesses are affected by decreased incomes and spending due to direct impacts. For example, if a farmer ceases operations due to a lack of irrigation water, they would likely reduce expenditures on supplies such as fertilizer, labor and equipment, and businesses that provide these goods would suffer as well.

Direct impacts accrue to immediate businesses and industries that rely on water and without water industrial processes could suffer. However, output responses may vary depending upon the severity of shortages. A small shortage relative to total water use would likely have a minimal impact, but large shortages could be critical. For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky.[4] As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production, but it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[5]

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[6]

- if water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;

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[4] Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[5] The efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

[6] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages,*" Spectrum Economics, Inc. November, 1991.

- if water needs are 5 to 30 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.50 percent reduction in output;
- if water needs are 30 to 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 0.75 percent reduction in output; and
- if water needs are greater than 50 percent of total water demand, for each additional one percent of water need that is not met, there is a corresponding 1.0 percent (i.e., a proportional reduction).

In some cases, elasticities are adjusted depending upon conditions specific to a given water user group.

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. The formula for a given IMPLAN sector is:

$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$

where:

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Secondary impacts were derived using the same formula used to estimate direct impacts; however, indirect multiplier coefficients are used. Methods and assumptions specific to each water use sector are discussed in Sections 1.1.2 through 1.1.4.

General Assumptions and Clarification of the Methodology

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1. Shortages as reported by regional planning groups are the starting point for socioeconomic analyses.

2. Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They are independent and distinct “what if” scenarios for each particular year and water shortages are assumed to be temporary events resulting from severe drought conditions combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, regardless of whether or not there is a drought. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under “normal” or “most likely” future climatic conditions.

3. While useful for planning purposes, this study is not a benefit-cost analysis. Benefit cost analysis is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a benefit cost study if done so properly. Since this is not a benefit cost analysis, future impacts are not weighted differently. In other words, estimates are not discounted. If used as a measure of economic benefits, one should incorporate a measure of uncertainty into the analysis. In this type of analysis, a typical method of discounting future values is to assign probabilities of the drought of record recurring again in a given year, and weight monetary impacts accordingly. This analysis assumes a probability of one.

4. IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as “final sales,” multipliers for the ranching sector do fully account for all losses to a region’s economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

5. Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on ”fixed-proportion production functions,” which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to

purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses for employment and secondary losses in sales and employment should be considered an upper bound. Similarly, since projected population losses are based on reduced employment in the region, they should be considered an upper bound as well.

6. IO models are static. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in 2006. In contrast, water shortages are projected to occur well into the future. Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon, and the farther out into the future we go, this assumption becomes less reliable.

7. Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in most regions of Texas lasted several years.

8. Monetary figures are reported in constant year 2006 dollars.

1.1.2 Impacts to Agriculture

Irrigated Crop Production

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Farm Services Agency (FSA) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 1 shows the TWDB crops included in corresponding IMPLAN sectors, and Table 2 summarizes acreage and estimated annual water use for each crop classification (five-year average from 2003-2007). Table 3 displays average (2003-2007) gross revenues per acre for IMPLAN crop categories.

Table 1: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors	
IMPLAN Category	**TWDB Category**
Oilseeds	Soybeans and "other oil crops"
Grains	Grain sorghum, corn, wheat and "other grain crops"
Vegetable and melons	"Vegetables" and potatoes
Tree nuts	Pecans
Fruits	Citrus, vineyard and other orchard
Cotton	Cotton
Sugarcane and sugar beets	Sugarcane and sugar beets
All "other" crops	"Forage crops", peanuts, alfalfa, hay and pasture, rice and "all other crops"

Table 2: Summary of Irrigated Crop Acreage and Water Demand for the Rio Grande Regional Water Planning Area (average 2003-2007)

Sector	Acres (1000s)	Distribution of acres	Water use (1000s of AF)	Distribution of water use
Oilseeds	4	1%	5	1%
Grains	143	31%	253	27%
Vegetable and melons	73	16%	120	13%
Tree nuts	7	1%	18	2%
Fruits	13	3%	34	4%
Cotton	59	13%	111	12%
Sugarcane	42	9%	142	15%
All other crops	120	26%	252	27%
Total	459	100%	937	100%

Source: Water demand figures are a 5- year average (2003-2007) of the TWDB's annual Irrigation Water Use Estimates. Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the Farm Service Agency. Values do not include acreage or water use for the TWDB categories classified by the Farm Services Agency as "failed acres," "golf course" or "waste water."

Table 3: Average Gross Sales Revenues per Acre for Irrigated Crops for the Rio Grande Regional Water Planning Area (2003-2007)		
IMPLAN Sector	**Gross revenues per acre**	**Crops included in estimates**
Grains	$267	Based on five-year (2003-2007) average weighted by acreage for "irrigated grain sorghum," "irrigated corn", "irrigated wheat" and "irrigated 'other' grain crops."
Oilseed Farming	$214	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated soybeans" and "irrigated 'other' oil crops."
Vegetable and melons	$6,246	Based on five-year (2003-2007) average weighted by acreage for "irrigated shallow and deep root vegetables", "irrigated Irish potatoes" and "irrigated melons."
Tree nuts	$3,304	Based on five-year (2003-2007) average weighted by acreage for "irrigated pecans."
Fruits	6,305	Based on five-year (2003-2007) average weighted by acreage for "irrigated citrus", "irrigated vineyards" and "irrigated 'other' orchard."
Cotton	$389	Based on five-year (2003-2007) average weighted by acreage for "irrigated cotton."
Sugarcane	$1,051	Based on five-year (2003-2007) average weighted by acreage for irrigated sugarcane.
All other crops	$254	Irrigated figure is based on five-year (2003-2007) average weighted by acreage for "irrigated 'forage' crops", "irrigated peanuts", "irrigated alfalfa", "irrigated 'hay' and pasture" and "irrigated 'all other' crops."

*Figures are rounded. Source: Based on data from the Texas Agricultural Statistics Service, Texas Water Development Board, and Texas A&M University.

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[7] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a substantial amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. Predominant in this case are crops that comprise at least one percent of total acreage in the region.

The following steps outline the overall process used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed previously and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2006 baseline. Using multipliers, we then generate estimates of forgone income, jobs, and tax revenues based on reductions in gross sales and final demand.

Livestock

The approach used for the livestock sector is basically the same as that used for crop production. As is the case with crops, livestock categorizations used by the TWDB differ from those used in IMPLAN datasets, and TWDB groupings were assigned to a given IMPLAN sector (Table 4). Then we:

1) *Distribute projected water needs equally among predominant livestock sectors and estimate lost output*: As is the case with irrigation, shortages are assumed to affect all livestock sectors equally; however, the category of “other” is not included given its small size. If water needs were small relative to total demands, we assume that producers would haul in water by truck to fill stock tanks. The cost per acre-foot ($24,000) is based on 2008 rates charged by various water haulers in Texas, and assumes that the average truck load is 6,500 gallons at a hauling distance of 60 miles.

3) *Estimate reduced output in forward processors for livestock sectors*. Reductions in output for livestock sectors are assumed to have a proportional impact on forward processors in the region such as meat packers. In other words, if the cows were gone, meat-packing plants or fluid milk manufacturers) would likely have little to process. This is not an unreasonable premise. Since the 1950s, there has been a major trend towards specialized cattle feedlots, which in turn has decentralized cattle purchasing from livestock terminal markets to direct sales between producers and slaughterhouses. Today, the meat packing industry often operates large processing facilities near high concentrations of feedlots to increase

[7] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. “*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a.” Western Consortium for Public Health. May 1993.

capacity utilization.[8] As a result, packers are heavily dependent upon nearby feedlots. For example, a recent study by the USDA shows that on average meat packers obtain 64 percent of cattle from within 75 miles of their plant, 82 percent from within 150 miles and 92 percent from within 250 miles.[9]

Table 4: Description of Livestock Sectors

IMPLAN Category	**TWDB Category**
Cattle ranching and farming	Cattle, cow calf, feedlots and dairies
Poultry and egg production	Poultry production.
Other livestock	Livestock other than cattle and poultry (i.e., horses, goats, sheep, hogs)
Milk manufacturing	Fluid milk manufacturing, cheese manufacturing, ice cream manufacturing etc.
Meat packing	Meat processing present in the region from slaughter to final processing

1.1.3 Impacts to Municipal Water User Groups

Disaggregation of Municipal Water Demands

Estimating the economic impacts for the municipal water user groups is complicated for a number of reasons. For one, municipal use comprises a range of consumers including commercial businesses, institutions such as schools and government and households. However, reported water needs are not distributed among different municipal water users. In other words, how much of a municipal need is commercial and how much is residential (domestic)?

The amount of commercial water use as a percentage of total municipal demand was estimated based on “GED” coefficients (gallons per employee per day) published in secondary sources.[10] For example, if year 2006 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x 200 = 6,000 gallons) or 6.7 acre-feet per year. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as “county-other.” Based on our analysis, commercial water use is about 5 to 35 percent of municipal demand. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

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[8] Ferreira, W.N. “*Analysis of the Meat Processing Industry in the United States*.” Clemson University Extension Economics Report ER211, January 2003.

[9] Ward, C.E. “*Summary of Results from USDA’s Meatpacking Concentration Study*.” Oklahoma Cooperative Extension Service, OSU Extension Facts WF-562.

[10] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: “*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*,” Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, “*Evaluation of Water Conservation for Municipal and Industrial Water Supply*.” U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

After determining the distribution of domestic versus commercial water use, we developed methods for estimating impacts to the two groups.

Domestic Water Uses

Input output models are not well suited for measuring impacts of shortages for domestic water uses, which make up the majority of the municipal water use category. To estimate impacts associated with domestic water uses, municipal water demand and needs are subdivided into residential, and commercial and institutional use. Shortages associated with residential water uses are valued by estimating proxy demand functions for different water user groups allowing us to estimate the marginal value of water, which would vary depending upon the level of water shortages. The more severe the water shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic impacts would be much higher in the latter case because people, and would be forced to find emergency alternatives assuming alternatives were available.

To estimate the value of domestic water uses, TWDB staff developed marginal loss functions based on constant elasticity demand curves. This is a standard and well-established method used by economists to value resources such as water that have an explicit monetary cost.

A constant price elasticity of demand is estimated using a standard equation:

$$w = kc^{(-\varepsilon)}$$

where:

- w is equal to average monthly residential water use for a given water user group measured in thousands of gallons;
- k is a constant intercept;
- c is the average cost of water per 1,000 gallons; and
- ε is the price elasticity of demand.

Price elasticities (-0.30 for indoor water use and -0.50 for outdoor use) are based on a study by Bell et al.[11] that surveyed 1,400 water utilities in Texas that serve at least 1,000 people to estimate demand elasticity for several variables including price, income, weather etc. Costs of water and average use per month per household are based on data from the Texas Municipal League's annual water and wastewater rate surveys - specifically average monthly household expenditures on water and wastewater in different communities across the state. After examining variance in costs and usage, three different categories of water user groups based on population (population less than 5,000, cities with populations ranging from 5,000 to 99,999 and cities with populations exceeding 100,000) were selected to serve as proxy values for municipal water groups that meet the criteria (Table 5).[12]

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[11] Bell, D.R. and Griffin, R.C. "*Community Water Demand in Texas as a Century is Turned*." Research contract report prepared for the Texas Water Development Board. May 2006.

[12] Ideally, one would want to estimate demand functions for each individual utility in the state. However, this would require an enormous amount of time and resources. For planning purposes, we believe the values generated from aggregate data are more than sufficient.

Table 5: Water Use and Costs Parameters Used to Estimated Water Demand Functions (average monthly costs per acre-foot for delivered water and average monthly use per household)				
Community Population	**Water**	**Wastewater**	**Total monthly cost**	**Avg. monthly use (gallons)**
Less than or equal to 5,000	$1,335	$1,228	$2,563	6,204
5,000 to 100,000	$1,047	$1,162	$2,209	7,950
Great than or equal to 100,000	$718	$457	$1,190	8,409
Source: Based on annual water and wastewater rate surveys published by the Texas Municipal League.				

As an example, Table 6 shows the economic impact per acre-foot of domestic water needs for municipal water user groups with population exceeding 100,000 people. There are several important assumptions incorporated in the calculations:

1) Reported values are net of the variable costs of treatment and distribution such as expenses for chemicals and electricity since using less water involves some savings to consumers and utilities alike; and for outdoor uses we do not include any value for wastewater.

2) Outdoor and "non-essential" water uses would be eliminated before indoor water consumption was affected, which is logical because most water utilities in Texas have drought contingency plans that generally specify curtailment or elimination of outdoor water use during droughts.[13] Determining how much water is used for outdoor purposes is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of single family residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[14] Earlier findings of the U.S. Water Resources Council showed a national average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[15] A study conducted for the California Urban Water Agencies (CUWA) calculated average annual values ranging from 25 to 35 percent.[16] Unfortunately, there does not appear to be any comprehensive research that has estimated non-

[13] In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of "non-essential water uses." Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[14] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. "*Residential End Uses of Water*." Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

[15] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[16] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study.

3) As shortages approach 100 percent values become immense and theoretically infinite at 100 percent because at that point death would result, and willingness to pay for water is immeasurable. Thus, as shortages approach 80 percent of monthly consumption, we assume that households and non-water intensive commercial businesses (those that use water only for drinking and sanitation would have water delivered by tanker truck or commercial water delivery companies. Based on reports from water companies throughout the state, we estimate that the cost of trucking in water is around $21,000 to $27,000 per acre-feet assuming a hauling distance of between 20 to 60 miles. This is not an unreasonable assumption. The practice was widespread during the 1950s drought and recently during droughts in this decade. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water delivered to their homes by private contractors.[17] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[18]

[17] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[18] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

Table 6: Economic Losses Associated with Domestic Water Shortages in Communities with Populations Exceeding 100,000 people				
Water shortages as a percentage of total monthly household demands	**No. of gallons remaining per household per day**	**No of gallons remaining per person per day**	**Economic loss (per acre-foot)**	**Economic loss (per gallon)**
1%	278	93	$748	$0.00005
5%	266	89	$812	$0.0002
10%	252	84	$900	$0.0005
15%	238	79	$999	$0.0008
20%	224	75	$1,110	$0.0012
25%	210	70	$1,235	$0.0015
30%[a]	196	65	$1,699	$0.0020
35%	182	61	$3,825	$0.0085
40%	168	56	$4,181	$0.0096
45%	154	51	$4,603	$0.011
50%	140	47	$5,109	$0.012
55%	126	42	$5,727	$0.014
60%	112	37	$6,500	$0.017
65%	98	33	$7,493	$0.02
70%	84	28	$8,818	$0.02
75%	70	23	$10,672	$0.03
80%	56	19	$13,454	$0.04
85%	42	14	$18,091 ($24,000)[b]	$0.05 ($0.07)[b]
90%	28	9	$27,363 ($24,000)	$0.08 ($0.07)
95%	14	5	$55,182 ($24,000)	$0.17 ($0.07)
99%	3	0.9	$277,728 ($24,000)	$0.85 ($0.07)
99.9%	1	0.5	$2,781,377 ($24,000)	$8.53 ($0.07)
100%	0	0	Infinite ($24,000)	Infinite ($0.07)

[a] The first 30 percent of needs are assumed to be restrictions of outdoor water use; when needs reach 30 percent of total demands all outdoor water uses would be restricted. Needs greater than 30 percent include indoor use

[b] As shortages approach 100 percent the value approaches infinity assuming there are not alternatives available; however, we assume that communities would begin to have water delivered by tanker truck at an estimated cost of $24,000 per acre-foot when shortages breached 85 percent.

Commercial Businesses

Effects of water shortages on commercial sectors were estimated in a fashion similar to other business sectors meaning that water shortages would affect the ability of these businesses to operate. This is particularly true for "water intensive" commercial sectors that are need large amounts of water (in addition to potable and sanitary water) to provide their services. These include:

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hospitals and medical facilities,
- hotels and lodging places, and
- eating and drinking establishments.

A key assumption is that commercial operations would not be affected until water shortages were at least 50 percent of total municipal demand. In other words, we assume that residential water consumers would reduce water use including all non-essential uses before businesses were affected.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City A experiences an unexpected shortage of 50 acre-feet per year when their demands are 200 acre-feet per year. Thus, shortages are only 25 percent of total municipal use and residents of City A could eliminate needs by restricting landscape irrigation. City B, on the other hand, has a deficit of 150 acre-feet in 2020 and a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and some indoor conservation measures could eliminate 50 acre-feet of projected needs, yet 50 acre-feet would still remain. To eliminate" the remaining 50 acre-feet water intensive commercial businesses would have to curtail operations or shut down completely.

Three other areas were considered when analyzing municipal water shortages: 1) lost revenues to water utilities, 2) losses to the horticultural and landscaping industries stemming for reduction in water available for landscape irrigation, and 3) lost revenues and related economic impacts associated with reduced water related recreation.

Water Utility Revenues

Estimating lost water utility revenues was straightforward. We relied on annual data from the "*Water and Wastewater Rate Survey*" published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, average retail water and sewer rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as "county-other" were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or "unaccountable" water that comprises things such as leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the "miscellaneous gross receipts tax, "which the state collects from utilities located in most incorporated cities or towns in Texas. We do not include lost water utility revenues when aggregating impacts of municipal water shortages to regional and state levels to prevent double counting.

Horticultural and Landscaping Industry

The horticultural and landscaping industry, also referred to as the "green Industry," consists of businesses that produce, distribute and provide services associated with ornamental plants, landscape and garden supplies and equipment. Horticultural industries often face big losses during drought. For example, the recent drought in the Southeast affecting the Carolinas and Georgia horticultural and landscaping businesses had a harsh year. Plant sales were down, plant mortality increased, and watering costs increased. Many businesses were forced to close locations, lay off employees, and even file for bankruptcy. University of Georgia economists put statewide losses for the industry at around $3.2 billion during the 3-year drought that ended in 2008.[19] Municipal restrictions on outdoor watering play a significant role. During drought, water restrictions coupled with persistent heat has a psychological effect on homeowners that reduces demands for landscaping products and services. Simply put, people were afraid to spend any money on new plants and landscaping.

In Texas, there do not appear to be readily available studies that analyze the economic effects of water shortages on the industry. However, authors of this report believe negative impacts do and would result in restricting landscape irrigation to municipal water consumers. The difficulty in measuring them is two-fold. First, as noted above, data and research for these types of impacts that focus on Texas are limited; and second, economic data provided by IMPLAN do not disaggregate different sectors of the green industry to a level that would allow for meaningful and defensible analysis.[20]

Recreational Impacts

Recreational businesses often suffer when water levels and flows in rivers, springs and reservoirs fall significantly during drought. During droughts, many boat docks and lake beaches are forced to close, leading to big losses for lakeside business owners and local communities. Communities adjacent to popular river and stream destinations such as Comal Springs and the Guadalupe River also see their business plummet when springs and rivers dry up. Although there are many examples of businesses that have suffered due to drought, dollar figures for drought-related losses to the recreation and tourism industry are not readily available, and very difficult to measure without extensive local surveys. Thus, while they are important, economic impacts are not measured in this study.

Table 7 summarizes impacts of municipal water shortages at differing levels of magnitude, and shows the ranges of economic costs or losses per acre-foot of shortage for each level.

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[19] Williams, D. *"Georgia landscapers eye rebound from Southeast drought."* Atlanta Business Chronicle, Friday, June 19, 2009

[20] Economic impact analyses prepared by the TWDB for 2006 regional water plans did include estimates for the horticultural industry. However, year 2000 and prior IMPLAN data were disaggregated to a finer level. In the current dataset (2006), the sector previously listed as "Landscaping and Horticultural Services" (IMPLAN Sector 27) is aggregated into "Services to Buildings and Dwellings" (IMPLAN Sector 458).

Table 7: Impacts of Municipal Water Shortages at Different Magnitudes of Shortages		
Water shortages as percent of total municipal demands	Impacts	Economic costs per acre-foot*
0-30%	✓ Lost water utility revenues ✓ Restricted landscape irrigation and non-essential water uses	$730 - $2,040
30-50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use	$2,040 - $10,970
>50%	✓ Lost water utility revenues ✓ Elimination of landscape irrigation and non-essential water uses ✓ Rationing of indoor use ✓ Restriction or elimination of commercial water use ✓ Importing water by tanker truck	$10,970 - varies
*Figures are rounded		

1.1.4 Industrial Water User Groups

Manufacturing

Impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. For example, if a planning group estimates that during a drought of record water supplies in County A would only meet 50 percent of total annual demands for manufactures in the county, we reduced output for each sector by 50 percent. Since projected manufacturing demands are based on TWDB Water Uses Survey data for each county, we only include IMPLAN sectors represented in the TWBD survey database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable purposes. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes both databases were cross referenced in county with shortages. Non-matches were excluded when calculating direct impacts.

Mining

The process of mining is very similar to that of manufacturing. We assume that within a given county, shortages would apply equally to relevant mining sectors, and IMPLAN sectors are cross referenced with TWDB data to ensure consistency.

In Texas, oil and gas extraction and sand and gravel (aggregates) operations are the primary mining industries that rely on large volumes of water. For sand and gravel, estimated output reductions are straightforward; however, oil and gas is more complicated for a number of reasons. IMPLAN does not necessarily report the physical extraction of minerals by geographic local, but rather the sales revenues reported by a particular corporation.

For example, at the state level revenues for IMPLAN sector 19 (oil and gas extraction) and sector 27 (drilling oil and gas wells) totals $257 billion. Of this, nearly $85 billion is attributed to Harris County. However, only a very small fraction (less than one percent) of actual production takes place in the county. To measure actual potential losses in well head capacity due to water shortages, we relied on county level production data from the Texas Railroad Commission (TRC) and average well-head market prices for crude and gas to estimate lost revenues in a given county. After which, we used to IMPLAN ratios to estimate resultant losses in income and employment.

Other considerations with respect to mining include:

1) Petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as enhanced or water flood extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level TRC data that show the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

2) A substantial portion of output from mining operations goes directly to businesses that are classified as manufacturing in our schema. Thus, multipliers measuring backward linkages for a given manufacturer might include impacts to a supplying mining operation. Care was taken not to double count in such situations if both a mining operation and a manufacturer were reported as having water shortages.

Steam-electric

At minimum without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline. Low water levels could affect raw water intakes and outfalls at electrical generating units in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low water levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[21] However, the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This would affect safety related pumps, increase operating costs and/or result in sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity.

Among all water use categories steam-electric is unique and cautions are needed when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenues. In the case of water shortages, one assumes that businesses will suffer lost output if process water

[21] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several electrical generating units in a given region. If one unit became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily on water such as gas powered turbines might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[22] Thus, depending upon the severity of the shortages and conditions at a given electrical generating unit, energy supplies for local and regional communities could be maintained.
But in general, without enough cooling water, utilities would have to throttle back plant operations, forcing them to buy or generate more costly power to meet customer demands.

Measuring impacts end users of electricity is not part of this study as it would require extensive local and regional level analysis of energy production and demand. To maintain consistency with other water user groups, impacts of steam-electric water shortages are measured in terms of lost revenues (and hence income) and jobs associated with shutting down electrical generating units.

1.2 Social Impacts of Water Shortages

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are harder to quantify. Nevertheless, social effects associated with drought and water shortages are closely tied to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[23]

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on demographic projection models developed by the Texas State Data Center and used by the TWDB for state and regional water planning. Basically, the social impact model uses results from the economic component of the study and assesses how changes in labor demand would affect

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[22] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place such as transmission constraints; utilities could offset lost power that resulted from waters shortages with purchases via the power grid.

[23] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

migration patterns in a region. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

2. Results

Section 2 presents the results of the analysis at the regional level. Included are baseline economic data for each water use category, and estimated economics impacts of water shortages for water user groups with reported deficits. According to the 2011 *Rio Grande Regional Water Plan*, during severe drought irrigation- water user groups would experience water shortages in the absence of new water management strategies.

2.1 Overview of Regional Economy

On an annual basis, the Rio Grande regional economy generates roughly $29 billion in gross state product for Texas ($26 billion in income and $2 billion worth of business taxes) and supports an estimated 567,277 jobs (Table 8). Generating about $3.6 billion worth of income per year, agriculture, manufacturing, and mining are the primary base economic sectors in the region.[24] Municipal sectors also generate substantial amounts of income and are major employers. However, while municipal sectors are the largest employer and source of wealth, many businesses that make up the municipal category such as restaurants and retail stores are non-basic industries meaning they exist to provide services to people who work would in base industries such as manufacturing, agriculture and mining. In other words, without base industries such agriculture, many municipal jobs in the region would not exist.

[24] Base industries are those that supply markets outside of the region. These industries are crucial to the local economy and are called the economic base of a region. Appendix A shows how IMPLAN's 529 sectors were allocated to water use category, and shows economic data for each sector.

Table 8: The Rio Grande Regional Economy by Water User Group ($millions)*						
Water Use Category	**Total sales**	**Intermediate sales**	**Final sales**	**Jobs**	**Income**	**Business taxes**
Irrigation	$587.19	$66.29	$472.13	9,576	$368.38	$8.80
Livestock	$337.00	$162.43	$174.57	3,253	$28.32	$4.20
Manufacturing	$7,516.54	$804.21	$6,712.33	51,443	$2,051.56	$43.87
Mining	$1,489.38	$641.26	$848.12	4,822	$1,034.67	$71.02
Steam-electric	$295.72	$83.19	$212.53	790	$205.34	$35.05
Municipal	$36,755.66	$8,169.71	$28,585.95	497,393	$22,215.26	$1,788.13
Regional total	**$46,981.49**	**$9,927.09**	**$37,005.63**	**567,277**	**$25,903.53**	**$1,951.07**

[a] Appendix 1 displays data for individual IMPLAN sectors that make up each water use category. Based on data from the Texas Water Development Board, and year 2006 data from the Minnesota IMPLAN Group, Inc.

2.2 Impacts of Agricultural Water Shortages

According to the 2011 *Rio Grande Regional Water Plan*, during severe drought the counties of Cameron, Hidalgo, Maverick, Starr, Webb, Willacy, and Zapata would experiences shortages of irrigation water. Shortages range from 28 to 45 percent of annual irrigation demands, and farmers would be short nearly 407,500 acre-feet in 2010 and 258,375 acre-feet in 2060. Shortages of these magnitudes would reduce gross state product (income plus state and local business taxes) by an estimated $126 million per year in 2010 and $50 million in 2060.

Table 9: Economic Impacts of Water Shortages for Irrigation Water User Groups ($millions)			
Decade	**Lost income from reduced crop production [a]**	**Lost state and local tax revenues from reduced crop production**	**Lost jobs from reduced crop production**
2010	$123.82	$2.91	1,235
2020	$62.69	$1.59	785
2030	$44.56	$1.16	613
2040	$45.79	$1.19	627
2050	$47.02	$1.22	641
2060	$48.16	$1.25	655

*Changes to income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.3 Impacts of Municipal Water Shortages

Water shortages are projected to occur in a significant number of communities in the region. Deficits range anywhere from 5 to 10 percent of total annual water demands. At the regional level, the estimated economic value of domestic water shortages totals $176 million in 2010 and $3,108 million in 2060 (Table 10). Due to curtailment of commercial business activity operation, municipal shortages would reduce gross state product (income plus taxes) by an estimated $18 million in 2020 and $2,460 million in 2060.

Table 10: Economic Impacts of Water Shortages for Municipal Water User Groups ($millions)					
Decade	**Monetary value of domestic water shortages**	**Lost income from reduced commercial business activity***	**Lost state and local taxes from reduced commercial business activity**	**Lost jobs from reduced commercial business activity**	**Lost water utility revenues**
2010	$176.41	$15.43	$2.23	510	$38.93
2020	$360.33	$19.19	$2.80	667	$103.99
2030	$848.77	$36.04	$4.82	1,135	$188.77
2040	$1,452.62	$437.72	$49.32	11,137	$289.15
2050	$2,277.47	$988.84	$109.90	24,585	$412.11
2060	$3,195.41	$2,213.85	$248.58	53,679	$543.69

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.4 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in Cameron and Hidalgo counties. In 2010, the Rio Grande planning group estimates that these manufacturers would be short about 1,900 acre-feet; and by 2060, this figure increases to nearly 4,450 acre-feet. Shortages of these magnitudes would reduce gross state product (income plus taxes) by an estimated $206 million in 2010 and $453 million in 2060 (Table 11).

Table 11: Economic Impacts of Water Shortages for Manufacturing Water User Groups ($millions)			
Decade	**Lost income due to reduced manufacturing output**	**Lost state and local business tax revenues due to reduced manufacturing output**	**Lost jobs due to reduced manufacturing output**
2010	$184.26	$22.14	3,336
2020	$226.44	$27.20	4,100
2030	$264.64	$31.79	4,791
2040	$302.44	$36.33	5,476
2050	$346.05	$41.46	6,265
2060	$404.80	$48.37	7,329

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.5 Impacts of Steam-electric Water Shortages

Water shortages for electrical generating units are projected to occur in Cameron, Hidalgo and Webb counties, and would result in estimated losses of gross state product totaling $19 million dollars in 2020, and $306 million 2060 (Table 12).

Table 12: Economic Impacts of Water Shortages for Steam-electric Water User Groups ($millions)			
Decade	**Lost income due to reduced electrical generation**	**Lost state and local business tax revenues due to reduced electrical generation**	**Lost jobs due to reduced electrical generation**
2010	$0.00	$0.00	0
2020	$16.70	$2.40	57
2030	$36.89	$5.30	125
2040	$122.99	$17.65	418
2050	$186.31	$26.74	633
2060	$267.93	$38.46	911

*Changes to Income and business taxes are collectively equivalent to a decrease in gross state product, which is analogous to gross domestic product measured at the state rather than national level. Appendix 2 shows results by water user group.

2.6 Social Impacts of Water Shortages

As discussed previously, estimated social impacts focus on changes in population and school enrollment in the region. In 2010, estimated population losses total 6,112 with corresponding reductions in school enrollment of 1,724 students (Table 13). In 2060, population in the region would decline by 75,252 and school enrollment would fall by 21,349.

Table 13: Social Impacts of Water Shortages (2010-2060)		
Year	**Population Losses**	**Declines in School Enrollment**
2010	6,112	1,724
2020	6,756	1,917
2030	8,027	2,277
2040	21,269	6,034
2050	38,597	10,950
2060	75,252	21,349

2.7 Distribution of Impacts by Major River Basin

Administrative rules require that impacts are presented by both planning region and major river basin. To meet rule requirements, impacts were allocated among basins based on the distribution of water shortages in relevant basins. For example, if 50 percent of water shortages in River Basin A and 50 percent occur in River Basin B, then impacts were split equally among the two basins. Table 14 displays the results.

Table 14: Distribution of Impacts by Major River Basin (2010-2060)						
River Basin	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Nueces	1%	1%	1%	1%	1%	1%
Nueces-Rio Grande	80%	76%	71%	70%	70%	70%
Rio Grande	19%	23%	28%	29%	29%	29%

Appendix 1: Economic Data for Individual IMPLAN Sectors

Economic Data for Agricultural Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Irrigation	Oilseed Farming	1	$0.79	$0.20	$0.59	17	$0.38	$0.02
Irrigation	Grain Farming	2	$42.70	$11.19	$31.33	1,265	$19.56	$0.77
Irrigation	Vegetable and Melon Farming	3	$328.47	$9.66	$318.81	3,755	$241.23	$3.09
Irrigation	Tree Nut Farming	4	$22.56	$0.00	$22.56	295	$15.24	$0.55
Irrigation	Fruit Farming	6	$85.84	$12.52	$73.32	1,346	$49.11	$1.86
Irrigation	Cotton Farming	8	$23.86	$1.53	$22.33	283	$8.79	$0.22
Irrigation	Sugarcane and Sugar Beet Farming	9	$48.83	$0.98	$47.85	2,339	$17.29	$1.63
Irrigation	All "Other" Crop Farming	10	$34.14	$31.19	$3.19	276	$16.78	$0.66
	Total irrigation	**NA**	**$587.19**	**$66.29**	**$472.13**	**9,576**	**$368.38**	**$8.80**
Livestock	Animal- except poultry- slaughtering	67	$153.41	$41.02	$112.39	412	$13.09	$0.73
Livestock	Cattle ranching and farming	11	$153.34	$106.32	$47.01	2,472	$12.11	$3.22
Livestock	Meat processed from carcasses	68	$18.98	$5.60	$13.38	44	$1.76	$0.09
Livestock	Animal production- except cattle and poultry	13	$10.18	$8.63	$1.55	320	$0.99	$0.16
Livestock	Poultry and egg production	12	$1.09	$0.85	$0.24	5	$0.37	$0.00
Livestock	Animal- except poultry- slaughtering	67	$153.41	$41.02	$112.39	412	$13.09	$0.73
	Total livestock	**NA**	**$337.00**	**$162.43**	**$174.57**	**3,253**	**$28.32**	**$4.20**
	Total agriculture		**$924.19**	**$229.69**	**$694.55**	**12,829**	**$396.70**	**$13.00**

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Mining and Steam-electric Water User Groups ($millions)									
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Mining	Support activities for oil and gas operations	28	$701.94	$97.50	$604.44	3,431	$636.63	$28.62
Mining	Oil and gas extraction	19	$580.52	$539.12	$41.40	907	$333.91	$35.21
Mining	Drilling oil and gas wells	27	$175.11	$0.87	$174.23	295	$47.62	$6.28
Mining	Other nonmetallic mineral mining	26	$15.37	$1.54	$13.83	60	$7.62	$0.47
Mining	Sand- gravel- clay- and refractory mining	25	$14.65	$1.55	$13.10	115	$8.44	$0.43
Mining	Gold- silver- and other metal ore mining	23	$1.13	$0.63	$0.50	10	$0.10	$0.01
Mining	Stone mining and quarrying	24	$0.56	$0.06	$0.50	3	$0.31	$0.00
Mining	Support activities for other mining	29	$0.12	$0.00	$0.11	1	$0.04	$0.01
	Total mining	**NA**	**$1,489.38**	**$641.26**	**$848.12**	**4,822**	**$1,034.67**	**$71.02**
Steam-electric	**Power generation and supply**	**30**	**$295.72**	**$83.19**	**$212.53**	**790**	**$205.34**	**$35.05**

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Manufacturing Water User Groups ($millions)

Water Use Category	IMPLAN Sector	IMPLAN Code	Total Sales	Intermediate Sales	Final Sales	Jobs	Income	Business Taxes
Manufacturing	New residential 1-unit structures- all	33	$1,041.91	$0.00	$1,041.91	7,615	$298.50	$4.70
Manufacturing	Commercial and institutional buildings	38	$554.41	$0.00	$554.41	6,638	$255.32	$3.16
Manufacturing	Flour milling	48	$373.27	$23.80	$349.47	489	$40.43	$2.27
Manufacturing	Motor vehicle parts manufacturing	350	$368.28	$29.61	$338.67	1,061	$73.64	$1.13
Manufacturing	Other oilseed processing	53	$345.06	$11.24	$333.82	165	$13.88	$1.86
Manufacturing	Construction machinery manufacturing	259	$281.29	$38.39	$242.90	452	$23.42	$0.71
Manufacturing	Ship building and repairing	357	$272.69	$1.58	$271.11	1,691	$82.69	$0.93
Manufacturing	Other new construction	41	$239.53	$0.00	$239.53	3,045	$118.49	$0.93
Manufacturing	Agriculture and forestry support activities	18	$235.57	$133.91	$101.66	9,428	$156.33	$1.76
Manufacturing	Ready-mix concrete manufacturing	192	$176.82	$0.86	$175.96	748	$43.38	$1.08
Manufacturing	Paperboard container manufacturing	126	$165.55	$1.75	$163.80	561	$35.93	$1.39
Manufacturing	Fruit and vegetable canning and drying	61	$164.09	$6.08	$158.01	408	$22.71	$0.70
Manufacturing	Soft drink and ice manufacturing	85	$157.13	$8.78	$148.36	254	$20.85	$0.92
Manufacturing	New residential additions and alterations-all	35	$145.30	$0.00	$145.30	907	$47.26	$0.67
Manufacturing	Seafood product preparation and packaging	71	$142.04	$70.24	$71.80	546	$10.63	$0.28
Manufacturing	Coated and uncoated paper bag manufacturing	130	$124.31	$3.51	$120.80	473	$22.71	$0.79
Manufacturing	Highway- street- bridge- and tunnel construct	39	$118.74	$0.00	$118.74	1,286	$54.68	$0.70
Manufacturing	New multifamily housing structures- all	34	$108.80	$0.00	$108.80	1,106	$46.20	$0.27
Manufacturing	Frozen food manufacturing	60	$102.23	$3.21	$99.03	419	$11.90	$0.32
Manufacturing	Aircraft manufacturing	351	$98.51	$5.01	$93.50	202	$14.50	$0.30
Manufacturing	Motor vehicle body manufacturing	346	$98.19	$5.70	$92.49	357	$15.34	$0.34
Manufacturing	Motor and generator manufacturing	334	$89.93	$8.54	$81.38	362	$25.26	$0.55
Manufacturing	Water- sewer- and pipeline construction	40	$88.39	$0.00	$88.39	841	$35.09	$0.51
Manufacturing	Hunting and trapping	17	$77.24	$6.32	$70.92	439	$23.72	$4.44
Manufacturing	Forest nurseries- forest products- and timber	15	$76.26	$1.18	$75.09	132	$10.95	$1.75
Manufacturing	Metal valve manufacturing	248	$70.57	$7.64	$62.92	275	$29.89	$0.39
Manufacturing	**All other manufacturing**		$1,729.89	$434.61	$1,295.28	10,863	$502.82	$10.82
Manufacturing	**Total manufacturing**		$7,516.54	$804.21	$6,712.33	51,443	$2,051.56	$43.87

Based on year 2006 data from the Minnesota IMPLAN Group, Inc.

Economic Data for Municipal Water User Groups ($millions)								
Water Use Category	**IMPLAN Sector**	**IMPLAN Code**	**Total Sales**	**Intermediate Sales**	**Final Sales**	**Jobs**	**Income**	**Business Taxes**
Municipal	State & Local Education	503	$2,872.91	$0.00	$2,872.90	74,700	$2,872.90	$0.00
Municipal	Owner-occupied dwellings	509	$2,647.04	$0.00	$2,647.04	0	$2,050.58	$313.00
Municipal	Wholesale trade	390	$1,921.04	$919.72	$1,001.32	16,298	$1,010.52	$285.00
Municipal	Hospitals	467	$1,740.08	$0.00	$1,740.08	13,940	$975.26	$12.46
Municipal	Monetary authorities and depository credit in	430	$1,733.72	$571.01	$1,162.71	8,871	$1,217.44	$22.18
Municipal	Food services and drinking places	481	$1,558.30	$198.99	$1,359.30	34,123	$612.65	$71.61
Municipal	Truck transportation	394	$1,520.81	$823.48	$697.34	13,157	$626.91	$14.24
Municipal	Offices of physicians- dentists- and other he	465	$1,376.77	$0.00	$1,376.77	13,818	$960.83	$8.40
Municipal	State & Local Non-Education	504	$1,272.59	$0.00	$1,272.59	23,176	$1,272.59	$0.00
Municipal	Federal Non-Military	506	$1,254.27	$0.00	$1,254.26	7,677	$1,254.27	$0.00
Municipal	Home health care services	464	$1,240.24	$0.01	$1,240.24	41,747	$701.40	$4.12
Municipal	Real estate	431	$1,070.39	$423.72	$646.67	7,015	$619.45	$131.74
Municipal	Motor vehicle and parts dealers	401	$929.81	$101.11	$828.70	9,435	$476.11	$135.01
Municipal	Telecommunications	422	$875.21	$300.62	$574.59	2,632	$350.89	$58.66
Municipal	General merchandise stores	410	$803.47	$84.68	$718.79	15,679	$353.06	$112.32
Municipal	Other State and local government enterprises	499	$759.62	$247.35	$512.26	3,759	$265.66	$0.09
Municipal	Scenic and sightseeing transportation and sup	397	$657.16	$246.54	$410.62	9,272	$446.86	$75.11
Municipal	Food and beverage stores	405	$653.61	$87.39	$566.22	12,000	$328.89	$72.05
Municipal	Legal services	437	$516.88	$328.04	$188.84	5,486	$309.72	$9.81
Municipal	Other ambulatory health care services	466	$479.93	$31.21	$448.71	3,976	$208.81	$3.09
Municipal	Clothing and clothing accessories stores	408	$450.59	$56.41	$394.17	8,756	$230.89	$65.51
Municipal	Social assistance- except child day care services	470	$424.55	$0.08	$424.47	16,832	$179.71	$1.24
Municipal	Building material and garden supply stores	404	$375.36	$58.21	$317.14	4,864	$172.99	$52.61
Municipal	Business support services	455	$312.99	$146.48	$166.51	6,877	$151.73	$5.73
Municipal	Architectural and engineering services	439	$305.74	$192.73	$113.01	2,975	$145.46	$1.22
Municipal	Civic- social- professional and similar organ	493	$305.42	$107.31	$198.11	8,549	$157.56	$0.99
Municipal	All other municipal	NA	$8,697.19	$3,244.61	$5,452.57	131,779	$4,262.14	$331.94
Municipal	**Total**		$36,755.66	$8,169.71	$28,585.95	497,393	$22,215.26	$1,788.13
Based on year 2006 data from the Minnesota IMPLAN Group, Inc.								

Appendix 2: Impacts by Water User Group

Irrigation ($millions)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Cameron						
Reduced income from lost crop production	$19.10	$16.64	$13.74	$14.03	$14.32	$14.58
Reduced business taxes from lost crop production	$0.59	$0.51	$0.42	$0.43	$0.44	$0.45
Reduced jobs from lost crop production	363	317	261	267	273	278
Hidalgo						
Reduced income from lost crop production	$79.47	$28.76	$14.62	$15.30	$15.99	$16.62
Reduced business taxes from lost crop production	$1.75	$0.63	$0.32	$0.34	$0.35	$0.37
Reduced jobs from lost crop production	607	220	112	117	122	127
Maverick						
Reduced income from lost crop production	$14.17	$6.57	$5.95	$6.05	$6.14	$6.23
Reduced business taxes from lost crop production	$0.32	$0.19	$0.17	$0.18	$0.18	$0.18
Reduced jobs from lost crop production	104	85	77	79	80	81
Starr						
Reduced income from lost crop production	$1.78	$1.59	$1.41	$1.44	$1.47	$1.50
Reduced business taxes from lost crop production	$0.03	$0.02	$0.02	$0.02	$0.02	$0.02
Reduced jobs from lost crop production	12	11	10	10	10	10
Webb						
Reduced income from lost crop production	$1.97	$1.72	$1.49	$1.52	$1.55	$1.57
Reduced business taxes from lost crop production	$0.03	$0.03	$0.02	$0.03	$0.03	$0.03
Reduced jobs from lost crop production	13	11	10	10	10	10
Willacy						
Reduced income from lost crop production	$5.37	$5.67	$5.84	$5.91	$5.98	$6.05
Reduced business taxes from lost crop production	$0.16	$0.17	$0.17	$0.18	$0.18	$0.18
Reduced jobs from lost crop production	123	130	134	135	137	138
Zapata						
Reduced income from lost crop production	$1.97	$1.74	$1.52	$1.55	$1.58	$1.60
Reduced business taxes from lost crop production	$0.03	$0.03	$0.02	$0.02	$0.02	$0.02
Reduced jobs from lost crop production	13	11	10	10	10	10

Manufacturing ($millions)						
	2010	2020	2030	2040	2050	2060
Cameron County						
Reduced income from lost manufacturing	$184.26	$226.44	$264.64	$302.44	$335.19	$379.51
Reduced business taxes from lost manufacturing	$22.14	$27.20	$31.79	$36.33	$40.27	$45.59
Reduced jobs from lost crop livestock manufacturing	3,336	4,100	4,791	5,476	6,069	6,871
Hidalgo County						
Reduced income from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$10.85	$25.28
Reduced business taxes from lost manufacturing	$0.00	$0.00	$0.00	$0.00	$1.19	$2.78
Reduced jobs from lost crop livestock manufacturing	0	0	0	0	196	458

Steam-electric ($millions)						
	2010	2020	2030	2040	2050	2060
Cameron County						
Reduced income from lost electrical generation	$0.00	$0.00	$0.00	$0.00	$0.89	$6.29
Reduced business taxes from lost electrical generation	$0.00	$0.00	$0.00	$0.00	$0.13	$0.90
Reduced jobs from lost electrical generation	0	0	0	0	3	21
Hidalgo County						
Reduced income from lost electrical generation	$0.00	$16.70	$36.89	$122.99	$182.97	$256.11
Reduced business taxes from lost electrical generation	$0.00	$2.40	$5.30	$17.65	$26.26	$36.76
Reduced jobs from lost electrical generation	0	57	125	418	622	871
Webb County						
Reduced income from lost electrical generation	0	0	0	0	$2.45	$5.52
Reduced business taxes from lost electrical generation	0	0	0	0	$0.35	$0.79
Reduced jobs from lost electrical generation	0	0	0	0	8	19

Municipal ($millions)						
	2010	2020	2030	2040	2050	2060
Alamo						
Monetary value of domestic water shortages	$0.05	$4.40	$18.75	$24.08	$33.17	$50.40
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$5.86	$9.87	$27.98
Lost jobs due to reduced commercial business activity	0	0	0	185	311	882
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.83	$1.41	$3.99
Lost utility revenues	$0.11	$1.37	$2.78	$4.34	$6.13	$7.95
Alton						
Monetary value of domestic water shortages	$0.00	$0.00	$17.22	$33.49	$51.71	$64.37
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$9.27	$13.54	$36.11
Lost jobs due to reduced commercial business activity	0	0	0	584	854	1,139
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$1.32	$1.93	$5.15
Lost utility revenues	$0.00	$0.00	$4.84	$6.77	$8.88	$11.09
Brownsville						
Monetary value of domestic water shortages	$9.13	$23.47	$149.52	$247.63	$399.63	$465.79
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$261.86	$345.50
Lost jobs due to reduced commercial business activity	0	0	0	0	5,826	7,687
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$27.87	$36.77
Lost utility revenues	$14.79	$30.60	$46.58	$63.25	$79.82	$96.19
County-other (Hidalgo)						
Monetary value of domestic water shortages	$0.00	$3.04	$32.68	$73.03	$135.24	$242.12
County-other (Jim Hogg)						
Monetary value of domestic water shortages	$0.66	$0.72	$0.86	$0.89	$0.87	$0.79
County-other (Maverick)						
Monetary value of domestic water shortages	$0.06	$0.81	$1.89	$9.47	$13.10	$17.19
County-other (Starr)						
Monetary value of domestic water shortages	$68.67	$148.68	$185.90	$223.97	$260.26	$294.62
County-other (Webb)						
Monetary value of domestic water shortages	$0.16	$0.55	$0.96	$4.80	$7.76	$11.06

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
County-other (Webb)						
Monetary value of domestic water shortages	$0.27	$0.68	$5.21	$3.93	$4.73	$5.83
Donna						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.09
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20
East Honda WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.25	$1.29
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.55	$1.99
Edcouch						
Monetary value of domestic water shortages	$0.19	$1.09	$1.80	$4.02	$5.09	$5.28
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.53
Lost jobs due to reduced commercial business activity	0	0	0	0	0	21
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08
Lost utility revenues	$0.23	$0.34	$0.46	$0.60	$0.76	$0.93
Edinburgh						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$1.85	$7.43	$45.34
Lost utility revenues	$0.00	$0.00	$0.00	$3.25	$9.26	$15.43
El Cenizo						
Monetary value of domestic water shortages	$0.00	$0.05	$0.61	$4.61	$11.08	$15.02
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$2.93	$4.64
Lost jobs due to reduced commercial business activity	0	0	0	0	92	146
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.42	$0.66
Lost utility revenues	$0.00	$0.11	$0.74	$1.44	$2.23	$3.08
El Jardin						
Monetary value of domestic water shortages	$0.36	$1.19	$6.76	$11.38	$20.00	$24.21
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$5.55	$7.32
Lost jobs due to reduced commercial business activity	0	0	0	0	175	231
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.79	$1.04
Lost utility revenues	$0.61	$1.45	$2.32	$3.20	$4.07	$4.94

Municipal (cont.)						
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Harlingen						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$1.41	$3.49
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$2.48	$5.47
Hidalgo						
Monetary value of domestic water shortages	$0.00	$0.01	$0.24	$1.15	$7.24	$15.58
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$5.74
Lost jobs due to reduced commercial business activity	0	0	0	0	0	138
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$4.99
Lost utility revenues	$0.00	$0.03	$0.43	$1.28	$2.26	$3.26
Hidalgo County MUD#1						
Monetary value of domestic water shortages	$34.98	$58.71	$87.21	$123.26	$157.30	$107.53
Lost income from reduced commercial business activity	$2.24	$3.59	$5.12	$6.77	$8.60	$10.47
Lost jobs due to reduced commercial business activity	$2.76	$4.89	$7.30	$9.89	$12.76	$15.71
Lost state and local taxes from reduced commercial business activity	$0.43	$0.76	$1.13	$1.53	$1.98	$2.44
Lost utility revenues	111	196	293	398	513	632
Indian Lake						
Monetary value of domestic water shortages	$0.25	$0.38	$0.28	$0.46	$0.66	$1.18
Lost income from reduced commercial business activity	$0.00	$0.00	$0.03	$0.05	$0.06	$0.08
Lost jobs due to reduced commercial business activity	0	0	1	2	3	3
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01
Lost utility revenues	$0.04	$0.05	$0.07	$0.09	$0.11	$0.13
La Grulla						
Monetary value of domestic water shortages	$5.52	$7.46	$8.53	$6.96	$7.73	$8.63
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$1.03	$1.27	$1.60
Lost jobs due to reduced commercial business activity	0	0	0	18	23	27
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.53	$0.64	$0.77
Lost utility revenues	$0.68	$0.79	$0.90	$1.02	$1.15	$1.29

Municipal (cont.)	2010	2020	2030	2040	2050	2060
La Joya						
Monetary value of domestic water shortages	$0.00	$0.01	$0.12	$0.31	$2.22	$3.41
Lost utility revenues	$0.00	$0.01	$0.17	$0.34	$0.53	$0.75
Laguna Madre WD						
Monetary value of domestic water shortages	$0.00	$0.00	$0.65	$2.71	$16.14	$27.20
Lost utility revenues	$0.00	$0.00	$1.02	$3.01	$5.03	$6.95
Laredo						
Monetary value of domestic water shortages	$4.76	$26.01	$198.41	$320.89	$498.32	$752.76
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$292.93	$465.20	$1,304.36
Lost jobs due to reduced commercial business activity	0	0	0	6,517	10,349	29,019
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$31.17	$49.51	$138.81
Lost utility revenues	$9.52	$33.91	$61.81	$92.91	$126.62	$163.22
Los Fresnos						
Monetary value of domestic water shortages	$0.00	$0.00	$0.18	$0.70	$5.31	$8.77
Lost utility revenues	$0.00	$0.00	$0.29	$0.77	$1.27	$1.75
McAllen						
Monetary value of domestic water shortages	$0.00	$2.56	$10.89	$24.05	$126.60	$207.37
Lost utility revenues	$0.00	$4.50	$15.24	$26.67	$39.44	$52.97
Military Highway WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.07	$1.16	$2.84
Lost utility revenues	$0.00	$0.00	$0.00	$0.16	$1.71	$3.32
Mission						
Monetary value of domestic water shortages	$1.68	$7.25	$49.95	$111.71	$149.64	$223.31
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$66.64	$104.34	$285.95
Lost jobs due to reduced commercial business activity	0	0	0	1,482	2,321	6,362
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$7.09	$11.10	$30.43
Lost utility revenues	$2.64	$8.03	$14.07	$20.43	$27.81	$35.38

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
North Alamo WSC						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$2.51	$10.77	$48.66
Lost utility revenues	$0.00	$0.00	$0.00	$4.85	$14.78	$24.88
Olmito WSC						
Monetary value of domestic water shortages	$0.00	$0.46	$4.01	$9.14	$14.01	$20.78
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.99	$1.59	$2.16
Lost jobs due to reduced commercial business activity	0	0	0	40	64	87
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.15	$0.25	$0.33
Lost utility revenues	$0.00	$0.57	$1.25	$1.91	$2.60	$3.26
Palm Valley						
Monetary value of domestic water shortages	$0.13	$0.12	$0.11	$0.09	$0.08	$0.08
Lost utility revenues	$0.15	$0.14	$0.12	$0.11	$0.10	$0.10
Palm Valley Estates UD						
Monetary value of domestic water shortages	$0.01	$0.02	$0.04	$0.09	$0.50	$0.70
Lost utility revenues	$0.01	$0.03	$0.06	$0.09	$0.12	$0.15
Palmhurst						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.30	$1.19	$2.65
Lost utility revenues	$0.00	$0.00	$0.00	$0.59	$1.84	$3.23
Palmview						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.71	$1.84
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.89	$1.79
Penitas						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.01	$0.03

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
Pharr						
Monetary value of domestic water shortages	$0.00	$2.01	$6.73	$39.24	$67.93	$124.37
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$34.40
Lost jobs due to reduced commercial business activity	0	0	0	0	0	1,085
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$4.90
Lost utility revenues	$0.00	$3.47	$8.22	$13.46	$19.11	$25.14
Port Isabella						
Monetary value of domestic water shortages	$33.67	$37.00	$41.05	$45.40	$49.14	$52.79
Lost income from reduced commercial business activity	$12.67	$14.30	$15.97	$17.60	$19.35	$21.06
Lost jobs due to reduced commercial business activity	400	451	503	555	610	664
Lost state and local taxes from reduced commercial business activity	$1.81	$2.04	$2.28	$2.51	$2.76	$3.00
Lost utility revenues	$3.74	$4.14	$4.55	$4.95	$5.37	$5.79
Primera						
Monetary value of domestic water shortages	$1.10	$2.12	$4.71	$6.01	$12.83	$15.97
Lost income from reduced commercial business activity	$0.00	$0.00	$0.44	$0.65	$0.86	$1.06
Lost jobs due to reduced commercial business activity	0	0	18	26	34	43
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.07	$0.10	$0.13	$0.17
Lost utility revenues	$0.38	$0.60	$0.82	$1.06	$1.30	$1.54
Rio Bravo						
Monetary value of domestic water shortages	$0.00	$0.58	$11.78	$16.50	$27.00	$44.50
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$1.13	$2.01	$5.84
Lost jobs due to reduced commercial business activity	0	0	0	46	81	235
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.18	$0.31	$0.91
Lost utility revenues	$0.00	$0.51	$1.32	$2.22	$3.22	$4.27
Rio Grande City						
Monetary value of domestic water shortages	$0.55	$1.09	$1.73	$2.21	$9.77	$12.91
Lost utility revenues	$0.87	$1.36	$1.92	$2.45	$3.04	$3.66

Municipal (cont.)						
	2010	2020	2030	2040	2050	2060
Rio WSC						
Monetary value of domestic water shortages	$1.91	$3.44	$6.92	$10.66	$13.94	$17.11
Lost income from reduced commercial business activity	$0.00	$0.00	$0.51	$1.46	$1.93	$2.38
Lost jobs due to reduced commercial business activity	0	0	21	59	78	96
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.08	$0.23	$0.30	$0.37
Lost utility revenues	$0.34	$0.62	$0.91	$1.19	$1.49	$1.77
Roma City						
Monetary value of domestic water shortages	$0.09	$0.56	$1.29	$2.13	$10.06	$13.81
Lost utility revenues	$0.21	$0.97	$1.77	$2.60	$3.45	$4.31
San Benito						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.19	$0.85
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.38	$1.49
San Juan						
Monetary value of domestic water shortages	$0.55	$8.68	$20.65	$42.22	$69.32	$137.01
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$12.41	$38.15	$51.83
Lost jobs due to reduced commercial business activity	0	0	0	391	1,203	1,634
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$1.77	$5.44	$7.39
Lost utility revenues	$0.95	$3.25	$5.81	$8.64	$11.90	$15.24
San Perlita						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
Sebastian						
Monetary value of domestic water shortages	$0.00	$0.00	$0.04	$0.10	$0.13	$0.17
Lost utility revenues	$0.00	$0.00	$0.07	$0.12	$0.16	$0.18
Sharyland WSC						
Monetary value of domestic water shortages	$0.00	$0.40	$0.41	$1.71	$3.72	$19.25
Lost utility revenues	$0.00	$0.77	$0.79	$2.64	$4.55	$6.60

Municipal (cont.)	2010	2020	2030	2040	2050	2060
South Padre Island						
Monetary value of domestic water shortages	$8.23	$16.74	$12.58	$18.82	$30.52	$36.03
Lost income from reduced commercial business activity	$0.00	$0.00	$11.79	$17.80	$47.58	$59.10
Lost jobs due to reduced commercial business activity	0	0	262	396	1,059	1,315
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$1.25	$1.89	$5.06	$6.29
Lost utility revenues	$1.35	$2.48	$3.66	$4.83	$6.01	$7.13
Sullivan City						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.27	$0.84
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$0.39	$0.81
Valley MUD #2						
Monetary value of domestic water shortages	$0.00	$0.00	$0.15	$2.16	$6.56	$7.18
Lost income from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.50
Lost jobs due to reduced commercial business activity	0	0	0	0	0	20
Lost state and local taxes from reduced commercial business activity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08
Lost utility revenues	$0.00	$0.00	$0.19	$0.43	$0.69	$0.94
Webb County Water Utility						
Monetary value of domestic water shortages	$0.07	$1.26	$3.01	$5.05	$9.28	$14.37
Lost utility revenues	$0.08	$0.28	$0.49	$0.72	$0.98	$1.25
Weslaco						
Monetary value of domestic water shortages	$0.00	$0.00	$0.00	$0.00	$0.47	$1.93
Lost utility revenues	$0.00	$0.00	$0.00	$0.00	$1.02	$3.33

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CHAPTER 6.0 : CONSOLIDATED WATER CONSERVATION & DROUGHT MANAGEMENT RECOMMENDATIONS OF THE REGIONAL WATER PLAN

Until one occurs, people tend to ignore or forget the difficulties caused by severe drought. This chapter will aid in preparing for drought conditions and establishing water conservation methods.

"Drought is a complex physical and social process of widespread significance. Although drought affects the entire State, it frequently is a regional problem due to the vast geography and varying climatic conditions within the state. Despite the frequency and economic damage caused by drought, the term drought remains difficult to define" (State Drought Preparedness Plan).

In order to ensure a region's water source(s), each town/city in the region should prepare its own drought management and water conservation plan by first identifying needs and establishing goals for water conservation.

6.1 WATER CONSERVATION PLAN

This chapter's attachment section contains various drought management and water conservation plans that have been researched as effective strategies by state agencies such as TCEQ and TWDB.

The following strategies are referenced from TWDB's *Water Conservation Best Management Practices Guide*, Report 362. Under Senate Bill 1094, the 78th Texas Legislature created the Texas Water Conservation Implementation Task Force and charged the group with reviewing, evaluating, and recommending optimum levels of water use efficiency and conservation for the state. Report 362 was prepared in partial fulfillment of this charge. The *Guide* is organized in three sections for municipal, industrial, and agricultural user groups and includes 55 Best Management Practices (BMPs). Each BMP describes efficiency measures, implementation techniques and schedules, program scope, cost considerations, water-savings estimating procedures, and other references to assist end-users in implementing the plan. This document can be accessed at TWDB's web site: http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

The objective of a specific water conservation plan is reducing the quantity of water required within a given water entity's service area through implementation of efficient water use procedures. The key to success is implementing and enforcing effective city ordinances. This policing approach has proved effective in various Texas communities.

These water conservation strategies from Report 362 help reduce effects of drought in this region:

1. golf course conservation
2. metering all new connections & retrofitting existing connections
3. showerhead, aerator, and toilet flapper retrofitting
4. educating through schools
5. landscape irrigation conservation
6. water-wise landscape design
7. athletic field conservation
8. dissemination of public information
9. rainwater harvesting
10. parklands conservation
11. residential clothes washer incentives

Attachment 6-4 includes Report 362's strategy descriptions.

6.2 EXAMPLES OF WATER CONSERVATION PLANS IMPLEMENTED IN REGION M

Several cities have taken precautions to conserve water with formal plans. Here is a brief description of a conservation plan for a Region M Water User Group (WUG).

6.2.1 Laguna Madre Water District Water Conservation & Drought Contingency Plan

Water conservation goals for the Laguna Madre Water District (LMWD) are based on the entity's utility profile and water practices. The LMWD's goals are:

1. Water Loss: Accounting for all water use is one of the first steps in establishing a goal for water losses
2. Per capita usage: The average daily customer use is currently 171 gpcd. The goal is to reduce this to 166 gpcd in 5 years and 153 gpcd in 10 years.
3. Water recycling: The LMWD is actively trying to reclaim at least 50% of its wastewater effluent and/or substitute potable water for raw water and effluent.
4. Alternative source: The LMWD is evaluating alternative sources of water to serve the needs of the customers.

The LMWD Water Conservation plan consists of certain key elements. The first element is a Public Education Campaign. The public education campaign will consist of brochures, website, media, school and media education, and a drought awareness campaign.

The second element of the plan is to implement a conservation based water rates structure. The proposed block rate structure will be aimed at reducing consumption and putting a high priority on water conservation.

The third element is a plumbing fixture and retrofit program. Building owners will be encouraged to replace old, leaky fixtures with new, high efficiency fixtures. As a long term goal, the LMWD will assist by providing retrofit kits to potential customers.

The fourth element is the implementation of water savings plumbing code. The LMWD has already passed a resolution that includes water conservation for new construction and renovations. Improved technology has made the effectiveness of this campaign a reality.

The fifth element is to implement universal metering, meter repair, and meter replacement. Currently, all customers of the LMWD are metered, however, a retrofit program will increase the efficiency of water measurements and reduce consumption. This element will also reduce the amount of unaccounted for water which can lead to system-wide losses.

The sixth element is to reduce the overall quantity of unaccounted for water. Water leaks are a major source of unaccounted for water. This task will require the replacement of old, leaky lines with new lines. The water losses due to seepage will be significantly reduced.

The seventh element is the implementation of a leak detection and repair program. Currently, the LMWD does not have a leak detection program in place. Through the implementation of such a program, the District's goal is to reduce the amount of water lost due to leaking pipes, fittings, and valves. Further, the District will be implementing a line repair program.

The eighth element is the implementation of water conservative landscaping. An educational program aimed at notifying the public of potential water savings due to water conservative landscaping will be implemented.

The ninth element is to implement water conservation programs for industrial, commercial and institutional customers. A large portion of the water consumption is made up of such customers. By reducing operational costs due to a reduction in overall water consumption, both the District and its users will benefit from such improvements.

A copy of the LMWD's Water Conservation and Drought Contingency Plan is included in the appendix.

6.3 TEXAS DROUGHT MANAGEMENT STRATEGIES

Without substantial rains, the next ten years may produce a severe drought worse for Texas agriculture than the disastrous drought of 1996. No amount of scientific knowledge can make up for lack of rain and the resultant water depletion in soil profiles and in-ground and surface water supplies.

This information was gleaned from information provided by specialists with the Texas Agricultural Extension Service (TAES) and others who provide information that might reduce further losses to Texas' beleaguered agricultural industry. TAES has access to many resources helpful in reducing water usage and losses associated with drought. The text is provided also to help assemble the State Drought Preparedness Plan for the Texas Department of Safety. This information addresses water conservation measures suitable for urban residents as cities and municipalities face declining water supplies and are forced to implement rationing.

TAES recommends several drought strategies for this region. Although this section presents a few of those strategies, the full report titled "Texas Drought Management Strategies" is found in the Appendix of this water plan. At least two options are listed for most of the 14 categories.

1. AG ECONOMICS AND MANAGEMENT
   Summary of Weather-Related Sales Rules for Livestock
   Crop Insurance and Disaster Payments

2. LIVESTOCK AND RANGE
   Cattle Market Situation and Drought Strategies
   Drought Feeding Management

3. MANAGEMENT OF IMPROVED PASTURES
   Maximizing Limited Rainfall for Forage Growth
   Protecting Plant Vigor during a Drought

4. CORN AND SORGHUM
   Production Decisions
   Economic Decisions

5. COTTON
   Production Decisions
   Economic Decisions

6. WILDLIFE AND FISHERIES
   Wildlife and Fish in a Drought

7. DROUGHT STRATEGIES FOR DAIRY PRODUCERS
   Guidelines for Use of Aflatoxin-containing Feeds in Dairy Rations
   Feeding Whole Cottonseed to Dairy Cows and Replacements

8. MANAGEMENT OF RANGELAND
   Livestock Management during Drought
   Supplemental Feeding during Drought

9. DROUGHT MANAGEMENT FOR HORTICULTURAL CROPS
   Tree Watering
   Drought and Trees

10. HOME LAWN IRRIGATION DURING DROUGHT CONDITIONS
    Stages of Water Rationing
    Irrigation and Management Tips

11. NON-IRRIGATED TURF MAINTENANCE---LAWNS, PARKS, SCHOOL GROUNDS, SPORTS FIELDS, AND GOLF COURSES

12. WATER-EFFICIENT PRACTICES FOR SAVING YOUR LANDSCAPE
    Landscape Maintenance Practices Save Water
    Irrigation Systems for Xeriscape Landscapes

13. IRRIGATION WATER-QUALITY STANDARDS AND SALINITY MANAGEMENT
    Water Analysis: Units, Terms and Sampling
    Two Types of Salt Problems

14. FINDING FIRM FINANCIAL FOOTING
    Spending Plans
    Insurance Coverage

Texas has a Drought Preparedness Plan written by the Drought Preparedness Council, which was formed by Governor George W. Bush in May 1999 through HB 2550 to emphasize Texas' need for a proactive approach to drought planning. This law required that the State Drought Preparedness Council develop a comprehensive plan providing for (1) systematic data collection, analysis, and dissemination of drought-related information; (2) an organizational structure defining the duties, responsibilities, and information flow among all levels of government; (3) an inventory of state and federal programs related to drought emergencies; (4) a mechanism to improve the timely and accurate assessment of drought impact; and (5) the provision of accurate and timely information to media.

The National Drought Mitigation Center outlines ten steps to drought planning.
(1) Appoint a drought task force.
(2) Determine the purpose and objectives of the drought plan.
(3) Seek stakeholder participation and resolve conflict.
(4) Inventory resources and identify at-risk groups.

(5) Develop an organizational structure.
(6) Prepare an actual drought plan; then integrate science and policy.
(7) Close institutional gaps and publicize the proposed plan.
(8) Solicit reactions from all parties.
(9) Implement the plan and coordinate education programs.
(10) Conduct a post-drought evaluation.

6.4 MODEL WATER CONSERVATION PLANS FROM TCEQ

Water Conservation Plan forms are available from TCEQ in WordPerfect and PDF formats. Forms for the following entity types are available at the links below. Print copies of forms may be obtained by calling 512-239-4691 or by emailing wras@tceq.state.tx.us. (http://www.tceq.state.tx.us/permitting/water_supply/water_rights/contingency.html)

Municipal Users - *Utility Profile and Water Conservation Plan Requirements for Municipal Water Use by Public Water Suppliers* (TCEQ-10218) (http://www.tceq.state.tx.us/)

Wholesale Public Water Suppliers - *Profile and Water Conservation Plan Requirements for Wholesale Public Water Suppliers* (TCEQ-20162) WordPerfect or PDF (http://www.tceq.state.tx.us/)

Industrial/Mining Users - *Industrial/Mining Water Conservation Plan* (TCEQ-10213) WordPerfect or PDF (http://www.tceq.state.tx.us/)

Agricultural Users – (http://www.tceq.state.tx.us/)

- *Agriculture Water Conservation Plan for Non-Irrigation System* (TCEQ-10541) WordPerfect or PDF
- *System Inventory and Water Conservation Plan for Individually-Operated Irrigation System* (TCEQ-10238) WordPerfect or PDF
- *System Inventory and Water Conservation Plan for Agricultural Water Suppliers Providing Water to More Than One User* (TCEQ-10244) WordPerfect or PDF

6.5 WATER CONSERVATION TIPS

The TWDB provides significant information and services about water conservation at http://www.twdb.state.tx.us/assistance/conservation/consindex.asp. Likewise, *Water Conservation Tips* was developed by the TCEQ's Clean Texas 2000. It is also recommended to use native plant species that will be more drought tolerant and require less water than non native plant species.

6.5.1 Water Loss Audit Report

In 2007, a report was released that was funded by a Research and Planning Fund Grant by the Texas Water Development Board. The research project is an analysis of water loss in the state of Texas. This research provides information necessary for the Texas Water Development Board (TWDB), Regional Water Planning Groups (RWPGs), and retail public utilities to direct planning and funding resources, to recover lost revenue through reduction of non-revenue water, and to achieve water savings through reduction of real loss. This information is vital to Region M because of the current situation in which the region is in; namely, there is a projected water supply deficit for the region and water conservation and water management strategies are key to overcoming this convoluted situation.

The current analysis of Texas water loss data represents the first comprehensive effort to assess water loss performance in Texas using data reported in a uniform manner. The estimated value of total water loss in Texas is between $152 million and $513 million per year. Based on Texas water loss performance results presented in this report, it suggests that regional water planning groups need to set water loss performance goals. Because there has been little experience with setting water loss performance goals in Texas, it is appropriate to consider what goals utilities and agencies, both nationally and internationally, have set. The American Water Works Association (AWWA) Water Loss Control Committee recommends that the goal should be to reduce water loss to the "economic level of leakage," defined as "the level at which the cost of leakage reduction activities meets the cost of water saved through leakage reduction." The economic level of leakage will change as the local economics of water supply change.

The U.S. Bureau of Reclamation (BOR) has designated a number of "hot spots" in the Western U.S. where existing water supplies are projected to be inadequate to meet the demands of people, farms, and the environment by the year 2025. These include six hot spots in Texas. The BOR rated hot spots by the likelihood of "conflict," or water shortage, by the year 2025. The hotspots were rated on a scale of moderate, substantial, and highly likely. The BOR indicated that there was a "highly likely" potential for conflict along the Gulf Coast and in the Rio Grande Valley. Specifically, this potential exists for all counties that constitute Region M, with the exception of Jim Hogg and Willacy County.

Region M has an average balancing adjustment (absolute value) that is more than 10 percent of the corrected input volume. This suggests that utilities in Region M should refine their water accounting procedures to more accurately quantify water use in each category. Strategies for reducing non-revenue water must be evaluated at the utility level: What might be a cost-effective strategy for one utility may not be cost-effective for another. It is estimated that water loss data have been reported for between 70 and 84 percent of the state population. Reporting utilities experienced total water loss of 212,221 to 464,219 acre-feet per year, or 5.6 to 12.3 percent of the water entering their systems. Based on the 2004 statewide average municipal water use of 150 gallons per capita per day, equivalent water volumes could supply between 1.3 million and 2.7 million Texans. However, not all water loss can be recovered. The estimated total value of nonrevenue water in Texas is between $253 million and $635 million per year, which includes an estimated total water loss value between $152 million and $513 million.

Several conclusions and recommendations were drawn in the report. Firstly, although utilities are only required to report their water audits every five years, utilities should implement annual or biennial programs to develop the data necessary to gradually reduce the uncertainty in their water audits and should review their water audits annually or biennially. Rio Grande RPG should use the research results to estimate potential water savings from system water audits and water loss prevention strategies and should update the regional water plan as appropriate. During the previous two regional water planning efforts, limited water audit data were available and those data were not uniformly reported, making estimation of potential water savings from system water audits and water loss prevention strategies difficult. The research results provide baseline water audit information for each reporting retail public utility, greatly enhancing the Rio Grande RPG's knowledge of how water is being used in the region and of the potential for water and cost savings.

6.6 POTENTIAL DROUGHT RELIEF PROGRAMS

The State of Texas has prepared a report explaining various potential drought relief options. The U.S. Department of Agriculture (USDA) offers eight different programs through the Farm Service Agency (FSA).

(1) The Conservation Reserve Program (CRP) offers cost-sharing of up to 50 percent of expenses for specific new conservation practices on existing Conservation Reserve Program land.

(2) The Emergency Haying and Grazing Program provides help in approved counties to livestock producers when yield of hay and pastureland have been substantially reduced by widespread natural disaster (in this case, a drought). This program gives livestock producers authority to harvest hay and allows livestock to graze croplands devoted to the Conservation Reserve Program, from date of authorization through the date established by the federal agency. Currently, four million acres of conservation land in Texas are permitted for grazing or haying.

(3) Farm Operating Loans provides growers funds to pay expenses, refinance debts, purchase livestock and farm equipment, and make minor improvements to buildings and real estate. Assistance comes in the forms of direct loans, guaranteed/insured loans, and technical help.

(4) Farm Ownership Loans are meant to assist farmers with developing, constructing, improving, or repairing their farms, farm homes, and service buildings; they also assist

with drilling wells, improving farm water supplies, and making other necessary improvements. Aid takes the forms of direct loans, guaranteed/insured loans, and technical assistance.
(5) The Environmental Quality Incentive Program (EQIP) provides assistance through cost-sharing of various practices such as livestock water wells, livestock watering facilities, and pasture reseeding. Recipients must be agricultural producers.

(6) The Non-insured Crop Disaster Assistance Program (NAP) targets losses in commercially grown food or fiber crops resulting from natural disasters (in this case, drought). When catastrophic risk protection is not otherwise available, the program pays producers directly for such yield losses.

(7) The Farm Labor Housing Loans and Grants Program offers project grants and/or guaranteed/insured loans to provide decent, safe, and sanitary low-rent housing and related facilities for domestic farm laborers.

Another program in this category, the Rural Housing Site Loan provides direct loans for purchasing and developing adequate sites for water and sewer facilities (if otherwise unavailable), including necessary equipment (which becomes a permanent part of the development) and money for legal fees and closing costs.

(8) Finally, the Natural Resources Conservation Service (NRCS) provides three programs. One, the Emergency Watershed Protection (EWP) program, assists sponsors who implement emergency recovery measures that relieve imminent hazards to life and property when a natural disaster causes sudden watershed impairment. Assistance comes in the form of direct payments and technical help. Secondly, the Resource Conservation and Development (RC&D) Program provides technical assistance and coordination of projects including land and water conservation, water resource improvements, fire prevention, public recreational developments, and waste disposal projects. A third scheme is the Watershed Surveys and Investigations Program, offering technical and data services to help solve water and related land resource problems.

Another federal source of assistance is the U.S. Department of Commerce's Economic Development Administration Program (EDA), which provides grants to pay for developing strategies to alleviate long-term economic deterioration or sudden and severe economic dislocation, or to pay for a project to implement such a strategy.

Programs with official declaration are also available. For example, with a U.S. Declaration, the Secretary of Agriculture offers emergency loans to assist established family farmers, ranchers, and aquaculture operators in covering losses from disasters such as drought. With an SBA Declaration, the Small Business Administration offers Economic Injury Disaster Loans (EIDL) to assist businesses suffering economic injury created by certain presidential-, Secretary of Agriculture-, and/or SBA-declared disasters.

Moreover, Special Agriculture Designation of the Emergency Conservation Program provides CIS assistance to agriculture producers who have suffered severe damage to farmland as a result of natural disasters such as drought. Damage must be of such magnitude that the producer cannot afford to rehabilitate without federal assistance; direct payments are made for specified uses. Alternatively, a Governor's Declaration offers two available programs. One, the Emergency Water Supply/Drought Assistance Program, is implemented by the U.S. Army Corps of Engineers (COE). The COE is authorized to construct wells and transport water for human consumption only during emergencies in drought-distressed areas (not including recreational uses). Another avenue of relief comes through the Reclamation State Emergency Drought Relief Act of 1991. The Act's Title I provides for construction, management, and conservation activities to minimize losses and damages resulting from drought conditions.

Finally, several programs to make drought more bearable may be offered in case of a Presidential Disaster Declaration. The Disaster Relief and Emergency Assistance Program, Workforce Investment Program, Disaster Unemployment Assistance (DUA), and Emergency Community Water Assistance Grants (ECWAGs) are only available when the President himself declares an official disaster.

6.7 WATER CONSERVATION AND DROUGHT MANAGEMENT RECOMMENDATIONS

As previously described in this chapter, there are a number of available resources to aid municipalities, special districts, and other water user groups/wholesale water providers to help aid in developing water conservation and drought management strategies for their use. As population growth places increased stress on current water supplies in the Region, the method of conservation will play a critical role in ensuring future water supplies for all users. Therefore, the Rio Grande Regional Water Planning Group would like to make the following recommendations towards water conservation and drought management:

- All water users shall be encouraged to develop accurate Water Conservation and Drought Management Plans as specified in the Texas Administrative Code.

- The Texas Water Development Board and the Texas Commission on Environmental Quality shall place a higher degree of scrutiny on measurable goals laid forth in the Water Conservation and Drought Management Plans. These goals should be quantifiable and achievable.

- Special consideration should be given to entities whose per capita demand is higher than average. However, per-capita demand is often skewed for those entities that see a high rate of tourist or other transient populations. Per capita demand for base water demand loads should be evaluated to determine those entities that use larger amounts of water on their base population.

- Education should continue to be enforced on the local and state levels in terms of water conservation. Often a relatively minimal fiscal investment in education can reap rewards for many generations.

- The importance of accurate water accounting shall be stressed on the state and local levels. For those entities whose water accounting practices and procedures are in question, special consideration should be given to improving the way raw water and treated water are accounted for. A simple error in water flow measurement, either on the raw water side, treated water side, or delivered water through the distribution system, can lead to inaccurate accounting of water losses.

- Water losses should be monitored yearly to determine if accounting procedures are consistent from year to year.

- Unmetered water should be closely monitored. In terms of water accounting, the amount of water utilized for all users (metered, unmetered, estimated, etc.) should be accounted for. If there are questions regarding the amount of water used on unmetered accounts, special consideration should be given to developing a method to accurately estimate such accounts.

- Entities should actively pursue changes to water usage during periods of drought. Often, state and local agencies will set standards for water conservation based on water levels in Amistad and Falcon reservoirs. These conservation standards should be actively enforced.

- The state should take a more active role in monitoring compliance with submitted water conservation and drought management plans. In addition, the development of the water conservation and drought management plans should be consistent with the Regional Water Plan.

- TAES recommendations for agricultural conservation during times of drought should be actively pursued for all components of the agriculture sector. However, in order for the recommendations to be achievable during a drought, certain steps must be made in the meantime, including the following: investment of local, state, and federal monetary resources towards infrastructure and on-farm improvements, additional testing related to on-farm delivery efficiency improvements, on-farm water metering where applicable, and public education.

- The Regional Water Planning Group should take a more active role in reviewing and evaluating Water Conservation and Drought Management Plans. Current rules and regulations require entities to submit a copy of the plan to the Regional Water Planning Group. However, the planning group does not have any official role in the review process.

- Alternative sources of water should be actively pursued to alleviate water deficits during periods of drought. A sole source of water can put the end user in a precarious position should the volume of water be limited or growth exceeds water availability.

ATTACHMENT 6-1

MODEL DROUGHT CONTINTENGY PLAN FOR WATER SUPPLY CORPORATIONS

Texas Commission on Environmental Quality

DROUGHT CONTINGENCY PLAN
FOR

____
(Name of Utility)

____
(Address, City, Zip Code)

____
(CCN#)

____
(PWS #s)

____
(Date)

Section 1 Declaration of Policy, Purpose, and Intent
of a public meeting to accept input on the Plan

The meeting took place at: ____.
In cases of extreme drought, periods of abnormally high usage, system contamination, or extended reduction in ability to supply water due to equipment failure, temporary restrictions may be instituted to limit nonessential water usage. The purpose of the Drought Contingency Plan (Plan) is to encourage customer conservation in order to maintain supply, storage, or pressure or to comply with the requirements of a court, government agency, or other authority.
Please note: Water restriction is not a legitimate alternative if a water system does not meet the Texas Commission on Environmental Quality (TCEQ) capacity requirements under normal conditions **or** if the utility fails to take all immediate and necessary steps to replace or repair malfunctioning equipment.

Section 2 Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by:

(check at least one of the following)

☐ *scheduling and providing public notice*

Date: ________________ Time: _____________ Location: ______________________

☐ *mailed survey with summary of results* **(attach survey and results)**

☐ *bill insert inviting comment* **(attach bill insert)**

☐ *other method* ____

Section 3 Public Education

The ______________________________ *(name of utility)* will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage.

Drought plan information will be provided by:
(check at least one of the following)

☐ *public meeting*

☐ *press releases*

☐ *utility bill inserts*

☐ *other* ____

Section 4 Coordination with Regional Water Planning Groups

The service area of the ______________________________ *(name of your utility)* is located within Regional Water Planning Group (RWPG) _____.

____________________________ *(name of your utility)* has mailed a copy of this Plan to the RWPG.

Section 5 Notice Requirements

Written notice will be provided to each customer **prior to implementation or termination of each stage of the water restriction program.** Mailed notice must be given to each customer 72 hours prior to the start of water restriction. If notice is hand-delivered, the utility cannot enforce the provisions of the plan for 24 hours after notice is provided. The written notice to customers will contain the following information:

1. the date restrictions will begin;
2. the circumstances that triggered the restrictions;
3. the stages of response and explanation of the restrictions to be implemented; and,
4. an explanation of the consequences for violations.

The utility must notify the TCEQ by telephone at (512) 239-4691 or by electronic mail at *watermon@tceq.state.tx.us* prior to implementing Stage III and must notify, in writing, the Public Drinking Water Section at MC - 155, P.O. Box 13087, Austin, Texas 78711-3087 within five (5) working days of implementation, including a copy of the utility's restriction notice. The utility must file a status report of its restriction program with the TCEQ at the initiation and termination of mandatory water use restrictions (i.e., Stages III and IV).

Section 6 Violations

1. First violation: The customer will be notified by written notice of their specific violation.

2. Subsequent violations:

   a. After written notice, the utility may install a flow restricting device in the line to limit the amount of water which will pass through the meter in a 24-hour period. The utility may charge the customer for the actual cost of installing and removing the flow restricting device, not to exceed $50.00.

b. After written notice, the utility may discontinue service at the meter for a period of seven (7) days, or until the end of the calendar month, whichever is LESS. The normal reconnect fee of the utility will apply for restoration of service.

Section 7 Exemptions or Variances

The utility may grant any customer an exemption or variance from the drought contingency plan for good cause **upon written request.** A customer who is refused an exemption or variance may appeal such action of the utility, in writing, to the Texas Commission on Environmental Quality. The utility will treat all customers equally concerning exemptions and variances, and shall not discriminate in granting exemptions and variances. No exemption or variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section 8 Response Stages

Unless there exists an immediate and extreme reduction in water production or some other absolute necessity to declare an emergency or severe condition, the utility will initially declare Stage I restrictions. If, after a reasonable period of time, demand is not reduced enough to alleviate outages, reduce the risk of outages, or comply with restrictions required by a court, government agency or other authority, Stage II may be implemented with Stage III to follow, if necessary.

STAGE I - CUSTOMER AWARENESS

Stage I will begin:
Every April 1st, the utility will mail a public announcement to its customers.
No notice to TCEQ is required.

Stage I will end:
Every September 30th, the utility will mail a public announcement to its customers.
No notice to TCEQ is required.

Utility Measures:
This announcement will be designed to increase customer awareness of water conservation and to encourage the most efficient use of water. A copy of the current public announcement on water conservation awareness shall be kept on file available for inspection by TCEQ.

Voluntary Water Use Restrictions:
Water customers are requested to voluntarily limit the use of water for nonessential purposes and to practice water conservation.

STAGE II - VOLUNTARY WATER CONSERVATION:

Target: Achieve a ______ percent reduction in __________ *(example: total water use, daily water demand, etc.).*

The water utility will implement Stage II when any one of the selected triggers is reached.

Supply-Based Triggers: (Check at least one and fill in the appropriate value).

- ☐ Well level reaches ___________ ft. mean sea level (m.s.l.).
- ☐ Overnight recovery rate reaches ___________ ft.
- ☐ Reservoir elevation reaches ___________ ft. (m.s.l.).
- ☐ Stream flow reaches ___________ cfs at USGS gauge # __________.
- ☐ Wholesale supplier's drought Stage II ____
- ☐ Annual water use equals ________ % of well permit/water right/purchased water contract amount.
- ☐ Other ____

Demand- or Capacity-Based Triggers: (Check at least one and fill in the appropriate value).

- ☐ Drinking water treatment as % of capacity ___________ %
- ☐ Total daily demand as % of pumping capacity ___________ %
- ☐ Total daily demand as % of storage capacity ___________ %
- ☐ Pump hours per day ___________ hrs.
- ☐ Production or distribution limitations
- ☐ Other ____

Upon initiation and termination of Stage II, the utility will mail a public announcement to its customers. No notice to TCEQ is required.

Requirements for Termination:
Stage II of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage II, Stage I becomes operative.

Utility Measures:
Visually inspect lines and repair leaks on a daily basis. Review customer use records monthly, and follow up on any that have unusually high usage.

Describe additional measures, if any, to be implemented directly by the utility to manage limited water supplies and/or reduce water demand. Examples include reduced or discontinued flushing of water mains, activation and use of *alternative supply source(s), and use of reclaimed water for non-potable purposes.*

The second water source for ______________________________ *(name of utility)* is: (check one)

- ☐ other well
- ☐ inter-connection with other system
- ☐ purchased water
- ☐ other ____

Voluntary Water Use Restrictions:

1. Restricted Hours: Outside watering is allowed daily, but only during periods specifically described in the customer notice *(between 10:00 pm and 5:00 am, for example).*

2. Restricted Days/Hours: Water customers are requested to voluntarily limit the irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems. Customers are requested to limit outdoor water use to **Mondays for water customers with a street address ending in 1, 2, or 3; Wednesdays for water customers with a street address ending in 4, 5, or 6; and Fridays for water customers with a street address ending in 7, 8, 9, or 0.** Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 am and between 8:00 pm and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or a drip irrigation system.

3. Other uses that waste water, such as water running down gutters.

STAGE III - MANDATORY WATER USE RESTRICTIONS:

Target: Achieve a ______ percent reduction in __________ (example: total water use, daily water demand, etc.)

The water utility will implement Stage III when any one of the selected triggers is reached.

Supply-Based Triggers: (Check at least one and fill in the appropriate value.)

- ☐ Well level reaches __________ ft. (m.s.l.)
- ☐ Overnight recovery rate reaches __________ ft.
- ☐ Reservoir elevation reaches __________ ft. (m.s.l.)
- ☐ Stream flow reaches __________ cfs at USGS gauge # _________
- ☐ Wholesale supplier’s drought Stage III

____

- ☐ Annual water use equals ________ % of well permit/water right/purchased water contract amount
- ☐ Other ____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Drinking water treatment as % of capacity ___________ %
- ☐ Total daily demand as % of pumping capacity ___________ %
- ☐ Total daily demand as % of storage capacity ___________ %
- ☐ Pump hours per day ___________ hrs.
- ☐ Production or distribution limitations
- ☐ Other ____

Upon initiation and termination of Stage III, the utility will mail a public announcement to its customers. Notice to TCEQ is required.

Requirements for Termination:

Stage III of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage III, Stage II becomes operative.

Utility Measures:

Visually inspect lines and repair leaks on a regular basis. Flushing is prohibited except for dead end mains.

Describe additional measures, if any, to be implemented directly by the utility to manage limited water supplies and/or reduce water demand. Examples include activation and use of alternative supply source(s), use of reclaimed water for non-potable purposes, and offering low-flow fixtures and water restrictors.

Mandatory Water Use Restrictions

The following water use restrictions shall apply to all customers:

1. Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems **shall be limited to Mondays for water customers with a street address ending in 1, 2, or 3; Wednesdays for water customers with a street address ending in 4, 5, or 6; and Fridays for water customers with a street address ending in 7, 8, 9, or 0.** Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 am and between 8:00 pm and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time if it is by means of a

hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or a drip irrigation system.

2. Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 am and between 8:00 pm and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public are contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

3. Use of water to fill, refill, or add to any indoor or outdoor swimming pool, wading pool, or "jacuzzi" type pool is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 am and between 8:00 pm and 12:00 midnight.

4. Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

5. Use of water from hydrants or flush valves shall be limited to maintaining public health, safety, and welfare.

6. Use of water for the irrigation of golf courses, parks, and green belt areas is prohibited except by hand-held hose, and then only on designated watering days between the hours of 12:00 midnight and 10:00 am and between 8:00 pm and 12:00 midnight.

7. The following uses of water are defined as nonessential and are prohibited:

   a. washing down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
   b. use of water to wash down buildings or structures for purposes other than immediate fire protection;
   c. use of water for dust control;
   d. flushing gutters or permitting water to run or accumulate in any gutter or street;
   e. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
   f. any waste of water.

STAGE IV - CRITICAL WATER USE RESTRICTIONS:

Target: Achieve a ______ percent reduction in __________ (example: total water use, daily water demand, etc.).

The water utility will implement Stage IV when any one of the selected triggers is reached.

Supply-Based Triggers: (Check at least one and fill in the appropriate value).

- ☐ Well level reaches __________ ft. (m.s.l.)
- ☐ Overnight recovery rate reaches __________ ft.
- ☐ Reservoir elevation reaches __________ ft. (m.s.l.)
- ☐ Stream flow reaches __________ cfs at USGS gauge # _________
- ☐ Wholesale supplier's drought Stage IV ____
- ☐ Annual water use equals _______ % of well permit/water right/purchased water contract amount
- ☐ Supply contamination
- ☐ Other ____

Demand- or Capacity-Based Triggers: (Check at least one and fill in the appropriate value).

- ☐ Drinking water treatment as % of capacity __________ %
- ☐ Total daily demand as % of pumping capacity __________ %
- ☐ Total daily demand as % of storage capacity __________ %
- ☐ Pump hours per day __________ hrs.
- ☐ Production or distribution limitations
- ☐ System outage
- ☐ Other ____

Upon initiation and termination of Stage IV, the utility will mail a public announcement to its customers. Notice to TCEQ is required.

Requirements for Termination:
Stage IV of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage IV, Stage III becomes operative.

Operational Measures:

The utility shall visually inspect lines and repair leaks on a daily basis. Flushing is prohibited except for dead end mains and only between the hours of 9:00 pm and

3:00 am. Emergency interconnects or alternative supply arrangements shall be initiated. All meters shall be read as often as necessary to insure compliance with this program for the benefit of all customers. *Describe additional measures, if any, to be directly implemented to manage limited water supplies and/or reduce water demand.*

Mandatory Water Use Restrictions: (All outdoor use of water is prohibited).

1. Irrigation of landscaped areas is absolutely prohibited.
2. Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is absolutely prohibited.

SYSTEM OUTAGE or SUPPLY CONTAMINATION

Notify the TCEQ Regional Office immediately.

EXAMPLE RESOLUTION FOR ADOPTION OF A DROUGHT CONTINGENCY PLAN

RESOLUTION NO. __________

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE __________________ (name of water user group) ADOPTING A DROUGHT CONTINGENCY PLAN.

WHEREAS, the Board recognizes that the amount of water available to the ____________ (name of water supplier) and its water utility customers are limited and subject to depletion during periods of extended drought;

WHEREAS, the Board recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes;

WHEREAS, Section 11.1272 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the _________________ *(name of water supply system),* the Board deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE _________________ *(name of water user group):*

SECTION 1. That the Drought Contingency Plan attached hereto as Exhibit "A" and made a part hereof for all purposes be, and the same is hereby, adopted as the official policy of the ________________ *(name of water supplier*).

SECTION 2. That the _______________ *(e.g., general manager)* is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.DULY PASSED BY THE BOARD OF DIRECTORS OF THE ________________ *(name of water user group)*, ON THIS ___ day of _______________, 20___.

____
President, Board of Directors

ATTESTED TO:

____
Secretary, Board of Director

ATTACHMENT 6-2

MODEL WATER CONSERVATION PLAN FOR MUNICIPAL WATER USE

Texas Commission on Environmental Quality

REQUIREMENTS FOR WATER CONSERVATION PLANS FOR MUNICIPAL WATER USE BY PUBLIC WATER SUPPLIERS

In addition to the utility profile, a water conservation plan for municipal use by a public water supplier must include, at a minimum, additional information as required by Title 30, Texas Administrative Code, §288.2. <u>Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.</u>

Specific, Quantified 5 & 10-Year Targets

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for *municipal use in gallons per capita per day* (see Appendix A). Note that the goals established by a public water supplier under this subparagraph are not enforceable.

Metering Devices

The water conservation plan must include a statement about the water supplier's metering device(s), within an accuracy of plus or minus five percent (5.0%), in order to measure and account for the amount of water diverted from the source of supply.

Universal Metering

The water conservation plan must include a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

Unaccounted-For Water Use

The water conservation plan must include measures to determine and control unaccounted-for uses of water. Examples are periodic visual inspections along distribution lines, annual or monthly audits of the water system to determine illegal connections, abandoned services; etc.).

Continuing Public Education & Information

The water conservation plan must include a description of the program of continuing public education and information regarding water conservation by the water supplier.

Non-Promotional Water Rate Structure

The water supplier must have a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. This rate structure must be listed in the water conservation plan.

Reservoir Systems Operations Plan

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

Enforcement Procedure & Plan Adoption

The water conservation plan must include a means of implementation and enforcement which shall be evidenced by 1) a copy of the ordinance, resolution, or tariff indicating **official adoption** of the water conservation plan by the water supplier; and, 2) a description of the authority by which the water supplier will implement and enforce the conservation plan.

Coordination with the Regional Water Planning Group(s)

The water conservation plan must include documentation of coordination with the regional water planning group(s) for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

Example statement to be included within the water conservation plan:

The service area of the ______________ (name of water supplier) is located within the ____________ (name of regional water planning area or areas) and ____________ (name of water supplier) has provided a copy of this water conservation plan to the _____________ (name of regional water planning group or groups).

Additional Requirements:

(for suppliers serving populations of 5,000 or more or a projected population of 5,000 or more within ten years)

1. Program for Leak Detection, Repair, and Water Loss Accounting

The plan must include a description of the program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted for uses of water.

2. Record Management System

The plan must include a record management system (to record water pumped, water deliveries, water sales, and water losses) which allows for the desegregation of water sales and uses into the following user classes--residential, commercial, public and institutional, and industrial.

Plan Review and Update

Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

Best Management Practices Guide

On November 2004, the Texas Water Development Board's (TWDB) Report 362 was completed by the Water Conservation Implementation Task Force. Report 362 is the Water Conservation Best Management Practices (BMP) Guide. The BMP Guide is a voluntary list of management practices that water users may implement in addition to the required components of Title 30, Texas Administrative Code, Chapter 288. The BMP Guide is available on the TWDB's website at the link below or by calling (512) 463-7847.

http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WC

ATTACHMENT 6-3

MODEL WATER CONSERVATION & DROUGHT CONTINGENCY PLAN FOR A (WATER USER GROUP)

Water Conservation &
Model Drought Contingency Plan
For [WATER USER GROUP]
Date

CONTENTS OF PLAN

1. Objectives for Water User Group
2. Texas Commission on Environmental Quality Rules (Texas Administrative Codes)
3. Water Conservation Plan
4. Public& School Education
5. Coordination with Region M Planning Group
6. Drought Contingency Plan
7. Review and Update of Drought Contingency Plan

1. Water Conservation Plan for [Public Water Supplier]
Objectives

- To reduce the loss and waste of water
- To reduce water consumption
- To improve the efficiency in the use of water

Model Drought Contingency Plan for [Public Water Supplier]
Objectives

This drought contingency plan (the Plan) is intended for use by [municipal water supplier]. The plan includes all current TCEQ requirements for a drought contingency plan.
This drought contingency plan serves to:

- To conserve available water supplies during times of drought and emergency.
- To reduce adverse impacts of water supply shortages.
- To reduce the adverse impacts of emergency water supply conditions.
- To preserve public health, welfare, and safety.

2. Texas Commission on Environmental Quality Rules
Water Conservation & Drought Contingency Plans

The TCEQ rules governing development of water conservation plans for public water suppliers are contained in Title 30 part 1, Chapter 288, Subchapter A, Rule 288.2 of the Texas Administrative Code. According to TCEQ rules, water conservation plans for public water suppliers must have a certain minimum content, Must have additional content for public water suppliers that are projected to supply 5,000 or more people in the next ten years and may have additional optional content.

The TCEQ rules governing development of drought contingency plans for public water suppliers are contained in Title 30, Part 1, Chapter 288, Subchapter B, Rule 288.20 of the Texas Administrative Code.

<u>Minimum Conservation Plan Requirements</u>

The minimum requirements in the Texas Administrative Code for Water Conservation

Plans for Public Water Suppliers are covered in this report as follows:
- 288.2(a)(1)(A) – Utility Profile,
- 288.2(a)(1)(B) – Specification of Goals,
- 288.2(a)(1)(C) – Accurate Metering ,
- 288.2(a)(1)(D) – Universal Metering,
- 288.2(a)(1)(E) – Determination and Control of Unaccounted Water,
- 288.2(a)(1)(F) – Public Education and Information Program,
- 288.2(a)(1)(G) – Non-Promotional Water Rate Structure,
- 288.2(a)(1)(H) – Reservoir System Operation Plan,
- 288.2(a)(1)(I) – Means of Implementation and Enforcement, and
- 288.2(a)(1)(J) – Coordination with Regional Water Planning Group

Additional Conservation Strategies
TCEQ rules also list additional optional but not required conservation strategies, which may be adopted by suppliers. The following optional strategies are included in this plan:
- 288.2(a)(3)(A) – Conservation Oriented Water Rates,
- 288.2(a)(3)(B) – Ordinances, Plumbing Codes or Rules on Water-Conserving
- 288.2(a)(3)(F) – Considerations for Landscape Water Management Regulations
- 288.2(a)(3)(G) – Monitoring Method

Conservation Additional Requirements (Population over 5,000)
The Texas Administrative Code includes additional requirements for water conservation plans for cities with a population over 5,000:
- 288.2(a)(2)(A) – Leak Detection, Repair, and Water Loss Accounting – Sections 5.3, 5.4, and 5.5,
- 288.2(a)(2)(B) – Record Management System – Sect. 5.2, and
- 288.2(a)(2)(C) – Requirement for Water Conservation Plans by Wholesale

3.

WATER CONSERVATION PLAN
FOR THE
(Name of Water User Group)
(Date)

[Water User Group] will give customers the opportunity to provide public input into the preparation of the plan by one of the following methods:
• Holding a public meeting.
• Providing written notice of the proposed plan and the opportunity to comment on the plan by newspaper or posted notice.

Utility Profile
The utility profile will provide information which will include population and customer data, water use data, water supply system data, and wastewater system data.

Current Population	
Current Connections	
Total Increase in Connections in Last Ten Years	
Total Increase in Connections in Last Five Years	
Miles of Distribution Pipe	
Water Supply Sources	
Number of Water Treatment Plants	
Treatment Plant Capacity #1	
Treatment Plant Capacity #2	
Number of Ground StorageTanks	
Ground Storage Tank Capacity #1	
Ground Storage Tank Capacity #2	
Number of Elevated StorageTanks	
Elevated StorageTank Capacity #1	
Elevated StorageTank Capacity #2	
Current Total Annual Wastewater Flow	
Current Water Use	
Peak Day Use for Last Year	
Average Day Use for Last Year	
Unaccounted Water	

Specification of Water Conservation Goals
This section must include 5, 10, & 20 year targets for water savings. This will include goals for water loss programs and goals for municipal use in gallons per capita per day.

1. The Water User Group's water conservation Goals for the ____ years:

2. Achieve_____ per capita municipal water use of ____gpcd or less, as shown in following table. This will represent a reduction of ___ gpcd from TWDB's projected per capita municipal water use without low-flow plumbing fixtures or other conservation measures.

3. Implement and maintain a meter replacement program.

4. Keep the level of unaccounted water in the system less than ___ percent in____ (Target year) and subsequent years.

5. Raise Public Awareness of water conservation and encourage responsible public behavior through a public/school education and information program.

6. Implement a Reservoir System Operation Plan
   The _________________(WUG Name) has the following rights to divert water from _______________Reservoir.
   *This plan must include a reservoir system operation plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

7. (Optional) Decrease waste in lawn irrigation through implementation and enforcement of a landscape water management ordinance.

8. (Optional) Decrease outdoor water use by implementing; residential customer water audit, landscape irrigation systems rebate program, and landscape design and conversion program.
9. (Optional) Create a non-promotional water rate structure
   Must include a water rate structure that is not "promotional" i.e, a rate structure which is cost based and which does not encourage excessive use of water with the intent of encouraging water conservation.

*Attachment 6-4 of Chapter Six of this water plan has several Best Management Practices that can be used for water conservation.

4. Public Education & School Education
[Public water supplier] will notify the public & public schools about the drought contingency plan, including changes in Stage and drought measures to be implemented, by one or more of the following methods:

• Prepare a description of the Plan and make it available to customers at appropriate locations.
• Include utility bill inserts that detail the Plan
• Provide radio announcements that inform customers of stages to be initiated or terminated and drought measures to be taken
• Include an ad in a newspaper of general circulation to inform customers of stages to be initiated or terminated and drought measures to be taken

5. Coordination with the Region M Water Planning Group
This drought contingency plan will be sent to the Chair of the Region M Water Planning Group in order to ensure consistency with the Region M Water Plan. If any changes are made to the model conservation plan, a copy of the newly adopted plan will be sent to the Regional Water Planning Group.

6.

DROUGHT CONTINGENCY PLAN
FOR THE
(Name of Water User Group)
(Date)

Section I: Declaration of Purpose, Policy, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ____________________ *(name of water user grour)* hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance/or resolution. (see Appendix C for an example.)

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential, and continuation of such uses during times of water shortage or other emergency water supply conditions are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the _______________ *(name of wateruser group)* by means of _________________ *(describe methods used to inform the public about the preparation of the plan and provide opportunities for input; for example, scheduling and providing public notice of a public meeting to accept input on the Plan).*

Section III: Public Education

The _________ *(name of water user group)* will periodically provide the public with information about the Plan, including the conditions under which each stage is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of __________________ *(describe methods to be used to provide information to the public about the Plan; for example, public events, press releases, or utility bill inserts).*

Section IV: Coordination with Regional Water Planning Groups

The service area of the _____________ *(name of water user group)* is located within the ____________ *(name of regional water planning area or areas)* and ___________ *(name of water user group)* has provided a copy of this Plan to the ____________ *(name of regional water planning group or groups).*

Section V: Authorization

The ___________________ *(designated official; for example, the mayor, city manager, utility director, general manager, etc.)* or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _______________ *(designated official) or his/her designee)* shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the __________________ *(name of supplier).* The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan, the following definitions shall apply:

<u>Aesthetic water use</u>: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens

<u>Commercial and institutional water use</u>: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

<u>Conservation</u>: practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficient use of water, or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses

Customer: any person, company, or organization using water supplied by __________________ *(name of water user group)*

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses

Industrial water use: the use of water in processes designed to convert materials of lower value into forms of greater value and usability

Landscape irrigation use: water used for irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians

Non-essential water use: water uses that are not essential or required for the protection of public, health, safety, and welfare including:

(a) irrigation of landscape areas including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
- use of water to wash down buildings or structures for purposes other than immediate fire protection
- flushing gutters or permitting water to run or accumulate in any gutter or street
- use of water to fill, refill, or add to any indoor or outdoor swimming pool or jacuzzi-type pool
- use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life
- failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s)
- use of water from hydrants for construction purposes or any purposes other than fire-fighting

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The _____________ *(designated official)* or his/her designee shall monitor water supply and/or demand conditions on a _____ (*e.g., daily, weekly, monthly)* basis and shall determine when conditions warrant initiation or termination of each stage of the Plan; that is, when the specified “triggers” are reached.

The triggering criteria described below are based on

____

____

(Provide a brief description of the rationale for the triggering criteria; for example, statistical analysis of the vulnerability of the water source under drought of record conditions, or known system capacity limits).

Stage 1 Triggers -- MILD Water Shortage Conditions

Requirements for initiation

Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII–Definitions, when

____

(Describe triggering criteria / trigger levels; see examples below).

Following are examples of the types of triggering criteria that might be used in one or more successive stages of a drought contingency plan. One or a combination of such criteria must be defined for each drought response stage, but usually not all will apply. Select those appropriate to your system:

Example 1: Annually, beginning on May 1 through September 30.

Example 2: When the water supply available to the _____________ *(name of water user group)* is equal to or less than _______ *(acre-feet, percentage of storage, etc.).*

Example 3: When, pursuant to requirements specified in the ____________ *(name of water user group's)* wholesale water purchase contract with _____________ *(name of wholesale water user group),* notification is received requesting initiation of Stage 1 of the Drought Contingency Plan.

Example 4: When flows in the _______ *(name of stream or river)* are equal to or less than _____cubic feet per second.

Example 5: When the static water level in the ________________ *(name of water user group's)* well(s) is equal to or less than _____ feet above/below mean sea level.

Example 6: When the specific capacity of the ___________________ *(name of water user group's)* well(s) is equal to or less than _____ percent of the well's original specific capacity.

Example 7: When total daily water demand equals or exceeds ______ million gallons for ___consecutive days of ____ million gallons on a single day (e.g., based on the "safe" operating capacity of water supply facilities).

Example 8: Continually falling treated water reservoir levels which do not refill above___ percent overnight *(e.g., based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water user group may also devise other triggering criteria which are tailored to its system.

Requirements for Termination
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ *(e.g., 3)* consecutive days.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when _____________ *(describe triggering criteria; see examples in Stage 1).*

Requirements for Termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ____ *(e.g., 3)* consecutive days. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Triggers – SEVERE Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when _____________ *(describe triggering criteria; see examples in Stage 1).*

Requirements for Termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ____ *(e.g., 3)* consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when _____________ *(describe triggering criteria; see examples in Stage 1).*

Requirements for Termination

Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ *(e.g., 3)* consecutive days. Upon termination of Stage 4, Stage 3 becomes operative.

Stage 5 Triggers -- EMERGENCY Water Shortage Conditions

Requirements for Initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when _____________ *(designated official)* or his/her designee determines that a water supply emergency exists based on:

1. major water line breaks or pump or system failures, which cause unprecedented loss of capability to provide water service; or

2. natural or man-made contamination of the water supply source(s).

Requirements for Termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ *(e.g., 3)* consecutive days.

Stage 6 Triggers -- WATER ALLOCATION

Requirements for Initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and to comply with the requirements and restrictions for Stage 5 of this Plan when ___________________________ *(describe triggering criteria, see examples in Stage 1).*

Requirements for Termination -- Water allocation may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ *(e.g., 3)* consecutive days.

> Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water user group, an analysis of water supply availability under drought-of-record conditions may indicate essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water user group might only address facility capacity limitations and emergency conditions *(e.g., supply source contamination and system capacity limitations).*

Section IX: Drought Response Stages

The __________ *(designated official)* or his/her designee shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency, or water-shortage condition exists and shall implement the following notification procedures:

Notification

Notification of the Public:

The _____________ *(designated official)* or his/ her designee shall notify the public by means of:

Examples:
publication in a newspaper of general circulation
direct mail to each customer
public service announcements
signs posted in public places
take-home fliers at schools

Additional Notification:

The _____________ *(designated official)* or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

Examples:
mayor / chairman and members of the city council / utility board
fire chief(s)
city and/or county emergency management coordinator(s)
county judge and commissioner(s)
state disaster district / Department of Public Safety
TCEQ *(required when mandatory restrictions are imposed)*
major water users
critical water users *(i.e. hospitals)*
parks / streets superintendents & public facilities managers

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Stage 1 Response -- MILD Water Shortage Conditions

Target: Achieve a voluntary ___ percent reduction in __________ (*e.g., total water use, daily water demand, etc.*).

Best Management Practices for Supply Management:

Describe measures, if any, to be implemented directly by ________________ *(name of water user group)* to manage limited water supplies and/or reduce water demand. Examples include reduced or discontinued flushing of water mains, activation and use of an alternative supply source(s), and use of reclaimed water for non-potable purposes.

Voluntary Water Use Restrictions for Reducing Demand:

(a) Water customers with a street address ending in even numbers (0, 2, 4, 6 or 8) are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays. Water customers with a street address ending in odd numbers (1, 3, 5, 7 or 9) are requested to limit the irrigation of landscaped areas to Saturdays and Wednesdays. All water customers are to irrigate only between the hours of midnight and 10:00 am and 8:00 pm to midnight on designated days.

(b) All operations of the _______________ (name of water user group) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response -- MODERATE Water Shortage Conditions

<u>Target</u>: Achieve a ___ percent reduction in __________ *(e.g., total water use, daily water demand, etc.).*

<u>Best Management Practices for Supply Management</u>:

Describe measures, if any, to be implemented directly by _____________ *(name of water user group)* to manage limited water supplies and/or reduce water demand.
Examples include reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas, use of alternative supply source(s), and use of reclaimed water for non-potable purposes.

<u>Water Use Restrictions for Demand Reduction</u>:

Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

- Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9). Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 am and between 8:00 pm and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at any time by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or a drip irrigation system.

- Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 am and between 8:00 pm and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public are contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

- Use of water to fill, refill, or add to any indoor or outdoor swimming pool, wading pool, or jacuzzi-type pool is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 am and between 8 pm and 12:00 midnight.

- Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountain or pond is equipped with a recirculation system.

- Use of water from hydrants shall be limited to fire-fighting, related activities, or other actions necessary to maintain public health, safety, and welfare; except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the ____________________ *(name of water user group).*

- Use of water to irrigate golf course greens, tees, and fairways is prohibited except on designated watering days between the hours 12:00 midnight and 10:00 am and between 8 pm and 12:00 midnight. However, if the golf course utilizes a water source other than that provided by the ________________ *(name of water user group),* the facility shall not be subject to these regulations.

- All restaurants are prohibited from serving water to patrons except upon request of the patron.

- The following uses of water are defined as non-essential and are prohibited:

  - wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas
  - use of water to wash down buildings or structures for purposes other than immediate fire protection
  - use of water for dust control
  - flushing gutters or permitting water to run or accumulate in any gutter or street
  - failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s)

Stage 3 Response -- SEVERE Water Shortage Conditions

<u>Target</u>: Achieve a ___ percent reduction in __________ *(e.g., total water use, daily water demand, etc.).*

<u>Best Management Practices for Supply Management</u>:

Describe measures, if any, to be implemented directly by ____________ *(name of water user group)* to manage limited water supplies and/or reduce water demand. Examples include reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas, use of alternative supply source(s), and use of reclaimed water for non-potable purposes.

<u>Water Use Restrictions for Demand Reduction</u>:

All requirements of Stage 2 shall remain in effect during Stage 3 except:

- Irrigation of landscaped areas shall be limited to designated watering days between the hours of 12:00 midnight and 10:00 am and between 8 pm and 12:00 midnight, and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler systems only.

  The use of hose-end sprinklers is prohibited at all times.

- The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the ____________________ *(name of water user group).*

- The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

Stage 4 Response -- CRITICAL Water Shortage Conditions

<u>Target</u>: Achieve a ___ percent reduction in __________ *(e.g., total water use, daily water demand, etc.).*

<u>Best Management Practices for Supply Management</u>:

Describe measures, if any, to be implemented directly by ____________ *(name of water user group)* to manage limited water supplies and/or reduce water demand. Examples include reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas, use of alternative supply source(s), and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

All requirements of Stage 2 and 3 shall remain in effect during Stage 4 except:

- Irrigation of landscaped areas shall be limited to designated watering days between the hours of 6:00 am and 10:00 am and between 8:00 pm and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems is prohibited at all times.

- Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle not occurring on the premises of a commercial car wash or commercial service station and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 am and 10:00 am and between 6:00 pm and 10 pm.

- The filling, refilling, or adding of water to swimming pools, wading pools, and jacuzzi-type pools is prohibited.

- Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

- No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response -- EMERGENCY Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ *(e.g., total water use, daily water demand, etc.).*

Best Management Practices for Supply Management:

Describe measures, if any, to be implemented directly by ____________ *(name of water user group)* to manage limited water supplies and/or reduce water demand. Examples include reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas, use of alternative supply source(s), and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 except:

- Irrigation of landscaped areas is absolutely prohibited.

- Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane, or other vehicle is absolutely prohibited.

Stage 6 Response -- WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare, the ____________ *(designated official)* is hereby authorized to allocate water according to the following allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

"Household" means the residential premises served by the customer's meter. "Persons per household" includes only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of two (2) persons unless the customer notifies the ____________ *(name of water user group)* of a greater number of persons per household using a form prescribed by the _________ *(designated official),* who shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the ____________ *(name of water user group)* offices to complete and sign the form claiming more than two (2) persons per household. New customers may claim more persons per household at the time of applying for water service using the form prescribed by the __________ *(designated official).* When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the _________ *(name of water user group)* on such form, and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the _________ *(name of water user group)* in writing within two (2) days. In prescribing the method for claiming more than two (2) persons per household, the _________ *(designated official)* shall adopt methods to insure the accuracy of claims. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the ____________ *(name of water user group)* of a reduction in the number of persons in a household shall be fined not less than $________.

Residential water customers shall pay the following surcharges:

$____ for the first 1,000 gallons over allocation
$____ for the second 1,000 gallons over allocation
$____ for the third 1,000 gallons over allocation
$____ for each additional 1,000 gallons over allocation

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units *(e.g., apartments, mobile homes)* shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the ____________ *(name of water user group)* of a greater number on a form prescribed by the __________ *(designated official).* The _________ *(designated official)* shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer.

If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the ____________ *(name of water user group)* offices to complete and sign the form claiming more than two (2) dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not. New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the __________ *(designated official).* If the number of dwelling units served by a master meter is reduced, the customer shall notify the _________ *(name of water user group)* in writing within two (2) days. In prescribing the method for claiming more than two (2) dwelling units, the _________ *(designated official)* shall adopt methods to insure the accuracy of claims. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the ____________ *(name of water user group)* of a reduction in the number of persons in a household shall be fined not less than $________. Customers billed from a master meter under this provision shall pay the following monthly surcharges:

$____ for 1,000 gallons over allocation up through 1,000 gallons for each dwelling unit.
$____ thereafter, for each additional 1,000 gallons over allocation up through a second 1,000 gallons for each dwelling unit.
$____ thereafter, for each additional 1,000 gallons over allocation up through a third 1,000 gallons for each dwelling unit.

$____ thereafter, for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the __________ *(designated official)* or his/her designee for each nonresidential commercial customer other than an industrial customer who uses water for processing purposes. The non-residential customer's allocation shall be approximately ___ percent *(e.g. 75%)* of the customer's usage for a corresponding month's billing period during the previous 12 months.

If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists; provided, however, a customer, ___ percent of whose monthly usage is less than ____ gallons, shall be allocated ____ gallons. The _________ *(designated official)* shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the ____________ *(name of water user group)* to determine the allocation. Upon request of the customer or at the initiative of the ___________ *(designated official),* the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage, (2) one nonresidential customer agrees to transfer part of its allocation to another nonresidential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the ___________ *(designated official or alternatively, a special water allocation review committee).* Nonresidential commercial customers shall pay the following surcharges.

Customers whose allocation is _____ gallons through ______ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation
$____ per thousand gallons for the second 1,000 gallons over allocation
$____ per thousand gallons for the third 1,000 gallons over allocation
$____ per thousand gallons for each additional 1,000 gallons over allocation

Customers whose allocation is ______ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation
___ times the block rate for each 1,000 gallons more than 15 percent above allocation

Surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Industrial Customers

A monthly water allocation shall be established by the __________ *(designated official)* or his/her designee for each industrial customer which uses water for processing purposes. The industrial customer's allocation shall be approximately ___ percent *(e.g., 90%)* of the customer's water usage baseline.
Ninety (90) days after the initial imposition of the allocation, the industrial customer's allocation shall be further reduced to ___ *percent (e.g., 85%)* of the customer's water usage baseline, computed on the average water use for the ___-month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than ___ months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The _________ *(designated official)* shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the ____________ *(name of water user group)* to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of receipt of written notice.

Upon request of the customer or at the initiative of the ___________ *(designated official),* the allocation may be reduced or increased (1) if the designated period does not accurately reflect the customer's normal water use because the customer had shut down a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shut down or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the ___________ *(designated official or alternatively, a special water allocation review committee).* Industrial customers shall pay the following surcharges:

Customers whose allocation is _____ gallons through _______ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation
$____ per thousand gallons for the second 1,000 gallons over allocation
$____ per thousand gallons for the third 1,000 gallons over allocation
$____ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is ______ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation

___ times the block rate for each 1,000 gallons more than 15 percent above allocation.

Surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the __________________ *(name of water user group)* for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by _____________*(designated official* or his/her designee in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction, shall be punished by a fine of not less than _______ dollars ($__) and not more than ______ dollars ($__). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the _____________ *(designated official)* shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a reconnection charge, hereby established at $______, and any other costs incurred by the ___________________ *(name of water user group)* in discontinuing the service. In addition, suitable assurance must be given to the ________________ *(designated official)* that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the ______________ *(name of water user group),* in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children, and proof that a violation committed by a child occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan, and that the parent could not have reasonably known of the violation.

(d) Any employee of the _______________ *(name of water user group),* police officer, or other _____ employee designated by the ___________ *(designated official),* may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, and the offense charged, and shall direct him/her to appear in the _____________ *(e.g., municipal court)* on the date shown on the citation, for which the date shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in _________ (e.g., municipal court) to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in __________ *(e.g., municipal court),* a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in __________ *(e.g., municipal court)* before all other cases.

Section XI: Variances

The ________________ *(designated official)* or his/her designee may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance, and if one or more of the following conditions is met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the _________________ *(name of water user group)* within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the __________ *(designated official)* or his/her designee and shall include the following:

(a) name and address of the petitioner(s)
(b) purpose of water use
(c) specific provision(s) of the Plan from which the petitioner is requesting relief
(d) a detailed statement as to how the specific provision of the Plan adversely affects the petitioner, or what damage or harm will occur to the petitioner or others, if petitioner complies with this Ordinance
(e) a description of the relief requested
(f) the period of time for which the variance is sought
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date

(h) Other pertinent information.

Variances granted by the ____________________ *(name of water user group)* shall be subject to the following conditions, unless waived or modified by the _____________ *(designated official)* or his/her designee:

(a) Variances granted shall include a timetable for compliance.
(b) Variances granted shall expire when the Plan is no longer in effect, unless the petitioner has failed to meet specified requirements.

No variance shall be retroactive or shall otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

7. Review and Update of Drought Contingency Plan
This drought contingency plan will be updated at least every 5 years as required by TCEQ regulations.

ATTACHMENT 6-4

MUNICIPAL WATER CONSERVATION STRATEGIES

These water conservation strategies from Report 362 for this region:

1. golf course conservation
2. metering all new connections & retrofitting existing connections
3. showerhead, aerator, and toilet flapper retrofitting
4. educating through schools
5. landscape irrigation conservation
6. water-wise landscape design
7. athletic field conservation
8. dissemination of public information
9. rainwater harvesting
10. parklands conservation
11. residential clothes washer incentives

Golf Course Conservation

Description
This water conservation strategy is designed for WUGs that serve golf course customer(s). Because golf courses in Region M's dry climate use significant amounts of water for maintenance, they attract public scrutiny. Fortunately, golf courses are often good candidates for reuse water (discussed in detail in Chapter 4) or other alternative water sources. In fact, non-potable water reuse is a recommended water management strategy for WUGs. Some utilities may already be implementing one or more of the elements of this strategy, and they may want to adopt additional features outlined below. Once a strategy is adopted, the utility should monitor it closely to achieve maximum water efficiency benefit.

The main goal of each WUG's water conservation plan is to reduce demand by predetermined goal amounts. WUGs should require each golf course to develop its own conservation plan to meet water savings goals, including calculating amounts needed to adequately maintain greens and referencing evapotranspiration (ET). A golf course's plan should utilize enhanced water conservation methods such as Computer-Controlled Irrigation Systems (CCIS) or similar technology. To achieve maximum efficiency, a CCIS should incorporate at least the following components: computer controller, software, interface modules, satellite field controller, soil sensors, and weather station. The CCIS should be designed to prevent over-watering, flooding, pooling, and losses from evaporation and run-off; further, sprinkler heads should be calibrated so as not to exceed the soil's saturation capacity.

Non-potable water strategies explained in Chapter 4 can also be incorporated into this conservation scheme. Switching from a potable to non-potable water source requires implementation dates for the conversion. Remember that reclaimed, reused, and/or recycled water used at golf courses must meet TCEQ quality standards for treated effluent and human contact.

Soil improvement is another effective method for reducing irrigation water usage. Soil improvement programs on high-visibility areas such as golf courses can demonstrate to the public the efficacy of this strategy. For golf courses, annual compost applications of ¼ to ½ inch on turf areas and 1 inch on flower beds are recommended. In addition, compost is most beneficial when applied in the fall.

Metering all New Connections and Retrofitting Existing Connections

Description
This strategy is intended for WUGs that do not have 100 percent metering of customer connections. Its purpose is to ensure that all aspects of meter installation, replacement, testing, and repair are managed for optimal water use efficiency. Increased maintenance efforts contributing to improved meter accuracy should result in higher revenue and less water loss. Metering of new customer connections and retrofitting of existing connections are effective methods of accounting for total water usage within a utility's service area.

Proper installation of correct sizes and types of meters is essential for good utility management. The American Water Works Association (AWWA) provides numerous resources in the reference section of this strategy. The purpose of this strategy is to ensure that all aspects of meter installation, replacement testing, and repair are managed for optimal water use efficiency.

To qualify as a bonafide strategy, a utility's meter program must include:

1) Mandatory metering of existing connections and new connections;
2) A policy governing installation of adequate and properly-sized meters, as determined by a customer's current water use patterns. Using compound meters for multifamily residential connections or other industrial and commercial accounts is also recommended;
3) Direct utility metering of each duplex, triplex, and fourplex unit, whether each occupies a separate lot, and whether multiple buildings occupy a single commercial lot;
4) Metering of all utilities, publicly owned facilities, and customers;
5) Mandatory construction meters and access keys to account for water used in new construction;
6) Mandatory separate irrigation meters for all new commercial buildings having a site plan area of more than 10,000 square feet and for all duplexes, triplexes, and fourplexes;
7) Implementation of the State requirements in HB 2404, passed by the 77th Legislature Regular Session and implemented through Texas Water Code 13.502, which requires that all new apartments be either directly metered by the utility or submetered by the owner;
8) Review of capital recovery fees to determine whether fees provide any disincentive for developers to use utility metering of apartment units;
9) Annual testing and maintenance of all meters larger than two inches, since a meter may under-register water use as it ages;
10) Regular testing and evaluation of ⅝-and ¼ inch meters which have been in service 8 to 10 years, to determine meter accuracy OR a periodic, consistent replacement program based on the meter's age or cumulative water volume through the meter. This program should be based on testing of meters at each utility to determine the optimal replacement/repair period, since it depends on both the quality of water and the average flow rate through the meter, versus the meter's capacity;

11) An effective monthly meter-reading program where readings are not estimated except due to inoperable meters or extenuating circumstances. Broken meters should be fixed within 7 days or an otherwise-stated reasonable time frame; and,
12) An accounting of water savings and revenue gains through implementation of the Meter Repair and Replacement Program.

Every year, the utility should estimate its annual water savings resulting from the strategy. Savings can be estimated based upon a statistical sample analyzed as part of the meter-testing program. The utility can then project potential future annual savings and include those figures in the plan's water savings targets and goals.

Showerhead, Aerator, and Toilet Flapper Retrofits

Description
This strategy is intended for WUGs that serve homes and apartment units constructed before 1995, when no active retrofit program existed for efficient showerheads and faucet aerators. Once a WUG adopts this strategy, it should closely monitor the strategy to achieve maximum water efficiency benefits.

Plumbing retrofits usually include showerheads as well as kitchen and bathroom faucet aerators. More recent studies show that toilet flappers should be included in this effective strategy to conserve water used by the residential sector. Four types of high-quality, low-flow plumbing devices are to be installed under this program:
showerheads rated at 2.0 gallons per minute (gpm) or less; kitchen faucet aerators of 2.2 gpm or less; bathroom faucet aerators of 1.5 gpm or less; and, toilet flappers that operate at the designed flush volume for a given toilet model.

Studies have shown that many 1.6 gallons-per-flush (gpf) toilets actually use more water. Therefore, if 1.6 gpf toilets are installed, their flush volume should be checked and, if necessary, the water level in their tanks should be adjusted to restore the flush volume to 1.6 gpf. If after adjustment a tank's flush volume is still well above 1.6 gpf, the toilet is likely to originally have had an early closure flapper. If so, the replacement flapper needed to restore a 1.6 gpf volume can often be determined by comparing the model number (usually located on the inside of the tank) with research on compatibility of flappers. If the device is one of several early models, the flapper could be replaced during the utility's survey, and/or information about the correct replacement flapper should be provided to the customer. The utility may meet this strategy's requirements through inspection programs and enforceable ordinances requiring replacement of inefficient plumbing when ownership of the property transfers, or by date certain no later than five years.
Under this strategy, the utility should:

1) Identify the total number of single-family (SF) and multi-family (MF) residences constructed prior to 1995. The utility may have data showing the number of SF homes existing at the end of 1994, or census data can be used; however, that data cannot be separated into SF and MF units. Another approach is to use the census data from 1990 and 2000, which does include the number of housing units by type. This information can then be used to estimate SF units ("detached units" in the census data) at the end of 1994. A

linear growth assumption yields the following approach: Take the difference (2000 detached units minus 1990 detached units) and multiply by 40 percent (4 years), and add this to the number of 1990 detached units. The answer produces an estimate of SF units at the end of 1994. Similar calculations can be used to determine MF units.

2) Develop a plan to directly install plumbing devices in single-family homes and multi-family residential facilities or, alternatively, provide kits for installation with follow up inspections.

3) If feasible, include a program to restore the flush volume of 1.6 gpf toilets to their designed flush volume. After determining the potential number of participants, select at least one of these approaches:
1) Direct Install and Kit Distribution Program
2) Ordinance Approach Upon Change of Ownership of Property
3) Ordinance Approach By Date Certain

School Education

Description
The goal of this strategy is to launch an elementary school-level education program since lessons learned by students about good water use habits are often shared with the whole family. The strategy is intended for WUGs that serve schools as a regular part of the customer base. A WUG may have already accomplished this strategy if it has a current school education program that meets the criteria. Before deciding whether this strategy is necessary, the utility should review existing curricula to see if the local school district is already offering water conservation-related courses. Once a WUG decides to adopt this strategy, the strategy must be closely monitored to achieve the maximum water efficiency benefit.

School education programs, while not directly related to any equipment change, may nevertheless result in both short- and long-term water savings. Students' behavioral changes based upon greater knowledge are often shared with parents and implemented at home. To be effective, a school education program should provide grade-level-appropriate curriculum materials which increase in complexity from elementary school through high school. If such a curriculum does not already exist, local experts may be willing to help develop the desired materials.

Implementation should consist of at least the following actions:

1) Evaluate available local and regional materials to determine their applicability to the WUG's local water conditions. Consider creating an advisory committee of local educators to assist in choosing or creating the curriculum.

2) Implement a school education program to promote water conservation and related benefits. Programs include providing instructional assistance, educational materials, and classroom presentations to public and private schools in the utility's service area that

identify urban, agricultural, and environmental issues and conditions in the local watershed and water service area. When possible, educational materials should meet the TEKS guidelines.

3) A water-oriented curriculum focused on conservation and resource issues should be made available for all grades.

a. Grade-appropriate programs and/or materials should first be implemented for grade levels 1 to 6. Alternatively, a presentation or educational show can be offered for some or all of these grade levels.

b. For grades 7 and 8 and for high school students, the WUG should do one of the following: distribute grade-appropriate materials for high school science, political science, or other appropriate classes; present assembly-type programs to high schools; sponsor science fairs with emphasis on conservation; implement education programs with community groups like Scouts, 4-H clubs, etc. The WUG can elect to meet this strategy by focusing only on grades 1 to 6 or 7 to 12 but with higher participation rates. In conjunction with the Showerhead and Aerator Strategy, consider providing a water audit unit as part of the curriculum whereby the students take flow measurements of showerheads and faucet aerators at their homes. If their showerheads and faucet aerators operate at higher than the current standard, the students would receive efficient showerheads and faucet aerators to install with their parents' assistance. This study unit can be successfully implemented as early as grade 5.

To track progress of this strategy, the WUG should gather and have available the following documentation (according to TWDB): Number of school presentations made during reporting period; number and type of curriculum materials developed and/or provided by water user group, including confirmation that curriculum materials meet state education framework requirements and are grade-level appropriate; number and percent of students reached by presentations and by curriculum; number of students reached outside the WUG's service area; number of in-service presentations or teacher's workshops conducted during there porting period; results of evaluation tools used, such as pre- and post-tests, student surveys, and teacher surveys; copies of program marketing and educational materials; and annual budget for school education programs related to conservation.

Landscape Irrigation Conservation

Description

This strategy is intended for use by a WUG having a substantial percentage of customers using automated landscape irrigation systems. If data are lacking or absent, the summer peak/winter average ratio can be used to determine whether to proceed with this strategy. A ratio of 1.6 or greater indicates the potential for substantial water savings upon implementation and enforcement of this strategy. For maximum water-use efficiency benefit, the WUG should adhere closely to the measures described below.

Landscape irrigation conservation practices are an effective method of accounting for and lowering outdoor water usage while maintaining landscapes and avoiding run-off. With this strategy, the WUG provides residential and non-residential customers with education, incentives, and assistance in improving their landscape water-use efficiency. Incentives include rebates for purchase and installation of water-efficient equipment. Successful implementation of this strategy can be accomplished by performing one or a combination of the approaches listed below.
1) ETo-Based Water Budgets
2) Water-Use Surveys, Metering, and Budgeted Water Use
3) Landscape Design
4) Minimum Standards and Upgrades

As a means of rapidly increasing cost-effectiveness and water savings, the WUG should consider offering the Landscape Irrigation Program to large-landscape customers first. Incentives can include rebates for irrigation audits and systems upgrades, recognition for water-efficient landscapes through signage and award programs, and certification of trained landscapers and volunteers who can promote the program. WUG staff can also be trained to provide irrigation audits which can include resetting irrigation controllers for more efficient schedules.

Water-wise Landscape Design

Description
This strategy is intended for a WUG with 20 percent or more of its residential customers having landscapes consisting of high-water-use materials that consume more than 20,000 gallon per month or which use more than twice as much water in summer as in winter. Using this strategy, the WUG would offer financial incentives for conversion to water-wise landscaping or would require by ordinance that all new landscapes incorporate water-wise principles (which involve not only plant selection but also the tactics listed below). Financial incentive programs further contain an educational component based on the seven principles of water-wise landscaping.

Because water-wise landscaping materials often consume whatever quantity of water the customer supplies, careful follow-up is necessary to guard against excess irrigation. From the outset, incentives should be designed to be rescinded if water use returns to previous levels or exceeds the projected water budget for the new landscape. For new customers and change-of-service customer accounts, the WUG should provide information on water-wise landscape design plus efficient irrigation equipment and management. The WUG should install water-wise landscaping at its facilities and offices. Other tactics of water-wise landscaping include encouraging capture of rainwater and limiting irrigation to the quantity of rainwater captured.

Some cities with lawmaking powers have adopted ordinances that define water-conserving landscapes to be installed in buffer areas, new commercial buildings, new homes, and apartment complexes. Any ordinance for new homes should incorporate requirements for water-wise principles, specifying water-efficient landscaping materials only. Soil improvement programs in high-visibility areas can publicly demonstrate their effectiveness.

For most landscapes, recommendations are for compost applications of ¼ to ½ inch annually on turf areas and 1 inch annually on flower beds. (Compost is most beneficial when applied in the fall.) Water-wise landscape programs follow the seven principles of XeriscapeTM, from the Texas A&M Horticulture website, listed below and explained in greater detail in resources listed in the reference section:

planning and design
soil analysis and improvement
appropriate plant selection
practical turf areas
efficient irrigation
use of mulches
appropriate maintenance

1) Rebate and Incentive Approach
   a. Within one year of implementation, develop and implement a plan to market a low-water landscape design and conversion program.
   b. Within one year of implementation, develop and implement a customer incentive program.
   c. Rescind incentives, including rebates, if water use returns to previous levels within two years.
2) Ordinance Approach
   In the first twelve (12) months, plan a program that includes stakeholder meetings as needed. Consider offering rebates for a portion or all of the time this program is in place. For example, offer rebates for five years and publicize this so customers will participate early in the program. Develop a plan for educating realtors and landscape companies about the requirements. Plan a follow-up inspection program after retrofit. Develop and pass the ordinance. Implement the ordinance and a tracking plan for the number of units retrofitted. In the second year and thereafter, continue the implementation and outreach program for realtors and landscape companies. Continue verification inspections. Provide estimates of water savings from landscape conversions based upon actual metered data.

Athletic Field Conservation

Description
Athletic field conservation is an effective method of reducing water system demand. The athletic field manager implements a water regimen using only what is necessary to maintain the turf's viability and protect users' health. Water is applied only to areas essential to the field's use. Athletic fields often involve visible water use during daylight hours, leading to perceptions by both the public and utility operators that water use may be excessive.

Measures listed for this strategy can be implemented individually or in combination; some utilities may already employ one or more measures and may decide to include others. Once adopted, the strategy should be monitored closely to achieve the maximum water efficiency benefits.

Using this strategy, a WUG provides the customer (through staff or a third party) a landscape water-use survey and uses the results to develop reference evapotranspiration (ETo)-based water-use budgets equal to no more than 100 percent ETo per square foot of landscape area.

At a minimum, the athletic field strategy should mandate replacement of all manually controlled and quick-couple irrigation systems with automatic irrigation systems and controllers. The automatic controllers should be capable of shutting off flows when sudden pressure loss occurs, as with a system break. Access to such controllers should be limited to the authorized landscape manager or should be designed to shut off flows automatically if the irrigation system is activated manually.

When the practice is cost-effective, athletic field users should be required to install computer-controlled irrigation systems (CCISs) or similar technology. To achieve maximum efficiency, a CCIS should incorporate at least the following components: computer controller, software, interface modules, satellite field controller, soil sensors, and weather station. The CCIS should be designed to prevent over-watering, flooding, pooling, and losses from evaporation and run-off; further, sprinkler heads should be calibrated so as not to exceed the soil's saturation capacity.

Use of reclaimed, reused, and/or recycled water for athletic fields is both recommended and encouraged; however, such use must meet TCEQ water quality standards for treated effluent and human contact. When utilizing reclaimed water or water with high levels of total dissolved solids (TDS) or hardness, the water budget must be adjusted to permit leaching of salts below the root zone of turf grass. Consultation with local extension agents can assist athletic field managers in properly utilizing lower-quality water for irrigation.

Figuring total water savings for this strategy may be difficult, but increased efficiencies can be estimated for each water-wasting action that is eliminated through this strategy. In replacing inefficient equipment, water savings are realized by using new or upgraded equipment. For landscape water, savings can be calculated based on each water waste incident. In an irrigation survey, water savings are expected in the range of 15-20 percent for athletic fields with no CCIS if recommended efficiency measures are implemented. Switching to artificial turf, reusing waste water, or employing other non-potable alternatives can save up to 100 percent of the potable water supply used in irrigation. Simple measurement of water use before and after conversions will reveal savings.

Public Information

Description

Public education about water conservation should begin at a young age. Elementary schools should incorporate a curriculum with lessons in water conservation methods starting at kindergarten. Varied activities could range from poster contests promoting water conservation in early grades to teaching xeriscape techniques in middle school. Projects with a hands-on approach enhance students' interest and might include field trips to water plants, guest speakers, lessons about water usage when bathing, brushing teeth, and washing dishes, cars, and pets. Providing pamphlets and newsletters also raises public awareness.

Any WUG can adopt this public information strategy to effectively promote specific water conservation programs and practices which emphasize the importance of using water efficiently. A WUG may have already accomplished this strategy if it is conducting a public information program that meets the criteria of this strategy. Once a WUG decides to adopt this strategy, the utility should monitor it closely to achieve maximum water efficiency benefits.

The goal is to provide an overall understanding of water resources in the community relating to the importance of managing and sustaining existing water supplies so that construction of new facilities can be delayed or avoided. An equally important objective of the program is to provide information about specific actions individual water users should take to implement these goals.

A broad variety of tools can be used to effectively communicate water conservation measures to the public including: print, radio, and television media; billboards; direct distribution; special events such as exhibits and facilities tours; and maintenance of an informative website. Print media activities can take the form of press releases and regular columns in gardening periodicals. Electronic media efforts include talk shows, news conferences, public service announcements, and even paid commercials. Utilities can also distribute materials directly through bill inserts, newsletters, fliers, and door hangers - all of which allow targeting of specific messages to specific audiences. In addition, special events provide excellent opportunities for direct interaction with the public at facility tours, exhibits, trade shows, group presentations, landscape conservation competitions, and seminars. And remember, web sites are now an essential and economical method of reaching the public since the same information can be posted electronically. Remember to include links to the WUG's web site.

Integrating a WUG's public information efforts with programs of other local agencies multiplies the impact. Other agencies which stress water conservation include Texas Cooperative Extension Service offices, Texas Water Development Board, Texas Parks & Wildlife, Texas Soil & Water Conservation Board, Texas Commission on Environmental Quality, and Texas Forest Service. Some business associations, neighborhood associations, and not-for-profit groups may also offer partnering opportunities for an overall WUG conservation program or specific strategies.

Rainwater Harvesting and Condensate Reuse

Description
TWDB publishes a guide for rainwater harvesting that is available upon request.
All rainwater harvesting systems are comprised of six basic components:
A. catchment surface (such as a roof) – the surface upon which the rain falls
B. gutters and downspouts – transport channels from catchment surface to storage
C. leaf screens and roof-washers – systems that remove contaminants and debris

D. cisterns or storage tanks – where collected rainwater is stored
E. conveying – the delivery system for stored rainwater, either by gravity or pump
F. water treatment – filters, equipment, and additives to settle, filter, and disinfect

This strategy is intended for use by WUGs concerned with reducing outdoor irrigation demands on their potable water systems. Calculation of potential savings will vary according to regional climate patterns. Rainwater harvesting and condensate reuse are applicable to Industrial, Commercial, and Institutional (ICI) buildings, but private homes can also benefit from rainwater harvesting. Utilities may help to realize savings possible with this strategy by customer education efforts. For maximum water-use efficiency benefits, the WUG should adhere closely to the measures described below.

Rainwater harvesting and condensate reuse (RWH/CR) conservation programs are practical methods of reducing potable water usage while maintaining healthy landscapes and avoiding run-off problems. Using this strategy, the WUG provides customer support, education, and incentives and assists with proper installation and use of RWH/CR systems. RWH/CR systems are most effective when used in conjunction with other water efficiency measures such as water-saving equipment and habits. Today's rainwater harvesting is based on ancient practices of collecting (usually from rooftops) and storing rainwater close to its source, in cisterns or surface impoundments, and using it for nearby needs. Some ICI users already save money by collecting condensate from large cooling systems and returning it to their cisterns. Facilities with large cooling demands are best positioned to take advantage of condensate reuse which due to its quality has potential uses for landscape irrigation, cooling tower make-up water, and some industrial processes. Because precipitation varies in rate and occurrence, rainwater or condensate should be used with maximum efficiency. Incentives to motivate rainwater collection may include rebates for purchasing and installing water-efficient equipment.

Several factors should be considered in the design of rainwater harvesting and condensate reuse systems. Components include the collection area, a first-flush device, a roof washer, an opaque storage structure with capacity for anticipated demand, and a distribution system. Design consideration should be given to the highest feasible elevations for collection and storage systems to take advantage of gravity flow. For proper design and implementation of RWH/CR guidelines, the Texas Water Development Board's *Texas Manual on Rainwater Harvesting 2004* should be used as a resource, as should technical assistance from professional installers and manufacturers of RWH/CR equipment.

Programs should consider these elements:

1) Retrofit or Rain Barrel Program
Using bill inserts to market the program will allow a WUG to target its largest summer-peak users first. The WUG should also consider asking local weather announcers, radio gardening show hosts, and newspaper columnists for assistance in publicizing the program. Public and/or private partnerships with non-profits (gardening clubs, neighborhood associations, and Texas Cooperative Extension Service offices), local building groups, and green-industry businesses are other potential avenues to leverage resources. Incentives can include rebates for RWH/CR systems, recognition through signage and

award programs, and certification of trained landscape company employees and volunteer representatives.

2) New Construction -- In addition to retrofitting existing homes and buildings, a WUG may also choose to focus support for RWH/CR systems in new construction. Under this approach, the WUG could:

a. adopt regulations requiring all new ICI properties to install a RWH/CR system that collects and stores rainwater and condensate from all eligible sources and distributes it to an irrigation system and/or a cooling tower make-up system;
b. implement an incentive program to encourage builders and owners of new ICI properties to install RWH/CR systems that collect and store rainwater and condensate from all eligible sources, then distribute to irrigation and/or a cooling tower make-up system. In large ICI buildings requiring cooling towers, designers should consider returning condensate flows from air conditioning coils to cooling tower make-up. This strategy could also be effective as part of a Green Builder- type rating system incorporating water-wise landscaping and adequate soil depth;
c. implement an incentive program to encourage builders and homeowners to install RWH systems for landscapes to reduce potable water consumption in hot weather; and,
d. adopt regulations requiring all new homes and/or multi-unit properties to install plumbing that separately collects and stores rainwater from all eligible sources and distributes the rainwater through a subsurface irrigation system, either around the foundation or for landscape use.

Park Conservation

Description
This strategy is targeted at all WUGs which manage parks or serve customers with parklands. Most WUGs fall into this category. Target areas include public facilities such as irrigated parks, recreation centers, fountains, and pools. These facilities use significant volumes of water and sometimes come under public scrutiny as a result. Specific measures listed under this strategy can be implemented individually or in combination. WUGs may already have adopted one or more of these principles since irrigation conservation practices and careful water use for operation and maintenance of park facilities can effectively reduce demand.

Under the park conservation strategy, WUGs require managers of every park having an irrigation system to develop a conservation plan. Municipal parks departments should develop comprehensive written policies and procedures for all irrigated parks under their jurisdiction. Operating and maintaining pools is also addressed. All park facilities should be metered so all water use can be billed as means of reinforcing the importance efficient water use. For parks with athletic fields, irrigation should be in accordance with the Athletics Fields strategy of this Plan. WUGs should encourage park managers to cease irrigation in areas not affected by public use.

Prior to developing a specific park conservation plan, the WUG should consider a series of planning meetings with park irrigation personnel and management to discuss water conservation issues and to prepare an adequate scope of action. Additionally, park irrigation staff could participate in voluntary environmental management programs.

Residential Clothes Washer Incentive Program

Description
This strategy can be implemented by any WUG serving residential customers. Under this strategy, the WUG would develop and implement an incentive program to encourage customers to purchase water-efficient clothes washers, best described by using water factor (WF) terminology. WF is calculated by dividing the gallons of water used to wash a full load of clothes by the capacity of the washer tub in cubic feet. An efficient washer using 27 gallons for a full load of clothes in a 3-cubic-foot tub would have a WF of 9. According to the tiers determined by the Consortium for Energy Efficiency (CEE) in 2004, a clothes washer needs a WF equal to or less than 9.5 to be considered "efficient." In 2001, Texas enacted legislation requiring washing machine manufacturers to report the efficiency of clothes washers sold in the state. According to the 2002 report, only 4.4 percent of washers sold in Texas qualified by having a WF equal to or less than 9.5. The 2003 report showed mild improvement, in that 9.4 percent of washers imported into Texas had a WF equal to or less than 9.5.

While the trend in Texas is positive, market share is well below the reported 30 percent market share in Washington State and far lower than the 50 percent market share in the Seattle area, where a regional incentive and marketing program for efficient washers has been in place for several years. Conventional top-loading clothes washers use 41 gallons of water per load, on average, while efficient front-loading clothes washers use only 11 to 25 gallons per load.

Manufacturers started producing efficient clothes washer models in the late 1990s in anticipation of rules being adopted by the Department of Energy (DOE) setting higher efficiency standards. The DOE did adopt rules in 2001 with a two-step phase-in of higher efficiency standards. Clothes washers manufactured after 2004 will be required to meet a modified energy factor (MEF) of 1.04 (20 percent more efficient than the current standard). This level will remain in effect until 2007, at which time an MEF of 1.26 (35 percent higher than the current standard) will be required. If manufacturers continue with current design trends for efficient clothes washers, the 2007 standard should result in significant water savings.

Of course, cost is a basic consideration. Full-featured inefficient machines cost only about $400 while the least expensive 'efficient' machines range between $600 to more than $1000. For low-income customers, this price difference is the most important factor influencing buying decisions, so low- and moderate-income customers would logically be more likely to purchase efficient machines if they were offered discount incentives at the time of purchase rather than after a four-to-six-week wait.

A clothes washer incentive program is most effective when offered in conjunction with local gas and/or electric utilities since the incentive can be increased through multiple-sponsorship, and the marketing reach can be expanded. Energy savings result from more efficient motors, less energy required for heating hot water, less hot water actually used, and shorter drying times (since spin cycles on 'efficient' washers is much faster).

Incentives should be directed only to customers who can verify installation of washers qualifying as water efficient. A list of such washers is maintained and regularly updated by the Consortium for Energy Efficiency (CEE), a nonprofit public benefits corporation which develops national initiatives to promote manufacture and purchase of energy-efficient products and services. The U.S. Department of Energy and the Environmental Protection Agency both support CEE through active participation and funding. The CEE Residential Clothes Washer Program consists of tiers for both water efficiency and energy efficiency. Many utilities across America use the CEE list as the source of qualifying their consumers' incentive payments.

Recommendation: develop and implement an incentive program designed to increase the market share of 'efficient' clothes washers to at least 20 percent by the second year of implementation. Offer the program to customers in single-family homes (including duplexes and triplexes) and in multi-family units with individual washer connections. Ask local gas and/or electric energy providers to participate, as many water utilities in Texas and other parts of the country have already successfully partnered with local energy companies. Organize stakeholder meetings. Develop a marketing plan to educate customers, appliance retailers, and realtors about this program. Initiate the program.

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ATTACHMENT 6-5

AGRICULTURAL WATER CONSERVATION TEMPLATE

Irrigation Water Conservation & Model Drought Contingency Plan For [WATER USER GROUP] Date

CONTENTS OF PLAN

1. Objectives for Water User Group
2. Texas Commission on Environmental Quality Rules (Texas Administrative Codes)
3. Water Conservation Plan

1. Water Conservation Plan for [Public Water Supplier]

Recognizing the need for efficient use of existing water supplies, TCEQ has developed rules governing the development of water conservation and drought contingency plans for irrigation users. Region M has provided a conservation plan pursuant to TCEQ rules.

Objectives

- To reduce the loss and waste of water
- To reduce water consumption
- To improve the efficiency in the use of water

Model Drought Contingency Plan for [Public Water Supplier]
Objectives

This drought contingency plan (the Plan) is intended for use by [Irrigation]. The plan includes all current TCEQ requirements for a drought contingency plan.
This drought contingency plan serves to:

- To conserve available water supplies during times of drought and emergency.
- To reduce adverse impacts of water supply shortages.
- To reduce the adverse impacts of emergency water supply conditions.
- To preserve public health, welfare, and safety.

2. Texas Commission on Environmental Quality Rules
Water Conservation & Drought Contingency Plans

The TCEQ rules governing development of water conservation plans for public water suppliers are contained in Title 30 part 1, Chapter 288, Subchapter A, Rule 288.4 of the Texas Administrative Code.

A water conservation plan is defined as "A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water."

The minimum requirements plans for agricultural use ("individual irrigation user") are as follows:

<u>Minimum Conservation Plan Requirements</u>

The minimum requirements in the Texas Administrative Code; Chapter 30:

- 288.4(a)(2)(A) – Description of Irrigation Production Process
- 288.4(a)(2)(B) – Description of the Irrigation Method or System and Equipment,
- 288.4(a)(2)(C) – Accurate Metering ,
- 288.4(a)(2)(D) – Specification of Conversion Goals before May 1,2005,
- 288.4(a)(2)(E) – Specification of Conversion Goals after May 1,2005,
- 288.4(a)(2)(F) – Description of Water Conserving Irrigation Equipment and Application System,
- 288.4(a)(2)(G) – Leak Detection, Repair, and Water-Loss Control,
- 288.4(a)(2)(H) – Irrigation Timing an/or Measuring the amount of Water Applied,
- 288.4(a)(2)(I) – Land Improvements for Retaining or Reducing Runoff and Increasing the Infiltration of Rain and Irrigation Water,
- 288.4(a)(2)(J) – Tailwater Recovery & Resuse, and
- 288.4(a)(2)(K) – Other Conservation Practices, Methods, or Techniques.

3.

WATER CONSERVATION PLAN
FOR THE
(Name of Water User Group)
(Date)

Description of the Irrigation Production Process

[This section will include a description of the irrigation production process which shall include, but is not limited to, the type of crops and acreage of each crop to be irrigated, monthly irrigation diversions, any seasonal or annual crop rotation, and soil types of the land to be irrigated.] Here is a sample list below.

Location:_______________________________________
County:____
Types of Crops Planted:__________________________
Acreage of each crop:____________________________
Acreage of land:________________________________

Description of land:______________________________
____

Acreage and Type of Vegetation to be Irrigated

List the acreage irrigated as part of the description of the irrigation production process.
Example Table

Type of Crop	Growing Season	Acres Irrigated/Year
Example Crop 1	May- October	200
Example Crop 2	May- September	200
Example Crop 3	April- September	200
	Total Number of Acres	600

Blank Table

Type of Crop	Growing Season	Acres Irrigated/Year
	Total Number of Acres	

Monthly Irrigation Diversions

List the monthly irrigation diversions to complete the description part of the irrigation production process

Month	Acre-ft
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Total	

Description of Soil Types

The Irrigation WUG_____________________________ has ____ soil types within the _______acres as determined by the soil survey for________________ County, published by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station.

Soil Type	Permeability
Example: Valley Clay	Moderate

Description of the Irrigation Method or System and Equipment
[Include a description of the irrigation Method or system and equipment including pumps, flow rates, plans, and/or sketches of the system layout.]

Accurate Measuring
[Include a description of the device or devices and/or methods being used in order to measure and account for the amount of water diverted from the source of supply.]

Specification of Water Conservation Goals
This section must include 5, 10, & 20 year targets for water savings. This will include goals for water loss programs and goals for municipal use in gallons per capita per day.

<u>These are example goals:</u> (They are not mandatory)

- Switch to a central, computer-controlled irrigation system with weather monitoring stations located throughout the ______ acre property. This change is projected to save ________ acre-ft/yr.

- Line 500 miles of pipeline for conveyance conservation.

- Implement and maintain a meter replacement program.

- Keep the level of unaccounted water in the system less than ___ percent in____ (Target year) and subsequent years.

- Raise Public Awareness of water conservation and encourage responsible public behavior through a public/school education and information program.

Best Management Practices provided for Irrigation can be used as a supplement for irrigation water conservation.

Description of Water-Conserving Irrigation Equipment and Application System
[Include a description of water-conserving irrigation equipment and application system or method including, but not limited to, surge irrigation, low pressure sprinkler, drip irrigation, and non leaking pipe.]

Scheduling the Timing and/or Measuring the Amount of Water Supplied
[Include a schedule of the timing and /or measuring the amount of water applied for example soil moisture monitoring].

Tailwater Recovery and Reuse
[Include a description of tailwater recovery and reuse.]

Land Improvements for Retaining or Reducing Runoff and Increasing the Infiltration of Rain and Irrigation

[Include a description of any land improvements for retaining or reducing runoff and increasing the infiltration of rain and irrigation water. For example weed controlling & furrow diking.]

Other Conservation Practices, Methods, or Techniques

[Provide any information on any other water conservation practice, method, or technique which the user shows to be appropriate fro preventing waste and achieving conservation.]

ATTACHMENT 6-6

LAGUNA MADRE WATER CONSERVATION PLAN

RESOLUTION No. 32-09-09 ADOPTING THE REVISED WATER CONSERVATION & DROUGHT CONTINGENCY PLAN FOR LAGUNA MADRE WATER DISTRICT

WHEREAS, the Laguna Madre Water District (District) previously adopted a Water Conservation and Drought Contingency Plan on September 09, 2009; and

WHEREAS, it is necessary that a Water Conservation and Drought Contingency Plan be updated and adopted by the District; and,

WHEREAS, Section 11.1271 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality and Texas Water Development Board require all public water supply systems in Texas to prepare a water conservation plan; and,

WHEREAS, as authorized under law, and in the best interests of the customers of the Laguna Madre Water District, the Board of Directors deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;and

WHEREAS, The Board of Directors further finds, determines and declares that the meeting at which this resolution has been considered and acted upon was open to the public and public notice of the time, place and subject of said meeting was duly given, all as required by Texas Water Code Ann. 49.063; Now therefore,

BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE LAGUNA MADRE WATER DISTRICT: THAT

SECTION 1. The Revised Water Conservation & Drought Contingency Plan attached hereto as Exhibit "1" is hereby adopted as the official policy of the Laguna Madre Water District.

SECTION 2. The General Manager of the Laguna Madre Water District and his/her designee are hereby directed to implement, administer and enforce the Revised Water Conservation & Drought Contingency Plan.

SECTION 3. This resolution shall take effect immediately upon its approval.

PASSED AND ADOPTED BY THE BOARD OF DIRECTORS OF THE LAGUNA MADRE WATER DISTRICT ON THIS 9TH DAY OF SEPTEMBER, 2009.

Scott Friedman, Chairman
Board of Directors

LAGUNA MADRE WATER DISTRICT
T E X A S

ATTEST:

Rudy H. Garcia, Secretary
Board of Directors

Water Conservation Plan

Prepared By:

Laguna Madre Water District
Administration Department

Port Isabel, Texas
May 2009

The Water Conservation Plan was revised by the Laguna Madre Water District pursuant to the provisions of the Texas Administrative Code Chapter 288, Water Conservation Plans, Guidelines, and Requirements.

Water Conservation Plan for the Laguna Madre Water District

May 2009

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LAGUNA MADRE WATER DISTRICT WATER CONSERVATION AND DROUGHT CONTINGENCY PLAN

1.0 INTRODUCTION

The Water Conservation and Drought Contingency Plan (WCDC Plan) has been revised by the Laguna Madre Water District (LMWD) pursuant to the provisions of the Texas Administrative Code Chapter 288, Water Conservation Plans, Guidelines, and Requirements. According to TAC Rule 288, conservation means "those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses." The Texas Commission on Environmental Quality (TCEQ) is responsible for overseeing these plans.

In August 2005, the LMWD submitted an earlier version of the Water Conservation Plan to the Texas Commission on Environmental Quality (TCEQ), as required by state law. In addition, a copy of the plan was submitted to the Texas Water Development Board (TWDB).

2.0 SERVICE AREA AND SYSTEM EVALUATION

The Laguna Madre Water District (LMWD) provides water and wastewater services to the City of Port Isabel, the Town of South Padre Island, the Village of Laguna Vista and the unincorporated area of Laguna Heights. Laguna Heights is a registered Colonia in the State of Texas and it is an economically distressed community such as Port Isabel.

The LMWD maintains its own water supply system from the Rio Grande to the two water treatment plants. The raw water system includes four pump stations, 3 reservoirs and 34 miles of pipeline (**Figure 1:** Laguna Madre Water District Service Area).

Raw water is pumped from the Rio Grande River under the LMWD's allotted water rights of 7,300.348 acre feet. This raw water is pumped via the LMWD's raw water transmission line from the Rio Grande River to Water Treatment Plant No. 2 (5.0 MGD) in Laguna Vista and Water Plant No. 1 (4.1 MGD) in Port Isabel, Texas. Once the raw water is treated, it is pumped into the LMWD's various storage tanks (8) which have a total capacity of 4.125 MGD and to the distribution system.

Water availability and usage:

- The LMWD owns 7,300.348 Acre-Feet of Municipal Water Rights
- The LMWD uses and average of 4,724.058 Acre-Feet/year of Municipal Water Rights
- The LMWD uses 808-930 Acre-Feet of water for irrigation/year.

2.1 LMWD RAW WATER SOURCE AND DELIVERY SYSTEM

At present, the only raw water source for the LMWD is the Rio Grande River. The dependence on the Rio Grande River as a major water source should continue, but will be reduced when economically feasible through the use of supplemental water sources such as groundwater and/or seawater treated through membrane technology.

As it was mentioned, the Rio Grande is the main source of water for the entire Rio Grande Valley including the Laguna Madre Water District service area. This region of Texas is facing steady growth and diminishing water supplies. Because of the increasing cost of delivering treated surface water from the Rio Grande and the desire for alternative sources, the LMWD decided to evaluate the cost and feasibility of developing a seawater desalination facility to supplement its existing water supply. To address these challenges, LMWD has pursued the development of 1.0 million gallons per day (mgd) Seawater Desalination Treatment Facility for producing potable water. The South Padre Desalination Project is the result of several years of planning for the LMWD (**Figure 2:** Seawater Desalination Project).

Another critical component of the proposed project is the construction and implementation of an alternative energy generation facility using wave powered generation. This new alternative of energy will produce 1MW of energy, enough to supply all of the power for the Seawater Desalination facility.

2.2 RAW WATER SYSTEM AND USE

Raw Water is diverted out of the Rio Grande through three pumps with a total capacity to treat 14.8 mgd each pump. There are five miles of 42-inch concrete pipeline which lead to Reservoir No. 4 which is divided in four sections. Reservoir No.4 contains 610 acre-feet of storage. The reservoir pump station has a total capacity of 15 mgd with space for a fourth pump. 10 miles of 36-inch pipeline connects this reservoir and pump station to Cuates pump station east of City of Los Fresnos. The water from Reservoir 4 may flow by gravity or be pumped to either Cuates pump station or Reservoir No.3. In December 2008, one thousand (1000 lf) of the 36-inch concrete line was replaced because of a major water leak. There was an estimated loss of 250,000 gallons. The LMWD considers that by establishing a line replacement program with good construction standards and high quality materials can help minimize the amount of water loss.

The Cuates Pump Station pumps water into two pipelines (16 inch and 20 inch) which lead to Reservoir No.3 at WTP No. 2. On the other end, Reservoir No.3 which is located in Water Treatment Plant No.2 is the last settling reservoir before water is treated in WTP No. 2 and it contains 230 acre-feet of storage.

There is a raw water pump station at this plant which pumps to WTP No. 1 through two lines (16 inch and 15 inch). Finally, reservoir No. 1 in WTP No. 1 has a capacity of 30 acre-feet. The total storage capacity of raw water in the LMWD is 870 acre-feet.

The South Padre Island Golf Course currently buys raw water from the LMWD. The total average in FY 2008-2009 was 23,214,300 mg.

2.3 LMWD TREATED WATER SYSTEM AND USE

Water Treatment Plant No.1 was built 50 years ago and substantially upgraded in 2006. The plant basically serves to supply peak demands, particularly in the summer months and is typically shut down during the fall and winter. The plant has an overall capacity of 5.1 mgd, but is limited to 4.1 mgd in production based on hydraulic bottlenecks in the clarification/filtration system (Asset management plan, 2008). WTP No.1 normally serves Port Isabel, Texas and Laguna Heights.

Water Treatment Plant No. 2 is one of the main facilities in the LMWD for water production. However, this facility requires substantial improvements to sustain a reliable water supply. This plant serves Laguna Vista, Outdoor Resorts, and South Padre Island, Texas.

The LMWD is an area of potential growth, particularly north of South Padre Island and west side of Laguna Vista. Spring breakers and summer tourism can result in extended periods of peak water usage greatly in excess of the usage by existing customers. However, because of our location to the Gulf of Mexico, hurricanes can be the most frequent hazardous experience in this area affecting the tourism industry. The economic and social consequences of this type of events can be severe, but the economic and social disruption caused by a disastrous event is hard to grasp.

The LMWD suffered **$2,099,468** million in direct damage and loses approximately $1.7 million in revenues. For six months hurricanes are a constant threat for the LMWD and a reminder of how fragile the system can be.

In 2004, the LMWD conducted a *Comprehensive Plan for Water and Wastewater Facilities* which defined a number of treatment and collection system facilities of "high risk", meaning they could cause serious environmental and health problems resulting from exceeding capacity if not corrected. Since 2005, the LMWD started implementing some of the recommendations including major repairs at WTP No.1.

The *Asset Management Plan (AMP)* completed in 2008 reinforced the need for replacement and rehabilitation in the LMWD system throughout the service area.

Water Distribution System: The LMWD has been working system wide to improve the reliability and efficiency in the distribution system. Efficiency in the water system along with the other services will ensure continued quality and reliability in the essential services it provides. One of the primary recommendations in the *Comprehensive Plan for Water and Wastewater Facilities study includes* creating a water line replacement program that can be implemented on a yearly basis. This was reinforced with additional prioritization in the AMP.

The LMWD includes nearly 200 miles of pipeline. The system consists of pipelines ranging in sizes from 2" to 24". Pipe types include PVC, cast iron, asbestos cement, and epoxy coated steel (*Comprehensive Plan for Water and Wastewater Facilities, 2004*).

Approximately 75% of the pipe in the system is 8-inches or less in diameter. A concern for the LMWD is that there are too many 2-inch lines that are inadequate to supply many customers during peak day demands. The 2-inch diameter pipelines create substantial head loss in the system during peak delivery times that result in insufficient water pressures in parts of the water distribution system, portending risk of regulatory non-compliance. As a result of undersized pipes and leaks, the LMWD as a whole is in need of water line replacements (*Asset Management Plan, 2008*).

A summary of proposed water distribution system pipelines has been prepared using the LMWD's AMP. Recommended improvements are proposed for pipelines requiring upsizing due to excessive line breaks or system pressures, and material type prone to excessive failures. This result in a recommended program for implementing only the highest priority distribution system improvements at this time with additional improvements proposed for implementation in later years.

Billing Cycles Process: The LMWD is divided in three billing cycles. The Billing Cycle determines when the water meter is read and the billing due date. The billing cycle is an integral part of the remote reading process therefore; an address cannot be changed to another location.

The LMWD mails monthly utility bills for each billing cycle, approximately 30 days. While the billing dates may fluctuate slightly from month-to month, customers know when to expect their bill. Unfortunately, out of 3000 bills 50 to 75 customers are disconnected per cycle.

The LMWD follows these three different billing cycles depending on customers' physical addresses. ***Cycle one*** includes customers who live in the town of Laguna Vista, ***Cycle two*** includes customers who live in City of Port Isabel, and ***Cycle three*** includes customers who live in South Padre Island (**Figure 3:** Billing Cycles).

Each cycle has several books that determine distribution of water consumption within the LMWD (**Figure 3:** Billing Cycles). In average, South Padre Island used 45% of the water in

2006, 46% in 2007, and 43% in 2008. Port Isabel used 21% in 2006, 20% in 2007, and 20% in 2008. Laguna Vista & Laguna Heights used 33 % in 2006, 35% in 2007, and 37% in 2008.

The water and sewer rates to all customers within each class of service are uniform.

As shown in **Appendix A:** The LMWD consisted of 6738 connections, comprised of ten different classes of customers (residential, commercial, industrial, churches, schools, hotels, mobile homes, apartments, and restaurants, condominiums, and unassigned). The current population served by the LMWD is estimated at 10,475 (**Appendix A:** Water Utility Profile).

As part of the Water Management System, the Superintendent ensures that monthly reports of water pumped from the Rio Grande, water deliveries to the two water treatment plants, and water system sales are generated.

2.4 LMWD TREATED WASTEWATER SYSTEM AND USE

The LMWD also operates and maintains regional wastewater facilities where wastewater from the service area is collected at four wastewater treatment plants. The mainland Wastewater Treatment Plant located in Port Isabel, Texas was built in 1974 and is permitted to treat 1.1 mgd. The Laguna Vista Wastewater Treatment Plant was built in 2005 with a treatment capacity of 0.65 mgd. Two wastewater treatment plants are located on the island, one in Isla Blanca built in 1974 with a treatment capacity of 2.6 mgd, and one located at Andy Bowie built in 1974 with a treatment capacity of 0.75 mgd (**Figure 5:** Wastewater System).

The Laguna Madre has experienced increasing wet weather impacts resulting from infiltration/inflow creating a burden in both dollars and the risk posed to the general public with potential overflows of untreated wastewater. While some improvements have been made in improving the wastewater collection and treatment facilities, three of the four wastewater treatment plants and a portion of the collection systems for each treatment facility will require major rehabilitation and upsizing in the near future to prevent the occurrence of sewer overflows and the potential for regulatory penalties.

The AMP completed in 2008 identified ***245,725*** feet of wastewater collection system pipe lines in poor condition which have not been replaced as needed, and are therefore subject to root intrusion, cracks, leakage and corrosion. Some of these factors result from geography and location with contributing conditions such as poor soil conditions, elevated groundwater, root intrusion, grease build-up and other factors which have accelerated the end of the service life for a number of the wastewater collection pipelines.

The considerations to maintaining LMWD's wastewater collection systems include the practical use of the staff, cost and equipment. When sewer problems have arisen in the LMWD's service area, the quickest solution has been to dig up and replace the failed pipe sections. However, this find and fix approach is costly and inefficient, in part because it involves a mobilization for a repair that with planning might be reduced in cost. Thus, there is a need to comprehensively address area wide problems where conditions are contributing to redundant and inefficient spot repairs discover the extent of a problem before it can be fixed.

One of the main goals for the LMWD is to find the best available technology that can be used in the design, construction, operation and maintenance of the collection system.

Other options to consider will include a regular maintenance and a grease control program that can help extend the life of the sewer system.

Wastewater Collection Systems Rehabilitation/Replacement:

A program was developed through the AMP to comprehensively address those portions of the LMWD collection systems which due to current condition, warrant replacement. Projects have been identified and defined in scope for highest priority replacement needs based on system-wide pipe reaches, by pipe diameter. Costs have then been developed for each set of pipeline sizes based on a replacement/rehabilitation strategy that will result in these pipeline reaches having a fully renewed service life.

3.0 LMWD SERVICE AREA AND WATER USE PROJECTIONS:

The LMWD is located at the eastern edge of Cameron County in the growing Rio Grande Valley of Texas. The LMWD serves three municipalities including the Town of South padre Island, the City of Port Isabel, the Town of Laguna Vista, and Laguna Heights. The LMWD is faced with the challenges of population growth, increased demand, diminishing supplies, stricter regulations and aging infrastructure. According to the TWDB, the population growth rate for this area in the next 20 years is estimated to be 1.7%. However, South Padre Island population in year 2000 was 2,422. Estimated number of inhabitants in 2008 was 5,900. Due to the large number of visitors, the residents' population is only a small percentage of the total number of people who are in the Town of South padre Island at any given time (http://www.spichamber.com/relocation.pdf).

The LMWD is committed to meet its long water needs and regulatory requirements by addressing these important issues. The AMP identified significant problems in the water distribution and collection system, but those improvements have been already presented to senior management for immediate consideration.

While satisfying the needs of water customers, the LMWD must be mindful of the sometimes severe impact that water supply withdrawal has on the total environment. The goal of an effective water conservation program should be to maintain and follow the goals cited on this plan while not causing damage to the environment.

3.1 PROBLEMS IDENTIFICATION:

The most significant water supply and distribution problems in the LMWD are identified in the following paragraphs.

3.1.1 Inadequate Raw Water Supply to Meet Expected Water Demands

The LMWD water demands are projected to increase in the years to come. Historical growth rates for South Padre Island and the Mainland were estimated as the historical growth in treated water pumped at each plant. The monthly meter book records were analyzed to determine distribution of water used within the LMWD. On the average, South Padre Island used 44.75% (**Figure 3:** Billing Cycles Map).

The annual growth rate for the mainland .83%, while South Padre Island is 2.83% this results in an average combined growth rate of 1.83 % (Rio Grande Regional Water Planning Group, 2009).

The LMWD future water demands are projected to increase in the next 60 years; the average population growth rate for this area is **1.34%.** Because of this reason, the LMWD needs to continue seeking for other sources of water such as seawater desalination, brackish water or reuse and become more proactive by implementing water conservation measures that will help the system reducing future water demands.

3.1.2. Identification and Reduction of Raw Water Losses:

As it was mentioned, in 2008, the LMWD has replaced 1000 lf of a 36-inch raw water pipe line that distributes water from the river to WTP No. 2. It should be noted, however, that this project was initiated by the Department of Transportation (DOT) but this project has resulted beneficial to the LMWD raw water distribution system.

The AMP completed in 2008 did not include other issue identified in the distribution system which consists of valves that are overlapping on the water line connections. The LMWD has contracted a company to perform a valve insertion process at some of these locations meeting the AWWA standards. Benefits for this process include avoiding loss of critical service to hotels, restaurants, and commercial business zones. In addition, other benefit includes avoiding possible system contamination.

3.2.3 Identification and Reduction of Treated Water Losses:

In 2005, the LMWD committed to be more efficient by reducing treated water losses and has taken several steps to improve the effectiveness of the treated water distribution system. Major distributions system efficiency projects include:

1. Metering: Universal Metering- The LMWD requires the metering of all connections to the water system including residential, industrial, municipal, commercial and other customers. The LMWD started the meter replacement program in December 2005, and it was completed in July 2006. All 5/8" meters were replaced. The 2", 4", and 6" were mostly replaced; however, those that were not changed were retrofitted. From 2006 to present, some of these meters (retrofitted) have been replaced.

2. Metering at point of diversion- The LMWD has replaced the distribution meters that has resulted in a better accountability of raw water in the River Pump Station and other measuring points in the distribution system.

3. The AMP identified too many 2-inch water lines that are inadequate to supply many customers during peak day demands. The 2-inch diameter pipelines create substantial head loss in the system during peak delivery times that result in insufficient water pressures in parts of the water distribution system, portending risk of regulatory non-compliance. As a result of undersized pipes and leaks, the District as a whole has implemented a water line replacements program.

4. The LMWD maintains a total of 1,625,000 gallons of elevated storage capacity. Two of the tanks are located on the Island while Port Isabel, Laguna Vista and Laguna Heights each one has one elevated tank. Approximately 51% of the demand, however, is located on the South Padre Island. The existing volume of elevated storage capacity is adequate to satisfy State requirements for the next 20 years. However, the development of new annexation on the north end of South Padre Island will best benefit the construction of a new elevated storage tank to provide short term and long term needs for South Padre Island. The LMWD is in the process of developing a maintenance program to that will ensure that all five elevated tanks are painted, disinfected, and maintained with current AWWA standards.

5. The LMWD has four wastewater treatment plants and a very small amount of these plants' effluent has been utilized to wash down and for irrigation of the treatment plant

grounds and for irrigation of local highway medians (please review cited paragraphs below). However, back in the 90's a reuse study was conducted that identified potential customers that are currently using potable water for their irrigation needs. The main concern for some of these customers is the initial cost that is involved for further treatment (Comprehensive Plan for Water and Wastewater Facilities, 2004).

The LMWD will like to include other reuse projects at some of these facilities (please review considered projects below).

- ***Port Isabel Wastewater Treatment Plant***- the LMWD is seeking the opportunity to substitute potable water for raw water and effluent. The benefits of this program includes conserving the limited water resources for the LMWD's service area, providing economic benefits to customers, and providing lower-cost water for residential, commercial, and park irrigation. The School District (High-School) has been approached by the LMWD to have an additional savings in its water consumption. Based on the data retrieved in 2006, the total average water consumption in both meters is 6,794,800 gallons/year. The substitution of this project will help to relieve the demand on the LMWD's water supply and treatment.
- ***Andy Bowie Wastewater Treatment Plant***- The Birding Center has approached the LMWD to use the effluent of this wastewater facility. As per the TCEQ, the LMWD does not require an authorization permit for reusing the effluent at this facility.
- ***Laguna Vista Wastewater Treatment Plant***- The South Padre Island Golf Course located in Laguna Vista is using raw water for irrigation. However, LMWD is seeking the opportunity to substitute raw water for effluent.

6. The LMWD has implemented several of the recommendations in the Water and Wastewater Treatment Plants Study that was completed in 2004 by NRS Consulting Engineers.

4.0 WATER UTILITY PROFILE

Appendix A to this water conservation plan is the Laguna Madre Water District utility profile based on the format recommended by the Texas Commission on Environmental Quality (TCEQ).

5.0 LMWD WATER CONSERVATION GOALS:

GOAL ONE: Water Loss: Accounting for all water use is one of the first steps in establishing a goal for water loss. Determining water loss quantity requires reliable estimates of water production and use. Therefore, identifying the total water loss, the LMWD needs to ensure that the total number of gallons treated and the total water gallons billed are accurately estimated. Once this accurate measure of the water distribution system is implemented, not only the LMWD will be able to provide a value of unaccounted-for-water, but also, it will make sure to establish goals that can help reduce any potential water loss in the water system.

Once the LMWD starts implementing the water conservation plan, the LMWD will conduct a water modeling that can provide a better idea of the conditions of the water distribution system.

GOAL TWO: Per Capita Usage: The average daily a customer use of water expressed in gallons per capita per day (gpcd) has averaged **171** gpcd over the past five Years (**TABLE 2:** Gallons per Capita per Day).

Beginning FY 2009-2010, the LMWD goals are to achieve municipal use of 166 gallons per capita per day for the first five years (2009-2014) and also achieve 153 gallons per capita per day in 2019.

GOAL THREE: Water Recycling: The LMWD is seeking the opportunity to reuse or reclaimed at least 50% of its wastewater effluent and/or substitute potable water for raw water and effluent. Type II Reclaimed Water Use includes irrigation or other uses in areas where the public is not present during the time when irrigation activities occur or other uses where the public would not come in contact with the reclaimed water (Texas Administrative Code, 2009). The benefits of this program include conserving the limited water resources, providing economic benefits to customers, and providing lower-cost water for residential, commercial, and park irrigation.

GOAL FOUR: Alternative Source: The LMWD is evaluating other opportunities for water supply including a desalination facility. Considering other sources of water will allow the LMWD to drought-proof its long-term water supply in a highly vulnerable part of the state.

6.0 WATER CONSERVATION PLAN ELEMENTS

Education and Public Information

A. **Public Education Campaign-** the LMWD will promote water conservation by informing its customers of different methods to conserve water. The educational program will include a "Water Conservation Night" at the LMWD where experts in the water field such as the Water Master will be invited to discuss water conservation issues and provide current data regarding the Drought on the Rio Grande and the situation at Falcon and Amistad Dams (**APPENDIX E:** Water Conservation Campaign). Consulting Engineers can also participate by providing feedback on the LMWD's water supplies opportunities (seawater desalination facility).

- **Brochures-** New customers would be provided with brochures on water conservations upon initiation of water services and/or upon request. In addition, brochures will be also available in the customer service department and would be available in English and Spanish (the ABC's water conservation, Be Water Smart Indoors, Water Savings Tips, Forty Nine tips to Conserve Water (Spanish Version).

- **LMWD website-** water conservation and water saving tips and mandatory water conservation restrictions are found on the LMWD website: http//www.lmwd.org. However, the LMWD will commit to update information on a monthly basis/or as needed.

- **Media-**Press releases will be published during the summer time providing methods for conserving water.

- **School and Community Education-** the LMWD will become more proactive by including school presentations to promote water conservation. In addition, ***touring the water treatment plants*** will make our community understand our **"Water"**. Some of the objectives for the tour will include:

    - Understanding where their local drinking water comes from.
    - Explore pollution and other risks to drinking water sources.
    - Understand the relationship between water treatment and public health.
    - Understand drinking water and wastewater treatment processes.
    - Become familiar with the laws that govern drinking water and wastewater treatment.

- The goal of the Water Conservation Information Program is to provide information to the LMWD's customers several times a year as recommended in the Texas Water Development Board's water conservation best management practice guide.

B. **Drought Awareness Campaign**-In addition to the public and education promotion, once the LMWD is in a drought conditions, a drought awareness campaign can be initiated. The campaign could include press releases through the local newspaper, radio and television advertisements. Customers will receive detailed information of the drought conditions through bill inserts and handouts that can be distributed by the LMWD staff.

Water Rate Structure

CONSERVATION-ORIENTED WATER RATE STRUCTURE

The District imposes an inverted block rate structure on both water and wastewater customers which do not and will not encourage water waste. All customers are subject to the conservation oriented rate structure so that all customer classes (single family residence, multi-family residence, industrial, commercial, etc.) are equally encouraged to conserve.

The current rate structure takes the form of an inverted block rate so that high volume users are penalized for high water usage, in essence, the more you use, the more you pay. For example, on our 5/8" meters, the first 4,000 gallons a month used by a residential customer has a base rate of $9.75; and, the next 6,000 are $2.10/thousand, with the next 10,000 at $3.20/thousand and any consumption over that is at $4.50/thousand gallons used. Minimum charges and volumetric rates increase by meter size. The above-discussed rates adopted by the District in August 2002 for all classes of customers will help encourage water conservation.

The tables provided below illustrate the current inverted block rates for both water and wastewater. Note that in December 2008 LMWD engaged CAPEX Consulting Group to prepare a comprehensive rate study and long-term financial plan. The study's rate recommendations, which should be implemented in May or June 2009, build-upon the inverted block rates and will enable LMWD to more effectively incentivize water conservation.

WATER AND WASTEWATER RATE STRUCTURE

LAGUNA MADRE WATER DISTRICT
CURRENT WATER RATE STRUCTURE

		5/8" METER	1" METER	2" METER	4" METER	6" METER
Minimum Charge - Gallons		4,000	6,000	26,000	101,000	101,000
All		$9.75	$13.50	$65.00	$245.00	$560.00
Volumetric Rate [Gallons]						
4,001	5,000	$2.10	$0.00	$0.00	$0.00	$0.00
5,001	6,000	$2.10	$0.00	$0.00	$0.00	$0.00
6,001	10,000	$2.10	$2.20	$0.00	$0.00	$0.00
10,001	15,000	$3.20	$2.20	$0.00	$0.00	$0.00
15,001	20,000	$3.20	$2.20	$0.00	$0.00	$0.00
20,001	26,000	$4.50	$3.30	$0.00	$0.00	$0.00
26,001	40,000	$4.50	$3.30	$0.00	$0.00	$0.00
40,001	50,000	$4.50	$4.65	$2.30	$0.00	$0.00
50,001	100,000	$4.50	$4.65	$2.30	$0.00	$0.00
100,001	200,000	$4.50	$4.65	$2.30	$0.00	$0.00
200,001	350,000	$4.50	$4.65	$3.45	$2.40	$2.60
350,001	500,000	$4.50	$4.65	$5.15	$2.40	$2.60
500,001	650,000	$4.50	$4.65	$5.15	$2.40	$2.60
650,001	800,000	$4.50	$4.65	$5.15	$3.60	$3.90
800,001	1,000,000	$4.50	$4.65	$5.15	$3.60	$3.90
1,000,001	Greater	$4.50	$4.65	$5.15	$3.60	$3.90
					$4.95	$5.25

LAGUNA MADRE WATER DISTRICT
CURRENT WASTEWATER RATE STRUCTURE

		5/8" METER	1" METER	2" METER	4" METER	6" METER
Minimum Charge - Gallons		4,000	6,000	26,000	101,000	101,000
All		$9.90	$12.50	$85.00	$195.00	$400.00
Volumetric Rate [Gallons]						
4,001	5,000	$2.10	$0.00	$0.00	$0.00	$0.00
5,001	6,000	$2.10	$0.00	$0.00	$0.00	$0.00
6,001	10,000	$2.10	$2.30	$0.00	$0.00	$0.00
10,001	15,000	$3.20	$2.30	$0.00	$0.00	$0.00
15,001	20,000	$3.20	$2.30	$0.00	$0.00	$0.00
20,001	26,000	$4.50	$3.45	$0.00	$0.00	$0.00
26,001	40,000	$4.50	$3.45	$2.50	$0.00	$0.00
40,001	50,000	$4.50	$5.15	$2.50	$0.00	$0.00
50,001	100,000	$4.50	$5.15	$2.50	$0.00	$0.00
100,001	200,000	$4.50	$5.15	$3.75	$2.60	$2.70
200,001	350,000	$4.50	$5.15	$5.20	$2.60	$2.70
350,001	500,000	$4.50	$5.15	$5.20	$2.60	$2.70
500,001	650,000	$4.50	$5.15	$5.20	$3.90	$4.05
650,001	800,000	$4.50	$5.15	$5.20	$3.90	$4.05
800,001	1,000,000	$4.50	$5.15	$5.20	$3.90	$4.05
1,000,001	Greater	$4.50	$5.15	$5.20	$5.30	$5.40

Plumbing Fixtures and Retrofit Programs

Building owners will be encouraged to replace plumbing devices with more efficient fixtures. As a long term goal, the LMWD will eventually provide conservation kits to its customers that include low-flow showerheads, dye tables, and toilet bags that can be used to identify water leaks at home.

Water Savings Plumbing Code-

In June 25, 1986, the LMWD adopted a resolution that includes water conservation requirements for new construction and renovations. For example, toilets that were installed before 1980 would draw about 5.5 gallons per flush. Therefore, improved technology has made it possible considerable water savings.

FIXTURE	STANDARD
Lavatory & Sink	No more than 2.2 gallons per minute at 60 pounds per square inch of pressure.
Wall Mounted, Flush meter Toilets	No more than 1.6 gallons per flush.
All other Toilets	No more than 1.6 gallons per flush.
Urinals	No more than 1.0 gallons per flush.
Drinking Water Fountains	Must be self closing.
All Hot Water Lines	Must be insulated.
Swimming Pools	New pools must have re-circulating Filtration equipment.

Universal Metering, Meter Repair and Replacement Program-

The raw water that is diverted out of the Rio Grande used to be metered by a Transit Time Meters with transducers. However, those meters have been replaced by AMRS (Automated Meter Reading System) which are more efficient meters. The diversion meters are tested for accuracy by considering a plus or minus 5.0%. In addition, the meter reading results are also validated by the Water Masters.

Currently, all customers of the LMWD are metered. In December 2005, the LMWD begin the implementation of the meter change out program and was completed on July 2006. The LMWD tested and replaced its customers' meters. All 5/8" were replaced. The 2", 4", and 6" meters mostly were changed out. However, they were retrofitted. From 2006 to present, some of these retrofitted meters have been totally replaced.

On the other hand, when there is a major discrepancy on the billing department, staff contacts the Superintendent of the Water Treatment Plants for additional information, then after, a water profile for a given account is completed.

When the administration department was revising the existing water conservation plan, it was difficult to identify water losses in the system flow meters located at the water treatments plants have not been calibrated. Therefore, water losses cannot be estimated. The LMWD will ensure that these meters are tested for accuracy. If accuracy is not within specified standards for the meter type and size, the meter will be repaired or replaced during the first year of implementation of the water conservation plan.

The LMWD plans to implement the following concerning to water metering:

1. The LMWD will make sure that flow meters at the water treatment plants are calibrated on a yearly basis.
2. Establish a meter repair and testing program and procedures by the end of the first year of implementation of the WCP.
3. Establish a random testing program to test the efficiency of new meters for accuracy.
4. The LMWD will monitor unaccounted water that includes water that is metered but not billed and water that is not metered. Unmetered water consists of authorized uses (fire protection, flushing mains, etc.), as well as unauthorized uses (losses due to accounting errors, thefts, inaccurate meters, and leaks).

Control of Unaccounted for Water Use

In 2008, in an effort to reduce raw water losses, one thousand (1000 lf) of the 36-inch concrete line was replaced because of a major water leak. There was an estimated loss of 250,000 gallons. The LMWD will implement the following to have more control and measure of the unaccounted water:

1. The LMWD will conduct water modeling which is an integral part of implementing a water conservation plan. This water modeling will serve as a baseline measure of water use and will determine other existing conditions in the water system. The study will be implemented in 2009.
2. The LMWD will develop a report on water use and losses that can be presented in the financial report. (PETE)
3. The Texas Legislature amended Section 16.0121 of the Texas Water Code to require public utilities companies to conduct a water audit every five years (Texas Water Code, 2009). The LMWD will conduct a water audit that will determine the efficiency of the system and that will identify the location of water losses. The water audit will be conducted in FY 2009-2010. Four basic steps for a water audit includes:

    a. Identify and quantify each source of water
    b. Identify, quantify and verify authorized metered water uses
    c. Identify and estimate unmetered water uses
    d. Identify and estimate water loss

Leak Detection and Repair Program-

The LMWD does not have in place a leak detection program. However, staff addresses leaks in the water distribution system when a customer calls in, when there is a low pressure in the system, when there is no water, or when staff has been notified that water is visible on alleys and/or roadways. In addition, water plant operators monitor tank levels and pressure in a monitor system (a system that is similar to a SCADA system) when there is a significant drop on the water level. This information can be used as indicator that there is a possible leak in the water distribution system.

The LMWD will continue taking the following actions to improve and prevent leaks in the water system:

1. The LMWD will establish a line replacement program with good construction standards and high quality materials can help minimize the amount of water loss.
2. Establish a leak detection program in the distribution system.
3. Establish a valve maintenance and replacement program.

Water Conservation Landscaping-

The LMWD will establish a water conservation landscaping education program that will promote reducing outdoor by the end of the first year. Educational resource related to outdoor water conservation will be provided. In addition, the LMWD will have available at its offices resources related to conservation that include watering, planting, and maintenance recommendations for customers.

The LMWD is in the process of making a demonstration garden that intends to demonstrate a water conserving and aesthetic landscape for a reasonable cost. In addition, this demo garden will include plants that can easily adapt to this area conditions and will give customers ideas for their water conserving gardens.

Pressure Control in the Distribution System

The water distribution system provides economical and compatible facilities that are capable of furnishing sufficient water at suitable pressures. The system consists of almost 200 miles of underground water mains, two pumping stations, two ground storage tanks, five elevated storage tanks, approximately 6,200 meters and making 5,900 active (5/8" up to 8" meters).

After the water is processed at the treatment plants and tested, it is stored in water storage tanks or pumped into the water distribution system. The distribution network is laid out in a continuous looped system to circulate water and maintain constant system pressure minimum of 35 psi, but maintaining an average of 45 psi.

Water Recycling and Reuse-

As it was mentioned, the LMWD currently recycle water within their plants for non potable used including wash-down stations and chlorine system. The LMWD will continue seeking the opportunity to substitute potable water and effluent opportunities to accommodate future growth.

Conservation Programs for Industrial, Commercial, and Institutional Customers (ICI)

The LMWD will develop a water conservation program for ICI customers that will include the resources to implement efficient water management practices that will help them reduce operating costs for water and energy without sacrificing production quality. In addition, this program will help ICI customers become more efficient to reduce the impact of any potential mandatory water regulation necessitated by drought or other water shortages. Perhaps best of all, a well-planned and efficiently implemented program of water conservation on the part of these customers will help to extend LMWD service area and help to make future growth (Texas Water Development Board, Water Conservation Task Force).

Conservation Additional Requirements (Population over 5,000)

The Texas Administrative Code includes additional requirements for water conservation plans for drinking water supplies serving a population over 5,000:

- 288.2(a)(2)(C) – Requirement for Water Conservation Plans by Wholesale Customers

Requirement for Water Conservation Plans by Wholesale Customers

If should LMWD acquires a Wholesale Customer , a requirement in every wholesale water supply contract entered into or renewed after the adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures following the requirements of *Title 30, Part 1, Chapter 288, Subchapter A, Rule 288.2* of the Texas Administrative Code. The requirement will also extend to each successive wholesale customer in the resale of the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provision of this chapter.

Implementation and Enforcement

The General Manager at the Laguna Madre Water District or his/her designee will responsible for the implementation and enforcement of the Water Conservation Plan. In addition, he will ensure that records are maintained in the administration building to prepare reports requested by the TCEQ.

Coordination with Regional Water Planning Groups

The District will be in coordination with the Lower Rio Grande Chair of Development Council at 311 North 15th, McAllen, TX 78501, for the Water Conservation Plans. A copy of the water conservation plan will be provided to the Regional Water Planning Group.

Periodic Review and Evaluation

The LMWD personnel will ensure that water conservation goals are monitored and ensure that unaccounted for water is identified and measured. In addition, LMWD will be also responsible that the LMWD meets current and future demands. If there are major changes that require an amendment to the existing water conservation plan, the GM will be notified if any modifications exist for consideration.

DROUGHT & EMERGENCY CONTINGENCY PLAN

7.0 Purpose

In order to conserve the drought or a number of other uncontrollable circumstances can disrupt the normal availability of the District's water supply. Chapter three (3) summarizes the Drought & Emergency Contingency Plan (Plan) for the Laguna Madre Water District (LMWD). The purpose of this Plan is to conserve and limit the demand of water during emergencies in the LMWD's water system.

The General Manager or his/her designee shall have the authority to implement the Drought Contingency & Emergency Plan including initiating and terminating applicable drought stages. All persons, customers of the LMWD must fully comply with the terms in this plan.

The Drought & Emergency Contingency Plan includes the following elements:

- Criteria for Initiation and Termination of Plan Stages
- Drought Response Stages
- Public Education
- Coordination with Regional Water Planning Groups
- Implementation and Enforcement
- Application

7.1 Criteria for Initiation and Termination of Plan Stages

The following trigger conditions indicate when drought contingency measures will be put into effect. Trigger conditions will be set for mild, moderate, and severe conditions.

A. Stage 1 Triggers-

Guidelines for Initiation:

Voluntary conservation is the first phase of the "Plan". It is always in effect unless a higher phase is required and enacted.

Goal:

Achieve a voluntary reduction in water use on the Laguna Madre Water District.

Voluntary Water Use Restrictions:

1. Recommend that all landscape areas be irrigated on a twice per week schedule (as discuss under Phase 2) and that such irrigation occur from midnight through 7:00 p.m. or other schedules a determined from the General Manager.
2. Recommend water customers to discontinue water use for non-essential purposes such as washing any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard surface areas.

B. Stage 2 Triggers- Mild Water Shortage Conditions

Guidelines for Initiation:

1. When the level of U.S. water stored in Amistad and Falcon Reservoirs reaches 51% or 1.660,000 AF (or below). When the level of water is above this amount, this phase may be terminated.

2. Average daily water use is approaching 90 percent of system capacity.
3. Net storage in District's raw water reservoirs is at 75% and is continually decreasing on a daily basis such that a more serious problem may develop.
4. The availability of raw water is low.
5. The availability of water rights based on quarterly capacity:

1st Quarter	20%
2nd Quarter	40%
3rd Quarter	70%

6. The capacity to transport and/or treat raw water has been affected.
7. The distribution capacity to customers is approaching maximum availability.

Guidelines for Termination

1. Stage 2 of the Drought Contingency Plan may be rescinded when the conditions listed as triggering situation have ceased to exist for a period of three (3) consecutive days.

Goal:

The goal for Stage 2 is a three percent (3%) reduction in average daily water demands. This goal will be measured based on the average water use for thirty (30) days prior the initiation of the stage.

Water Use Restrictions:

Customers are asked to conserve water.

1. Landscape irrigation will be permitted from 7:00 p.m. through 9:00 a.m. and on designated watering days:

Monday & Thursday -	Laguna Heights and Laguna Vista
Tuesday & Friday -	South Padre Island
Wednesday & Saturday -	Port Isabel

2. Use of water to wash any motor vehicle, trucks, trailers, boats, airplanes, and other mobile equipment will be prohibited except of the landscape watering days described above.
3. Water use for non-essential purposes is prohibited.

C. Stage III Triggers - Moderate Water Shortage Conditions

Guidelines for Initiation:

1. During peak demand days such as Texas Week, Easter, Memorial Day, and Labor Day.
2. When the level of U.S. water stored in Amistad and Falcon Reservoirs reaches 25% or 834,600 MAF (or below). When the level of water is above this amount, this phase may be terminated.
3. Average daily water use is approaching 90 percent of system capacity for three (3) consecutive days.
4. Net storage in District's raw water reservoirs is at 50% and is continually decreasing on a daily basis such that a more serious problem may develop.
5. The availability of raw water is low.
6. The availability of water rights based on quarterly capacity:

1st Quarter	22%
2nd Quarter	46%
3rd Quarter	81%

Guidelines for Termination:

1. Stage 3 of the Drought Contingency Plan may be rescinded when the conditions listed as triggering situation have ceased to exist for a period of three (3) consecutive days. Upon termination of Phase 3, the restrictions imposed under Phase 2 remain in effect.

Goal:

The goal for Stage 3 is a five percent (5%) reduction in average daily water demands. This goal will be measured based on the average water use for thirty (30) days prior the initiation of the stage.

Water Use Restrictions:

1. During Spring Break (Texas Week) landscape irrigation will be restricted from 9am the Friday before the actual date of Spring Break through Monday at 9am. Peak demands on other Holidays falling on a Tuesday, Wednesday, or Thursday will have restrictions beginning at 9:00 am a day before the holiday ending a day after at 9:00am. Holidays falling on Friday thru Monday will have restrictions beginning on Friday 9am and end on Monday at 9am.
2. Landscape irrigation will be permitted on designated watering days:
   a. Watering will be permitted as follows:
      Monday & Thursday - Laguna Heights
      Laguna Vista
      Tuesday & Friday - South Padre Island
      Wednesday & Saturday - Port Isabel
   b. Landscape irrigation with a hand-held garden hose, soaker hose, hand-held bucket or water can, no more than 5 gallons capacity or drip irrigation.
   c. Landscape irrigation time will be 7:00 p.m. to 9:00 a.m.
3. Commercial nurseries and other similar establishments may these water restrictions:
   a. With hand-held buckets or water cans from 7:00 p.m. to 9:00 a.m.
   b. Drip or sprinkler irrigation systems from 7:00 p.m.to 9:00 a.m.
4. Water use for non-essential purposes is prohibited.
   a. Between the hours of 6:00 a.m. to 9:00 a.m. and 6:00 p.m. to 9:00 p.m.
5. Permitting or maintaining defective plumbing in a home or business is prohibited.
6. Operation of any outdoor ornamental fountain or pond for aesthetic or scenic purposes is prohibited, except where necessary to support aquatic life or where such fountain or ponds are equipped with a water recirculation system.
7. Landscape irrigation variances are available but customers need to apply by mail. Facsimile, or email their name, address where the new landscape is to be installed, and the date of installation.

D. **Phase IV Triggers - Severe Water Shortage Conditions**

Guidelines for Initiation:

1. When the level of U.S. water stored in Amistad and Falcon Reservoirs reaches 15% or 504,600 MAF (or below). When the level of water is above this amount, this phase may be terminated.
2. When a condition related to unexpected circumstances, such a major problem on the water system due to natural disaster or unanticipated restriction on the raw water delivery system that immediately diminishes the LMWD's ability to deliver a normal water level.
3. Net storage in District's raw water reservoirs is at 25% and is continually decreasing on a daily basis such that a more serious problem may develop.
4. Water Demand is exceeding the system's capacity on a regular basis.
5. Rio Grande River level is so low that the River Pumps cannot pump the daily raw water demand.
6. All raw water is being pumped from District's Storage Reservoirs and all replenishment of Raw Water Reservoirs has stopped.
7. The availability of water rights based on quarterly capacity:

1st Quarter	24%
2nd Quarter	50%
3rd Quarter	89%

8. Contamination of the water supply and/or transmission and distribution system due to hurricanes, freezes and/or other natural disaster or man-made cause may result in extraordinary loss of capability to provide service.
9. The alternative water source for the LMWD is to purchase "water" from another system or from a retail entity.

Guidelines for Termination:

1. Phase 4 of the Drought Contingency Plan may be rescinded when the conditions listed as triggering situation have ceased to exist for a period of three (3) consecutive days. Upon termination of Phase 4, the restrictions imposed under Phase 3 and Phase 2 remains in effect.

Goal:

The goal for Stage 4 is to restrict water usage to allow the LMWD's system to recover from the emergency condition.

Water Use Restrictions:

1. Water use for non-essential purposes is prohibited.

    a. Landscape water irrigation
    b. Washing of commercial or noncommercial automobiles, trucks, boats, airplanes, and other mobile equipment.
    c. Watering of golf courses
    d. Use of fountains and artificial waterfalls.

2. The use of fire hydrants for any purpose other than fire fighting is prohibited. The Water District's General Manager may permit the use of metered fire hydrant water to clear or clean sanitary or storm sewers.
3. The use of water by golf courses for landscape irrigation is prohibited except:

a. Areas designated as tees and greens.
b. Between 7:00 p.m. and 9:00 a.m. on designated watering days.

4. Industrial customers are required to implement an individual water conservation plans. Water Conservation Plans are subject to approval by the Water District's General Manager and/or his designee.
5. If the customer already has a water connection, a new water service connection is prohibited.
6. Restaurants will be prohibited from serving water to customers except when requested by the customers.
7. The use of water for the expansion of commercial nursery facilities is prohibited.
8. No applications for new, additional, expanded or increased-in-size water service connections, meters, service lines, or other water service facilities shall be allowed, approved or installed except as directed by the Water District's General Manager.
9. Maximum amounts of monthly water usage and surcharges may be implemented during the emergency as directed by the LMWD's General Manager with approval of the water district's Board of Directors.
10. The Water District's General Manager is authorized to take any actions deemed necessary to meet conditions resulting from the emergency.
11. Violation of this policy is subject to any or all of the following:

    a. $200 fine
    b. Disconnection of service

12. Imposing of surcharges fee would be initiated.

7.2 Public Input

The District can schedule a public meeting to provide public input into the preparation and/revision of this plan.

7.3 Continued Public Information Education

The LMWD will periodically provide its customers with information about the Plan, including information about conditions under which stage of the Plan will be initiated or terminated and the drought response measures to be implemented in each stage of the Plan. A continued report and emergency measures have been established, the public will be informed of the conditions, and measures to be taken. The avenues to notify the customers or provide more details about the drought conditions include:

1. Posting the Notice of Drought conditions.
2. Letters will be sent to Mayors of Communities serve by the LMWD.
3. Local Newspaper
4. Notify Local Radio Stations.
5. Customers will be notified by mail, regular board meetings and billing statements about existing drought conditions.

7.4 Coordination with Regional Water Planning Groups

The District will be in coordination with the Lower Rio Grande Chair of Development Council at 311 North 15th, McAllen, TX 78501, for the Water Conservation and Drought Contingency Plans. A copy of the water drought contingency plan will be provided to the Regional Water Planning Group once is approved by the TCEQ and the Board of Directors of the LMWD.

7.5 Means of Implementation

The General Manager and/or his designee will be authorized by the Board of Director of the LMWD to initiate a contingency measures when a trigger condition occurs, and the District has been informed that such measure is necessary to protect public health, safety and welfare of customers.

If there is an emergency situation, such as system failure, line breaks, etc., the General Manager is authorized to take immediate actions to minimize or mitigate the risks and impacts of the water supply system.

7.6 Variances

The General Manager, or his/her designee, will consider requests of water users for special considerations and will hear and decide on such requests. In special cases, the General Manager or his/her designee is authorized to grant such variances from the terms of this Drought Contingency Plan if is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the customer or the person requesting such variance.

Persons requesting a variance from the provisions of this Plan shall file a written petition for variance with the LMWD. All petitions for variances shall be evaluated and approved by the General Manager or his/her designee.

a) Name and address of the petitioner(s)
b) Purpose of water use
c) Specific provision (s) of the Plan from which the petitioner is requesting relief
d) Description of the relief requested
e) Period of time for which the variance is sought
f) Alternative water use restriction or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date
g) Other pertinent information

Drought Contingency Plan Definitions

Aesthetic use: The use of water for fountains, waterfalls, and landscape lakes and ponds where such use is entirely ornamental and serves no other functional purpose.

Bucket: Bucket or other container holding five gallons or less, used singly by one person.

Customer: Any person, company or organization using water supplied by the City.

Drip irrigation: An irrigation system (drip, porous, pipe, etc…) that applies water at low flow levels directly to the roots of the plant.

Existing landscaping plant: A landscaping plant existing after such period of time as to accomplish an establishment and maintenance of growth.

Golf Course: An irrigated and landscaped playing area made up greens, tees, fairways, roughs, and related areas used for the playing of golf.

Hand-held hose: A hose attended by one person, fitted with a manual or automatic shutoff nozzle.

Hose-end sprinkler: A sprinkler that applies water to landscape plants that is piped through a flexible, movable hose.

Household use: The use of water, other than uses in the Outdoor category, for personal needs or for household purposes, such as drinking, bathing, heating, cooking, sanitation or cleaning, whether the use occurs in a residence or in a commercial or industrial facility.

Irrigation System: Also referred to as an in-ground or permanent irrigation system, a system with fixed pies and emitters or heads that apply water to landscape plants.

Landscape watering: The application of water to grow or maintain landscaping plants, such as flowers, ground covers, turf or grasses (other than golf courses or athletic fields), shrubs, and tree. For purposes of this division, does not include:

a. Essential use without waste of water by a commercial nursery to the extent the water is used for production rather than decorative landscaping;
b. Application of water without waste to a non-commercial family garden or orchard the produce of which is for household consumption only; and
c. Application of water in the morning before 7:00 a.m. and in the evening after 7:00 p.m. by means of a bucket (not to exceed 5 gallons in capacity), hand-held hose, soaker hose, or properly-installed drip irrigation system, immediately next to a concrete foundation solely for the purpose of preventing, and to the extent the watering is necessary to prevent, substantial damage to the foundation or the structure caused by movement of the foundation.

Landscape irrigation use: Water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns; gardens, golf courses, parks, athletic fields, and rights-of-way and medians.

Non-essential water use: Water uses that are neither essential nor required for the protection public health, safety, and welfare, including:

- Landscape irrigation use, as defined above, except otherwise provided under this Plan.
- Use of water to wash any motor vehicle, motorbike, boar, trailer, airplane, or other vehicle.
- Use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas.
- Use of water to wash down buildings or structures for purposes other than immediate fire protection.
- Flushing gutters or permitting water to run into any gutter or street.
- Use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi type pools.
- Aesthetic water use, as defined above, except where necessary to support aquatic life.
- Use of water from hydrants for construction purposes or any other purposes other than fire fighting.

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APPENDIX A

Texas Commission on Environmental Quality

TCEQ

UTILITY PROFILE & WATER CONSERVATION PLAN REQUIREMENTS FOR MUNICIPAL WATER USE BY PUBLIC WATER SUPPLIERS

This form is provided to assist entities in water conservation plan development for municipal water use by a retail public water supplier. Information from this form should be included within a water conservation plan for municipal use. If you need assistance in completing this form or in developing your plan, please contact the conservation staff of the Resource Protection Team in the Water Supply Division at (512) 239-4691.

Name of Entity: Laguna Madre Water District

Address & Zip: 105 Port Road

Telephone Number: (956) 943-2626 Fax: (956) 943-6662

Form Completed By: Maribel Hinojosa

Title: Assistant to the General Manager Date: 3/4/09

Signature ____________________

Name and Phone Number of Person/Department responsible for implementing a water conservation program:_
Arturo Martinez
Director of Operations
(956) 943-2626

UTILITY PROFILE

I. POPULATION AND CUSTOMER DATA

A. Population and Service Area Data

1. Attach a copy of your service-area map and, if applicable, a copy of your Certificate of Convenience and Necessity (CCN).

2. Service area size (square miles): 54.0 sq.mi.
3. Current population of service area: 10,469

4. Current population served:

   a. water
   b. wastewater 10,469

5. Population served by water utility for the previous five years:

Year	Population
2008	10,475
2007	10,293
2006	10,114
2005	9,938
2004	9,765

6. Projected population for service area in the following decades:
(**TABLE3:**Population Forecast)

Year	Population
2010	10,660
2020	12,020
2030	14,342
2040	16,209
2050	18,077

7. List source/method for the calculation of current and projected population:

Source data from Rio Grande Regional Water Planning Group

B. Active Connections

1. Current number of active connections.

Treated water users:	Metered	Not-metered	Total
Residential	4755		4755
Commercial	1273		1273
Industrial	3		3
Other	83		83

2. List the net number of new connections per year for most recent three years:

Year	**2008**	**2007**	**2006**

Residential	63	181	229
Commercial	58	181	229
Industrial	______	______	______
Other	1	10	2

C. High Volume Customers

List annual water use for the five highest volume customers
(indicate if treated or raw water delivery)

	Customer	Use (1,000gal./yr.)	Treated/Raw Water
(1)	SPI Golf Course	277,767,400.	Raw Water
(2)	Outdoor Resorts	58,911,800.	Treated
(3)	Texas Pack Inc.	44,874,600.	Treated
(4)	Schlitterbahn	23,826,800.	Treated
(5)	Cameron County (Park System)	22,064,600.	Treated

II. WATER USE DATA FOR SERVICE AREA

A. Water Accounting Data

1. Amount of water use for previous five years (in 1,000 gal.):
Please indicate: Diverted Water

Treated Water

Total Water in Million Gallons (MG)

Year	2008	2007	2006	2005	2004
January	89.640	87.046	88.318	87.181	75.811
February	97.738	88.890	107.297	81.599	85.260
March	126.170	104.286	99.811	110.310	106.944
April	113.256	100.824	131.138	105.191	97.263
May	120.010	110.180	117.495	119.239	106.763
June	146.330	133.030	136.899	140.378	119.739
July	128.211	135.761	152.014	160.595	155.585

August	120.080	122.652	130.688	142.084	141.046
September	83.964	91.945	95.631	99.877	97.605
October	88.851	92.271	91.975	94.024	91.858
November	82.780	91.341	85.101	80.719	77.809
December	81.099	85.236	92.975	80.935	75.365
Total	1278.129	1243.462	1329.342	1302.132	1231.048

Indicate how the above figures were determined (e.g., from a master meter located at the point of a diversion from the source or located at a point where raw water enters the treatment plant, or from water sales).

Total combined treated flow meters of WTP's 1 & 2 (Monthly Operating Reports).

2. Amount of water (in 1,000 gallons) delivered (sold) as recorded by the following account types for the past five years.

Year	Residential	Commercial	Industrial	Wholesale	Other	Total Sold
2008						1,218,521,200
2007						1,213,553,400
2006						1,291,437,200
2005						1,109,816,300
2004						1,219,136,800

**Information on this table was retrieved from the Billing Registered Report (please review Table One).*

3. List previous five years records for water loss (the difference between water diverted (or treated) and water delivered (or sold)

Year	Amount (gal.)	%
2008	59,607,800	4.7 %
2007	29,908,600	2.4 %
2006	37,904,800	2.9 %
2005	192,315,700	14.8 %
2004	11,911,200	1.0 %

Based on the final result for water loss, it appears that treated water results are understated (please review Table One as a reference).

4. Municipal water use for previous five years:

Year	Population	Total Water Diverted or Pumped for Treatment (1,000 gal.)

2008	10,475	1,278,129,000
2007	10,293	1,243,462,000
2006	10,114	1,329,342,000
2005	9,938	1,302,132,000
2004	9,765	1,231,048,000

B. Projected Water Demands

If applicable, attach projected water supply demands for the next ten years using information such as population trends, historical water use, and economic growth in the service area over the next ten years and any additional water supply requirement from such growth.

TABLE ES-9
LAGUNA MADRE WATER DISTRICT
FORECAST WATER USAGE BY CUSTOMER CLASS

Water Volume	5/8" METER	1" METER	2" METER	4" METER	6" METER	IRRIG. 5/8" METER	IRRIG. 1" METER	IRRIG. 2" METER	IRRIG. 4" METER	IRRIG. 6" METER	FIRELINE HYDRANT	FIRELINE	Total	Total Water Demand Assuming 14% Water Loss
Annual Growth Rate	*1.3%*	*1.2%*	*1.3%*	*1.5%*	*1.6%*	*1.2%*	*1.2%*	*1.2%*	*1.3%*	*#NUM!*	*1.4%*	*1.4%*	*1.3%*	*1.3%*
FY 2007-08	331,409,600	110,861,900	150,570,000	346,075,700	40,039,800	38,914,600	54,341,100	60,136,000	16,625,300	0	1,464,000	457,800	1,150,895,800	1,309,810,950
2008-09	352,598,865	115,137,744	161,912,834	325,063,120	44,365,731	38,086,418	59,091,335	76,679,336	21,032,976	0	3,838,060	3,712,049	1,201,518,468	1,367,423,572
2009-10	355,397,441	113,305,830	163,427,208	345,519,401	49,001,046	37,837,798	59,103,889	75,437,212	21,527,378	0	3,909,416	3,750,240	1,228,216,860	1,397,808,466
2010-11	356,786,884	113,462,283	163,652,869	345,996,497	49,068,707	37,794,363	59,036,042	75,350,616	21,502,667	0	3,954,358	3,793,352	1,230,398,637	1,400,291,502
2011-12	358,228,579	113,633,805	163,900,264	346,519,540	49,142,884	37,755,912	58,975,981	75,273,956	21,480,790	0	4,000,339	3,837,461	1,232,749,510	1,402,966,982
2012-13	359,723,085	113,820,452	164,169,476	347,098,711	49,223,603	37,722,427	58,923,677	75,207,199	21,461,740	0	4,047,384	3,882,590	1,235,270,343	1,405,835,891
2013-14	364,000,983	115,174,027	166,121,812	351,216,358	49,808,980	38,171,030	59,624,409	76,101,577	21,716,967	0	4,095,516	3,928,763	1,249,960,423	1,422,554,370
2014-15	368,377,779	116,558,895	168,119,232	355,439,430	50,407,889	38,630,003	60,341,341	77,016,633	21,978,095	0	4,144,761	3,976,003	1,264,990,110	1,439,659,349
2015-16	372,855,742	117,975,773	170,162,923	359,760,115	51,020,643	39,099,586	61,074,844	77,952,839	22,245,258	0	4,195,144	4,024,335	1,280,367,202	1,457,159,702
2016-17	377,437,196	119,425,397	172,253,795	364,180,657	51,647,557	39,580,021	61,825,299	78,910,682	22,518,596	0	4,246,692	4,073,783	1,296,099,676	1,475,064,509
2017-18	382,124,517	120,908,518	174,392,982	368,703,348	52,288,959	40,071,558	62,593,096	79,890,659	22,798,250	0	4,299,431	4,124,375	1,312,195,692	1,493,383,055
2018-19	386,920,136	122,425,906	176,581,594	373,330,533	52,945,179	40,574,451	63,378,632	80,893,278	23,084,366	0	4,353,388	4,176,135	1,328,663,598	1,512,124,842

III. WATER SUPPLY SYSTEM DATA

A. Water Supply Sources

List all current water supply sources and the amounts authorized with each:

	Source	Amount Authorized
Surface Water:	Rio Grande	7,300.348 acre-feet
Groundwater:		acre-feet
Contracts:		acre-feet
Other:		acre-feet

B. **Treatment and Distribution System**

1. Design daily capacity of system: 9.1 MGD
2. Storage Capacity: Elevated 1.625 MGD, Ground 1.5 MGD
3. If surface water, do you recycle filter backwash to the head of the plant? Yes X No ____. If yes, approximately .03 MGD.
4. Please attach a description of the water system. Include the number of treatment plants, wells, and storage tanks. If possible, include a sketch of the system layout.

IV. WASTEWATER SYSTEM DATA

A. **Wastewater System Data**

1. Design capacity of wastewater treatment plant(s): 5.1 MGD
2. Is treated effluent used for irrigation on-site X, off-site X, plant washdown ____, or chlorination/dechlorination X ? If yes, approximately 2.073 gallons per month.
3. Briefly describe the wastewater system(s) of the area serviced by the water utility. Describe how treated wastewater is disposed of. Where applicable, identify treatment plant(s) with the TCEQ name and number, the operator, owner, and, if wastewater is discharged, the receiving stream. If possible, attach a sketch or map which locates the plant(s) and discharge points or disposal sites.

*The **Laguna Madre Water District (LMWD)** provides regional water and wastewater services to the City of Port Isabel, the Town of South Padre Island, the Village of Laguna Vista and the unincorporated area of Laguna Heights. The LMWD maintains its own water supply system from the Rio*

Grande which supplies two water treatment plants. LMWD also operates and maintains regional wastewater facilities where wastewater ftom the service area is collected at four wastewater treatment plants. The mainland wastewater plant, located in Port Isabel was built in 1974 and is permitted to treat 1.1 mgd. The Laguna Vista Wastewater Treatment Plant was built in 2005 with a treatment capacity of 0.65 mgd. Two wastewater treatment plants are located on the island, one in Isla Blanca built in 1974 with a treatment capacity of 2.6 mgd, and one located at Andy Bowie built in 1974 with a treatment capacity of 0.75 mgd.

B. Wastewater Data for Service Area

1. Percent of water service area served by wastewater system: 100 %

2. Monthly volume treated for previous three years (in 1,000 gallons):

Year	2008	2007	2006
January	59.7900	62.5270	53.0520
February	60.6600	62.2770	51.3210
March	72.2600	76.2320	65.4540
April	60, 8110	68.7850	62.2700
May	74.4020	69.5630	64.2744
June	77.7910	85.1750	76.8180
July	97.3780	108.3680	92.2000
August	68.4180	89.7044	74.8305
September	73.8383	71.0600	62.0520
October	54.3810	71.9899	64.0560
November	49.3380	58.0710	62.1104
December	44.2485	61.877	59.4383
Total	793.3158	885.58	787.8766

REQUIREMENTS FOR WATER CONSERVATION PLANS FOR MUNICIPAL WATER USE BY PUBLIC WATER SUPPLIERS

In addition to the utility profile, a water conservation plan for municipal use by a public water supplier must include, at minimum, additional information as required by Title 30, Texas Administrative Code, '288.2. Note: If the water conservation plan does not provide information for each requirement, an explanation must be included as to why the requirement is not applicable.

Specific, Quantified 5 & 10-Year Targets

The water conservation plan must include specific, quantified five-year and ten-year targets for water savings to include goals for water loss programs and goals for ***municipal use in gallons per capita per day*** (see Appendix A). Note that the goals established by a public water supplier under this subparagraph are not enforceable.

Metering Devices

The water conservation plan must include a statement about the water supplier=s metering device(s), within an accuracy of plus or minus 5.0% in order to measure and account for the amount of water diverted from the source of supply.

Universal Metering

The water conservation plan must include and a program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

Unaccounted-For Water Use

The water conservation plan must include measures to determine and control unaccounted-for uses of water (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections; abandoned services; etc.).

Continuing Public Education & Information

The water conservation plan must include a description of the program of continuing public education and information regarding water conservation by the water supplier.

Non-Promotional Water Rate Structure

The water supplier must have a water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. This rate structure must be listed in the water conservation plan.

Reservoir Systems Operations Plan

The water conservation plan must include a reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

Enforcement Procedure & Plan Adoption

The water conservation plan must include a means of implementation and enforcement which shall be evidenced by 1) a copy of the ordinance, resolution, or tariff indicating **official adoption** of the water conservation plan by the water supplier; and 2) a description of the authority by which the water supplier will implement and enforce the conservation plan.

Coordination with the Regional Water Planning Group(s)

The water conservation plan must include documentation of coordination with the regional water planning group(s) for the service area of the public water supplier in order to ensure consistency with the appropriate approved regional water plans.

Example statement to be included within the water conservation plan:

The service area of the ____________ (name of water supplier) is located within the ___________ (name of regional water planning area or areas) and ____________ (name of water supplier) has provided a copy of this water conservation plan to the ____________ (name of regional water planning group or groups).

Additional Requirements:

required of suppliers serving population of 5,000 or more or a projected population of 5,000 or more within ten years)

1. **Program for Leak Detection, Repair, and Water Loss Accounting**

   The plan must include a description of the program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water.

2. **Record Management System**

   The plan must include a record management system to record water pumped, water deliveries, water sales, and water losses which allows for the desegregation of water sales and uses into the following user classes (residential; commercial; public and institutional; and industrial.

Plan Review and Update

Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan not later than May 1, 2009, and every five years after that date to coincide with the regional water planning group. The revised plan must also include an implementation report.

On November 2004, the Texas Water Development Board=s (TWDB) Report 362 was completed by the Water Conservation Implementation Task Force. Report 362 is the Water Conservation Best Management Practices (BMP) Guide. The BMP Guide is a voluntary list of management practices that water users may implement in addition to the required components of Title 30, Texas Administrative Code, Chapter 288. The BMP Guide is available on the TWDB's website at the link below or by calling (512) 463-7847.

http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

Appendix A

Definitions of Commonly Used Terms

Conservation B Those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

Industrial use B The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, commercial fish production, and the development of power by means other than hydroelectric, but does not include agricultural use.

Irrigation B The agricultural use of water for the irrigation of crops, trees, and pastureland, including, but not limited to, golf courses and parks which do not receive water through a municipal distribution system.

Municipal per capita water use B The sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

Municipal use B The use of potable water within or outside a municipality and its environs whether supplied by a person, privately owned utility, political subdivision, or other entity as well as the use of sewage effluent for certain purposes, including the use of treated water for domestic purposes, fighting fires, sprinkling streets, flushing sewers and drains, watering parks and parkways, and recreational purposes, including public and private swimming pools, the use of potable water in industrial and commercial enterprises supplied by a municipal distribution system without special construction to meet its demands, and for the watering of lawns and family gardens.

Municipal use in gallons per capita per day B The total average daily amount of water diverted or pumped for treatment for potable use by a public water supply system. The calculation is made by dividing the water diverted or pumped for treatment for potable use by population served. Indirect reuse volumes shall be credited against total diversion volumes for the purpose of calculating gallons per capita per day for targets and goals.

Pollution B The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

Public water supplier B An individual or entity that supplies water to the public for human consumption.

Regional water planning group B A group established by the Texas Water Development Board to prepare a regional water plan under Texas Water Code, ' 16.053.

Retail public water supplier B An individual or entity that for compensation supplies water to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants when that water is not resold to or used by others.

Reuse B The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake, or other body of state-owned water.

Water conservation plan B A strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate document identified as such or may be contained within another water management document(s).

Water loss - The difference between water diverted or treated and water delivered (sold). Water loss can result from:

1. inaccurate or incomplete record keeping;
2. meter error;
3. unmetered uses such as firefighting, line flushing, and water for public buildings and water treatment plants;
4. leaks; and
5. water theft and unauthorized use.

Wholesale public water supplier B An individual or entity that for compensation supplies water to another for resale to the public for human consumption. The term does not include an individual or entity that supplies water to itself or its employees or tenants as an incident of that employee service or tenancy when that water is not resold to or used by others, or an individual or entity that conveys water to another individual or entity, but does not own the right to the water which is conveyed, whether or not for a delivery fee.

If you have any questions on how to fill out this form or about the ____________________________ program, please contact us at 512/239-_______.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.

APPENDIX B

Laguna Madre Water District

Water and Wastewater Rate Study

and Long-Term Financial Plan

Presentation

April 4, 2009

Capex Consulting Group

Email: jsnowden@capexconsulting.com

Web site: www.capexconsulting.com

CAPEX Consulting Group Project Finance & Economics

Study Objectives

- Compare LMWD's utility rates to surrounding utilities for the purpose of assessing the potential to implement rate adjustments that will be acceptable
- Analyze the consumption patterns of all current and recommended customer classes in order to assess peak/average day demands.
- Forecast the addition of new accounts based on conservative growth estimates.
- Evaluate the planned issuance of debt obligations in order to calculate the annual cash requirements for debt service, reserve funding, and rate/additional bonds debt service coverage.
- Evaluate operations, maintenance and capital costs for the current fiscal year and generate forecasts throughout the amortization periods of the proposed debt.
- Employ AWWA M1 cost of service methodology in order to provide a just and reasonable rate design for each defined customer class

CAPEX

LAGUNA MADRE WATER DISTRICT
WATER & WASTEWATER COST OF SERVICE AND RATE DESIGN STUDY
SUMMARY OF WATER REVENUES & EXPENDITURES

	2004-05	2005-06	2006-07 Actual	2007-08 Actual	2008-09 Forecast	AVG. ANNUAL GROWTH
OPERATING REVENUE						
Metered Water Sales	$3,520,027	$3,891,449	$4,036,585	$4,034,876	$3,977,735	3%
Bulk Water Sales	$16,378	$50,760	$19,825	$8,716	$18,792	3%
Total Other Charges for Services	$639,022	$772,425	$916,567	$1,015,518	$499,583	-6%
Total Operating Revenues	$4,175,427	$4,714,634	$4,972,977	$5,059,110	$4,496,110	2%
OPERATING EXPENSES						
WATER PLANT	$951,297	$1,093,509	$1,142,571	$1,223,077	$1,414,315	10%
DISTRIBUTION	$328,001	$356,607	$393,691	$601,979	$585,967	16%
MAINTENANCE	$265,934	$257,404	$227,714	$199,110	$212,474	-5%
LABORATORY	$102,356	$119,295	$126,913	$137,971	$153,497	11%
ADMINISTRATION	$649,532	$653,901	$658,434	$422,892	$483,368	-7%
SUPPORT SERVICES	$0	$0	$0	$169,611	$194,504	
FINANCE DEPARTMENT	$0	$0	$0	$230,691	$294,760	
Total Operating Expenditures	$2,297,120	$2,481,056	$2,569,323	$3,195,931	$3,338,914	10%

LAGUNA MADRE WATER DISTRICT
WATER & WASTEWATER COST OF SERVICE AND RATE DESIGN STUDY
SUMMARY OF SEWER REVENUES & EXPENDITURES

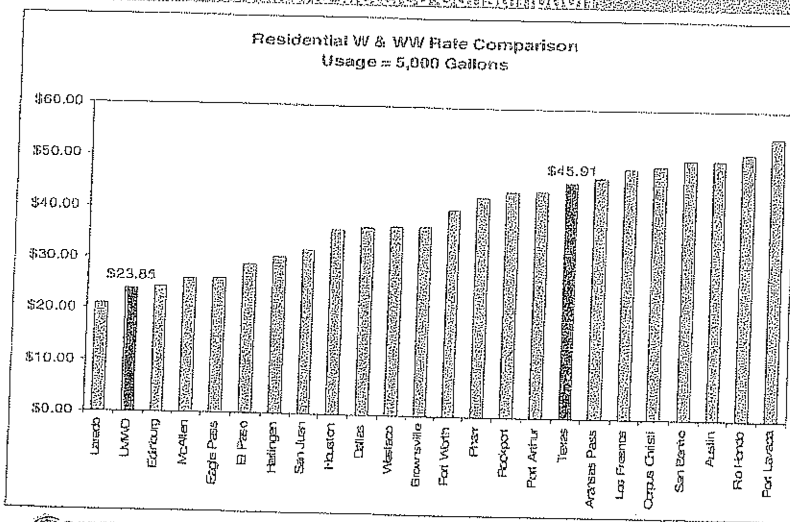
	2004-05	2005-06	2006-07 Actual	2007-08 Actual	2008-09 Forecast	AVG. ANNUAL GROWTH
OPERATING REVENUE						
Sewer Service Charges	$2,443,513	$2,620,224	$2,609,285	$2,664,161	$2,715,369	2.7%
Total Other Charges for Services	$252,082	$305,571	$347,791	$471,436	$117,967	-17%
Total Operating Revenues	$2,695,595	$2,925,795	$2,957,076	$3,135,597	$2,833,336	1%
OPERATING EXPENSES						
LIFT STATIONS	$493,529	$455,698	$489,770	$277,145	$447,774	-2%
COLLECTIONS	$357,521	$322,231	$430,550	$383,252	$397,655	0%
MAINTENANCE	$170,068	$171,097	$151,316	$132,307	$141,188	-5%
LABORATORY	$69,015	$79,265	$84,334	$91,681	$101,998	11%
ADMINISTRATION	$431,612	$434,516	$444,172	$260,879	$321,196	-7%
WASTEWATER TREATMENT PLANT	$576,416	$582,325	$645,817	$1,082,820	$1,163,542	19%
SUPPORT SERVICES	$0	$0	$0	$112,706	$129,267	
FINANCE DEPARTMENT	$0	$0	$0	$135,350	$158,909	
Total Operating Expenditures	$2,097,161	$2,045,122	$2,245,959	$2,486,140	$2,861,730	8%

Comparison of Raw Water Pumped, Water Treated, Metered and Sold, and Net Flows to WWTPs

LAGUNA MADRE WATER DISTRICT
COMPARISON OF PRODUCTION & TREATMENT

	Raw Water Pumpage	Treated Water Pumped	Percent of Raw Water Treated & Distributed	Metered Water Consumption	Percent of Raw Water Sold	Percent of Treated Water Sold	Influent to WWTP(s)	Percent of Water Sold to WWTP(s)
FY 2000-01	1,290,441	1,230,571	95%	1,030,822	80%	84%	510,288	50%
FY 2001-02	1,311,619	1,269,581	97%	1,026,250	78%	81%	723,070	70%
FY 2002-03	1,266,014	1,200,503	95%	1,007,764	80%	84%	806,449	80%
FY 2003-04	1,292,615	1,217,743	94%	1,015,806	79%	83%	897,170	88%
FY 2004-05	1,355,589	1,291,486	95%	1,164,287	86%	90%	784,677	67%
FY 2005-06	1,409,921	1,314,969	93%	1,173,770	83%	89%	771,610	66%
FY 2006-07	1,320,369	1,244,665	94%	1,110,683	84%	89%	879,296	79%
FY 2007-08	1,390,531	1,294,247	93%	1,150,896	83%	89%	837,237	73%
AVERAGE	1,329,637	1,257,971	95%	1,085,035	82%	86%	776,225	75%
AVG. ANNUAL RATE OF GROWTH	0.4%	0.3%		0.7%			6.2%	

Water & Wastewater 5/8" Meter Monthly Rate Comparison at 5,000 Gallons Metered Consumption



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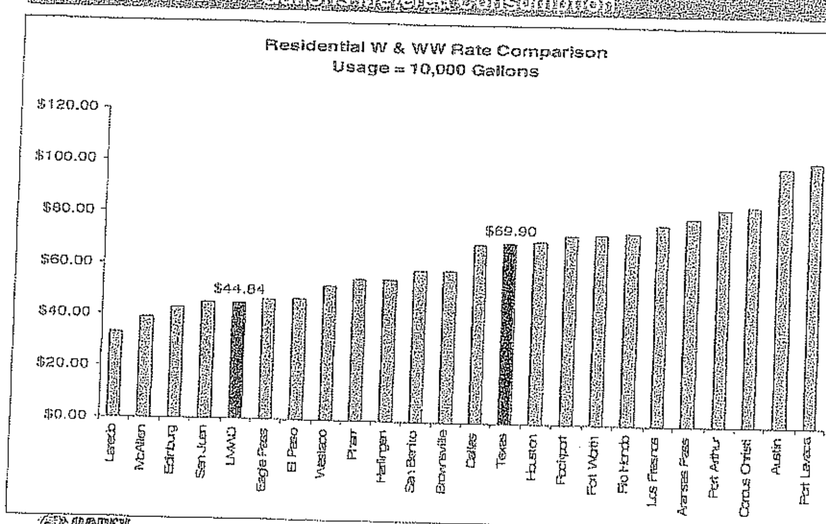
Water & Wastewater 5/8" Meter Monthly Rate Comparison at 10,000 Gallons Metered Consumption



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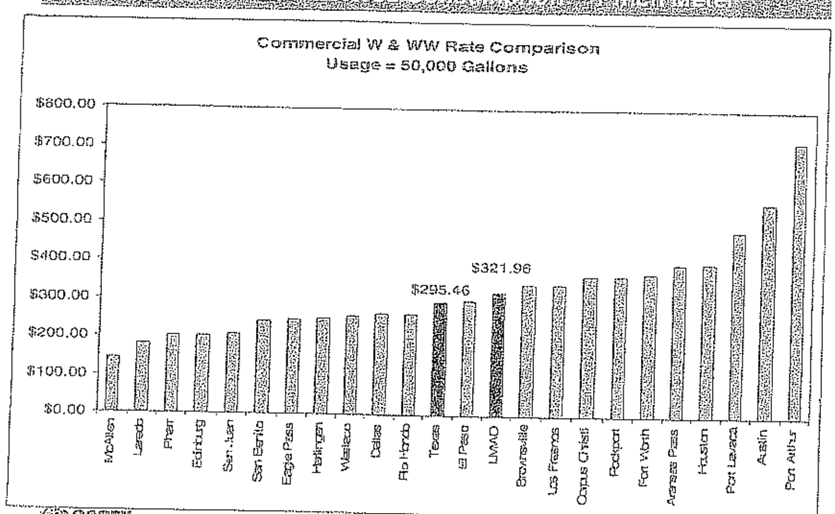
Comparison of Combined Res. Rate as % Median Household Income

LAGUNA MADRE WATER DISTRICT
WATER & WW RATE TO MHI COMPARISON

SYSTEM	MEDIAN HOUSEHOLD INCOME 2008	COMBINED RESIDENTIAL: Combined W & WW Rate @ 10,000 gallons — Monthly	Annual	% of 2008 MHI (10,000 gal)
Laredo	$33,282	$33.04	$396.48	1.19%
McAllen	$38,465	$39.00	$468.00	1.22%
El Paso	$36,730	$46.74	$560.88	1.53%
Edinburg	$33,087	$42.63	$511.56	1.55%
LMWD	$30,033	$44.84	$538.05	1.79%
Texas	$45,652	$69.90	$838.79	1.84%
Harlingon	$34,640	$55.05	$660.60	1.91%
Dallas	$43,023	$69.02	$828.24	1.93%
Eagle Pass	$28,067	$46.27	$555.24	1.98%
Houston	$41,866	$70.66	$847.92	2.03%
Weslaco	$30,383	$52.08	$624.96	2.06%
San Juan	$25,962	$44.80	$537.60	2.07%
Fort Worth	$42,390	$73.67	$884.04	2.09%
Rockport	$38,855	$73.37	$880.44	2.27%
San Benito	$30,033	$58.23	$698.76	2.33%
Pharr	$27,822	$54.80	$657.60	2.36%
Corpus Christi	$41,635	$85.03	$1,020.36	2.45%
Austin	$48,810	$100.20	$1,202.40	2.46%
Aransas Pass	$38,855	$80.29	$963.48	2.48%
Brownsville	$27,976	$58.65	$703.80	2.52%
Port Lavaca	$42,449	$102.53	$1,230.36	2.90%
Rio Hondo	$30,033	$74.43	$893.16	2.97%
Los Fresnos	$30,033	$77.60	$931.20	3.10%
Port Arthur	$30,248	$83.82	$1,005.84	3.33%
Peer Group Average	$35,430	$64.03	$768.32	2.18%

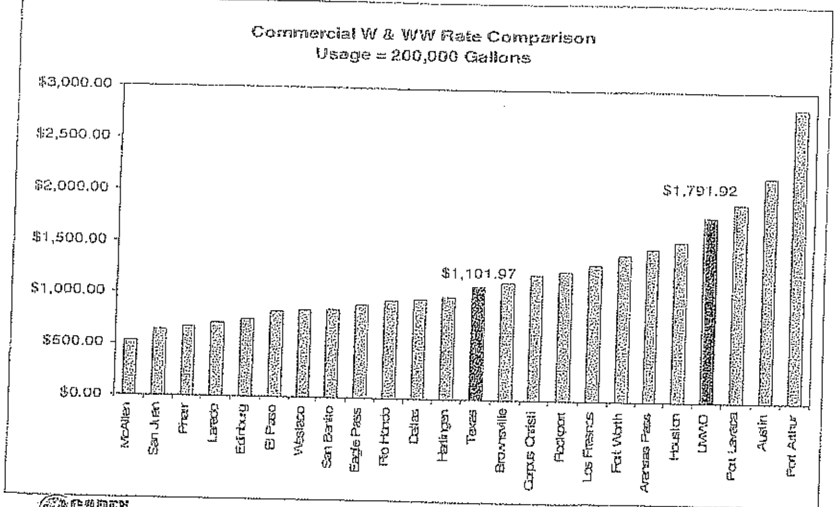
CAPEX

Water & Wastewater Commercial Monthly Rate Comparison at 50,000 Gallons Metered Consumption – 1 Inch Meter

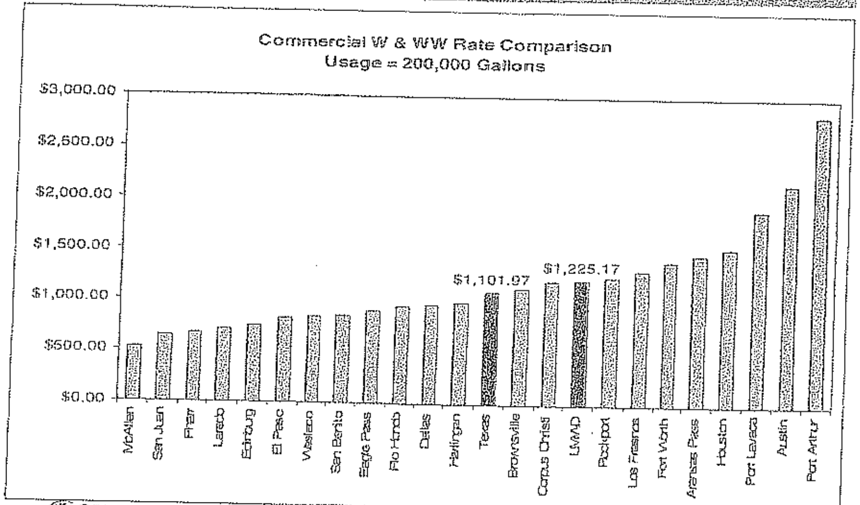


CAPEX

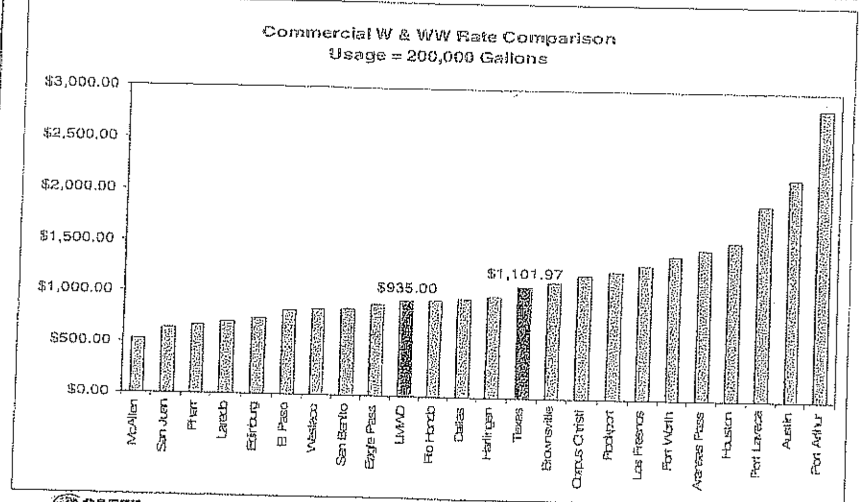
Water & Wastewater Monthly Rate Comparison at 200,000 Gallons Metered Consumption – 1 inch Meter



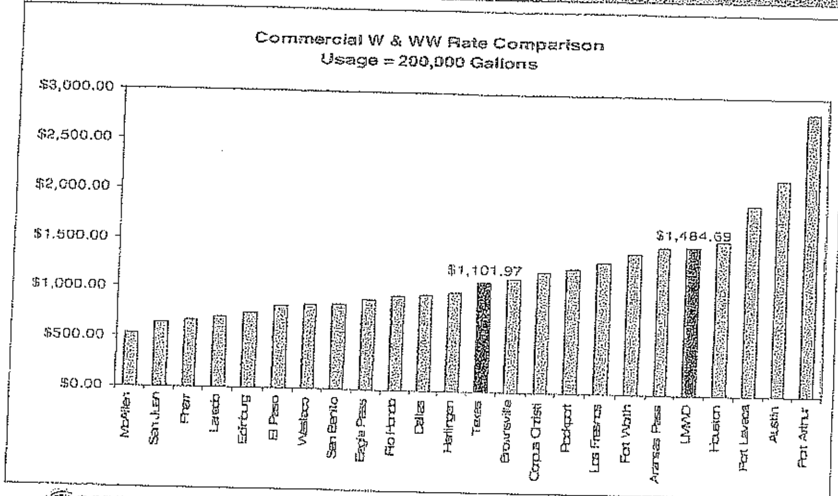
Water & Wastewater Monthly Rate Comparison at 200,000 Gallons Metered Consumption – 2 inch Meter



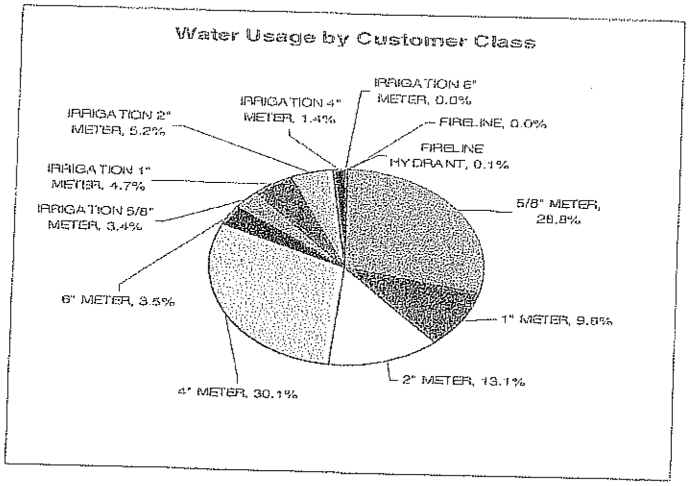
Water & Wastewater Monthly Rate Comparison at 200,000 Gallons Metered Consumption – 4 Inch Meter



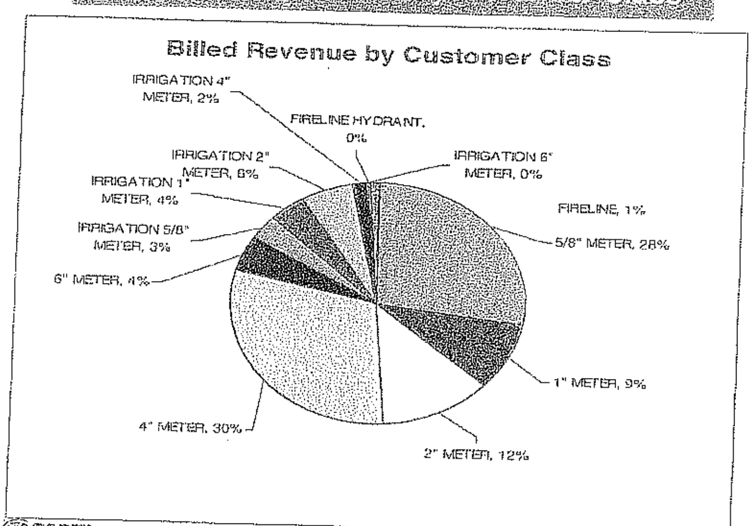
Water & Wastewater Monthly Rate Comparison at 200,000 Gallons Metered Consumption – 6 Inch Meter

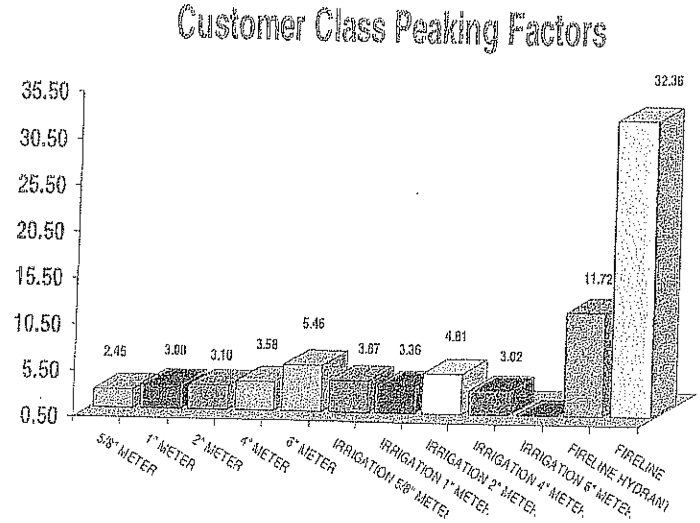


Metered Water Usage by Customer Class



Billed Water Revenue by Customer Class





CAPEX

COMPARISON OF AVERAGE MONTHLY RESIDENTIAL METERED CONSUMPTION

LAGUNA MADRE WATER DISTRICT
COMPARISON OF AVERAGE RESIDENTIAL METERED CONSUMPTION

SYSTEM	AVERAGE MONTHLY CONSUMPTION	% LMWD CONSUMPTION
Rio Hondo	3,000	43.8%
Port Arthur	4,500	65.7%
Aransas Pass	4,800	70.1%
Port Lavaca	5,000	73.0%
Corpus Christi	6,000	87.6%
San Juan	6,000	87.6%
LMWD	6,851	100.0%
Texas	6,858	100.1%
Houston	7,000	102.2%
San Benito	7,000	102.2%
Harlingen	7,077	103.3%
Fort Worth	7,173	104.7%
Rockport	7,500	109.5%
Brownsville	8,000	116.8%
Los Fresnos	8,000	116.8%
Dallas	8,300	121.1%
Austin	8,500	124.1%
Edinburg	8,500	124.1%
Pharr	8,500	124.1%
Eagle Pass	9,000	131.4%
Laredo	9,202	134.3%
El Paso	9,920	144.8%
McAllen	11,000	160.6%
Weslaco	13,000	189.7%
Peer Group Average	7,528	
LMWD Gallons Over / (Under) Average	677	

CAPEX

LAGUNA MADRE WATER DISTRICT
2008 WATER & WASTEWATER COST OF SERVICE AND RATE DESIGN STUDY
AVERAGE WATER CONSUMPTION PER CUSTOMER CLASS

Customer Class	5/8" METER			1" METER			2" METER		
	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account
FY 1999-00	277,125,000	3,085	7,467	78,750,800	350	18,759	166,503,800	157	89,709
FY 2007-08	331,409,600	4,318	6,396	110,861,500	740	12,487	150,570,000	208	60,252
Average Growth Rate	2.26%	4.29%	-1.96%	4.37%	9.81%	-4.96%	-1.26%	3.63%	-4.72%
Average Cons. per Account			6,851			14,404			71,268

Customer Class	4" METER			6" METER			IRRIGATION 5/8" METER		
	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account
FY 1999-00	314,143,400	57	463,336	79,520,930	22	303,511	10,796,500	87	10,332
FY 2007-08	346,075,790	73	397,331	40,039,500	13	258,321	38,914,600	281	11,534
Average Growth Rate	1.22%	3.16%	-1.90%	-6.22%	-6.35%	-2.00%	17.38%	15.78%	1.39%
Average Cons. per Account			399,672			313,116			11,535

CAPEX

LAGUNA MADRE WATER DISTRICT
2005 WATER & WASTEWATER COST OF SERVICE AND RATE DESIGN STUDY
AVERAGE WATER CONSUMPTION PER CUSTOMER CLASS

Customer Class	IRRIGATION 1" METER			IRRIGATION 2" METER			IRRIGATION 4" METER		
	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account
FY 1999-00	14,200,500	44	26,643	35,262,300	18	167,120	22,857,500	1	1,904,800
FY 2007-08	54,341,100	236	15,175	60,136,000	56	89,489	16,625,300	3	461,814
Average Growth Rate	18.26%	23.23%	-4.03%	6.90%	15.52%	-7.46%	-3.90%	14.72%	-16.23%
Average Cons. per Account			21,111			126,360			941,553

Customer Class	IRRIGATION 6" METER			FIRELINE HYDRANT			FIRELINE		
	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account	Total Consumption	Avg. No. of Accts	Average Consumption per Account
FY 1999-00	0	0	0	2,799,200	8	30,426	123,600	29	361
FY 2007-08	0	0	0	1,464,000	10	12,642	457,800	64	593
Average Growth Rate	0.00%	0.00%	0.00%	-7.78%	2.72%	-10.22%	17.78%	10.71%	6.39%
Average Cons. per Account			0			29,216			5,372

Customer Class	TOTAL		
	Total Consumption	Avg. No. of Accts	Average Consumption per Account
FY 1999-00	1,002,253,100	3,855	21,063
FY 2007-08	1,130,895,800	6,001	15,961
Average Growth Rate	1.74%	5.69%	-3.73%
Average Cons. per Account			18,764

CAPEX

LAGUNA MADRE WATER DISTRICT
WATER & WW ACCOUNTS BY CUSTOMER CLASS

	FY 1999-00 Average	FY 2000-01 Average	FY 2001-02 Average	FY 2002-03 Average	FY 2003-04 Average	FY 2004-05 Average	FY 2005-06 Average	FY 2006-07 Average	FY 2007-08 Average	Average Annual Rate of Growth	Average No. of New Accounts per Annum
WATER											
5/8" METER	3,085	3,192	3,311	3,449	3,584	3,759	3,976	4,195	4,310	4.3%	154
1" METER	350	382	431	477	538	807	665	709	740	9.0%	49
2" METER	157	166	170	170	175	181	190	205	208	3.6%	6
4" METER	57	61	66	72	70	68	63	71	73	3.2%	2
6" METER	22	27	31	32	20	27	24	15	13	-6.4%	-1
IRRIGATION 5/8" METER	67	80	97	112	129	151	212	253	201	15.8%	24
IRRIGATION 1" METER	44	65	96	110	120	139	174	212	236	23.2%	24
IRRIGATION 2" METER	16	18	22	23	29	36	41	47	56	15.5%	5
IRRIGATION 4" METER	1	1	1	2	2	2	2	3	3	14.7%	0
IRRIGATION 6" METER	0	0	0	0	0	0	0	0	0		
FIRELINE HYDRANT	8	12	11	11	11	13	10	12	10	2.7%	0
FIRELINE	29	25	26	28	34	40	46	58	64	10.7%	4
Total Water	3,866	4,046	4,259	4,480	4,723	5,033	5,403	5,780	6,001	5.7%	268
Annual Rate of Increase		5.0%	5.3%	5.2%	5.4%	6.4%	7.6%	7.0%	3.6%		
WASTEWATER											
5/8" METER	2,991	3,068	3,162	3,277	3,403	3,563	3,751	3,826	4,016	3.8%	128
1" METER	325	356	375	411	453	504	546	573	595	7.9%	34
2" METER	144	147	145	148	148	156	152	151	151	0.7%	1
4" METER	51	53	52	53	52	54	49	52	53	0.6%	0
6" METER	21	23	23	23	23	24	24	23	23	1.5%	0
IRRIGATION 5/8" METER	13	13	14	14	14	13	10	30	35	13.5%	3
IRRIGATION 1" METER	0	0	0	10	12	14	18	24	27		3
IRRIGATION 2" METER	0	0	0	13	16	19	25	31	35		4
IRRIGATION 4" METER	0	0	0	7	11	14	14	16	16		2
IRRIGATION 6" METER	1	2	2	2	2	2	2	5	6	24.4%	1
Total Wastewater	3,546	3,661	3,774	3,958	4,133	4,357	4,595	4,832	4,958	4.3%	177
Annual Rate of Increase		3.3%	3.1%	4.9%	4.4%	5.4%	5.5%	5.2%	2.6%		
SYSTEM TOTAL	7,400	7,707	8,033	8,438	8,856	9,360	9,998	10,612	10,959	5.0%	445
Annual Rate of Increase		4.1%	4.2%	5.0%	5.0%	5.9%	6.6%	6.1%	3.3%		

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LAGUNA MADRE WATER DISTRICT
FORECAST AVERAGE CONSUMPTION NET OF CONSUMPTION DECLINES

	5/8" METER	1" METER	2" METER	4" METER	2" METER	4" METER	6" METER	TOTAL	
Assumed Annual Elasticity of Water Demand	0.75%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%		
FY 2007-08 Avg. Mon. Consumption	7,917	12,724	66,700	390,869	66,700	390,869	311,207	789,437	
FY 2008-09 Avg. Mon. Consumption	7,857	12,597	66,033	386,960	66,033	386,960	308,095	781,563	-1.0%
FY 2009-10 Avg. Mon. Consumption	7,798	12,471	65,373	383,110	65,373	383,110	305,014	773,767	-1.0%
FY 2010-11 Avg. Mon. Consumption	7,740	12,346	64,719	379,279	64,719	379,279	301,964	766,049	-1.0%
FY 2011-12 Avg. Mon. Consumption	7,682	12,223	64,072	375,486	64,072	375,486	298,945	758,407	-1.0%
FY 2012-13 Avg. Mon. Consumption	7,624	12,101	63,431	371,731	63,431	371,731	295,955	750,843	-1.0%

CAPEK

LAGUNA MADRE WATER DISTRICT
SUMMARY OF CURRENT OUTSTANDING DEBT

ISSUE	Original Amount Issued	Range of Interest Rates	Bal. End of FY 2008-09	% Allocated to Water	% Allocated To WW
Series 1999 Unlimited Tax Bonds	$2,600,000	4.6% - 4.7%	$170,000	0%	100%
Series 2000 Unlimited Tax Bonds	$3,800,000	5.65% - 7.1%	$1,655,000	50%	50%
Series 2001 Unlimited Tax Bonds	$2,600,000	4% - 7%	$1,110,000	50%	50%
Series 2002 Unlimited Tax Bonds	$4,275,000	4% - 4.6%	$0	50%	50%
Series 2005-A USDA Loan	$1,163,000	4.720%	$1,097,000	0%	100%
Series 2005 USDA Loan	$650,000	4.250%	$610,000	100%	0%
Series 2007 WW & SS Revenue Notes	$9,815,000	4% - 4.5%	$8,545,000	50%	50%
Series 2008 Unlimited Tax Refunding Bonds	$2,860,000	4.04%	$1,835,000	50%	50%
TOTAL	$27,463,000		$15,022,000	$7,182,500	$7,839,500

	Begin Period Debt	Less Refundings	Plus Additions	Principal	Interest	Total Debt Service	Ending Principal
2008-09	$17,771,000	$2,860,000	$2,860,000	$2,749,000	$774,560	$3,523,560	$15,022,000
2009-10	$15,022,000	$0	$0	$2,960,000	$667,783	$3,627,783	$12,062,000
2010-11	$12,062,000	$0	$0	$775,000	$546,936	$1,321,936	$11,287,000
2011-12	$11,287,000	$0	$0	$436,000	$514,570	$950,570	$10,851,000
2012-13	$10,851,000	$0	$0	$457,000	$495,604	$952,604	$10,394,000
2019-20	$6,076,000	$0	$0	$768,000	$276,573	$1,044,573	$5,308,000
2020-21	$5,308,000	$0	$0	$519,000	$246,493	$765,493	$4,789,000
2026-27	$1,799,000	$0	$0	$685,000	$84,928	$769,928	$1,114,000
2041-42	$236,000	$0	$0	$87,000	$10,610	$97,610	$149,000
2042-43	$149,000	$0	$0	$89,000	$6,628	$95,628	$60,000
2043-44	$60,000	$0	$0	$30,000	$2,550	$32,550	$30,000
2044-45	$30,000	$0	$0	$30,000	$1,275	$31,275	$0
2045-46	$0	$0	$0	$0	$0	$0	$0

CAPEX

LAGUNA MADRE WATER DISTRICT
SUMMARY OF CURRENT OUTSTANDING DEBT

ISSUE	Original Amount Issued	Range of Interest Rates	Bal. End of FY 2008-09	% Allocated to Water	% Allocated To WW
Series 2007 WW & SS Revenue Notes	$9,815,000	4% - 4.5%	$8,545,000	50%	50%
TOTAL	$9,815,000		$8,545,000	$4,272,500	$4,272,500

	Begin Period Debt	Less Refundings	Plus Additions	Principal	Interest	Total Debt Service	Ending Principal
2008-09	$9,220,000	$0	$0	$675,000	$397,881	$1,072,881	$8,545,000
2009-10	$8,545,000	$0	$0	$700,000	$370,881	$1,070,881	$7,845,000
2010-11	$7,845,000	$0	$0	$325,000	$342,881	$667,881	$7,520,000
2011-12	$7,520,000	$0	$0	$340,000	$329,881	$669,881	$7,180,000
2012-13	$7,180,000	$0	$0	$355,000	$316,281	$671,281	$6,825,000
2019-20	$4,375,000	$0	$0	$465,000	$202,956	$667,956	$3,910,000
2020-21	$3,910,000	$0	$0	$485,000	$182,613	$667,613	$3,425,000
2026-27	$640,000	$0	$0	$640,000	$32,000	$672,000	$0
2041-42	$0	$0	$0	$0	$0	$0	$0

CAPEX

LAGUNA MADRE WATER DISTRICT
C.I.P SUMMARY - WATER [2008 DOLLARS]

	2007-08	2009-10	2010-15	Total	Funding Source
Reservoir IV Pump Station	$0	$0	$5,000,000	$5,000,000	G.O. Debt
Cuales Pump Station	$22,500	$0	$825,000	$847,500	G.O. Debt
WTP No. 2 Chemical feed System	$0	$0	$250,000	$250,000	G.O. Debt
WTP No. 2 Raw Water Pump Station	$0	$0	$300,000	$300,000	G.O. Debt
WTP No. 2 Transfer Pump Station	$0	$0	$300,000	$300,000	G.O. Debt
WTP No. 1 High Service Pump Station	$0	$0	$100,000	$100,000	G.O. Debt
WTP No. 1 Hydraulic Improvements	$0	$0	$150,000	$150,000	G.O. Debt
WTP No. 1 Raw Water Pumps	$0	$0	$150,000	$150,000	G.O. Debt
WTP No. 1 Clarifier Improvements	$0	$0	$150,000	$150,000	G.O. Debt
WTP No. 1 Rapid Mix Improve.	$0	$0	$600,000	$600,000	G.O. Debt
Water Main Replacement	$0	$183,750	$7,500,000	$7,683,750	G.O. Debt
Water Valve Replacement	$0	$90,000	$320,000	$410,000	G.O. Debt
Water Tank Rehabilitation	$0	$1,500,000	$2,500,000	$4,000,000	G.O. Debt
Issuance Costs		$500,000		$500,000	G.O. Debt
WTP No. 2 Rehab Clarifiers	$0	$1,500,000	$0	$1,500,000	G.O. Debt
WTP No. 2 Filtration System	$0	$3,875,000	$0	$3,875,000	G.O. Debt
WTP No. 2 Engineering	$0	$806,250	$0	$806,250	G.O. Debt
WTP No. 2 Contingency	$0	$645,000	$0	$645,000	G.O. Debt
Desal Plant			$0	$0	G.O. Debt / Revenue Bond
Sub Total	$22,500	$9,100,000	$18,145,000	$27,267,500	
WTP No. 2 Chlorine Bldg. (Jib Crane)	$20,000	$0	$0	$20,000	System Revenue
Elevated Storage Tank	$300,000			$300,000	System Revenue
Sub Total	$320,000	$0	$0	$320,000	
TOTAL	$342,500	$9,100,000	$18,145,000	$27,587,500	

LAGUNA MADRE WATER DISTRICT
C.I.P SUMMARY - SEWER [2008 DOLLARS]

	2007-08	2009-10	2010-15	Total	Funding Source
Sewage Main Rehabilitation	$0	$175,000	$3,500,000	$3,675,000	G.O. Bond
Manhole Rehabilitation	$0	$125,000	$250,000	$375,000	G.O. Bond
Issuance Costs		$500,000		$500,000	G.O. Bond
Sub Total	$0	$800,000	$3,750,000	$4,550,000	
Sewage Lift Stations	$0	$100,000	$0	$100,000	System Revenue
Odor Control	$40,000	$0	$0	$40,000	System Revenue
WW Line Repair	$40,000	$0	$0	$40,000	System Revenue
Manhole Repair	$50,000	$0	$0	$50,000	System Revenue
I & I	$250,000	$0	$0	$250,000	System Revenue
Sub Total	$380,000	$100,000	$0	$480,000	
TOTAL	$380,000	$900,000	$3,750,000	$5,030,000	

LAGUNA MADRE WATER DISTRICT
SUMMARY OF PROPOSED DEBT

ISSUE	Original Amount Issued	Range of Interest Rates	Bal. End of FY 2008-09	% Allocated to Water	% Allocated To WW
Series 2010 WW & SS Revenue Notes	$12,255,000	3.6% - 6.41%	$0	100%	0%
TOTAL	$12,255,000		$0	$0	$0

	Begin Period Debt	Less Refundings	Plus Additions	Principal	Interest	Total Debt Service	Ending Principal
2009-10	$0	$0	$0	$0	$0	$0	$0
2010-11	$0	$0	$12,255,000	$400,000	$663,670	$1,063,670	$11,855,000
2011-12	$11,855,000	$0	$0	$385,000	$676,124	$1,061,124	$11,470,000
2022-23	$6,510,000	$0	$0	$655,000	$409,438	$1,064,438	$5,855,000
2028-29	$1,940,000	$0	$0	$940,000	$124,166	$1,064,166	$1,000,000
2029-30	$1,000,000	$0	$0	$1,000,000	$64,100	$1,064,100	$0

CAPEX

LAGUNA MADRE WATER DISTRICT
30 YEAR FORECAST WATER ACCOUNTS

Water Accounts	5/8" METER	1" METER	2" METER	4" METER	6" METER	IRRIGATION 5/8" METER	IRRIGATION 1" METER	IRRIGATION 2" METER	IRRIGATION 4" METER	IRRIGATION 6" METER	FIRELINE HYDRANT	FIRELINE	Total	New Accounts per Annum
Average Annual Growth Rate	1.4%	1.3%	1.4%	1.6%	1.7%	1.4%	1.4%	1.4%	1.5%		1.4%	1.4%	1.4%	
2008-09	4,321	762	204	70	12	293	242	56	3	0	10	66	6,037	36
2009-10	4,369	757	208	75	13	291	245	50	3	0	10	67	6,116	79
2010-11	4,439	765	211	76	14	295	248	56	3	0	10	67	6,155	79
2011-12	4,491	775	213	77	14	299	250	59	3	0	10	59	6,250	72
2012-13	4,540	784	216	78	14	302	253	60	3	0	10	60	6,332	74
2013-14	4,597	793	218	79	14	305	256	61	3	0	10	70	6,407	75
2018-19	4,887	843	232	84	15	325	273	64	3	0	11	74	6,811	84
2023-24	5,311	916	252	91	16	353	295	70	4	0	12	81	7,402	130
2028-29	5,801	1,001	275	99	18	385	324	76	4	0	13	88	8,085	142
2033-34	6,200	1,070	294	106	19	412	345	82	4	0	14	91	8,640	135
2038-39	6,592	1,137	313	113	20	438	380	87	5	0	15	100	9,187	112
Average New Accounts per Annum														103

CAPEX

LAGUNA MADRE WATER DISTRICT
30 YEAR FORECAST WW ACCOUNTS

Wastewater Accounts	5/8" METER	1" METER	2" METER	4" METER	6" METER	IRRIGATION 5/8" METER	IRRIGATION 1" METER	IRRIGATION 2" METER	IRRIGATION 4" METER	IRRIGATION 6" METER	Total	New Accounts per Annum
Average Annual Growth Rate	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	*1.4%*	
2008-09	4,028	611	146	52	23	36	27	37	16	5	4,962	4
2009-10	4,091	608	163	57	25	32	27	34	15	5	5,047	85
2010-11	4,128	615	165	58	26	32	27	35	15	5	5,105	58
2011-12	4,176	622	167	58	26	33	27	35	15	5	5,164	59
2012-13	4,225	629	169	59	26	33	28	35	15	6	5,225	61
2013-14	4,275	637	171	60	27	34	28	36	16	6	5,287	62
2018-19	4,544	677	182	64	29	36	30	38	16	6	5,620	70
2023-24	4,938	735	197	69	31	39	32	41	18	6	6,108	107
2028-29	5,394	803	216	75	33	42	35	45	20	7	6,672	117
2033-34	5,765	859	230	81	36	45	38	48	21	8	7,130	87
2038-39	6,129	913	245	86	38	48	40	51	22	8	7,581	93
Average New Accounts per Annum												85

CAPEK

LAGUNA MADRE WATER DISTRICT
FORECAST OPERATING & CAPITAL COSTS

WATER SYSTEM	Personnel		Operating		Capital Outlays		Total		Avg. Annual % Change
	Value	% Increase	Value	% Increase	Value	% Increase	Value	% Increase	
2008-09	$1,760,783		$1,501,609		$194,386		$3,456,778		
2009-10	$1,866,070	6.0%	$1,491,940	-0.6%	$199,246	2.5%	$3,557,256	2.9%	
2013-14	$2,099,669	3.0%	$1,669,661	2.9%	$219,930	2.5%	$3,989,259	2.9%	
2014-15	$2,162,504	3.0%	$1,717,451	2.9%	$225,428	2.5%	$4,105,383	2.9%	
2020-21	$2,501,051	3.0%	$2,035,664	2.9%	$281,428	2.5%	$4,878,142	2.9%	
2026-27	$3,080,643	3.0%	$2,415,257	2.9%	$302,176	2.5%	$5,799,076	2.9%	
2032-33	$3,676,981	3.0%	$2,868,095	2.9%	$351,591	2.5%	$6,896,666	2.9%	
2038-39	$4,368,804	3.0%	$3,408,336	2.9%	$407,738	2.5%	$8,204,880	2.9%	2.9%
WW SYSTEM	Personnel		Operating		Capital Outlays		Total		Avg. Annual % Change
	Value	% Increase	Value	% Increase	Value	% Increase	Value	% Increase	
2008-09	$1,547,677		$1,209,833		$257,402		$3,015,112		
2009-10	$1,637,451	5.8%	$1,220,848	0.9%	$263,837	2.5%	$3,122,136	3.5%	
2013-14	$1,842,670	3.0%	$1,367,490	2.9%	$291,227	2.5%	$3,501,387	2.9%	
2014-15	$1,897,875	3.0%	$1,406,927	2.9%	$298,507	2.5%	$3,603,310	2.9%	
2020-21	$2,265,633	3.0%	$1,669,546	2.9%	$346,177	2.5%	$4,281,367	2.9%	
2026-27	$2,704,671	3.0%	$1,982,882	2.9%	$401,459	2.5%	$5,089,012	2.9%	
2032-33	$3,228,807	3.0%	$2,356,745	2.9%	$465,570	2.5%	$6,051,122	2.9%	
2038-39	$3,854,539	3.0%	$2,802,846	2.9%	$539,918	2.5%	$7,197,303	2.9%	2.9%
TOTAL SYSTEM	Personnel		Operating		Capital Outlays		Total		Avg. Annual % Change
	Value	% Increase	Value	% Increase	Value	% Increase	Value	% Increase	
2008-09	$3,308,660		$2,711,442		$451,788		$6,471,890		
2009-10	$3,503,521	5.9%	$2,712,788	0.0%	$463,083	2.5%	$6,679,392	3.2%	
2013-14	$3,942,339	3.0%	$3,037,150	2.9%	$511,157	2.5%	$7,490,646	2.9%	
2014-15	$4,060,379	3.0%	$3,124,378	2.9%	$523,936	2.5%	$7,708,693	2.9%	
2020-21	$4,846,684	3.0%	$3,705,210	2.9%	$607,605	2.5%	$9,159,499	2.9%	
2026-27	$5,785,314	3.0%	$4,398,139	2.9%	$704,635	2.5%	$10,888,088	2.9%	
2032-33	$6,905,767	3.0%	$5,224,840	2.9%	$817,161	2.5%	$12,947,768	2.9%	
2038-39	$8,243,343	3.0%	$6,211,184	2.9%	$947,656	2.5%	$15,402,183	2.9%	2.9%

CAPEK

LAGUNA MADRE WATER DISTRICT
RESERVE FUNDING DETAIL

TOTAL SYSTEM	O&M Reserve				Debt Service Reserve		RS Reserve	TOTAL RESERVES	
	Annual Contrib	Cum. Balance	Budgeted O&M	Days Reserve on Hand	Annual Contrib	Cum. Balance	Annual Contrib	Annual Contrib	Cum. Balance
Begin Balance	$0	$0			$0	$0	$0	$0	$0
2009-10	$0	$0	$5,700,351	0	$0	$0	$0	$0	$0
2010-11	$0	$0	$5,902,020	0	$212,388	$212,388	$0	$212,388	$212,388
2011-12	$0	$0	$6,110,877	0	$212,388	$424,775	$0	$212,388	$424,775
2012-13	$208,017	$208,017	$6,327,178	12	$212,388	$637,163	$80,000	$500,404	$925,180
2013-14	$208,017	$416,034	$6,551,191	23	$212,388	$849,551	$80,000	$500,404	$1,425,584
2014-15	$208,017	$624,050	$6,783,193	34	$212,388	$1,061,938	$80,000	$500,404	$1,925,989
2015-16	$208,017	$832,067	$7,023,471	43	$0	$1,061,938	$80,000	$288,017	$2,214,005
2016-17	$208,017	$1,040,084	$7,272,323	52	$0	$1,061,938	$80,000	$288,017	$2,502,022
2017-18	$197,733	$1,237,817	$7,530,056	60	$0	$1,061,938	$0	$197,733	$2,699,756
2018-19	$43,880	$1,281,697	$7,796,990	60	$0	$1,061,938	$0	$43,880	$2,743,635
2028-29	$62,345	$1,816,676	$11,051,447	60	$0	$1,061,938	$0	$62,345	$3,276,615
2038-39	$88,658	$2,577,169	$15,677,777	60	$0	$1,061,938	$0	$88,658	$4,039,107

CAPEX

LAGUNA MADRE WATER DISTRICT
FORECAST NET REVENUE REQUIREMENT

	Personnel & O&M		Cap Outlays		Debt Service & Reserves	Sub Total	Less Non Rate Revenues	Net Revenue Required from Rates	
WATER SYSTEM	Value	% Increase	Value	% Increase				Value	% Increase
2008-09	$3,338,914		$194,386		$536,441	$4,069,741	-$510,375	$3,551,366	
2009-10	$3,066,080	-8.2%	$199,246	2.5%	$535,441	$3,800,756	-$523,789	$3,276,970	-7.7%
2010-11	$3,173,961	3.5%	$204,227	2.5%	$1,609,998	$4,988,186	-$532,814	$4,455,371	36.0%
2011-12	$3,285,666	3.5%	$209,332	2.5%	$1,608,452	$5,103,400	-$542,676	$4,560,874	2.4%
2015-16	$3,773,522	3.5%	$231,064	2.5%	$1,549,614	$5,554,200	-$586,016	$4,968,104	-1.8%
2016-17	$3,906,491	3.5%	$236,840	2.5%	$1,547,410	$6,690,742	-$597,656	$6,093,086	2.5%
2027-28	$5,720,932	3.5%	$310,755	2.5%	$1,092,216	$7,124,003	-$742,958	$6,381,045	-2.3%
2038-39	$8,386,611	3.5%	$407,738	2.5%	$47,171	$8,641,520	-$923,774	$7,917,746	3.7%
WASTEWATER SYSTEM									
2008-09	$2,898,688		$257,402		$536,441	$3,692,531	-$117,967	$3,574,564	
2009-10	$2,634,271	-9.1%	$263,837	2.5%	$536,441	$3,433,549	-$119,878	$3,313,671	-7.3%
2010-11	$2,728,059	3.6%	$270,433	2.5%	$333,941	$3,332,433	-$121,309	$3,211,124	-3.1%
2011-12	$2,825,211	3.6%	$277,194	2.5%	$334,941	$3,437,345	-$123,486	$3,313,858	3.2%
2015-16	$3,249,949	3.6%	$305,970	2.5%	$472,133	$4,028,092	-$134,353	$3,893,699	3.1%
2016-17	$3,365,831	3.6%	$313,619	2.5%	$471,633	$4,151,083	-$137,390	$4,013,693	3.1%
2027-28	$4,951,243	3.6%	$411,495	2.5%	$28,097	$5,390,842	-$176,581	$5,214,261	-2.9%
2038-39	$7,291,166	3.6%	$539,818	2.5%	$41,407	$7,872,572	-$227,661	$7,644,910	3.5%
TOTAL SYSTEM									
2008-09	$6,237,602		$451,788		$1,072,881	$7,762,271	-$536,342	$7,125,929	
2009-10	$5,700,351	-8.6%	$463,093	2.5%	$1,070,881	$7,234,315	-$643,666	$6,590,649	-7.5%
2010-11	$5,902,020	3.5%	$474,660	2.5%	$1,943,939	$8,320,819	-$654,123	$7,666,496	16.3%
2011-12	$6,110,877	3.5%	$486,526	2.5%	$1,943,392	$8,540,795	-$666,062	$7,874,733	2.7%
2015-16	$7,023,471	3.5%	$537,034	2.5%	$2,021,747	$9,582,252	-$720,369	$8,861,883	0.3%
2016-17	$7,272,323	3.5%	$550,460	2.5%	$2,019,043	$9,841,826	-$735,046	$9,106,779	2.8%
2027-28	$10,672,181	3.6%	$722,251	2.5%	$1,120,413	$12,514,045	-$919,539	$11,595,306	-2.6%
2038-39	$15,677,777	3.6%	$947,658	2.5%	$88,658	$16,714,091	-$1,151,435	$15,562,656	3.6%

CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WATER RATES: 5/8" METER
AVERAGE CONSUMPTION 6,051

Minimum Charge		Current	May-09 Rate	May-09 % Incr.	May-10 Rate	May-10 % Incr.	May-11 Rate	May-11 % Incr.	May-12 Rate	May-12 % Incr.
All		$9.75	$11.25	15.4%	$12.60	12.0%	$13.85	9.9%	$14.85	7.2%
Consumption Charge										
4,001	5,000	$2.10	$2.27	8.0%	$2.45	8.0%	$2.65	8.0%	$2.72	3.0%
5,001	6,000	$2.10	$2.27	8.0%	$2.45	8.0%	$2.65	8.0%	$2.72	3.0%
6,001	10,000	$2.10	$2.27	8.0%	$2.45	8.0%	$2.65	8.0%	$2.72	3.0%
10,001	15,000	$3.20	$3.46	8.0%	$3.73	8.0%	$4.03	8.0%	$4.15	3.0%
15,001	20,000	$3.20	$3.46	8.0%	$3.73	8.0%	$4.03	8.0%	$4.15	3.0%
20,001	Greater	$4.50	$4.86	8.0%	$5.25	8.0%	$5.67	8.0%	$5.84	3.0%
Impact on Monthly Bill			Rate	% Incr.	Rate	% Incr.	Rate	% Incr.	Rate	% Incr.
Usage	5,000	$11.85	$13.52	14.1%	$15.45	14.3%	$16.48	9.6%	$17.57	6.5%
Cost Increase				*$1.67*		*$1.93*		*$1.45*		*$1.08*
Usage	6,000	$13.95	$15.79	13.2%	$17.49	10.9%	$19.14	9.4%	$20.29	6.1%
Cost Increase				*$1.84*		*$1.71*		*$1.64*		*$1.16*
Usage	10,000	$22.34	$24.85	11.2%	$27.29	9.8%	$29.71	8.9%	$31.19	5.0%
Cost Increase				*$2.51*		*$2.44*		*$2.43*		*$1.48*
Usage	15,000	$38.34	$42.13	9.9%	$45.75	8.6%	$49.67	8.5%	$51.75	4.2%
Cost Increase				*$3.79*		*$3.62*		*$3.92*		*$2.08*
Usage	20,000	$54.34	$59.41	9.3%	$64.61	8.8%	$70.02	8.4%	$72.70	3.8%
Cost Increase				*$5.07*		*$5.20*		*$5.41*		*$2.68*

CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WW RATES: 5/8" METER
WINTER AVERAGE 5,791

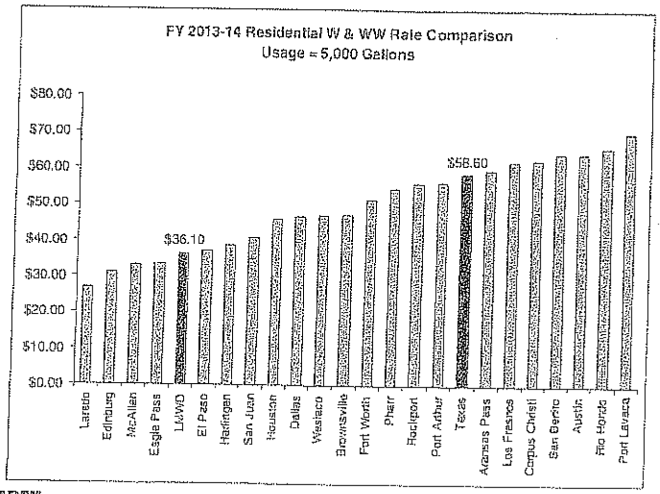
Minimum Charge		Current	May-09 Rate	May-09 % Incr.	May-10 Rate	May-10 % Incr.	May-11 Rate	May-11 % Incr.	May-12 Rate	May-12 % Incr.
All		$9.90	$11.50	16.2%	$13.05	13.5%	$14.50	11.1%	$15.70	8.3%
Consumption Charge										
4,001	5,000	$2.10	$2.33	11.0%	$2.54	9.0%	$2.74	8.0%	$2.83	3.0%
5,001	6,000	$2.10	$2.33	11.0%	$2.54	9.0%	$2.74	8.0%	$2.83	3.0%
6,001	10,000	$2.10	$2.33	11.0%	$2.54	9.0%	$2.74	8.0%	$2.83	3.0%
10,001	15,000	$3.20	$3.55	11.0%	$3.87	9.0%	$4.18	8.0%	$4.31	3.0%
15,001	20,000	$3.20	$3.55	11.0%	$3.87	9.0%	$4.18	8.0%	$4.31	3.0%
20,001	Greater	$4.50	$5.00	11.0%	$5.44	9.0%	$5.88	8.0%	$6.06	3.0%
Impact on Monthly Bill										
Usage	5,000	$12.00	$13.83	15.3%	$15.59	12.7%	$17.24	10.6%	$18.52	7.4%
Cost Increase				*$1.83*		*$1.76*		*$1.65*		*$1.28*
Usage	6,000	$14.10	$16.16	14.6%	$18.13	12.2%	$19.99	10.2%	$21.35	6.8%
Cost Increase				*$2.06*		*$1.97*		*$1.86*		*$1.36*
Usage	10,000	$22.49	$25.48	13.3%	$28.29	11.0%	$30.96	9.4%	$32.65	5.5%
Cost Increase				*$2.99*		*$2.81*		*$2.67*		*$1.69*
Usage	15,000	$38.49	$43.24	12.3%	$47.64	10.2%	$51.86	8.9%	$54.18	4.5%
Cost Increase				*$4.74*		*$4.41*		*$4.22*		*$2.32*
Usage	20,000	$54.49	$60.99	11.9%	$67.00	9.8%	$72.76	8.6%	$75.71	4.1%
Cost Increase				*$6.50*		*$6.00*		*$5.77*		*$2.95*

CAPEX

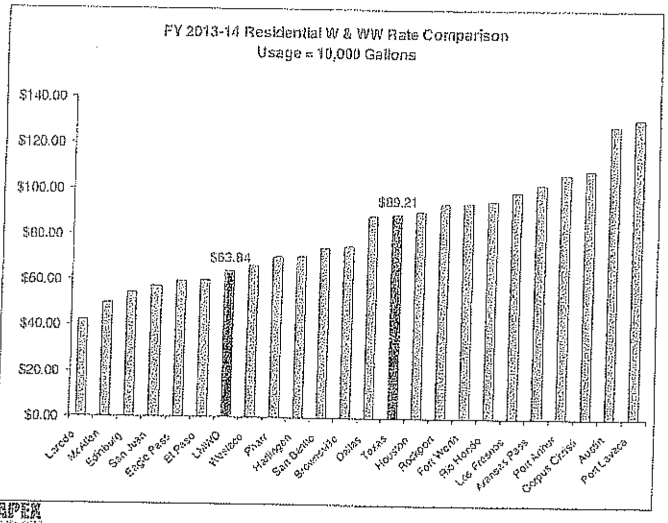
LAGUNA MADRE WATER DISTRICT
IMPACT OF PROPOSED WATER & WW RATES: 5/8" METER
AVERAGE CONSUMPTION 6,851
WINTER AVERAGE 5,791 85%

Monthly Gallons	Current	May-09	May-10	May-11	May-12	Avg. Annual Increase
5,000	$23.85	$27.34	$30.64	$33.73	$36.10	
$ Increase		$3.50	$3.29	$3.10	$2.36	$3.06
% Increase		*14.7%*	*12.0%*	*10.1%*	*7.0%*	*11.0%*
6,000	$28.04	$31.94	$35.62	$39.12	$41.64	
$ Increase		$3.90	$3.68	$3.50	$2.52	$3.40
% Increase		*13.9%*	*11.5%*	*9.8%*	*6.4%*	*10.4%*
10,000	$44.84	$50.33	$55.58	$60.67	$63.84	
$ Increase		$5.49	$5.25	$5.09	$3.17	$4.75
% Increase		*12.3%*	*10.4%*	*9.2%*	*5.2%*	*9.3%*
20,000	$108.82	$120.40	$131.60	$142.78	$148.41	
$ Increase		$11.57	$11.21	$11.18	$5.63	$9.90
% Increase		*10.6%*	*9.3%*	*8.5%*	*3.9%*	*8.1%*

CAPEX



CAPEX



CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WATER RATES: 1" METER
AVERAGE CONSUMPTION 14,716

			Current	May-09		May-10		May-11		May-12	
Minimum Charge				*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All			$13.50	$15.58	15.4%	$17.45	12.0%	$19.16	9.8%	$20.56	7.2%
Consumption Charge											
	6,001	10,000	$2.20	$2.38	8.0%	$2.57	8.0%	$2.77	8.0%	$2.85	3.0%
	10,001	15,000	$2.20	$2.38	8.0%	$2.57	8.0%	$2.77	8.0%	$2.85	3.0%
	15,001	20,000	$2.20	$2.38	8.0%	$2.57	8.0%	$2.77	8.0%	$2.85	3.0%
	20,001	25,000	$3.30	$3.56	8.0%	$3.85	8.0%	$4.16	8.0%	$4.28	3.0%
	25,001	40,000	$3.30	$3.56	8.0%	$3.85	8.0%	$4.16	8.0%	$4.28	3.0%
	40,001	Greater	$4.65	$5.02	8.0%	$5.42	8.0%	$5.86	8.0%	$6.03	3.0%
Impact on Monthly Bill				*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
Usage		10,000	$22.30	$25.06	12.5%	$27.71	10.5%	$30.25	9.2%	$31.98	5.7%
Cost Increase					*$2.76*		*$2.63*		*$2.55*		*$1.72*
Usage		15,000	$33.30	$36.96	11.0%	$40.84	9.7%	$44.11	8.8%	$46.25	4.8%
Cost Increase					*$3.66*		*$3.88*		*$3.58*		*$2.13*
Usage		25,000	$44.29	$48.83	10.3%	$53.36	9.3%	$57.97	8.6%	$60.52	4.4%
Cost Increase					*$4.54*		*$4.53*		*$4.60*		*$2.55*
Usage		50,000	$156.76	$170.32	8.6%	$184.57	8.4%	$199.67	8.2%	$206.47	3.4%
Cost Increase					*$13.54*		*$14.25*		*$15.10*		*$6.80*
Usage		200,000	$854.27	$923.61	8.1%	$998.12	8.1%	$1,078.31	8.0%	$1,111.47	3.1%
Cost Increase					*$69.34*		*$74.51*		*$80.18*		*$33.16*

CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WW RATES: 1" METER
WINTER AVERAGE 11,920

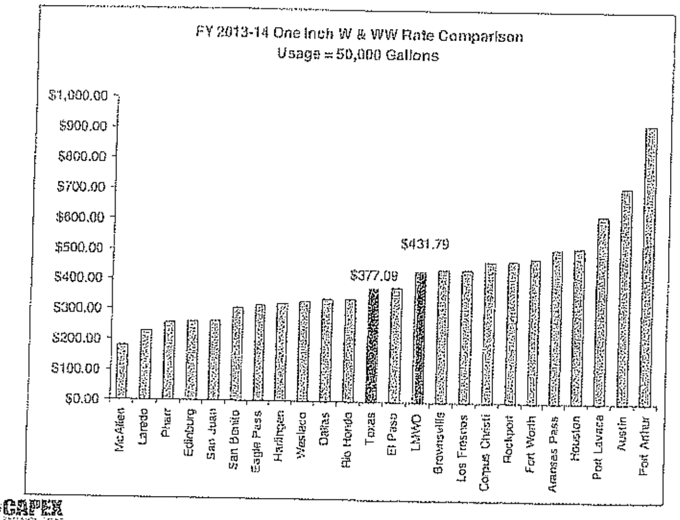
		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$12.50	$14.52	16.2%	$16.49	13.5%	$18.31	11.1%	$19.82	8.3%
Consumption Charge										
6,001	10,000	$2.30	$2.55	11.0%	$2.78	9.0%	$3.01	8.0%	$3.10	3.0%
10,001	15,000	$2.30	$2.55	11.0%	$2.78	9.0%	$3.91	8.0%	$3.10	3.0%
15,001	20,000	$2.30	$2.55	11.0%	$2.78	9.0%	$3.01	8.0%	$3.10	3.0%
20,001	25,000	$3.45	$3.83	11.0%	$4.17	9.0%	$4.51	8.0%	$4.64	3.0%
25,001	40,000	$3.45	$3.83	11.0%	$4.17	9.0%	$4.51	8.0%	$4.64	3.0%
40,001	Greater	$5.15	$5.72	11.0%	$6.23	9.0%	$5.73	8.0%	$6.93	3.0%
Impact on Monthly Bill										
Usage	6,000	$12.50	$14.52	16.2%	$16.40	13.5%	$18.31	11.1%	$19.82	8.3%
Cost Increase				*$2.02*		*$1.96*		*$1.83*		*$1.52*
Usage	10,000	$21.70	$24.73	14.0%	$27.61	11.6%	$30.33	9.9%	$32.20	6.2%
Cost Increase				*$3.03*		*$2.88*		*$2.72*		*$1.88*
Usage	15,000	$33.20	$37.49	12.9%	$41.52	10.7%	$45.35	9.2%	$47.68	5.1%
Cost Increase				*$4.30*		*$4.02*		*$3.83*		*$2.33*
Usage	50,000	$165.18	$184.00	11.4%	$201.21	9.4%	$217.82	8.3%	$225.32	3.4%
Cost Increase				*$18.82*		*$17.21*		*$16.61*		*$7.50*

CAPEX

LAGUNA MADRE WATER DISTRICT
IMPACT OF PROPOSED WATER & WW RATES: 1" METER
AVERAGE CONSUMPTION 14,716
WINTER AVERAGE 11,920 81%

Monthly Gallons	Current	May-09	May-10	May-11	May-12	Avg. Annual Increase
10,000	$44.00	$49.61	$55.31	$60.59	$64.18	
$ Increase		$5.61	$5.51	$5.27	$3.59	$5.05
% Increase		*13.2%*	*11.1%*	*9.5%*	*5.9%*	*9.9%*
15,000	$66.49	$74.45	$82.05	$89.46	$93.92	
$ Increase		$7.96	$7.60	$7.41	$4.46	$6.86
% Increase		*12.0%*	*10.2%*	*9.0%*	*5.0%*	*9.0%*
20,000	$88.99	$99.09	$108.79	$118.34	$123.67	
$ Increase		$10.10	$9.70	$9.55	$5.33	$8.67
% Increase		*11.4%*	*9.8%*	*8.8%*	*4.5%*	*8.6%*
50,000	$321.96	$354.32	$385.78	$417.49	$431.79	
$ Increase		$32.36	$31.46	$31.71	$14.30	$27.46
% Increase		*10.0%*	*8.9%*	*8.2%*	*3.4%*	*7.6%*
200,000	$1,791.94	$1,965.07	$2,133.96	$2,305.53	$2,376.47	
$ Increase		$173.13	$168.89	$171.56	$70.94	$146.13
% Increase		*9.7%*	*8.6%*	*8.0%*	*3.1%*	*7.3%*

CAPEX



LAGUNA MADRE WATER DISTRICT
PROPOSED WATER RATES: 2" METER
AVERAGE CONSUMPTION 72,130

		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$65.00	$75.00	15.4%	$84.00	12.0%	$92.33	9.9%	$99.00	7.2%
Consumption Charge										
26,001	40,000	$2.30	$2.48	8.0%	$2.68	8.0%	$2.90	8.0%	$2.98	3.0%
40,001	50,000	$2.30	$2.48	8.0%	$2.68	8.0%	$2.90	8.0%	$2.98	3.0%
50,001	100,000	$2.30	$2.48	8.0%	$2.69	8.0%	$2.90	8.0%	$2.98	3.0%
100,001	200,000	$3.45	$3.73	8.0%	$4.02	8.0%	$4.35	8.0%	$4.48	3.0%
200,001	Above	$5.15	$5.56	8.0%	$6.01	8.0%	$6.49	8.0%	$6.68	3.0%
Impact on Monthly Bill			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
Usage	50,000	$120.20	$134.61	12.0%	$148.38	10.2%	$161.86	9.1%	$170.62	5.4%
Cost Increase				*$14.42*		*$13.77*		*$13.48*		*$8.75*
Usage	100,000	$235.19	$258.81	10.0%	$282.51	9.2%	$306.73	8.6%	$319.83	4.3%
Cost Increase				*$23.62*		*$23.70*		*$24.21*		*$13.10*

LAGUNA MADRE WATER DISTRICT
PROPOSED W/W RATES: 2" METER
WINTER AVERAGE 57,076

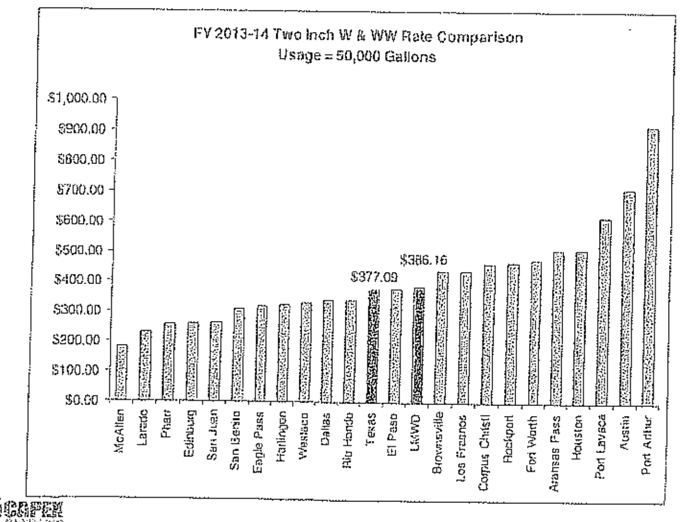
		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$85.00	$98.74	16.2%	$112.05	13.5%	$124.49	11.1%	$134.80	8.3%
Consumption Charge										
26,001	40,000	$2.50	$2.78	11.0%	$3.02	9.0%	$3.27	8.0%	$3.36	3.0%
40,001	50,000	$2.50	$2.78	11.0%	$3.02	9.0%	$3.27	8.0%	$3.36	3.0%
50,001	100,000	$2.50	$2.78	11.0%	$3.02	9.0%	$3.27	8.0%	$3.36	3.0%
100,001	200,000	$3.75	$4.16	11.0%	$4.54	9.0%	$4.90	8.0%	$5.05	3.0%
200,001	Above	$5.20	$5.77	11.0%	$6.29	9.0%	$6.79	8.0%	$7.00	3.0%
Impact on Monthly Bill										
Usage	50,000	$145.00	$165.33	14.0%	$184.63	11.7%	$202.89	9.9%	$215.54	6.2%
Cost Increase				*$20.34*		*$19.30*		*$18.26*		*$12.65*
Usage	100,000	$269.99	$304.08	12.6%	$335.87	10.5%	$366.22	9.0%	$383.78	4.8%
Cost Increase				*$34.09*		*$31.79*		*$30.36*		*$17.55*

CAPEX

LAGUNA MADRE WATER DISTRICT
IMPACT OF PROPOSED RATES: 2" METER
AVERAGE CONSUMPTION 72,130
WINTER AVERAGE 57,076 79%

Monthly Gallons	Current	May-09	May-10	May-11	May-12	Avg. Annual Increase
50,000	$265.19	$299.94	$333.01	$364.75	$386.16	
$ Increase		$34.75	$33.07	$31.74	$21.41	$30.24
% Increase		*13.1%*	*11.0%*	*9.5%*	*5.9%*	*9.9%*
100,000	$505.19	$562.89	$618.38	$672.95	$703.60	
$ Increase		$57.70	$55.49	$54.57	$30.65	$49.60
% Increase		*11.4%*	*9.9%*	*8.8%*	*4.6%*	*8.7%*
200,000	$1,225.18	$1,351.73	$1,474.49	$1,597.55	$1,655.94	
$ Increase		$126.55	$122.76	$123.06	$58.39	$107.69
% Increase		*10.3%*	*9.1%*	*8.3%*	*3.7%*	*7.9%*

CAPEX



LAGUNA MADRE WATER DISTRICT
PROPOSED WATER RATES: 4" METER
AVERAGE CONSUMPTION 425,566

		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$245.00	$282.69	15.4%	$316.62	12.0%	$348.03	9.9%	$373.15	7.2%
Consumption Charge										
100,001	200,000	$2.40	$2.60	8.2%	$2.81	8.2%	$3.04	8.2%	$3.14	3.1%
200,001	350,000	$2.40	$2.60	8.2%	$2.81	8.2%	$3.04	8.2%	$3.14	3.1%
350,001	500,000	$2.40	$2.60	8.2%	$2.81	8.2%	$3.04	8.2%	$3.14	3.1%
500,001	650,000	$3.60	$3.90	8.2%	$4.22	8.2%	$4.57	8.2%	$4.71	3.1%
650,001	800,000	$3.60	$3.90	8.2%	$4.22	8.2%	$4.57	8.2%	$4.71	3.1%
800,001	1,000,000	$3.60	$3.90	8.2%	$4.22	8.2%	$4.57	8.2%	$4.71	3.1%
1,000,001	Greater	$4.95	$5.36	8.2%	$5.80	8.2%	$6.28	8.2%	$6.47	3.1%
Impact on Monthly Bill			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
Usage	200,000	$485.00	$542.48	11.9%	$597.83	10.2%	$652.44	9.1%	$686.90	5.3%
Cost Increase				*$57.49*		*$55.35*		*$54.60*		*$34.54*
Usage	350,000	$845.00	$932.17	10.3%	$1,019.66	9.4%	$1,109.05	8.8%	$1,157.72	4.4%
Cost Increase				*$87.18*		*$87.49*		*$89.39*		*$48.67*
Usage	500,000	$1,204.99	$1,321.86	9.7%	$1,441.49	9.0%	$1,565.67	8.6%	$1,628.46	4.0%
Cost Increase				*$116.87*		*$119.63*		*$124.18*		*$62.79*

LAGUNA MADRE WATER DISTRICT
PROPOSED WW RATES: 4" METER
WINTER AVERAGE 285,691

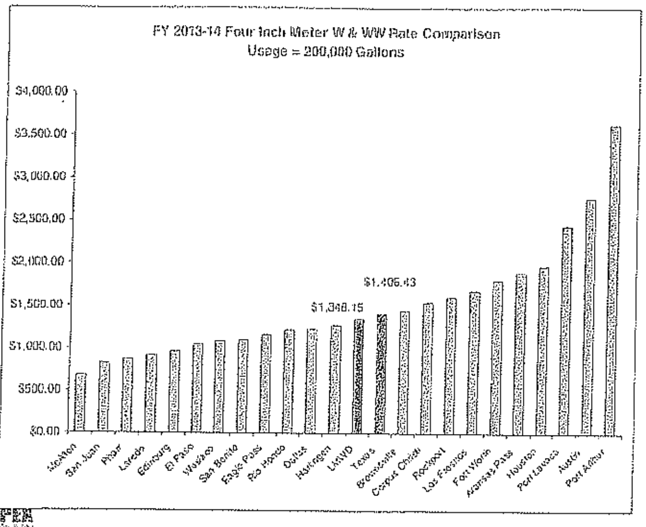
Minimum Charge		Current	May-09 Rate	May-09 % Incr.	May-10 Rate	May-10 % Incr.	May-11 Rate	May-11 % Incr.	May-12 Rate	May-12 % Incr.
All		$195.00	$226.52	16.2%	$257.05	13.5%	$285.61	11.1%	$309.24	8.3%
Consumption Charge										
100,001	200,000	$2.60	$2.89	11.0%	$3.15	9.0%	$3.40	8.0%	$3.50	3.0%
200,001	350,000	$2.60	$2.89	11.0%	$3.15	9.0%	$3.40	8.0%	$3.50	3.0%
350,001	500,000	$2.60	$2.89	11.0%	$3.15	9.0%	$3.40	8.0%	$3.50	3.0%
500,001	650,000	$3.90	$4.33	11.0%	$4.72	9.0%	$5.10	8.0%	$5.25	3.0%
650,001	800,000	$3.90	$4.33	11.0%	$4.72	9.0%	$5.10	8.0%	$5.25	3.0%
800,001	1,000,000	$3.90	$4.33	11.0%	$4.72	9.0%	$5.10	8.0%	$5.25	3.0%
1,000,001	Greater	$5.30	$5.88	11.0%	$6.41	9.0%	$6.93	8.0%	$7.13	3.0%
Impact on Monthly Bill:										
Usage	200,000	$455.00	$515.11	13.2%	$571.62	11.0%	$625.34	9.4%	$659.17	5.4%
Cost Increase				*$60.11*		*$56.50*		*$53.73*		*$33.83*
Usage	350,000	$844.99	$948.01	12.2%	$1,043.47	10.1%	$1,134.95	8.8%	$1,184.07	4.3%
Cost Increase				*$103.01*		*$95.46*		*$91.47*		*$49.12*
Usage	500,000	$1,234.99	$1,380.91	11.8%	$1,515.33	9.7%	$1,644.56	8.5%	$1,708.96	3.9%
Cost Increase				*$145.91*		*$134.43*		*$129.22*		*$64.40*

CAFEX

LAGUNA MADRE WATER DISTRICT
IMPACT OF PROPOSED RATES: 4" METER
AVERAGE CONSUMPTION 425,566 67%
WINTER AVERAGE 285,691

Monthly Gallons	Current	May-09	May-10	May-11	May-12	Avg. Annual Increase
200,000	$940.00	$1,057.60	$1,169.45	$1,277.78	$1,346.15	
$ Increase		$117.60	$111.85	$108.33	$68.37	$101.54
% Increase		*12.5%*	*10.6%*	*9.3%*	*5.4%*	*9.4%*
350,000	$1,689.99	$1,880.18	$2,063.13	$2,244.00	$2,341.78	
$ Increase		$190.19	$182.95	$180.87	$97.78	$162.95
% Increase		*11.3%*	*9.7%*	*8.8%*	*4.4%*	*8.5%*
500,000	$2,439.99	$2,702.77	$2,956.82	$3,210.23	$3,337.42	
$ Increase		$262.78	$254.05	$253.41	$127.19	$224.36
% Increase		*10.8%*	*9.4%*	*8.6%*	*4.0%*	*8.2%*

CAFEX



CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WATER RATES: 6" METER
AVERAGE CONSUMPTION 309,803

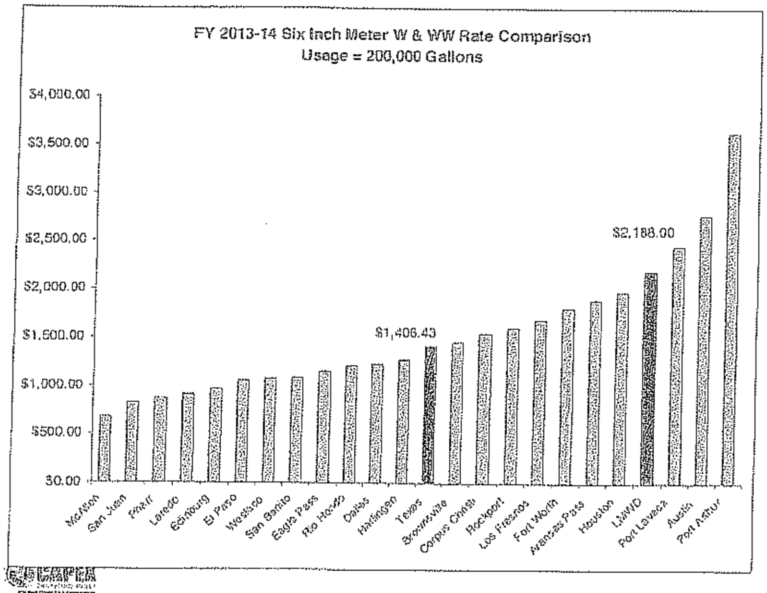
		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$560.00	$646.15	15.4%	$723.69	12.0%	$795.49	9.9%	$852.92	7.2%
Consumption Charge										
100,001	200,000	$2.60	$2.81	8.0%	$3.03	8.0%	$3.28	8.0%	$3.37	3.0%
200,001	350,000	$2.60	$2.81	8.0%	$3.03	8.0%	$3.28	8.0%	$3.37	3.0%
350,001	500,000	$2.60	$2.81	8.0%	$3.03	8.0%	$3.28	8.0%	$3.37	3.0%
500,001	650,000	$3.90	$4.21	8.0%	$4.55	8.0%	$4.91	8.0%	$5.06	3.0%
650,001	800,000	$3.90	$4.21	8.0%	$4.55	8.0%	$4.91	8.0%	$5.06	3.0%
800,001	1,000,000	$3.90	$4.21	8.0%	$4.55	8.0%	$4.91	8.0%	$5.06	3.0%
1,000,001	Greater	$5.25	$5.67	8.0%	$6.12	8.0%	$6.61	8.0%	$6.81	3.0%
Impact on Monthly Bill			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
Usage	200,000	$820.00	$925.95	13.0%	$1,026.95	10.9%	$1,123.01	9.4%	$1,190.27	6.0%
Cost Increase				*$105.95*		*$100.99*		*$96.06*		*$67.26*
Usage	350,000	$1,209.99	$1,348.15	11.4%	$1,481.85	9.9%	$1,614.29	8.9%	$1,695.29	5.1%
Cost Increase				*$138.15*		*$133.70*		*$132.45*		*$82.00*

CAPEX

LAGUNA MADRE WATER DISTRICT
PROPOSED WW RATES: 6" METER
WINTER AVERAGE 201,079

		Current	May-09		May-10		May-11		May-12	
Minimum Charge			*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*	*Rate*	*% Incr.*
All		$400.00	$464.65	16.2%	$527.27	13.5%	$585.86	11.1%	$634.34	8.3%
Consumption Charge										
100,001	200,000	$2.70	$3.00	11.0%	$3.27	9.0%	$3.53	8.0%	$3.63	3.0%
200,001	350,000	$2.70	$3.00	11.0%	$3.27	9.0%	$3.53	8.0%	$3.63	3.0%
350,001	500,000	$2.70	$3.00	11.0%	$3.27	9.0%	$3.53	8.0%	$3.63	3.0%
500,001	650,000	$4.05	$4.50	11.0%	$4.90	9.0%	$5.29	8.0%	$5.45	3.0%
650,001	800,000	$4.05	$4.50	11.0%	$4.90	9.0%	$5.29	8.0%	$5.45	3.0%
800,001	1,000,000	$4.05	$4.50	11.0%	$4.90	9.0%	$5.29	8.0%	$5.45	3.0%
1,000,001	Greater	$5.40	$5.99	11.0%	$6.53	9.0%	$7.06	8.0%	$7.27	3.0%
Impact on Monthly Bill										
Usage	200,000	$670.00	$764.34	14.1%	$853.94	11.7%	$938.66	9.9%	$997.73	6.3%
Cost Increase				*$94.35*		*$89.60*		*$84.72*		*$59.07*

CAPEX



CAPEX

LAGUNA MADRE WATER DISTRICT
CASH FLOW SUMMARY-WATER & WASTEWATER

REVENUES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	FISCAL YEAR ENDING APRIL 30										
Rate Revenues	$6,835,224	$7,581,583	$8,322,668	$8,817,629	$8,958,076	$9,065,789	$9,175,992	$9,288,741	$9,404,096	$9,522,117	$9,642,852
Non-Rate Revenues	$643,666	$654,123	$666,062	$678,821	$692,195	$706,072	$720,369	$735,046	$750,080	$765,459	$781,178
Total Revenues	$7,470,890	$8,235,706	$8,988,730	$9,496,450	$9,650,274	$9,771,861	$9,896,361	$10,023,788	$10,154,177	$10,287,576	$10,424,031
EXPENSES											
Personnel & Operating	$5,700,351	$5,902,020	$6,110,877	$6,327,178	$6,551,191	$6,783,193	$7,023,471	$7,272,329	$7,530,056	$7,796,990	$8,073,455
Net Rev. Avail. For Debt Svc.	$1,770,539	$2,333,686	$2,877,853	$3,169,272	$3,099,084	$2,988,668	$2,872,890	$2,751,455	$2,624,121	$2,490,586	$2,350,576
Net Income from Prev. FY	-$130,943	$113,632	$28,713	$476,654	$914,284	$1,269,907	$1,500,225	$1,814,334	$1,906,296	$2,127,643	$2,263,104
Total Income Avail. for D.S.	$1,647,596	$2,447,318	$2,906,572	$3,645,926	$4,013,372	$4,258,575	$4,373,115	$4,565,789	$4,620,417	$4,618,229	$4,613,679
DEBT SERVICE - FIRST LIEN REVENUE											
Existing P&I	$1,070,881	$667,881	$669,881	$671,281	$672,081	$672,281	$671,881	$670,881	$669,281	$672,081	$667,955
Proposed P&I	$0	$1,063,670	$1,061,124	$1,061,263	$1,059,823	$1,061,729	$1,061,849	$1,060,145	$1,061,538	$1,060,838	$1,063,013
Total Debt Service	$1,070,881	$1,731,551	$1,731,005	$1,732,544	$1,731,904	$1,734,010	$1,733,730	$1,731,026	$1,730,819	$1,732,919	$1,730,968
Debt Service: Current	$1,070,881	$1,731,551	$1,731,005	$1,732,544	$1,731,984	$1,734,010	$1,733,730	$1,731,926	$1,730,819	$1,732,919	$1,730,969
Debt Service: Average	$692,928	$1,732,697	$1,732,786	$1,732,897	$1,732,914	$1,732,951	$1,732,856	$1,732,726	$1,732,917	$1,733,130	$1,733,109
Coverage Ratio: Rates & Charges	1.66	1.35	1.66	1.83	1.79	1.72	1.66	1.59	1.52	1.44	1.36
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CASH AFTER FIRST LIEN D.S.	$576,714	$715,767	$1,175,568	$1,913,382	$2,281,468	$2,524,565	$2,635,385	$2,834,773	$2,889,598	$2,885,310	$2,882,719
RESERVE FUNDING											
O&M Reserve	$0	$0	$0	$208,017	$208,017	$209,017	$286,017	$208,017	$197,733	$43,880	$45,446
D.S. Reserve	$0	$212,388	$212,388	$212,388	$212,388	$212,388	$0	$0	$0	$0	$0
RS Reserve	$0	$0	$0	$80,000	$80,000	$80,000	$80,000	$80,000	$0	$0	$0
Total Reserve Contributions	$0	$212,388	$212,388	$500,404	$500,404	$500,404	$288,017	$286,917	$197,733	$43,880	$45,446
CASH AVAIL. FOR CAPITAL OUTLAYS	$576,714	$503,379	$963,180	$1,412,978	$1,781,064	$2,024,161	$2,351,368	$2,546,756	$2,691,864	$2,841,431	$2,837,254
CAPITAL OUTLAYS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FY END BALANCE	$113,632	$28,713	$476,654	$914,286	$1,269,907	$1,500,225	$1,814,334	$1,906,296	$2,127,643	$2,253,104	$2,244,979

CARPEX

LAGUNA MADRE WATER DISTRICT
CASH FLOW SUMMARY-ALL

REVENUES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	FISCAL YEAR ENDING APRIL 30										
Property Taxes, GF Interest Earnings	$2,735,930	$2,804,328	$2,874,436	$2,946,297	$3,019,955	$3,095,454	$3,172,840	$3,252,161	$3,333,465	$3,416,802	$3,502,222
Water Rate Revenues	$3,884,022	$4,283,881	$4,699,720	$4,953,530	$5,031,290	$5,091,785	$5,153,680	$5,217,009	$5,281,798	$5,348,080	$5,415,887
Wastewater Rate Revenues	$2,951,202	$3,297,703	$3,622,938	$3,864,099	$3,926,786	$3,974,004	$4,022,312	$4,071,738	$4,122,302	$4,174,036	$4,226,965
Non-Rate Revenues	$643,686	$654,123	$666,062	$678,821	$692,192	$706,073	$720,369	$735,046	$750,083	$765,459	$781,178
Total Revenues	$10,214,820	$11,040,035	$11,863,160	$12,442,747	$12,670,225	$12,867,315	$13,069,201	$13,275,949	$13,487,948	$13,704,378	$13,926,252
EXPENSES											
Personnel & Operating - W/WW	$5,700,351	$5,902,026	$6,110,877	$6,327,178	$6,551,191	$6,783,193	$7,023,471	$7,272,323	$7,530,056	$7,796,990	$8,073,451
Personnel & Operating - General	$225,006	$230,625	$236,391	$242,300	$248,356	$254,567	$260,531	$267,454	$274,141	$280,994	$288,016
Personnel & Operating - Total	$5,925,351	$6,132,646	$6,347,267	$6,569,478	$6,799,546	$7,037,760	$7,284,002	$7,539,777	$7,804,195	$8,077,984	$8,361,474
Net Rev. Avail. For Debt Svc.	$4,289,469	$4,907,389	$5,515,899	$5,873,269	$5,870,681	$5,829,555	$5,784,750	$5,736,172	$5,683,445	$5,626,394	$5,564,778
Net Income from Prev. FY	-$130,943	$113,632	$20,719	$476,654	$914,260	$1,263,987	$1,500,225	$1,814,334	$1,906,296	$2,127,643	$2,263,104
Total Income Avail. for D.S.	$4,158,526	$5,021,021	$5,544,618	$6,349,923	$6,784,809	$7,099,492	$7,285,024	$7,550,506	$7,579,741	$7,754,037	$7,827,882
DEBT SERVICE - FIRST LIEN REVENUE											
Existing P&I	$1,070,881	$667,081	$669,081	$671,201	$672,081	$672,281	$671,881	$670,881	$669,281	$672,081	$667,958
Proposed P&I	$0	$1,063,670	$1,061,124	$1,061,263	$1,059,823	$1,061,729	$1,061,849	$1,060,145	$1,061,538	$1,060,838	$1,063,013
Total Debt Service	$1,070,881	$1,731,551	$1,731,005	$1,732,544	$1,731,904	$1,734,010	$1,733,730	$1,731,029	$1,730,819	$1,732,910	$1,730,969
Debt Service: Average	$692,928	$1,732,007	$1,732,786	$1,732,897	$1,732,914	$1,732,981	$1,732,858	$1,732,706	$1,732,917	$1,733,130	$1,733,100
Coverage Ratio: Rates & Charges	1.60	1.39	1.06	1.80	1.70	1.72	1.60	1.59	1.52	1.44	1.30
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CASH AFTER FIRST LIEN D.S.	$3,087,644	$3,289,470	$3,813,613	$4,617,379	$5,053,085	$5,365,452	$5,551,294	$5,819,479	$5,848,922	$6,021,118	$6,096,913
DEBT SERVICE - GENERAL OBLIGATION											
Existing P&I	$2,560,902	$654,045	$380,089	$381,323	$511,709	$510,003	$511,332	$376,606	$377,570	$373,060	$376,877
Proposed P&I 2011-12	$0	$0	$811,328	$811,328	$811,328	$811,328	$811,328	$811,328	$811,328	$811,328	$811,328
Proposed P&I 2012-13				$598,115	$598,115	$598,115	$598,115	$598,115	$598,115	$598,115	$598,115
Proposed P&I 2013-14					$598,115	$598,115	$598,115	$598,115	$598,115	$598,115	$598,115
Proposed P&I 2014-15						$598,115	$598,115	$598,115	$598,115	$598,115	$598,115
Total Debt Service	$2,556,902	$654,045	$1,092,016	$1,690,765	$2,519,290	$3,116,966	$3,118,909	$3,102,270	$2,903,243	$2,970,248	$2,983,290
TOTAL ALL DEBT SERVICE	$3,627,783	$2,385,596	$2,823,021	$3,423,309	$4,251,192	$4,850,676	$4,850,639	$4,713,305	$4,714,062	$4,711,166	$4,713,259
CASH AFTER ALL DEBT SERVICE	$530,743	$2,635,433	$2,721,897	$2,926,614	$2,533,777	$2,248,707	$2,434,388	$2,837,200	$2,865,679	$3,042,877	$3,114,623
RESERVE FUNDING											
O&M Reserve	$0	$0	$0	$208,017	$208,017	$208,017	$208,017	$208,017	$197,733	$43,880	$45,446
D.S. Reserve	$0	$212,388	$212,388	$212,388	$212,388	$212,388	$0	$0	$0	$0	$0
RS Reserve	$0	$0	$0	$80,000	$80,000	$80,000	$80,000	$80,000	$0	$0	$0
Total Reserve Contributions	$0	$212,388	$212,388	$500,404	$500,404	$500,404	$288,017	$288,017	$197,733	$43,880	$45,446
CASH AVAIL. FOR CAPITAL OUTLAYS	$530,743	$2,423,037	$2,509,389	$2,426,209	$2,033,373	$1,748,302	$2,146,372	$2,549,183	$2,767,940	$2,998,998	$3,069,177
CAPITAL OUTLAYS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FY END BALANCE	$37,688	$1,048,377	$2,022,483	$1,927,520	$1,522,216	$1,224,447	$1,609,338	$1,990,724	$2,203,725	$2,420,671	$2,476,392

CARPEX

APPENDIX C

RESOLUTION No. 32-09-09 ADOPTING THE REVISED WATER CONSERVATION & DROUGHT CONTINGENCY PLAN FOR LAGUNA MADRE WATER DISTRICT

WHEREAS, the Laguna Madre Water District (District) previously adopted a Water Conservation and Drought Contingency Plan on September 09, 2009; and

WHEREAS, it is necessary that a Water Conservation and Drought Contingency Plan be updated and adopted by the District; and,

WHEREAS, Section 11.1271 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality and Texas Water Development Board require all public water supply systems in Texas to prepare a water conservation plan; and,

WHEREAS, as authorized under law, and in the best interests of the customers of the Laguna Madre Water District, the Board of Directors deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;and

WHEREAS, The Board of Directors further finds, determines and declares that the meeting at which this resolution has been considered and acted upon was open to the public and public notice of the time, place and subject of said meeting was duly given, all as required by Texas Water Code Ann. 49.063; Now therefore,

BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE LAGUNA MADRE WATER DISTRICT: THAT

SECTION 1. The Revised Water Conservation & Drought Contingency Plan attached hereto as Exhibit "1" is hereby adopted as the official policy of the Laguna Madre Water District.

SECTION 2. The General Manager of the Laguna Madre Water District and his/her designee are hereby directed to implement, administer and enforce the Revised Water Conservation & Drought Contingency Plan.

SECTION 3. This resolution shall take effect immediately upon its approval.

PASSED AND ADOPTED BY THE BOARD OF DIRECTORS OF THE LAGUNA MADRE WATER DISTRICT ON THIS 9TH DAY OF SEPTEMBER, 2009.

Scott Friedman, Chairman
Board of Directors

LAGUNA MADRE WATER DISTRICT

ATTEST:

Rudy H. Garcia, Secretary
Board of Directors

APPENDIX D

Texas Commission on Environmental Quality

Water Conservation Implementation Report

This report must be completed by entities that are required to submit a water conservation plan to the TCEQ in accordance with Title 30 Texas Administrative Code, Chapter 288. Please complete this report and submit it to the TCEQ. If you need assistance in completing this form, please contact the Resource Protection Team in the Water Supply Division at (512) 239-4691.

Name: Laguna Madre Water District

Address: 105 Port Road, Port Isabel, Texas

Telephone Number: (956) 943-2626 **Fax:** (956) 943-6662

Form Completed By: Maribel Hinojosa **Title:** Assistant to the GM

Signature: **Date:**

I. WATER USES

Indicate the type(s) of water uses (example: municipal, industrial, or agricultural).

Municipal Use

Commercial/ Industrial Use

__________ Use

II. WATER CONSERVATION MEASURES IMPLEMENTED

Provide the water conservation measures and the dates the measures were implemented.

Description of Water Conservation Measure:

Unaccounted for water losses: The LMWD's distribution department started the meter replacement program in December 2005, and it was completed in July 2006. All 578" meters were replaced. The 2", 4", and 6" were mostly changed; however, those that were not changed were retrofitted.

Date Implemented: **December 2005-July 2006**

Description of Water Conservation Measure:

Dead end main flushing program: The LMWD distribution department has identified several areas where "dead end mains" are in the distribution system. These lines are flushed out at least once per month to meet TCEQ requirements. The LMWD maintains records on all flushing points.

Date Implemented: **April 2008**

Description of Water Conservation Measure:

Automated Meter Reading System (AMRS):

This radio read system provides instantaneous information regarding when leaks occur, how much water has been lost, and when a leak has been fixed. The Meter Reader employee is responsible to notify the customer when a major leak is identified.

In addition to providing usage information, the system can be used to identify unusual usage patterns and detect meter malfunctions. Profiles are available upon request.

Date Implemented: **December 2005**

Description of Water Conservation Measure:

Water Line Replacement Program: The LMWD includes nearly 200 miles of pipeline. The system consists of pipelines ranging in sizes from 2" to 24". Pipe types include PVC, cast iron, asbestos cement, and epoxy coated steel (*Comprehensive Plan for Water and Wastewater Facilities, 2004*).

Approximately 75% of the pipe in the system is 8-inches or less in diameter. A concern for the LMWD is that there are too many 2-inch lines that are inadequate to supply many customers during peak day demands.

Date Implemented: **The line replacement program is not completed yet.**

Description of Water Conservation Measure:

The LMWD has replaced more than 1000 lf of a 36" raw water pipe line that transports water from the river to WTP No.2. It should be noted, however, that this project was initiated by the Department of Transportation (DOT) but that resulted beneficial to the LMWD raw water distribution system.

Date Implemented: **June 2007**

Description of Water Conservation Measure:

Brochures- brochures are available in the customer service department and in English and Spanish (the ABC's water conservation, Be Water Smart Indoors, Water Savings

Tips, Cuarenta y Nueve Consejos Para Conservar Agua).

Date Implemented: **Brochures are available all calendar year.**

Description of Water Conservation Measure:

Public Education:
Bill Inserts:
Media: A Press release was published on July 2008 informing customers about ways to reduce water thought conservation tips. In addition, information related to the Falcon and Amistad Conservation Capacity levels were included on the press release (Please see attached press release dated July 25, 2008).

Date Implemented: **Summer 2008**

Description of Water Conservation Measure
LMWD website- water conservation and water saving tips and mandatory water conservation restrictions are found on the LMWD website: **http//www.lmwd.org**. However, the LMWD will commit to update information on a monthly basis/or as needed.

Date Implemented: **Water Conservation Tips are available all calendar year on the LMWD website.**

Description of Water Conservation Measure:

Metering at point of diversion- The LMWD has replaced the raw water transmission meters that has resulted in a better accountability of raw water in the River Pump Station and other raw water transmission locations.

Date Implemented: **2007**

Description of Water Conservation Measure:

Reuse: The LMWD has four wastewater treatment plants and a very small amount of these plants' effluent has been utilized to wash down and for irrigation of the treatment plant grounds and for irrigation of local highway medians.

Date Implemented: **All Calendar Year**

III. TARGETS

A. Provide the **specific and quantified five and ten-year targets** as listed in water conservation plan for previous planning period.

5-Year Specific/Quantified Target:

1. The meter replacement program was initiated December 2005 and was completed in July 2006. Implementing this program has resulted in a better accountability of unaccounted water and water loss.
2. The LMWD has been using an estimate of 10 million gallons per year to irrigate medians at South Padre Island. However, the proposed project has not been implemented because of the cost involved (raw water has been used for irrigation purposes).
3. The LMWD has established a goal to replace the transmission meters in the River Pump Station. Those meters were replaced resulting in a better accountability of raw water in the River Pump Station and other raw water transmission locations.

Date to achieve target: The target was completed in 2007

10-Year Specific/Quantified Target:

Date to achieve target:

B. State if these targets in the water conservation plan are being met.

- The targets established in the conservation plan have been partially met. However, the LMWD will be more proactive once this revised plan is approved.

C. List the **actual amount of water saved.**

D. If the targets are not being met, provide an explanation as to why, including any progress on the targets.

Some of the goals established in the existing water conservation plan have been met. However, because of Hurricane Dolly, some of the established goals were not accomplished. The LMWD has done an excellent job by promoting water conservation to its internal and external customers. On the other hand, the General Manager considers that there is an opportunity to improve in some of these areas, once a water audit is conducted within the water supply and distribution system.

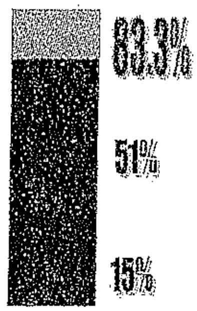
If you have any questions on how to fill out this form or about the Water Conservation program, please contact us at 512/239-4691.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.

cate... their be... travel up ... pus Christi and ... Alamo City.

"We didn't get to ... much of the Island and w... ally want to see it under differ... ent circumstances, but never again during a hurricane," Marla concluded.

LAGUNA MADRE WATER DISTRICT



FALCON & AMISTAD DAMS CONSERVATION CAPACITY

How to Reduce Your Water Bill

As we enter our water usage peak months of July and August we want to share with you some water conservation tips and practices that can help you reducing your water consumption that can result in significant savings in your water bills, and yet continue meeting all your water needs. Even though we are not experiencing any problems in providing our customers with all the water they need, both Falcon and Amistad reservoirs combined storage capacity is at 83.3% of capacity, we believe it can be beneficial to learn what you can do to reduce your water consumption. Following are some water conservation tips and practices that are easy to follow and save you money:

INDOOR WATER USAGE

- **Eliminate those leaks:** Check all your toilets and water faucets for possible leaks. Many leaks are silent, such as toilet leaks, that allow water and your money to be wasted. Check the flapper in your toilet, most of the time that's what is causing the leak. A worn out rubber washer is what usually causes a leaky faucet. Both the flapper and the washer are inexpensive and simple to replace.
- **Replace your toilet:** Toilets are the biggest users of water in your home. Those manufactured prior to 1992 use close to 4 gallons per flush with the average toilet using over 18 gallons per person per day. Newer toilets use 1.6 gallons or less of water per flush less than half of the older toilets. While it may be expensive to replace all your toilets the savings in your water bill should pay for the new toilets in a short period of time.
- **Clothes Washers:** The average washer uses 15 gallons per person per day. Newer washers use anywhere from 30% to 50% less water and 50% less energy. This doesn't mean you should run out and buy a new washer, but think about water and energy usage when you do have to replace your old one. In the meantime wash only full loads or adjust your water level if you have less than a full load.
- **Dishwashers:** For the most part dishwashers are pretty much water efficient. However, remember to wash only when you have a full load.
- **Showerheads:** The average showerhead manufactured prior to 1999 uses an average of 4 to 5 gallons per minute. Showerheads manufactured after 1999 use from 2 to 2.5 gallons per minute. Changing old showerheads to the newer ones can save up to 33% in water usage and reducing shower time by one minute can save up to 12% of water.
- **Baths vs. Showers:** Change your habits and take a shower rather than a bath. Showers use much less water than baths.

OUTDOOR WATER USAGE

- **Leaks:** Again, as indoors, fix those leaks. Replace any malfunctioning sprinkler head if you have an irrigation system. Check your yard for seepage and make necessary repairs for slow leaks can cost you money.
- **Landscape:** Plant the right plants. Plants that are appropriate for our climate can reduce your water demands.
- **Watering:** Most water is wasted by watering when your plants do not need it, or watering at the wrong time of the day. Water late at night or early in the morning. Watering during the day only wastes water and your money.
- **Driveways and Sidewalks:** Use a broom instead of washing your driveway and sidewalk. You can save up to 80 gallons of water each time you clean your driveway or sidewalk by sweeping rather than washing.
- **Swimming Pools:** It is not necessary to drain your pool each year. Maintaining the proper chemicals levels reduces the frequency of draining and refilling your pool. Using a pool cover during the months you don't use your pool will further reduce your water needs.

These are only a few tips that will help you reduce your water bill. I'm sure most of you already know about them. We just want to remind you that conserving water by using it wisely will also save you money.
If you have any other tips that will help to reduce water consumption we will be glad to hear from you. Please send us your suggestions via email: lmwd.org

General Manager
Laguna Madre Water District
105 Port Road, Port Isabel 78578
We will be glad to hear from you.

7-25-08

APPENDIX E

LAGUNA MADRE
WATER DISTRICT

WATER CONSERVATION CAMPAIGN
WATER MONTH COMMUNITY ACTIVITIES

- Declare May "National Drinking Water Month"
  - April - Resolution goes to the LMWD Board for consideration

- Poster Contest for 4th & 5th grade students (public and private schools)
  - April - Send letters to public and private schools
  - April - Posters due in our office by 5 p.m.
  - April – Judging of artwork this week
  - April - Winners notified
  - May - Party a LMWD for winners

  (Prizes: Gift Certificates - 1st place $50, 2nd place $30, 3rd place $20)
  - May – Winning Posters displayed in our Board Room
    - Other submissions can be displayed at the LMWD facilities

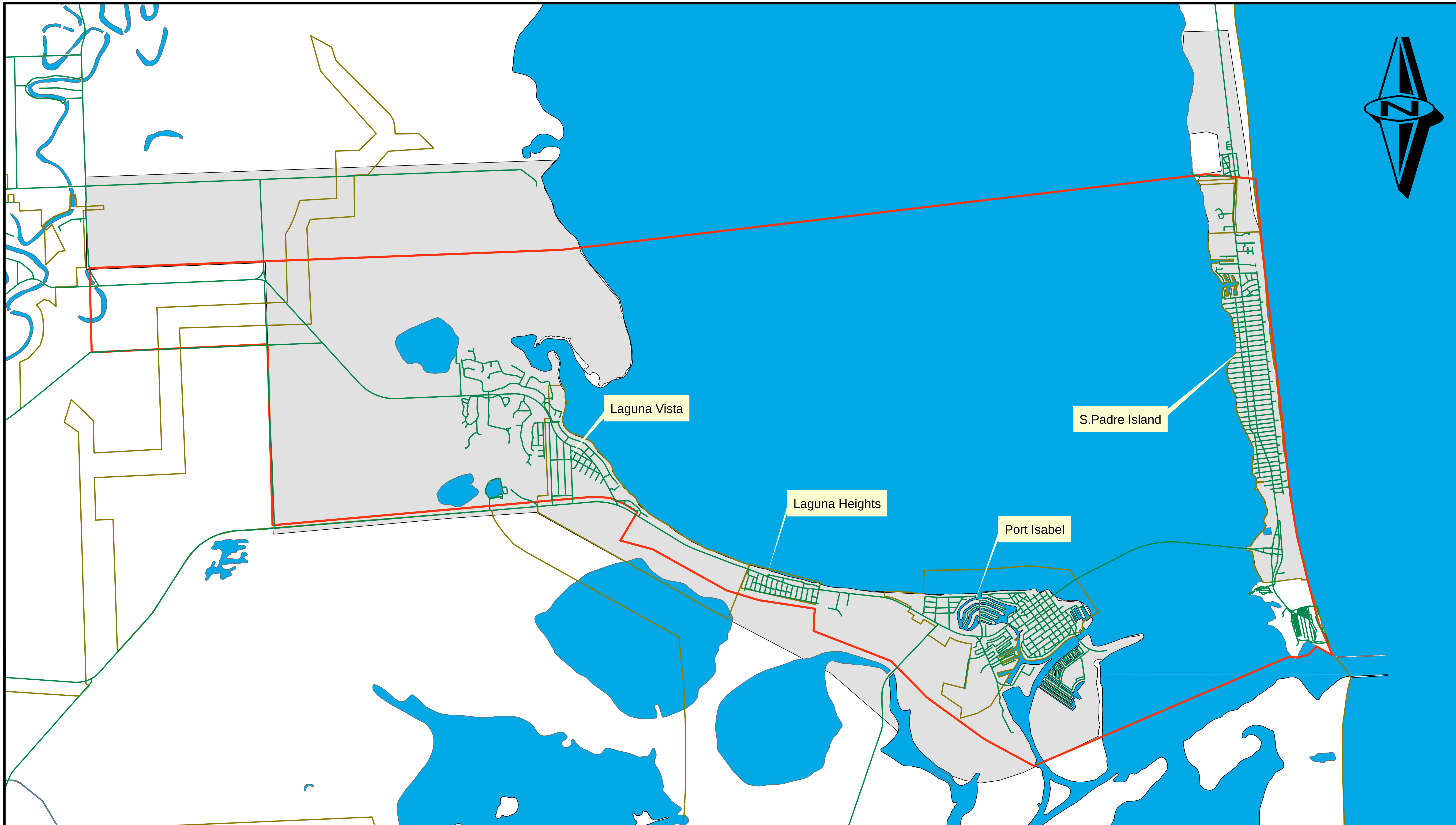
- Water Conservation Night at LMWD
  - Date to be Determined (May)

- Water Conservation Day/Earth Day
  - April 22 – Select a Park

- Water Conservation information to be distributed throughout the months May-July in Customer Service.
- Brochures/Bill Inserts can be mailed to all customers discussing some facet of water conservation.
- LMWD Website
- Tours of Water Plants available all month upon request.

P.O. Box 3270 Brownsville, TX 78523-3270
(956) 982-6100 Fax: (956) 982-6269

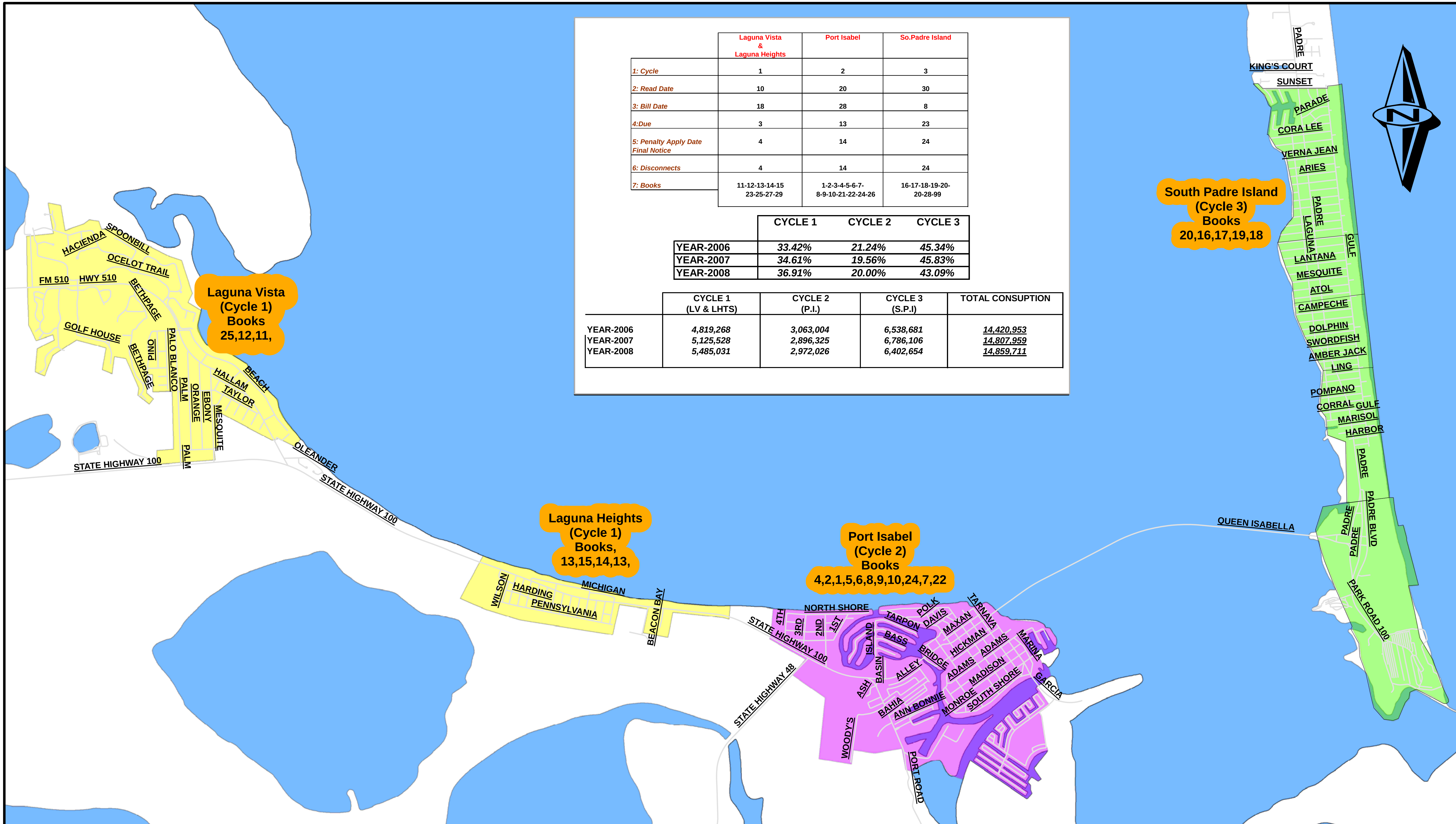
FIGURES



LAGUNA MADRE WATER DISTRICT
SERVICE MAP 2008

105 Port Rd
Port Isabel, Texas 78578

FIGURE 1



	Laguna Vista & Laguna Heights	Port Isabel	So.Padre Island
1: Cycle	1	2	3
2: Read Date	10	20	30
3: Bill Date	18	28	8
4:Due	3	13	23
5: Penalty Apply Date Final Notice	4	14	24
6: Disconnects	4	14	24
7: Books	11-12-13-14-15 23-25-27-29	1-2-3-4-5-6-7- 8-9-10-21-22-24-26	16-17-18-19-20- 20-28-99

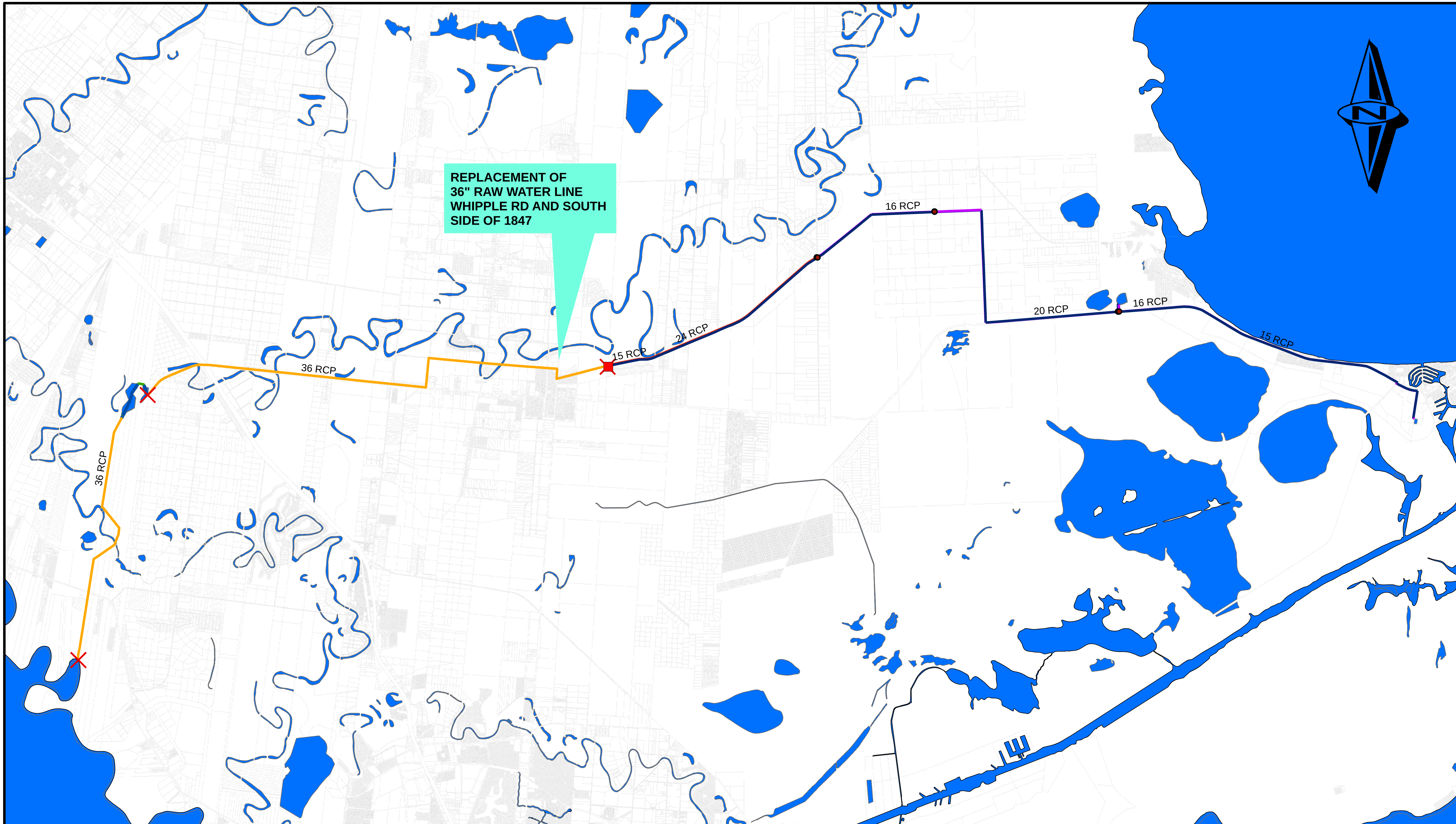
	CYCLE 1	CYCLE 2	CYCLE 3
YEAR-2006	*33.42%*	*21.24%*	*45.34%*
YEAR-2007	*34.61%*	*19.56%*	*45.83%*
YEAR-2008	*36.91%*	*20.00%*	*43.09%*

	CYCLE 1 (LV & LHTS)	CYCLE 2 (P.I.)	CYCLE 3 (S.P.I)	TOTAL CONSUPTION
YEAR-2006	*4,819,268*	*3,063,004*	*6,538,681*	*14,420,953*
YEAR-2007	*5,125,528*	*2,896,325*	*6,786,106*	*14,807,959*
YEAR-2008	*5,485,031*	*2,972,026*	*6,402,654*	*14,859,711*

LAGUNA MADRE WATER DISTRICT
BILLING CYCLES

105 Port Rd
Port Isabel, Texas 78578

FIGURE 3



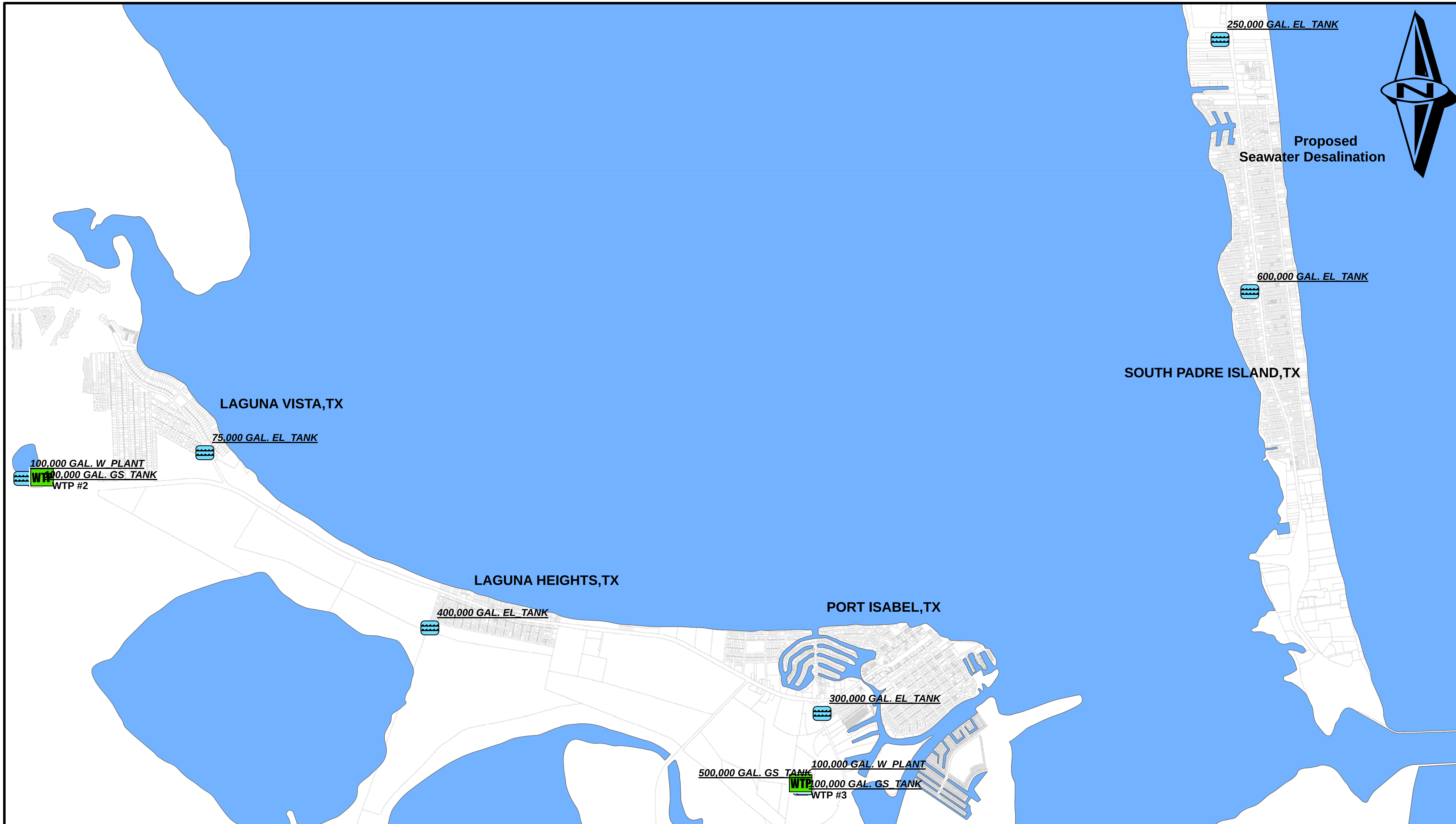
Legend

- TANKS
- PUMP STATION
- R_VALVES

LAGUNA MADRE WATER DISTRICT
36" RAW WATER REPLACEMENT
(945.00' SQ.FT APPROX.)

105 Port Rd
Port Isabel, Texas 78578

FIGURE 4



Legend

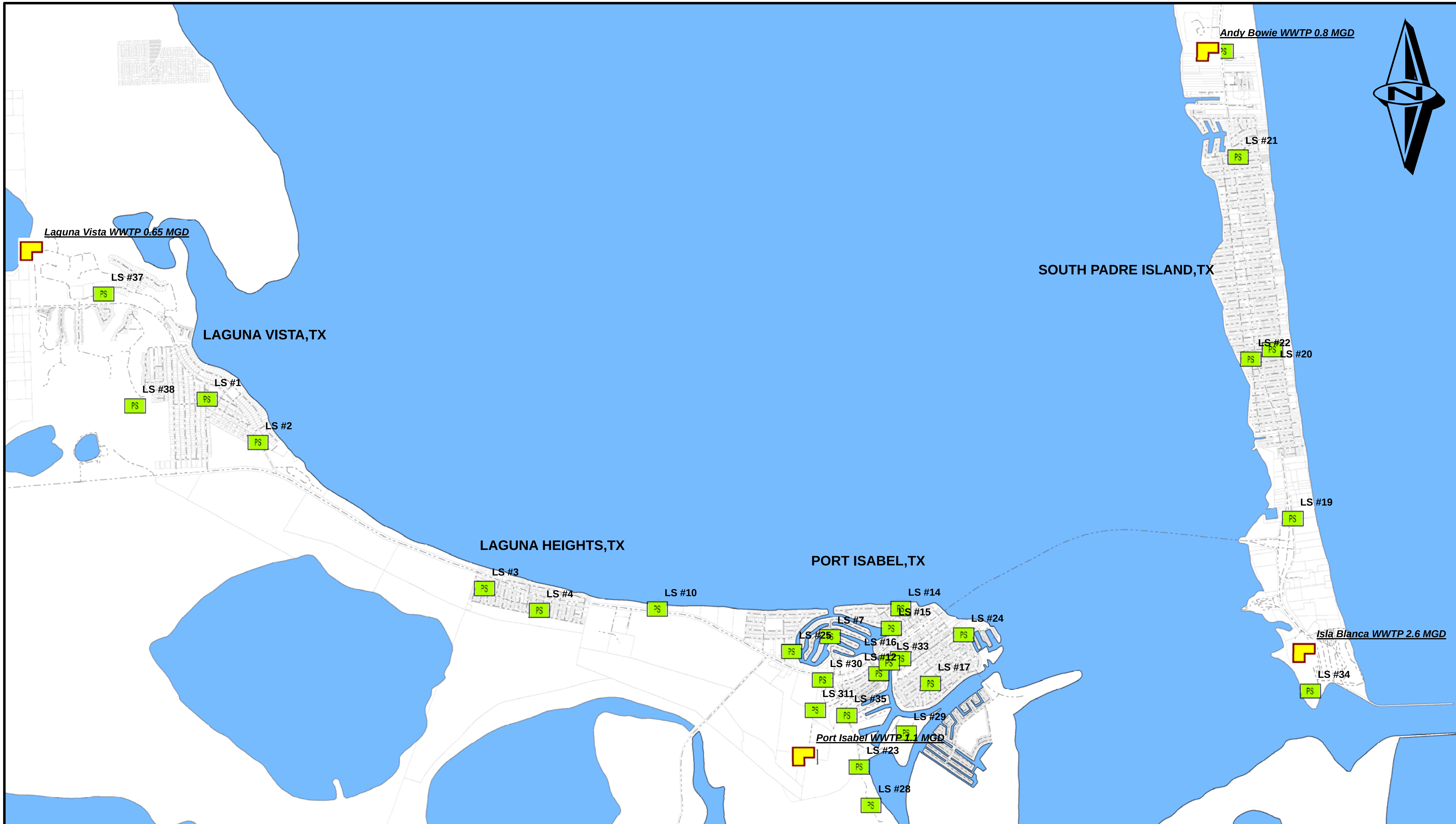
WTP WTP

WATER TANKS

LAGUNA MADRE WATER DISTRICT
WATER TREATMENT PLANT'S & ELEVATED TANKS

105 Port Rd
Port Isabel, Texas 78578

FIGURE 5



Legend

WWTP

PS LIFT STATION

LAGUNA MADRE WATER DISTRICT WASTEWATER SYSTEM

105 Port Rd
Port Isabel, Texas 78578

FIGURE 6

TABLE OF CONTENTS – CHAPTER SEVEN

CHAPTER 7.0 : LONG TERM PROTECTION OF THE STATE'S WATER RESOURCES, AGRICULTURAL RESOURCES, AND NATURAL RESOURCES

7.1 LONG TERM PROTECTION OF THE STATE'S WATER RESOURCES

The population of the region is expected to increase by over 300 percent over the next 50 years. In order to meet the associated DMI water demands, the Rio Grande Regional Water Planning Group has identified three goals aimed at curbing DMI water use through conservation and diversification: (1) optimize the supply of water available from the Rio Grande, (2) reduce projected DMI water demands through expanded water conservation programs, and (3) diversify water supply sources for DMI use through appropriate development of alternate water supply sources (i.e., reuse of reclaimed water, groundwater, desalination, etc.).

Chapter 2 of this report contains projected demand data provided by TWDB. Chapter 3 of this report gives an in-depth analysis of current and future water supplies for each Water User Group (WUG).

Past regional water planning studies included estimated water savings due to water conservation in the overall demand figure for each WUG. In this round of regional planning, the TWDB has determined that "reductions due to the installation of water-efficient plumbing fixtures in new construction, as well as from the replacement of older fixtures, will be included in the Regional Water Plans based on data provided by the TWDB." These measures are treated as a requirement for each municipal WUG, thereby reducing per-capita water demand throughout the extent of the planning study. In addition, the Regional Planning Group recognizes the effect of additional conservation measures on the water supply in the region. For this reason, Advanced Water Conservation was recognized as a Water Management Strategy. This strategy consists of public information, school education, and residential clothes washer conversion. Any additional conservation measures will be treated as Advanced Water Conservation. Water conserved actually decreases overall demand, resulting in less potential supply needed to meet that demand. This strategy is explained in more detail in Chapter 4.

Optimizing the supply of water available from the Rio Grande is another important aspect of protecting the state's water resources since the river is the main source for both DMI use and irrigation use. As populations grow, irrigable land is lost and the associated irrigation water demand is also reduced. Logically, a large portion of the region's future DMI water supply will come from the Rio Grande.

Municipalities can acquire Rio Grande water rights through purchase, urbanization, and contract. Chapter 2 explains projected reductions in irrigation demand. By 2060, irrigation demands are expected to decrease by 181,886 acre-feet. Since irrigation water rights can be converted to DMI use on a two-to-one basis, an additional DMI Rio Grande water supply of 113,949 acre-feet is possible. However, not all of this water is feasible for conversion to DMI use. A portion should be retained to reduce existing irrigation deficits.

Diversifying water supply sources for DMI use will also aid in protecting the State's water resources. Water management strategies such as brackish and seawater desalination, potable and non-potable reuse, and groundwater development will reduce the impact on existing water sources for DMI use, especially the Rio Grande.

7.1.1 Emergency Transfers[1]

RGRWPG has considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder. An operating reserve of 75,000 acre-feet can be allocated for emergency requirements; although, in case of such a situation, there are no emergency mechanisms that are in place which can transfer water. Additionally, the Rio Grande Operating Rules state that "if the balance available for the operating reserve is less than 275,000 acre-feet, but greater than 150,000 acre-feet, that amount will be the amount allocated to the operating reserve. If it is less than 150,000 acre-feet, the watermaster will deduct from the irrigation and mining accounts, via negative allocations, the amount necessary to provide 150,000 acre-feet for the operating reserve. A negative allocation will be made on a pro rata basis, from all the irrigation and mining accounts containing water at the time, based on the amount of water in such accounts." And it goes on to say that "once negative allocations have ceased and sufficient water is available for positive allocations, all accounts from which water has been deducted will be restored to the amount of water in each account prior to the negative allocation period." Rio Grande Operating Rules also stipulate that "at no time shall the watermaster allow an allottee to accumulate in storage more than 1.41 times the annual authorized right in acre-feet." This indicates that the existing water rights authorize more diversions for non-municipal purposes than are actually being used. As a result of having more annual diversion authorized under a particular water right than what actually may be used, a more reliable water supply year in and year out is established.

7.2 LONG-TERM PROTECTION OF THE STATE'S AGRICULTURAL RESOURCES

In 20 years, an irrigation water supply deficit of over 230,000 acre-feet is projected. Even considering the effects of urbanization on irrigable land, this deficit may increase

[1] Refer to Study No. 1, "Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing Water Rights on the Lower and Middle Rio Grande." August 24, 2009.

slightly, to 258,000 acre-feet by 2060. In Chapter 4, the Rio Grande RWPG recommends two Water Management Strategies (WMS)—on-farm conservation and conveyance system improvements—to reduce this impact. On-farm improvements include field-level water measurement, installation of poly or gated pipe, and improved water management practices. Conveyance system improvements include installation of no-leak gates, water measurement, canal linings, and conversion of canals to pipelines. Potential water savings associated with on-farm improvements is 219,226 acre-feet, while conveyance system improvements could yield savings of 218,783 acre-feet. In the long run, total water savings associated with both strategies would allow irrigators to offset water supply deficits. However, the implementation timeframe will not offer immediate relief.

Another factor in maintaining and supplementing irrigation water supplies is Mexico's compliance with the 1944 Treaty with the U.S. Even though Mexico is in the midst of repaying its water debt, there is little assurance of future compliance should the region be gripped by another severe drought. Due to Mexico's breach of its treaty obligations from 1992 to 2002, studies by Texas A&M University have shown that the Lower Rio Grande Valley lost nearly $1 billion in decreased economic activity and 30,000 jobs as a direct result of that shortfall.[2]

7.3 LONG-TERM PROTECTION OF THE STATE'S NATURAL RESOURCES

Environmental flow needs are in the forefront of all issues dealing with long-term protection of the Texas' natural resources. As water is diverted from the Rio Grande, river flows also drop. With the potential for increasing reliance on the Rio Grande, the issue of maintaining and/or increasing environmental flows should be a concern now and in coming years.

One possibility for maintaining and increasing environmental flows is the purchase or donation of Rio Grande water rights for environmental usage into the Texas Water Trust. These water rights could be managed to produce sufficient flows throughout the region. However, this option may not be viable because of the current water rights purchase and transfer structure.

The timetable for the development of the environmental flows program is as follows: the process is anticipated to start for the Rio Grande basin in June 2010, with flow recommendations due by October 2011; flow standards will be adopted by April 2013.

Even though environmental flows on the Rio Grande were previously discussed, flows in the Arroyo Colorado and other regional estuaries are equally as important.[3]

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[2] Press Release. Marzulla & Marzulla: Attorneys at Law. "Texas Water Rights Holders Still Seeking $500 Million in Compensation for Economic Injuries Caused by Mexico." March 14, 2005**.**

[3] More information on the Arroyo Colorado is located in Chapter 1.

Given the WUG format currently being implemented by the TWDB, no option exists to formally allocate projected water supplies for environmental use. Alternatively, environmental flows in the Rio Grande could be included as a separate WUG in the next round of regional planning to ensure minimums would be met in a manner consistent with all other WUGs.

International cooperation (i.e. Mexico's) is critically needed to maintain flow levels. The United States Fish and Wildlife Service is currently in talks with Mexico regarding the introduction of fish to the Rio Grande. Even though this is the case, if the United States were to implement an environmental flow program without Mexico's participation, the desired effect would be significantly reduced.

Another of the region's critical environmental issues is the growth of salt cedar and other invasive plants such as water hyacinth and hydrilla, among others. Salt Cedar has begun to make its way through the region. Water Hyacinth and Hydrilla are already well established. Unfortunately, eradication methods are both costly and physically strenuous.

The natural rise and fall of water elevation in rivers and streams somewhat curtails these plants by drowning out new seedlings. However, in areas of minimal water flow, a perfect scenario exists for invasive plant growth.

7.4 SUPPLEMENTAL EVALUATION OF POTENTIAL LONG-TERM CHANGES IN FRESHWATER INFLOWS TO THE LOWER LAGUNA MADRE ESTUARY

The National Wildlife Federation (NWF) has approached the Lower Rio Grande Planning Group with a proposal to supplement the assessment of potential cumulative effects of regional water plan implementation on the Lower Laguna Madre Estuary. This would be accomplished by calculating changes in freshwater inflow expected to the Lower Laguna Madre Estuary with the Region M Plan in place, comparing these inflows to two baselines, and providing two ecologically-based assessments. The baselines for comparison include freshwater inflows under "Natural" and "Present" conditions. The two ecologically-based assessments rely, in part, upon the freshwater inflow recommendations of the Texas Parks and Wildlife Department (TPWD) and the TWDB and focus upon spring/early summer freshwater inflow pulses and drought periods during the months of March through October as used in a recent NWF publication.

As indicated in Attachment 7-2, there is no significant impact to the freshwater inflows into the Laguna Madre as a result of this region's Water Management Strategies. Even with an increase in wastewater reuse, this is offset with an increase in population and subsequent wastewater flows.

ATTACHMENT 7-1

WATER PLANNING REGULATIONS CHECKLIST

CHECKLIST FOR COMPARISON OF THE REGIONAL WATER PLAN TO APPLICABLE WATER PLANNING REGULATIONS

The purpose of this attachment is to help determine how the Regional Water Plan is consistent with long-term protection of the water, agricultural, and natural resources of the State of Texas. Accordingly, the following checklist includes a regulatory citation (Column 1) for all subsections and paragraphs contained in the applicable portions of water planning regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.5
- 31 TAC Chapter 357.7
- 31 TAC Chapter 357.8
- 31 TAC Chapter 357.9

CHECKLIST FOR REVIEW OF 2010 IPPs		
Rule	Description (See Rule or Contract for Complete Description)	Chap.
Chapter 357	**REGIONAL WATER PLANNING GUIDELINES**	
§357.5	**Guidelines for Development of Regional Water Plans**	Exhibit B
§357.5(d)(1)&(2)	Use state population and water demand projections that have been adopted by the TWDB board	Chapter 2 Sections 2.2 & 2.3
§357.5(e)(1)	Adjusted WMSs for appropriate environmental water needs	Chapter 4 Chapter 5 Chapter 7
§357.5(e)(2)	Provided WMSs to be used during a drought of record	Chapter 4 Chapter 6
§357.5(e)(3)	Protected water rights, water contracts and option agreements. May consider amendments of water rights, contracts etc.	Chapter 4 Chapter 7
§357.5(e)(4)	Specific recommendations of WMSs were based on analysis and comparison of all potentially feasible WMSs	Chapter 4 Sections 4.3, 4.5, & 4.7
§357.5(e)(4)	Prior to identifying potentially feasible WMSs, RWPG documented its process for identifying potentially feasible WMSs	Chapters 4,10 Sections 4.0 & 4.1
§357.5(e)(5)	Incorporated water conservation and drought contingency planning	Chapters 4,6 Sections 4.4 & 4.5.4
§357.5(e)(6)	Conducted planning to achieve efficient use of existing water supplies	Chapter 4 Chapter 6

§357.5(e)(6)	Explored opportunities and benefits of regional water supply facilities or providing regional management of regional facilities	Chapter 4
§357.5(e)(6)	Coordinated actions of local and regional water resource management agencies	Chapter 1 Chapter 4 Chapter 10
§357.5(e)(6)	Provided substantial involvement by the public in the decision-making process and provide full dissemination of planning results	Chapter 10
§357.5(e)(7)(A)	Specific factors were considered to initiate a drought response for each water supply source designated in §357.7(a)(3)	Chapter 6
§357.5(e)(7)(B)	Actions to be taken as part of the drought response	Chapter 6 Attachments
§357.5(e)(8)	Effect of the regional water plan on navigation	Chapter 7
§357.5(f)	Prepared the regional water plan to be consistent with all laws applicable to water use in the RWPA	Chapter 4 Chapter 7
§357.5(h)	For special water resources, protected water rights, water supply contracts, etc. for demands outside the RWPA	Chapter 4
§357.5(h)	For special water resources, provided holders of interests in water rights, water supply contracts, etc. notice of and an opportunity to comment on the scope of work and proposed water plan.	Chapter 10
§357.5(i)	Consider emergency transfers of surface water to meet non-municipal use pursuant to TWC §11.139	Chapter 4 Chapter 7
§357.5(k)(1)	Consider existing plans and information, including the following:	
§357.5(k)(1)(A)	Water conservation plans	Chapter 6 Attachments
§357.5(k)(1)(B)	Drought contingency plans	Chapter 6 Attachments
§357.5(k)(1)(C)	Information from water loss audits - N/A until 2011 Regional Water Plans	
§357.5(k)(1)(D)	Certified groundwater conservation district management plans	Chapter 3 Chapter 4
§357.5(k)(1)(E)	Publicly available plans of major agricultural, municipal, manufacturing and commercial water users	Chapter 3 Chapter 4
§357.5(k)(1)(F)	Water management plans	Chapter 3 Chapter 4
§357.5(k)(1)(G)	Water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019	Chapter 3 Chapter 4
§357.5(k)(1)(H)	Any other information available from existing local or regional water planning studies	Chapter 3 Chapter 4

§357.5(k)(2)	Considered existing programs and goals, including the following:	
§357.5(k)(2)(A)	The state Clean Rivers Program	Chapter 3 Chapter 5
§357.5(k)(2)(B)	The federal Clean Water Act	Chapter 3 Chapter 5
§357.5(k)(2)(C)	Other planning goals, including but not limited to regionalization of water and wastewater services, where appropriate	Chapter 4 Chapter 5
§357.5(l)	Considered environmental water needs including instream flows and bay and estuary inflows	Chapter 3 Chapter 4 Chapter 7
§357.7	**Regional Water Plan Development**	
§357.7(a)(1)	Prepared description of regional water planning area, including:	Chapter 1
§357.7(a)(1)(A)	Wholesale water providers	Chapter 1
§357.7(a)(1)(B)	Current water use (for identified water use categories)	Chapter 1
§357.7(a)(1)(C)	Identified water quality problems	Chapter 1
§357.7(a)(1)(D)	Sources of groundwater and surface water including springs important for water supply or natural resource protection	Chapter 1
§357.7(a)(1)(E)	Major demand centers	Chapter 1
§357.7(a)(1)(F)	Agricultural and natural resources	Chapter 1
§357.7(a)(1)(G)	Social and economic aspects: current population and economic activities (primary and ones depend. on natural water resources)	Chapter 1
§357.7(a)(1)(H)	Assessed current preparations for drought	Chapter 1
§357.7(a)(1)(I)	Summarized existing regional water plans	Chapter 1
§357.7(a)(1)(J)	Summarized recommendations in state water plan	Chapter 1
§357.7(a)(1)(K)	Summarized of local water plans	Chapter 1
§357.7(a)(1)(L)	Any threats to agricultural and natural resources due to water quantity or water quality problems related to water supply	Chapter 1
§357.7(a)(2)	Presented current and projected population and water demands for the following:	Chapter 2
§357.7(a)(2)(A)(i)	Cities with populations greater than 500 people	Chapter 2
§357.7(a)(2)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 2
§357.7(a)(2)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 2
§357.7(a)(2)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 2

§357.7(a)(2)(B)	Categories of water use for WWPs considering counties and river basins. Include WWP's contractual obligations and demands.	Chapter 2
§357.7(a)(2)(C)	How water-saving plumbing fixtures (per Chapter 372 of Health and Safety Code) impact projected municipal water use	Chapter 2
§357.7(a)(3)	Evaluated water supplies legally and physically available during drought of record using TWDB approved methods	Chapter 3
§357.7(a)(3)(A)(i)	Cities with populations greater than 500 people	Chapter 3
§357.7(a)(3)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 3
§357.7(a)(3)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 3
§357.7(a)(3)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 3
§357.7(a)(3)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 3
§357.7(a)(4)	Analyzed water supplies and demands	Chapter 3
§357.7(a)(4)(A)	Compared water demands developed in §357.7(a)(2) with current supplies developed in §357.7(a)(3) to determine surpluses and needs.	Chapter 3
§357.7(a)(4)(A)(i)	Cities with populations greater than 500 people	Chapter 4
§357.7(a)(4)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 4
§357.7(a)(4)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 4
§357.7(a)(4)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 4
§357.7(a)(4)(A)	Evaluated social and economic impact of not meeting needs and report by RWPA and river basin.	Chapter 5
§357.7(a)(4)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 4
§357.7(a)(5)	Developed Water Management Strategies	
§357.7(a)(5)(A)(i)	Cities with populations greater than 500 people	Chapter 4
§357.7(a)(5)(A)(ii)	Retail public utilities for counties with less than five retail public utilities	Chapter 4
§357.7(a)(5)(A)(iii)	Individual retail public utilities or collective data for such utilities that form a logical reporting unit for counties with five or more	Chapter 4

§357.7(a)(5)(A)(iv)	Categories of water use for each county or portion of county in RWPA and by river basin if county is in more than one basin	Chapter 4
§357.7(a)(5)(B)	Categories of water use for WWPs considering counties and river basins	Chapter 4
§357.7(a)(5)(C)	Water Management Strategies not selected for WUGs or WWPs with need	Chapter 4
§357.7(a)(5)(C)(i)	Evaluation of WMSs must be shown and reasons given why no WMSs are feasible	Chapter 4
§357.7(a)(5)(C)(ii)	If political subdivision does not participate in planning process, has RWPG adopted equitable and reasonable terms of participation?	Chapter 4
§357.7(a)(6)	Presented data in additional reporting units, such as splitting a county into two, if desired by the RWPG	Chapter 4
§357.7(a)(7)	Evaluated all Water Management Strategies the RWPG determines to be potentially feasible:	Chapter 4
§357.7(a)(7)(A)	RWPG considered water conservation practices for each need identified in §357.7(a)(4)	Chapter 4
§357.7(a)(7)(A)(i)	Water conservation practices must be included for each WUG to which TWC §11.1271 applies in a manner consistent with §11.1271	Chapter 4
§357.7(a)(7)(A)(ii)	The RWPG shall adopt water conservation practices that exceed §11.1271 for affected WUGs or document the reason	Chapter 4
§357.7(a)(7)(A)(iii)	The highest practicable level of water conservation and efficiency achievable for interbasin transfers to which TWC §11.085(l) applies	Chapter 4
§357.7(a)(7)(A)(iv)	Considered strategies in response to an issues identified through water loss audits	Chapter 4
§357.7(a)(7)(B)	RWPG considered drought management measures for each need identified in §357.7(a)(4)	Chapter 4
§357.7(a)(7)(B)	Drought management measures must be included for each WUG to which TWC §11.1272 applies in a manner consistent with §11.1272	Chapter 4
§357.7(a)(7)(B)	The RWPG shall adopt drought management measures that exceed §11.1272 for affected WUGs or document the reason	Chapter 4
§357.7(a)(7)(C)	Reuse of wastewater	Chapter 4
§357.7(a)(7)(D)	Expanded use of existing supplies: systems optimization, conjunctive use, reallocation of reservoir storages, voluntary redistribution, etc.	Chapter 4
§357.7(a)(7)(E)	New supply development: construction and improvement of surface water and groundwater resources, brush control, etc.	Chapter 4

§357.7(a)(7)(F)	Interbasin transfers	Chapter 4
§357.7(a)(7)(G)	Other measures	Chapter 4
§357.7(a)(8)	Evaluated all Water Management Strategies the RWPG determines to be potentially feasible	
§357.7(a)(8)(A)(i)	Quantitative reporting of quantity, reliability, and cost of water delivered and treated for end user's requirements	Chapter 4
§357.7(a)(8)(A)(ii)	Quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, etc.	Chapter 4
§357.7(a)(8)(A)(iii)	Quantitative reporting of impacts on agricultural resources	Chapter 4
§357.7(a)(8)(B)	Impacts on other water resources of the state including other WMSs and groundwater surface water relationships	Chapter 4
§357.7(a)(8)(C)	Discussed how threats to agricultural and natural resources identified in §357.7(a)(1)(L) will be addressed or affected	Chapter 4
§357.7(a)(8)(D)	Other factors deemed relevant by the RWPG including recreational impacts	Chapter 4
§357.7(a)(8)(E)	Equitable comparison and consistent application of all WMSs the RWPGs determine to be potentially feasible for each need	Chapter 4
§357.7(a)(8)(F)	Consideration of the provisions in TWC §11.085(k)(1) for interbasin transfers of surface water, including summing needs	Chapter 4
§357.7(a)(8)(G)	Third party impacts from voluntary redistributions of water and moving water from rural and agricultural areas	Chapter 4
§357.7(a)(8)(H)	Consideration of water pipelines and other facilities that can be used for water conveyance as described in §357.7(a)(1)(M)	Chapter 4
§357.7(a)(9)	WMSs described in sufficient detail to allow state agencies to make financial or regulatory decisions to determine consistency	Chapter 4
§357.7(a)(10)	Regulatory, admin., or legislative recommendations that RWPG believes are needed and desirable to meet purpose of SB 1	Chapter 8
§357.7(a)(11)	Chapter consolidating the water conservation and drought management recommendations of the RWP	Chapter 6
§357.7(a)(12)	Described the major impacts of WMSs on key parameters of water quality important to the use of the water resource	Chapter 5
§357.7(a)(13)	Chapter describing how the Plan is consistent with long-term protection of water, agricultural, and natural resources	Chapter 7

§357.7(a)(14)	Chapter describing the financing needed to implement the WMSs. How local governments and others will pay for WMSs.	Chapter 9
§357.7(c)	Regional water plan includes a model water conservation plan pursuant to TWC §11.1271	Chapter 6
§357.7(d)	Regional water plan includes a drought contingency plan pursuant to TWC §11.1272	Chapter 6
§357.8	**Ecologically Unique River and Stream Segments**	
§357.8(a)	Recommendation package containing physical description and site characterization submitted to and evaluated by TPWD	Chapter 8
§357.8(c)	Impact of RWP on unique river and stream segments, comparing current conditions and conditions with WMSs	Chapter 8
§357.9	**Unique Sites for Reservoir Construction**	
§357.9	Description of the sites, reasons for the unique designation, and expected beneficiaries of water supply to be developed	Chapter 8
§357.10	**Format of Information to be Presented in RWPs**	
§357.10(a)(1)	Technical report and data prepared pursuant to rules and Exhibit B	Appendix
§357.10(a)(2)	Executive summary that documents the key RWP findings and recommendations	Attached to Report
§357.10(a)(3)	Summaries of comments from TWDB, any federal or state agency, and the public with RWPG response	Chapter 10
§357.10(b)	Transfer copies of all data and reports to TWDB	RWP
§357.10(b)	To extent possible data shall be in digital format per Exhibit B	RWP
§357.10(b)	One copy of all reports shall be in digital format per Exhibit B	RWP
§357.11	**Adoption of RWPs by RWPGs**	
§357.11(a)	IPP submitted in electronic and paper format as specified in Exhibit B	RWP
§357.11(a)	RWPG certification that IPP is complete and adopted by the RWPG	RWP
§357.12	**Notice and Public Participation**	
§357.12(a)(1)	Public meeting prior to preparation of the RWP	Chapter 10
§357.12(a)(2)	Opportunities for public input during preparation of RWP	Chapter 10
§357.12(a)(3)	Public hearing following adoption of initially prepared RWP	Chapter 10
§357.12(a)(5)	Notice published in newspaper of general circulation before 30th. day preceding date of public hearing and mailed to the following:	Chapter 10

§357.12(a)(5)(A)	Mayors of municipalities with population of 1000 or more	Chapter 10
§357.12(a)(5)(B)	County judges of counties located in whole or part of RWPA	Chapter 10
§357.12(a)(5)(D)	Retail public utilities that serve any part of RWPA or receives water from RWPA	Chapter 10
§357.12(a)(5)(E)	Holders of water rights for surface water diverted from RWPA	Chapter 10
§357.12(a)(6)	Notices shall include the following:	Chapter 10
§357.12(a)(6)(A)	Date, time and location of the public hearing	Chapter 10 Section 10.1
§357.12(a)(6)(B)	Summary of the proposed action to be taken	Chapter 10 Section 10.1
§357.12(a)(6)(C)	Name, telephone number, and address of the person for questions and requests for additional information	Chapter 10 Section 10.1
§357.12(a)(6)(D)	That RWPG will accept written and oral comments at hearing	Chapter 10 Section 10.1
§357.12(a)(6)(D)	How public may submit written comments separate from hearing	Chapter 10 Section 10.1
§357.12(a)(6)(D)	Deadline for submitting written comments not earlier than 30 days after the hearing	Chapter 10 Section 10.1
§357.12(b)	Copies of RWP available for public inspection at least one month before hearing at the following locations:	Chapter 10 Section 10.1
§357.12(b)	At least one public library in each county	Chapter 10 Section 10.1
§357.12(b)	Either the county courthouse's law library, county clerk's office, or some other accessible place within the county courthouse	Chapter 10 Section 10.1
§357.12(b)	Notice shall include locations of copies of RWP	Chapter 10 Section 10.1
§357.14	**Approval of RWP by the Board**	
§357.14(2)(B)	RWP must include water conservation and drought management practices that incorporate §357.7(7)(a)(A), a(B), (c), and (d)	Chapter 4 Section 4.5.4 Chapter 6
§357.14(2)(C)	Consistent with long-term protection of water, agricultural, and natural resources	Chapter 5 Chapter 7
§357.14(3)	No interregional conflict exits	Chapter 3 Chapter 4
Chapter 358	**STATE WATER PLAN DEVELOPMENT**	
§358.3	**Guidelines**	
§358.3(b)	Development of the state and regional water plans shall be guided by the following principles:	
§358.3(b)(1)	Identified policies and actions to meet water needs and to respond to drought conditions to assure sufficient water supply for Texas	Chapter 4 Chapter 7

§358.3(b)(2)	Decision-making open to and accountable to the public; based on accurate, objective and reliable information	Chapter 4 Chapter 10
§358.3(b)(3)	Considered effects of policies or WMS on public interest, water supply, and those entities that provide water supply	Chapter 4 Chapter 5 Chapter 7
§358.3(b)(4)	Considered all WMS the board considers potentially feasible that are cost effective and which are consistent with long-term protection of water, agricultural, and natural resources	Chapter 4 Chapter 7
§358.3(b)(5)	Opportunities that encourage and result in voluntary transfers of water, including regional water banks, sales, leases etc.	Chapter 4
§358.3(b)(6)	Balance of economic, social, aesthetic, and ecological viability	Chapter 4
§358.3(b)(8)	Orderly development, management, and conservation of water resources	Chapter 4 Chapter 7
§358.3(b)(9)	Principles that all surface water is held by the state, use is via rights administered by the TCEQ, and prior appropriation applies	Chapter 3 Chapter 4
§358.3(b)(10)	Protection of existing water rights, water contracts, and option agreements	Chapter 3 Chapter 4
§358.3(b)(11)	Principal that use of groundwater is governed by the right of capture, unless under a local groundwater management district	Chapter 3
§358.3(b)(12)	Considered recommendations of river and stream segments of unique ecological value	Chapter 8
§358.3(b)(13)	Considered recommendation of sites of unique value for the construction of reservoirs	Chapter 8
§358.3(b)(14)	Coordinate water planning and management activities of local, regional, state and federal agencies	Chapter 4
§358.3(b)(15)	Designated water quality and related water uses shown in the state water quality plan should be improved or maintained	Chapter 5
§358.3(b)(16)	Coordination of water planning/management activities of RWPGs to identify common needs, issues, and/or problems and working together to resolve conflicts equitably and fairly	Chapter 3 Chapter 4
§358.3(b)(17)	Describe WMSs in sufficient detail for state agencies to make financial/regulatory decisions that are consistent with the RWP	Covered by §357.7(a)(9)
§358.3(b)(18)	Evaluated alternative WMS using environmental criteria	Chapter 4
§358.3(b)(19)	Considered environmental water needs including instream flows and bay and estuary inflows	Chapter 7

§358.3(b)(20)	Planning consistent with all laws applicable to water use	Chapter 3 Chapter 4
§358.3(b)(21)	Inclusion of ongoing water development projects for which TCEQ has issued a permit	Chapter 3 Chapter 4
Exhibit B	**GUIDELINES FOR REGIONAL WATER PLAN DEVELOPMENT**	
PART 1	**Regional Water Plan Tasks and Requirements for Deliverables**	
1.2	Requirements for Deliverables	
1.2.1	Introduction	
1.2.1	All computer files and formats 100 percent compatible with PC-type computers.	RWP
1.2.1	Copies of electronic files (disc or CD) and electronic file lists and file description print outs (including metadata files).	RWP
1.2.1	Formats of all computer files shall be compatible with the widely distributed versions of the following programs:	RWP
1.2.1	Word processor files - Microsoft Word (MS Office 97 or newer)	RWP
1.2.1	GIS coverages - Arc/Info (7.21 or newer)	RWP
1.2.1	GIS shape files – Arc View (3.1 or newer)	RWP
1.2.1	Database files - Microsoft Access (MS Office 97 or newer)	RWP
1.2.1	Internet browsers – Internet Explorer (5.5 or newer) or Netscape (6 or newer)	RWP
1.2.1	Spreadsheets Files - Microsoft Excel (MS Office 97 or newer)	RWP
1.2.1	Graphs, bar-charts, pie-charts - Microsoft Excel (MS Office 97 or newer)	RWP
1.2.1	Drawings and graphs shall be provided in an Encapsulated PostScript format with tiff preview using Pantone process colors	RWP
1.2.2	Data Units	
1.2.2	The following units shall be used, although equivalents in other units may be shown simultaneously:	
1.2.2	Land area - square miles (mi^2)	RWP
1.2.2	Water area - acres (ac)	RWP
1.2.2	Water volume - acre-feet (ac-ft)	RWP
1.2.2	Demand and supply rates - acre-feet per year (ac-ft/yr)	RWP
1.2.2	Treatment plant capacities - million gallons per day (mgd)	RWP

1.2.2	Water use per capita - gallons per capita per day (gpcd)	RWP
1.2.2	Stream flows and reservoir releases - cubic feet per second (cfs)	RWP
1.2.2	Pumping rates - gallons per minute (gpm) or million gallons per day (mgd)	RWP
1.2.2	Cost – 2007 US Dollars (Engineering News Record (ENR) Construction Cost Index)	Chapter 4
1.2.3	Maps	
1.2.3	Minimum requirements of the maps are:	
1.2.3	Figures should be designed so that a black and white photocopy of the original is readable	RWP
1.2.3	Maps shall include title, border, and a title box that includes the Planning Group letter name, map name and number, and date prepared	RWP
1.2.3	For maps drawn to scale, the scale shall be clearly shown and clearly labeled including a scale bar.	RWP
1.2.3	Reference source of both the base map and any substantial additions to the base map.	RWP
1.2.3	Where possible, all maps shall be developed from source maps available from TWDB	RWP
1.2.5	Data Time Frame and Time Steps:	
1.2.5	Time periods and increments shall be 2010 (current year), 2020, 2030, 2040, 2050, and 2060 for planning	RWP
1.2.7	Initially Prepared and Adopted Regional Water Plans	
1.2.7	The RWP will consist of the following:	
1.2.7	Executive summary of 30 pages or less	ES
1.2.7	Ten chapters:	
1.2.7	Planning area description	Chapter 1
1.2.7	Population and water demand projections	Chapter 2
1.2.7	Water supply analysis	Chapter 3
1.2.7	Identification, evaluation, and selection of WMS based on needs	Chapter 4
1.2.7	Impacts of WMSs on key parameters of water quality and impacts of moving water from rural and agricultural areas	Chapter 5
1.2.7	Consolidated water conservation and drought management recommendations	Chapter 6
1.2.7	Description of how the RWP is consistent with long-term protection of water, agricultural and natural resources	Chapter 7
1.2.7	Unique stream segments/reservoir sites/Legislative recommendations	Chapter 8

1.2.7	Report on water infrastructure funding recommendations	Not due until 10/1/2010
1.2.7	Adoption of RWPs	Chapter 10
PART 2	**Introduction to Regional Water Planning Data**	
2.1	Overview	
2.1	Access and update data in DB12 via the internet	RWP
2.1	Data in the final RWP cannot contradict DB12	RWP
2.2	General Requirements	
2.2	Water availability determined as the maximum amount of water from current source during DOR , after accounting for legal constraints and management philosophies	Chapter 3
2.2	Water supply determined as the volume of water for a WUG or WWP from existing and connected water sources as of February 1, 2010 or anticipated prior to end of current planning cycle	Chapter 3
2.2	Data submitted shall be accurate and the best available	RWP
PART 3	**Water Sources**	
3.1	Introduction	
3.1	Document all current water sources and their water availability	Chapter 3
3.1.1	Sources identified and quantified by county and basin location	Chapter 3
3.2.1	Sources not over-allocated on a permanent basis; Sum of supplies on county-basin basis does not exceed DOR availability	Chapter 3
3.2.2	Groundwater	Chapter 3
3.2.2	Calculated largest amount of groundwater that can be pumped annually without violating most restrictive physical, regulatory or policy condition	Chapter 3
3.2.2	TWDB's GAM used to determine groundwater availability	Chapter 3
3.2.3	Surface Water	Chapter 3
3.2.3	Surface water availability for lakes and reservoirs reported as firm yield, TCEQ-permitted yield or operational supply	Chapter 3
3.2.3	Documented any modifications of input data set for WAM Run 3 to reflect return flows and changed conditions	Chapter 3
3.2.3.b	TCEQ's official WAM Run 3 used to determine firm yields of reservoirs	Chapter 3
3.2.3.c	Reservoir firm yield developed in accordance with eight criteria in 3.2.3.c as applicable	Chapter 3

3.2.3.d	TCEQ's official WAM Run 3 used to determine firm diversions from diversion sites	Chapter 3
3.2.3.e	Firm diversion developed in accordance with five criteria in 3.2.3.e as applicable	Chapter 3
3.3	Required Data Elements - Form 1	Chapter 3
3.3	RWP shall document the sources of information and methodologies used to estimate source availability values	Chapter 3
3.3	RWP shall list all water rights permit numbers for each availability source	Chapter 3
3.3	All water used by a WUG must be attributed to one or more sources	Chapter 3
3.3	DB12 Form 1 - Sources completed in accordance with Section 3.3 of Exhibit B	DB07
PART 4	`	
4.1	Introduction	
4.1	All required WUGs shall be included in the Water User Group Form	DB07
4.2.6	Water quality considered as a factor in evaluation of WMS	Chapter 4
4.2.6	Cost of water delivered and treated to end user requirements included for all potentially feasible WMS	Chapter 4
4.2.7.a	Conservation WMS that achieves the most practicable, achievable level of water conservation and efficiency included for each WUG or WWP that will obtain water from a new IBT	Chapter 4
4.2.7.b	Conservation WMS identified by type of measure, estimated savings, timeline and anticipated costs	Chapter 4
4.2.8.c	Use site-specific studies if available, if not the Consensus Criteria for environmental flows for WMS needing new permits	Chapter 4
4.2.9	Costs of Strategies	Chapter 4
4.2.9	Calculation of debt service in accordance with Exhibit B	Chapter 4
4.2.9	Capital costs to include construction costs, engineering, land and easements, environmental, interest during construction, and purchased water cost (if applicable)	Chapter 4
4.2.9	Annual costs to include operations and maintenance, power cost, purchased water cost (if applicable), and debt service	Chapter 4
4.2.9	Total costs to be discounted and shown in terms of present value	Chapter 4

4.3	DB12 Form 2 - Water User Groups completed in accordance with Section 4.3 of Exhibit B	DB12
PART 5	**Data by Wholesale Water Providers**	
5.1	Introduction	
5.1	All WWPs must be included in the Wholesale Water Providers form	DB12
5.1	All the WWPs contractual or non-contractual obligations throughout the 50-year planning horizon must be included	Chapter 3
5.2.2	If a recipient shows a need, WWP must include a WMS to address that need	Chapter 4
5.3	DB12 Form 3 - Wholesale Water Providers completed in accordance with Section 5.3 of Exhibit B	DB12

ATTACHMENT 7-2

BAYS IN PERIL – EFFECTS OF WATER PLAN ON FRESHWATER INFLOWS

BAYS IN PERIL: Evaluating the Effects of the 2006 Region M Water Plan on Freshwater Inflows to the Lower Laguna Madre Estuary of Texas.

by the National Wildlife Federation
in cooperation with NRS Consulting Engineers

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Evaluating the Effects of the 2006 Region M Water Plan on Freshwater Inflows to the Lower Laguna Madre Estuary of Texas.

Introduction

Texas coastal estuaries, where freshwater from inland runoff mixes with the salty waters of the Gulf of Mexico, support an amazing abundance of wildlife. Young fish, shrimp, and crabs feed and hide in brackish estuary waters until they are mature enough to survive in the Gulf of Mexico. Resident and migratory birds by the thousands rest and feed in estuarine marshes. In fact, 95 percent of the Gulf's recreationally and commercially important fish and other marine species rely on estuaries during some part of their life cycle.

Although the estuaries that line the Texas coast are highly variable with regard to freshwater inflow volumes, salinity regimes, and other important characteristics, there is little doubt that freshwater is an important requirement. The southernmost estuary, the Laguna Madre, is typified by lower inflows and higher salinities than others up the coast. However, adequate freshwater inflows are still needed to maintain the estuary's function as a nursery and habitat for a vast array of marine life.

The Texas Water Development Board (TWDB) rules for regional water planning require an evaluation of the plan's consistency with long-term protection of the state's water, agricultural, and natural resources. Obviously a critical component of that evaluation for the Lower Rio Grande Region is an assessment of the Region M plan's potential effects on the Lower Laguna Madre. In early 2005 the National Wildlife Federation (NWF) approached the Lower Rio Grande Regional Water Planning Group (LRGWPG) with a proposal to assess these potential cumulative effects. This would be accomplished by calculating changes in freshwater inflow expected to the Lower Laguna Madre Estuary with the Region M Plan in place at the ultimate 2060 time frame and assessing the ecological significance of these changes. The NWF has developed a two-step method for accomplishing such assessments, which was applied to the other principal estuaries of the Texas coast in a report issued in late 2004[4].

Figure 7.2-1 is a basic illustration of the NWF method. The initial step is to calculate freshwater inflows for various scenarios including "year 2060 with the regional plan implemented" conditions. This step is accomplished with the Texas Commission on Environmental Quality's water availability model (WAM) that performs predictions of streamflows in the Nueces-Rio Grande coastal basin under various scenarios. The Nueces-Rio Grande coastal basin is the official hydrological name of the area draining to the Lower Laguna Madre. The name refers to the geographic location, lying between the Nueces river basin to the north and the Rio Grande basin to the south. Much of the lower three counties of the Lower Rio Grande Region lies in the area of the Nueces-Rio Grande coastal basin. The results of this first step also provide the ability to compare the "with plan" conditions to two baselines: "Natural" and "Current use" conditions.

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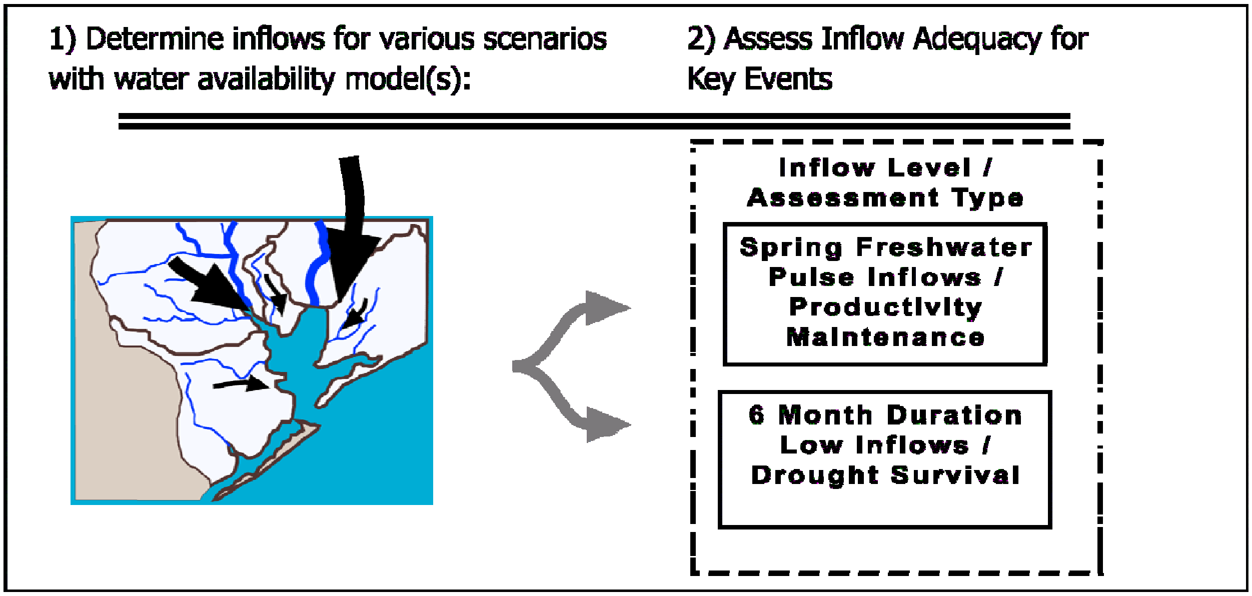
[4] Johns, N.D., Hess, M., Kaderka, S., McCormick, L., & McMahon, J., "Bays in Peril, A Forecast for Freshwater Flows to Texas Estuaries," National Wildlife Federation, October 2004.

In the second step of the NWF method, two evaluations of the ecological significance of these inflow changes are performed. The two ecologically-based assessments rely, in part, upon the freshwater inflow recommendations of the Texas Parks & Wildlife Department (TPWD) and the TWDB.[5] The criteria in this step focus upon spring / early summer freshwater inflow pulses and also drought periods during the months of March through October. More details on each step are provided below.

Figure 7.2-1 National Wildlife Federation's method for assessing freshwater inflow status of Texas estuaries



At its April 2005 meeting the LRGWPG approved in concept this cooperative work. Several subsequent meetings and phone discussions were held between NWF and the Region's consultant in order to carry out these analyses. This section describes these supplemental evaluations of potential long-term changes, at the 2060 time frame, of freshwater inflows to the Lower Laguna Madre Estuary with implementation of the 2006 Region M water plan.

Elements of the Region M water plan that will affect freshwater inflows

There are approximately 325,000 ac-ft/yr in new municipal water supplies proposed in the 2006 Region M water plan. All of this except approximately 19,000 ac-ft/yr of advanced water conservation can affect either freshwater inflows to the Lower Laguna Madre or streamflows in the Rio Grande. Alteration in flows on the Rio Grande is beyond the scope of the present evaluation. For Nueces-Rio Grande coastal basin streams draining to the Lower Laguna Madre there are no major dams, diversions, or other water management strategies proposed that can cause changes in streamflows. However, many of the proposed water management strategies can influence freshwater inflow through alteration of wastewater discharges based upon supplies imported from the Rio Grande basin or

[5] TPWD & TWDB, "Freshwater Inflow Recommendation for the Laguna Madre Estuary of Texas."

groundwater. Many of Region's growing municipalities lie in the Nueces-Rio Grande coastal basin and will have greatly altered wastewater discharge into the streams that drain to the Laguna Madre.

For example, the type of municipal water management strategy with the largest proposed volume in the 2006 Region M water plan is the conversion of water currently used for irrigation into the municipal use category. This amounts to about 140,000 ac-ft/yr in the whole region[6]. While most irrigated agriculture has little or no return flow, most municipal use will return about 60% to rivers and streams typically. For the Lower Rio Grande Region, the region-wide annual average value is 63%[7]. Other water management strategies proposed that will alter wastewater discharges to Nueces-Rio Grande coastal basin streams are increased pumping of groundwater[8], desalination of brackish groundwater and seawater, and a portion of the supply from the Brownsville Weir[9]. Another type of water management strategy in the 2006 Region M water plan that can affect freshwater inflow is reuse of wastewater. While reuse can be an efficient water use, it also reduces the return flows of wastewater. In some cases such return flows are all that keep some streams flowing during drier times.

Of the total proposed changes in municipal water supply, not all of this will affect the Nueces-Rio Grande coastal basin and the Lower Laguna Madre. For instance, major water supplies are proposed for Laredo, but this will not affect the Nueces-Rio Grande coastal basin. It is necessary to narrow down the proposed water management strategies to those that will potentially affect the Lower Laguna Madre. The key was to first select the municipalities and other municipal water user groups (i.e. currently rural, but urbanizing counties) that either currently discharge, or in the future will discharge, to streams that drain to the Lower Laguna Madre. .Detailed information was provided by Region M's consultant (and found in Appendix C of the plan) regarding the proposed water management strategy(ies) for each municipal water user group. In conjunction with the Region M consultant, NWF was able to compile Figure 7.2-2, which shows the locations of current and future discharges that will affect Nueces-Rio Grande coastal basin streams and the Lower Laguna Madre.

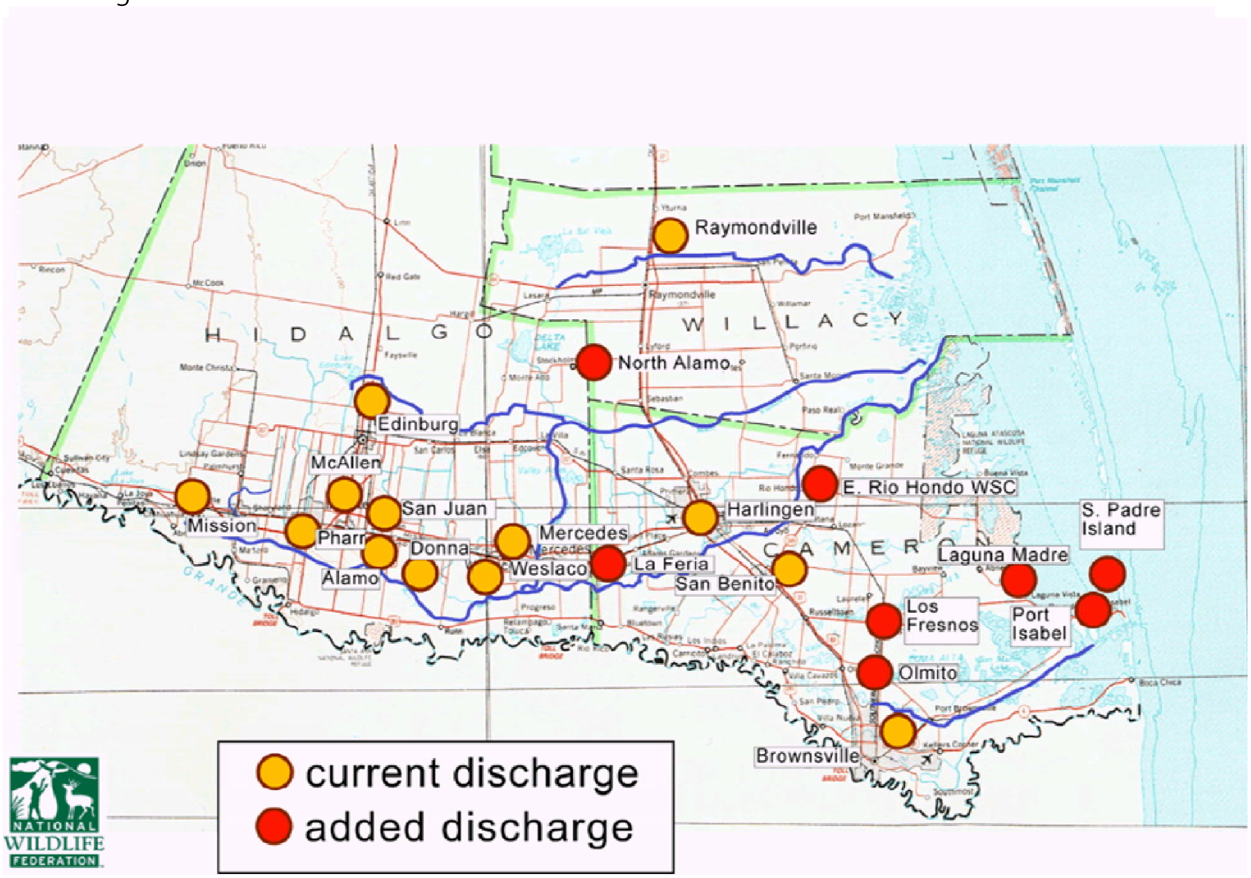
[6] data provided by NRS Consulting Engineers, November 2005

[7] spreadsheet provided by NRS Consulting Engineers, November 2005.

[8] Emerging research at Texas A&M in Kingsville and UT in Port Aransas on this topic is finding a discharge pathway from the Gulf Coast Aquifer to the lower Texas estuaries. Therefore any increase in return flows from groundwater pumping to surface water streams may be offset by long-term loss of aquifer discharge to the coastline. However, this is beyond the scope of this evaluation. In these analyses, groundwater for municipal use was discharged as surface water addition.

[9] NRS Engineers estimates that approximately 80% of the growth in Brownsville will be on the north side of the city and the wastewater resulting from this will likely end up discharging to the Brownsville Ship Channel and reach the Lower Laguna Madre. Personal communication December 9, 2005.

Figure 7.2-2 Locations of current and future wastewater discharges to streams draining to the Lower Laguna Madre



The list of current discharges and their respective volumes are shown in Table 7.2-1. The entities included in this table are those which are included in the Nueces-Rio Grande coastal basin WAM "current conditions" data set[10].

[10] There are probably more wastewater discharges than in this list of fourteen entities. The original guidance from TCEQ on WAM development required all entities with permits greater than 1mgd to be included (though their actual discharges might not be 1mgd). Table 2-1 in the Nueces Rio Grande WAM report, prepared in 2002 by PBS& J Engineers, list about 125 entities with permits, including many other municipal entities such as Rio Hondo, Los Fresnos, and Olmitto. Apparently the actual levels of discharge for most of these were negligible although the criteria for narrowing the list to just the given fourteen was not documented.

Table 7.2-1 Original municipal water user groups with wastewater discharges in the Nueces-Rio Grande (NRG) coastal basin WAM

	Water user group	total current effluent (ac-ft/yr)	total current effluent (mgd)	WAM point of discharge	WAM point terminus at Lower Laguna Madre	common name of this stream pathway
1	Raymondville	662.9	0.59	V20010	V10000	East or North Main Floodway
2	Edinburg	2959.1	2.64	W20200	W10000	Main Floodway
3	Weslaco	1903.8	1.70	W20160	W10000	Main Floodway
4	McAllen	1560.6	1.39	W20190	W10000	Main Floodway
5	Mercedes	1227.2	1.10	X20060	X10000	Arroyo Colorado
6	San Benito	1323	1.18	X20020	X10000	Arroyo Colorado
7	Mission	2348.6	2.10	X20130	X10000	Arroyo Colorado
8	Harlingen	4463.3	3.98	X20040	X10000	Arroyo Colorado
9	Donna	1026.8	0.92	X20080	X10000	Arroyo Colorado
10	Pharr	3205.9	2.86	X20110	X10000	Arroyo Colorado
11	McAllen	7474.9	6.67	X20120	X10000	Arroyo Colorado
12	San Juan	734.7	0.66	X20100	X10000	Arroyo Colorado
13	Alamo	1016.5	0.91	X20090	X10000	Arroyo Colorado
14	Brownsville	5133.7	4.58	Y10150	Y10000	other to Laguna Madre
	Total	35,041.0	31.28			

Table 7.2-2 details the proposed additional water supplies for these existing dischargers and other municipal groups that will discharge to the Nueces-Rio Grande coastal basin in the future with the Region M plan implemented. The final columns to the right of Table 7.2-2 show the change in wastewater volumes resulting from the proposed water supply strategies. These are based on return flow factor of 63% for conventional wastewater discharge and a loss factor of 27% for reuse water supplies[11].

While Table 7.2-2 gives the details of the many proposed water management strategies for twenty three municipal entities, Table 7.2-3 summarizes these changes for the "2060 with Region M plan" condition. Basically, there will be vast increase in wastewater discharges to the streams of the Nueces-Rio Grande coastal basin that feed freshwater to the Lower Laguna Madre. While these currently total about 35,000 ac-ft/yr (Table 7.2-1), they will increase to approximately 100,000 ac-ft/yr in 2060. Of course, much of this increased discharge (about 37,000 ac-ft[12]) will come at the expense of the Rio Grande basin.

[11] spreadsheet provided by NRS Consulting Engineers, November 2005
[12] calculated as the sum of all irrigation conversion itemized in Table 7.2-2 times a return flow factor of 63%

Table 7.2-2 Tabulation of changes in supplies for individual water user groups (WUGs) and corresponding change in discharge to Nueces-Rio Grande (NRG) coastal basin streams

		Region M proposed water supply additions										NRS-NWF Calculation			
						Irrigation conversion			Desalination			change wastewater return flow			
	Water user group	Add. Gr'd-water	Non-Pot. Water Reuse	Pot. Water Reuse	B'ville Weir	Purch.	Urban-ization	Con-tracts	Brack. Gr'd-water	Sea-water	*total supply*	portion discharge to NRG stream [1]	conven-tional addtnl.. supply[2]	reuse waste-water supply[3]	net
Original entities with discharges in Nueces-Rio Grande WAM															
1	Raymondville								100		100	100%	63	0	63
2	Edinburg		4000			6619	0	348	25		10992	100%	4405	-1480	2925
3	Weslaco	500	1120			135		7			1762	100%	404	-414	-10
4	McAllen	1450	9893			7220		380	7841		26784	100%	10641	-3660	6981
5	Mercedes								560		560	100%	353	0	353
6	San Benito					789		42			831	100%	524	0	524
7	Mission		4548				11660		560		16768	100%	7699	-1683	6016
8	Harlingen								2022		2022	100%	1274	0	1274
9	Donna								50		50	100%	32	0	32
10	Pharr	100	50			8522	1300	449			10421	100%	6534	-19	6515
11	McAllen										0	100%	0	0	0
12	San Juan					7312		385			7697	100%	4849	0	4849
13	Alamo	100	500			451	2100	24	1255		4430	100%	2476	-185	2291
14	Brownsville	1000	500		20643	1793		129	6070		30135	80%	14936	-148	14788
SUBTOTALS		3150	20611	0	20643	32841	15060	1764	18483	0	112552		54189	-7589	46600
Other Reg M entities with surface discharges in Nueces-Rio Grande WAM to add.															
15	N. Alamo WSC (Hidalgo)					902			11201		12103	70%	5337	0	5337
16	N. Alamo WSC (Willacy)								11201		11201	50%	3528	0	3528
17	Port Isabel					1389		73	1463		2925	100%	1843	0	1843
18	S. Padre Island					3769		198			3967	100%	2499	0	2499
19	La Feria								280		280	100%	176	0	176
20	E. Rio Hondo WSC					95			906		1001	100%	631	0	631
21	Laguna Madre WSC					950		50	2000	864	3864	100%	2434	0	2434
22	Los Fresnos								997		997	100%	628	0	628
23	Olmito WSC					1723		91			1814	100%	1143	0	1143
SUBTOTALS		0	0	0	0	8828	0	412	28048	864	38152		18220	0	18220

Table 7.2-3 Summary of year 2060 effluent volumes for current (first fourteen) and future wastewater dischargers to streams of the Nueces-Rio Grande coastal basin that drain to the Lower Laguna Madre

	Water user group	total effluent w. plan (ac-ft/yr)	total effluent w. plan (mgd)	WAM point at discharge	WAM point terminus at Lower Laguna Madre	common name of this stream pathway
Original entities with wastewater discharges in WAM						
1	Raymondville	726	0.65	V20010	V10000	East Main Floodway
2	Edinburg	5884	5.25	W20200	W10000	Main Floodway
3	Weslaco	1894	1.69	W20160	W10000	Main Floodway
4	McAllen	2747	2.45	W20190	W10000	Main Floodway
5	Mercedes	1580	1.41	X20060	X10000	Arroyo Colorado
6	San Benito	1847	1.65	X20020	X10000	Arroyo Colorado
7	Mission	8364	7.47	X20130	X10000	Arroyo Colorado
8	Harlingen	5737	5.12	X20040	X10000	Arroyo Colorado
9	Donna	1058	0.94	X20080	X10000	Arroyo Colorado
10	Pharr	9721	8.68	X20110	X10000	Arroyo Colorado
11	McAllen	13269	11.85	X20120	X10000	Arroyo Colorado
12	San Juan	5584	4.98	X20100	X10000	Arroyo Colorado
13	Alamo	3307	2.95	X20090	X10000	Arroyo Colorado
14	Brownsville	19922	17.78	Y10150	Y10000	Brownsville Ship Channel
	SUBTOTALS	81641	72.88			
Entities with new wastewater discharges to be added to WAM						
15	N. Alamo WSC (Hidalgo)	5337	4.76	V20010	V10000	East Main Floodway
16	N. Alamo WSC (Willacy)	3528	3.15	V20010	V10000	East Main Floodway
17	Port Isabel	1843	1.65	Y10100	Y10000	Direct
18	S. Padre Island	2499	2.23	Y10100	Y10000	Direct
19	La Feria	176	0.16	X20010	X10000	Arroyo Colorado
20	E. Rio Hondo WSC	631	0.56	X20000	X10000	Arroyo Colorado
21	Laguna Madre WSC	2434	2.17	Y10120	Y10000	Brownsville Ship Channel
22	Los Fresnos	628	0.56	Y10030	Y10000	Brownsville Ship Channel
23	Olmito WSC	1143	1.02	Y10030	Y10000	Brownsville Ship Channel
	SUBTOTALS	18220	16.26			
	TOTALS	99861	89.15			

Predicting freshwater inflows with the Nueces-Rio Grande coastal basin WAM

There already exist standard data from the TCEQ which allow determination of Lower Laguna Madre inflows under "natural" and "current conditions" with the Nueces-Rio Grande coastal basin WAM.

For the “natural” scenario, the WAM predicts what inflows to the estuary would have been if there were no dams or pipelines or other human-induced alterations in the streams’ flow pattern, and if there were a repeat of past rainfall patterns. The Nueces-Rio Grande coastal basin WAM also can predict what freshwater inflows to the estuary would be with the same rainfall but with the “current use” scenario. Under this scenario, water use from surface water rights (irrigation, municipal, mining, other) is set to the maximum reported use of the previous ten years and wastewater discharges (those in Table 7.2-1) are at the minimum of the previous 5 years at the time the WAM data was assembled (about year 2000). Water rights use levels in this scenario are fairly low, at about 5,650 ac-ft/yr compared to the full authorization that the rights hold which is in the vicinity of 47,000 ac-ft/yr[13].

The remaining scenario is that of “2060 with the Region M plan.” To model this scenario it is necessary to modify the Nueces-Rio Grande coastal basin WAM to reflect the changed wastewater discharge conditions described above in Table 7.2-3. After the changes in wastewater discharges were tabulated it was necessary to add these altered wastewater discharges into the WAM at the points indicated in the column labeled “WAM point at discharge.” These points of discharge were determined in conjunction with Region M’s consultant using available descriptions of the physical location of the so-called “control points” in the Nueces-Rio Grande coastal basin WAM. The data set used as a beginning point in this process was the standard TCEQ data representing full utilization of existing surface water rights. As mentioned above there is a great deal of water use authorized compared to current use levels. The motivation for use of this data was to get a picture of inflows with the maximum use levels possible in place as well as the changes in wastewater discharges.

The resulting inflows under these three scenarios are summarized in the next two figures. The first shows changes in median inflows. Median inflow is the level that is exceeded 50% of the time. The effects of the increased wastewater discharge can be seen in the graph in most months. The slight decline in “current” and “2060” conditions during the typically high flow month of September probably reflects the effects of off channel reservoirs or other storage capturing a portion of occasional higher flows. During lower flow months these would not be impeding flows and the wastewater discharge increases predominate.

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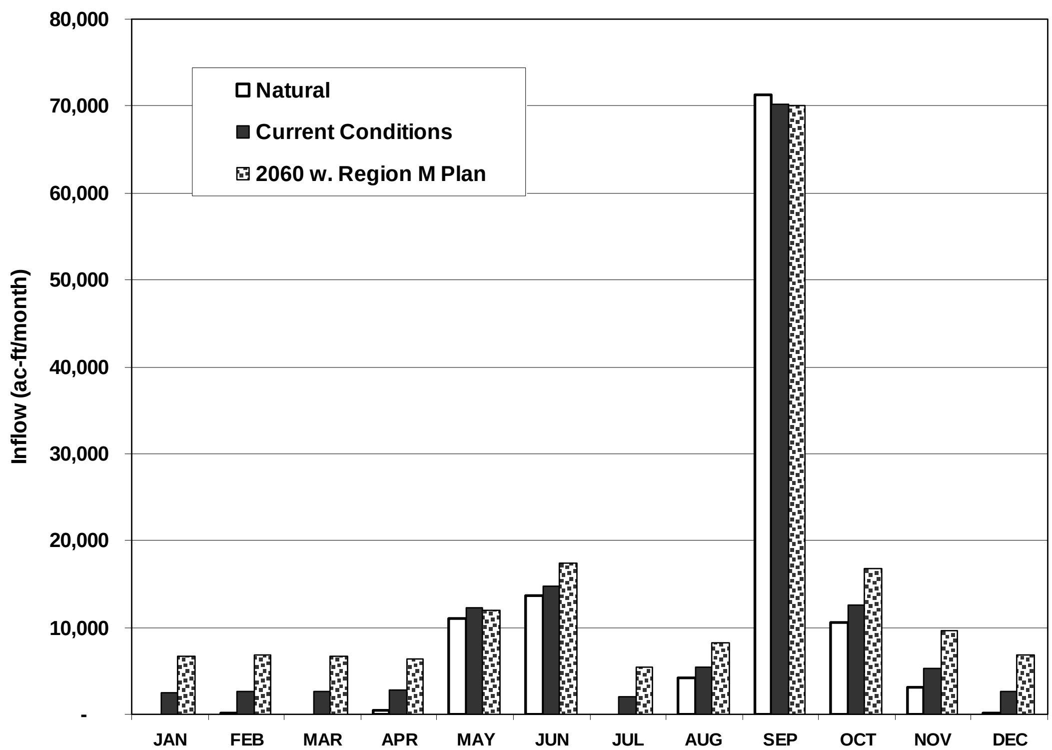
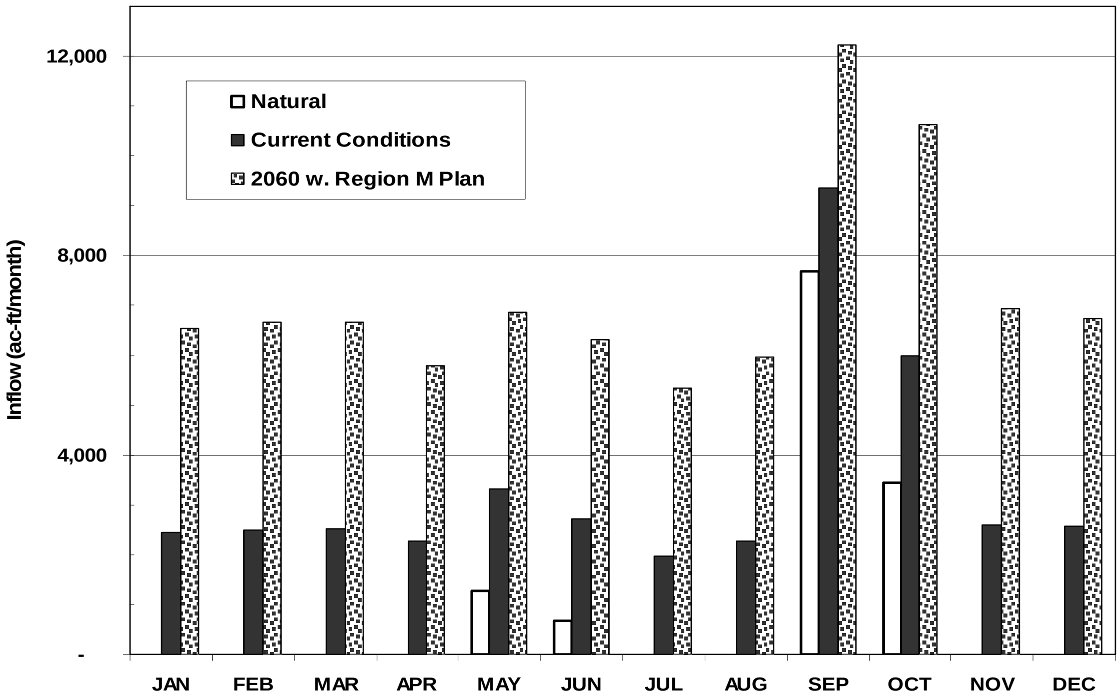
[13] NWF analysis of TCEQ’s Run 8 and Run 3 data for Nueces-Rio Grande coastal basin water availability model.

Figure 7.2-3 Median inflow patterns to Lower Laguna Madre: natural, current, and year 2060 with Region M water plan conditions



While the medians represent one important measure of inflow patterns, for an area of scant rainfall it is also desirable to look at changes expected under low-flow conditions. Thus Figure 7.2-4 shows expected inflow patterns at the 25th percentile level. Inflow of the 25th percentile level is fairly low benchmark level; it is the flow that would be exceeded 75% of the time. For such low flows, the figure shows that natural inflows are non-existent in many months. This means that during 25% of those months there would be no inflows under natural conditions. The inflows are increased in all months under both the "current" and the "2060 with plan" condition.

Figure 7.2-4 Low (25th percentile) inflow patterns to Lower Laguna Madre: natural, current, and year 2060 with Region M water plan conditions



Evaluating the ecological significance of the freshwater inflow changes to the Lower Laguna Madre

While determining changes in the freshwater inflow pattern under the three scenarios is instructive, it is also desirable to understand the ecological significance of these changes. As a starting point, it is critical to recognize the high variability of Texas weather and the resulting fluctuation of freshwater inflows to any given estuary. Not only are inflows variable between years, but there are recognizable patterns of fluctuation within most years. Typically, there is a fairly pronounced peak in inflows during the spring to early summer period, followed by a marked decline during the summer months as hot dry weather often prevails over much of Texas. The low inflows of summer are quite often followed in late summer to early fall by another increase in flows, sometimes sizeable if associated with tropical storm activity. By referring to Figure 7.2-3 above for the Lower Laguna Madre current condition inflows, it is apparent that there is a minor peak in the April - July period that corresponds to spring/early summer and a pronounced September peak showing the influence of tropical storm activity.

To a great extent, Texas estuaries, like all ecosystems, are resilient and have adapted to some degree of variability and, indeed, depend on it. Because of this expected variability of freshwater inflow to our estuaries, both within a year and between years, NWF uses multiple measures of flow adequacy. With this ecologically-based evaluation approach in mind, we have focused on two key assessments for Texas estuaries as illustrated in the second panel of Figure 7.2-1 above. These assessments are both conducted using the estuary inflows predicted by the Nueces-Rio Grande coastal basin WAM.

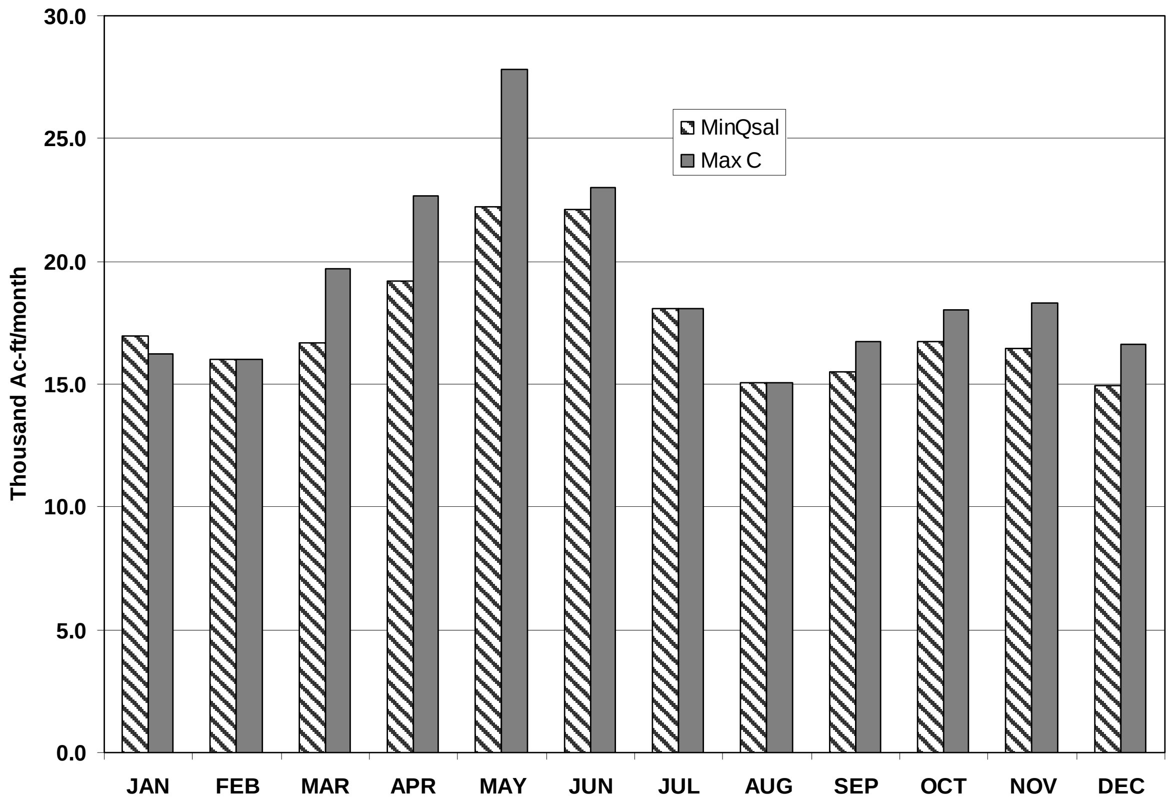
Spring / early summer freshwater pulse criteria

First, NWF examines how often adequate spring-to-early-summer pulses of inflows would occur. These "freshwater pulses," sometimes referred to as "freshetes" are generally indicated to support strong levels of reproduction and growth[14]. Thus, the 'freshwater pulse' evaluations represent an assessment of how well the estuaries would be expected to fare under '2060 with Region M plan' conditions during years that spring/early summer rainfall is in the normal to high range. For the analysis here, we identified a seasonal spring/early summer window of 4 consecutive months during which the occurrence of a 'freshwater pulse' would be assessed. The 4 months included were those with the highest consecutive 'target' level inflow criteria in the state's studies of freshwater inflow needs shown in Figure 7.2-5 (known as MaxC). This was an attempt to focus on the most critical 4-month spring/early summer period, occurring no later than July. For the Lower Laguna Madre the highest four consecutive months in this window are March – June. The sum of the target criteria for the 4 months was used as the benchmark or target volume for the freshwater pulse, which in this case totaled approximately 93,000 ac-ft.

For both the "freshwater pulse" and low-inflow criteria discussed below, NWF first examined how often the inflows predicted under 'naturalized conditions' fell below each of the two inflow criteria. The Nueces-Rio Grande coastal basin WAM simulates a repeat of the weather patterns over the 51-year period of 1948-98. The frequency of periods of "below-criteria" inflows under "natural" conditions became a baseline for each estuary, because it reflects <u>natural</u> variations in inflows. Then, the NWF analysis examined how often the inflows predicted under the "current conditions" and "2060 with Region plan" scenarios for the same time period would fall below the inflow criteria.

[14] see inflow versus productivity relationships for white shrimp and crabs found in a recent study of Matagorda Bay in LCRA, 2005, Determination of Freshwater Inflow Needs for the Matagorda Bay system. Also see Texas Parks and Wildlife Department, 2002, Freshwater Inflow Recommendation for the Nueces Estuary.

Figure 7.2-5 The freshwater inflow criteria for the Lower Laguna Madre as developed by the Texas Water Development Board and Texas Parks and Wildlife Department



Results of the freshwater inflow pulse analysis

As shown in Figure 7.2-3 above, median flows to the Lower Laguna Madre were predicted to change by about 1,000 to 2,000 ac-ft/month for the "current conditions" scenario as compared to "natural" conditions. For the "2060 with Region M plan" condition, flows in the March-June window increased by about 1,000 – 7,000 ac-ft. However, as shown in the following table, these flow changes do not result in great change in these inflow assessment criteria. Under the increased flows of the "current" and "2060 with Region M plan" scenarios the spring/early summer freshwater pulse inflow criteria is meet in only two additional years. The table also provides the supplemental results for consecutive years with a low freshwater pulse inflow. It would appear that the inflow changes ranging from 1,000 to 7,000 ac-ft/month are not very significant compared to the spring/early summer freshwater pulse benchmark volume of 93,000 ac-ft. In other words, this inflow criteria volume is sufficiently high that the increases in wastewater volume alone do not greatly affect whether or not it is met: it remains primarily a weather-driven event.

Table 7.2-4 Key results of the spring / early summer freshwater pulse analysis

Criteria	Natural conditions	Current use conditions	2060 w. Region M Plan
*Number of yrs with inadequate 4 month spring/early summer Freshete**	31	29	29
Max. number consecutive yrs with inadequate 4 month Freshete	5	5	5

* key criteria used in NWF's Bays in Peril report.

Low-flow inflow criteria for the Lower Laguna Madre

Because of Texas' weather variability as discussed above, we also believe it is critical to look at how well the Lower Laguna Madre would fare during drier years. Accordingly, we undertook a second assessment focused on whether enough freshwater would be available to keep salinity conditions within reasonable tolerance ranges and enable sufficient populations of organisms such as fish, shrimp, and crabs to survive drought periods.

In addition to the 'target' criteria used in the spring/early summer freshwater pulse analysis, the state's freshwater inflow study results for each bay also include a set of lower inflow criteria knows as MinQsal. These inflows reflect the amount needed "…to avoid reproductive failure and loss of biodiversity…" during lower inflow periods[15]. As noted in the state's studies, for inflows between the target and the drought tolerance values "biological productivity and fisheries harvest … are significantly reduced from average historical levels." Basically, these inflows are calculated to maintain salinity levels in the estuaries within identified salinity bounds. Thus, inflows equaling drought-tolerance values would just maintain salinity levels within tolerance limits for key species at various points in the estuary. Inflows at these low levels would not be expected to maintain substantial fishery production over any extended period.

For this analysis, a period of six consecutive months below MinQsal inflow is used because such a period represents a significant portion of the life-cycle of several principal estuarine species. Under a half-year-long period of inflows below the MinQsal level, any area of lower salinity would be greatly compressed into regions near the mouths of Nueces-Rio Grande coastal basin streams. Upper estuary marshes could begin to become saltier. Direct effects on populations of fishery species (crabs, shrimp, and some finfish) would be anticipated due to lack of food and habitat, or to unfavorable salinities, especially if occurring in the spring/early summer period. Thus, a six-month consecutive period is considered in this assessment to be indicative of a serious deprivation of freshwater inflows. We also limited this analysis to periods of six consecutive months falling only within the March-October window because that window of time is particularly important for biological activity within Texas estuaries[16].

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[15] MinQsal definition is from Powell, G., J. Matsumoto, and D. A. Brock. 2002. *Methods for Determining Minimum Freshwater Inflow Needs of Texas Bays and Estuaries*. Estuaries, Vol. 25, pg 1271.
[16] see discussion in Bays in Peril, op cit.

Results of the low-inflow analysis

As shown in Figure 7.2-4 above, low inflows (as measured by 25th percentile values) to the Lower Laguna Madre have changed appreciably in the "current conditions" scenario and are predicted to change much more in the "2060 with Region M plan" condition. However, these changes on the order of 2,000 to 7,000 ac-ft/month do not greatly affect the estuary as measured by this analysis for low inflows. There are slight improvements in two of the criteria below, but no change in two others, including the key criteria of six-consecutive months in the March-October window. It is quite surprising though, that even under "natural" conditions this key criterion was not met in 29 of 51 years. This may indicate that this evaluation criterion is an ill-suited yardstick for evaluating these inflow changes (more on this below).

Table 7.2-5 Key results of the low-flow analysis.

Criteria	Natural conditions	Current use conditions	2060 w. Region M Plan
Fraction of months with inflow not meeting MinQsal	44.8%	44.4%	43.0%
Low Flow Frequency - No. 6 month periods below MinQsal	29	29	26
*Low Flow Frequency - 6 mo. periods below MinQsal within Critical (Mar-Oct) months**	6	5	6
Duration Analysis - Longest Consecutive Month Period Below MinQsal	11	11	11

* key criteria used in NWF's Bays in Peril report.

Discussion

The results of our analysis indicate no problems for freshwater inflows to the Lower Laguna Madre. The key spring and early summer inflow pulses needed to support strong productivity would not be impacted significantly. Nor would the ability of the Nueces-Rio Grande coastal basin to provide low-flows during drought be altered very much. It should be kept in mind that much of the increase in wastewater discharge shown here is based on imports of water into the Nueces-Rio Grande coastal basin. These obviously come at the expense of the neighboring Rio Grande basin. We would hope that an analogous effort to evaluate flow needs and effects of the Region M plan can be undertaken there in the next cycle of regional water planning.

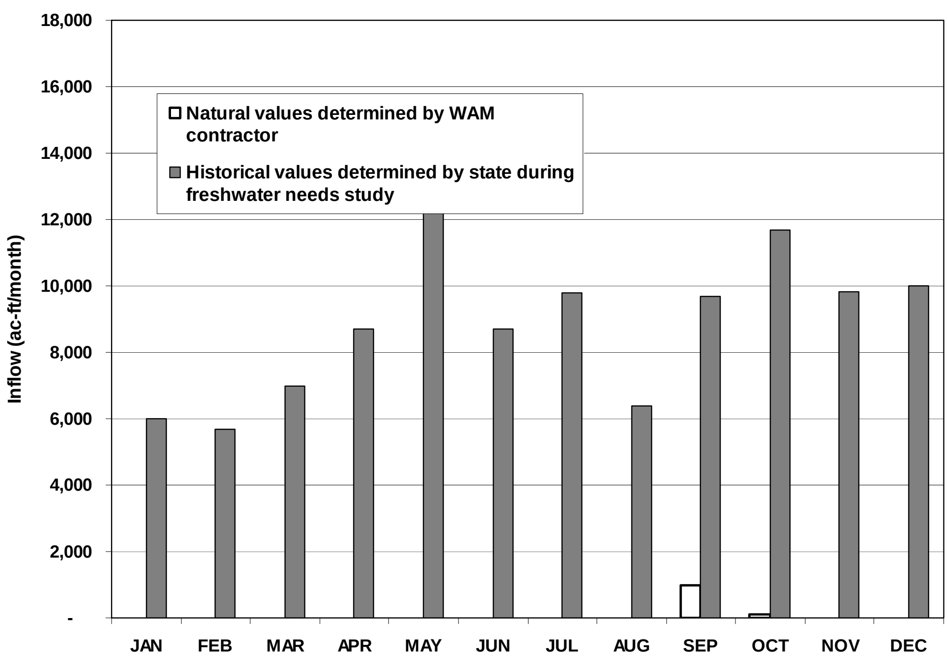
For the current analyses, the lack of changes in the ecological criteria is somewhat surprising, especially for low inflows given the magnitude of the flow changes expected in the lower range (Figure 7.2-4). There is one possible factor that may be leading to the seeming insensitivity of the analyses used here to the changes in inflows, especially low flows.

As noted in the report accompanying the release of the Nueces-Rio Grande coastal basin WAM[17], there are essentially no streamflow gauges in this area. Thus any estimates of flows rest heavily on models which synthesize rainfall estimates into runoff estimates. In addition to the need for rainfall data, which is usually scattered, such models are subject to many imprecisely know variables such as runoff factors related to land-use. Thus the natural inflow estimates in the WAM are largely based on such synthesized flows.

Similarly, when the state performed its study to relate freshwater inflows to measured productivity for the Lower Laguna Madre, it was necessary to estimate historical inflows. While these flows would have included historic return flows, it is probable that a predominant factor in this determination was the same need to develop flow estimates for this largely unguaged area.

There are only a few inflow levels that can be compared (medians, 10th percentiles, and 90th percentiles). To explore the possibility of flow estimating discrepancies, we have included an additional chart comparing extremely low inflows, namely the 10th percentile values, available for both the WAM and the state's inflow study.

Figure 7.2-6 Comparison of low-flow values for the Lower Laguna Madre as developed by the WAM contractor and state (Texas Water Development Board and Texas Parks and Wildlife Department)



While some difference in these would be expected, due to corrections for diversion and return flows in the historic data as compared to natural values, the size and constant nature of the changes here is disconcerting.

[17] PBS& J Engineers, 2002, Water availability model for the Nueces-Rio Grande coastal basin.

The historic values are over 100,000 ac-ft greater for the whole year although there are only about 35,000 ac-ft/yr of known wastewater discharge currently according to the Nueces-Rio Grande coastal basin WAM report. We believe that there is some other fundamental difference at work in the derivation of these flow data and it quite likely rest in the rainfall-runoff synthesis. With further time and effort the origin of this discrepancy could be pursued and possibly an adjustment to either the state's inflow criteria values or the WAMs natural flow values made.

Acknowledgements

The National Wildlife Federation thanks the Houston Endowment Inc., the Meadows Foundation, the Brown Foundation, the Jacob and Terese Hershey Foundation, and the Magnolia Trust for their financial support in the preparation of this report.

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CHAPTER 8.0 : UNIQUE STREAM SEGMENTS/RESERVOIR SITES/LEGISLATIVE RECOMMENDATIONS

In addition to making recommendations regarding strategies for meeting current and future water needs, TWDB rules for SB 1 regional planning allow the regional water planning groups (RWPG) to include recommendations in the regional water plan with regard to legislative designation of ecologically unique streams, sites for future reservoir development, and policy issues. The Rio Grande RWPG elected to consider recommendations in each of these areas, which are presented in this chapter.

8.1 LEGISLATIVE DESIGNATION OF ECOLOGICALLY UNIQUE STREAM SEGMENTS

TWDB rules for SB 1 regional water planning describe the process by which RWPGs may prepare and submit recommendations for legislative designation of ecologically unique river and stream segments. This process involves multiple steps with the Rio Grande RWPG, the Texas Parks and Wildlife Department (TPWD), the TWDB, and ultimately, the Texas Legislature each having a role. According to SB 1, the Rio Grande RWPG may recommend legislative designation of river or stream segments within the region as "ecologically unique." TWDB rules (30 Texas Administrative Code 357.8) state:

> *Regional water planning groups may include in adopted regional water plans recommendations for all or parts of river and stream segments of unique ecological value located within the regional water planning area by preparing a recommendation package consisting of a physical description giving the location of the stream segment, maps, and photographs of the stream segment and a site characterization of the segment documented by supporting literature and data.*

According to state law (Texas Water Code Sections §6.101 and §10.053), state agencies and local units of government cannot develop a water supply project that would destroy the ecological value of a river or stream segment that has been designated by the Texas Legislature as ecologically unique. Also, the TWDB is prohibited from financing water supply projects that would be located on a stream segment that has been designated as ecologically unique.

TWDB rules provide that the RWPGs forward any recommendations regarding legislative designation of ecologically unique streams to the TPWD and include TPWD's written evaluation of such recommendations in the adopted regional water plan. The RWPG's recommendation is then to be considered by the TWDB for inclusion in the state water plan. Finally, the Texas Legislature will consider any recommendations presented in the state water plan regarding designation of stream segments as ecologically unique.

8.1.1 Criteria for Designation of Ecologically Unique Stream Segments

TWDB rules also specify the criteria that are to be applied in the evaluation of potential ecologically unique river or stream segments. These are:

- Biological Function: stream segments that display significant overall habitat value, including both quantity and quality, considering the degree of biodiversity, age and uniqueness observed, and including terrestrial, wetland, aquatic or estuarine habitats;
- Hydrologic Function: stream segments that are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization or groundwater recharge and discharge;
- Riparian Conservation Areas: stream segments that are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas or other areas held by governmental organizations for conservation purposes, or segments that are fringed by other areas managed for conservation purposes under a governmentally-approved conservation plan;
- High Water Quality/Exceptional Aquatic Life/High Aesthetic Value: stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; and/or
- Threatened or Endangered Species/Unique Communities: sites along streams where water development projects would have significant detrimental effects on state- or federally-listed threatened and endangered species, and sites along segments that are significant due to the presence of unique, exemplary, or unusually extensive natural communities.

8.1.2 Candidate Stream Segments

To assist each of the 16 RWPGs, the TPWD developed a list of candidate stream segments in each region that appear to meet the criteria for designation as ecologically unique. For the Rio Grande Region, TPWD prepared a report entitled *Ecologically Significant River and Stream Segments of Region M, Regional Water Planning Area* (May 2000) that presents information on four (4) stream segments within the region that meet one or more of the criteria for designation as ecologically unique. (The report is available on-line at http://www.tpwd.state.tx.us/texaswaters/sb1/rivers/unique/regions text/region m.htm).

The Rio Grande RWPG also received suggestions from the U.S. Fish & Wildlife Service, Zapata County, and the Texas Shrimp Association through two stakeholder "focus group" meetings during the previous plan. The focus group meetings were held in December 1999 and January 2000, and more than 200 individuals representing local, state, and federal agencies, environmental groups, and other parties with a known interest in the subject received written invitations to attend and provide input. Nominations for stream segment designations, as well as support for TPWD-nominated segments, were received at both meetings. The information provided by the TPWD and through the focus group meetings is summarized in Table 8.2.

Subsequent to the last plan, a request for additional consideration of unique stream segments was made. An Environmental Subcommittee to the RGRWPG was formed to look in greater detail at various environmental issues related to water management strategies, unique stream segments and other items affecting environmental considerations. The subcommittee met on several occasions with discussion relating to the unique stream segments on the Rio Grande. The U.S. Fish and Wildlife Service and the TPWD made formal requests for designation of unique stream segments on the Rio Grande. A workshop was held by the RGRWPG for a presentation by the TPWD on January 25, 2005. No action was taken then. A meeting of the subcommittee was held February 16, 2005 to consider the proposals. A motion was made to accept the designation of the segment of the Rio Grande from the mouth of the Rio Grande upstream to the upstream boundary of the U.S. Fish and Wildlife Service Tulosa tract. The motion died for a lack of a second.

8.1.3 Recommendation

The Rio Grande RWPG reviewed the nominations submitted by TPWD and others with regard to legislative designation of river or stream segments as ecologically unique. The Environmental Subcommittee had no recommendation for the RGRWPG for inclusion in the plan. Designation would have the advantage of allowing entities to receive federal and state financial assistance for the preservation of lands adjoining these segments. The perceived disadvantage to the RGRWPG would be that a designation could cause that segment to be more susceptible to such issues as environmental flows and water quality issues upstream of the designation. Lack of action by the RGRWPG indicates a non-designation of unique stream segments recommendation at this time. It was agreed that the issue could be brought up and considered in the future.

Figure 8.1: TPWD Proposed Ecologically Significant Stream Segments

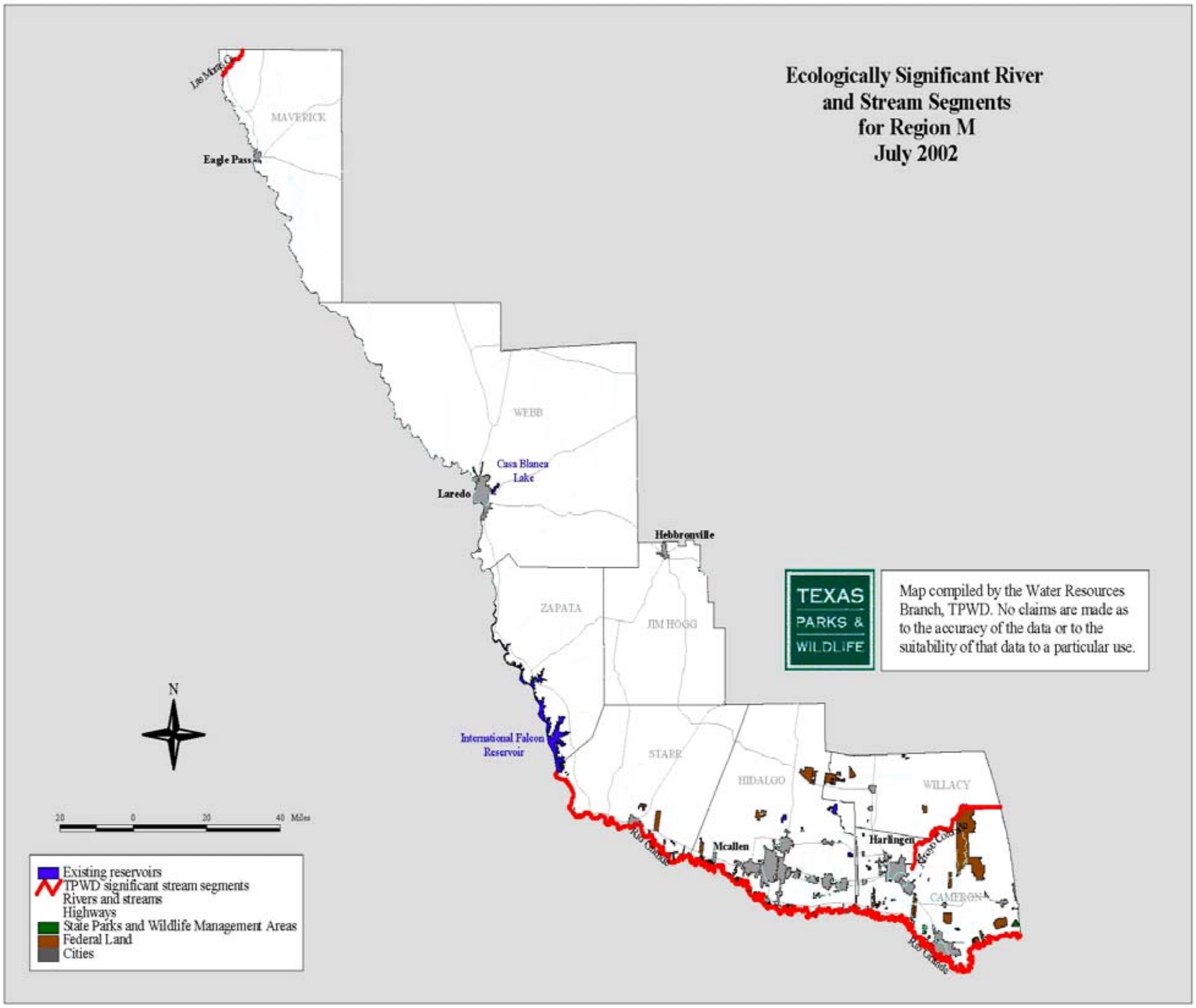

Table 8.1: Potential Ecologically Unique River and Stream Segments within the Rio Grande Region Group

River segment number	TCEQ segment ID number	Basin/ Waterway	Location/ Sublocation	Remarks and Nominating Entity	Functions B: Biological H: Hydrological RCA: Riparian Conservation Areas Q: High Water Quality, Exceptional Aquatic Life, High Aesthetic Value S: Threatened or Endangered Species, Unique Communities
1		Lower Rio Grande /Las Moras Creek	From confluence with Rio Grande in Maverick County upstream to Maverick/Kinney County line	Entire segment identified as significant, but primary area of concern due to spring-fed springs lies in Kinney County, outside Region M boundaries. Selection criteria from *Ecologically Significant River & Stream Segments of the Rio Grande (Region M) Regional Water Planning Area* (TPWD) Nominated by: TPWD	B: Riparian habitat with trees & shrubs; habitat & associated water very valuable for fish/wildlife H: Regulation & protection of baseflows, fisheries habitat, water supplies & groundwater RCA: None identified on this segment Q: Ecoregion stream, dissolved oxygen, benthic macroinvertebrates; aesthetic & economic value for fishing, birding, hiking, picnicking, camping S: wood stork, least tern, Proserpine shiner, ocelot, jaguarondi, several other state-threatened species
2	2301 2302	Lower Rio Grande/Rio Grande	From confluence with Gulf of Mexico in Cameron County upstream to Falcon Dam in Starr County	Selection criteria from *Ecologically Significant River & Stream Segments of the Rio Grande (Region M) Regional Water Planning Area* (TPWD) Nominated by: TPWD with support from FWS – Lower Rio Grande National Wildlife Refuge, Zapata County, and Texas Shrimp Association	B: Extensive freshwater and estuarine wetland habitat, resaca woodlands, lomas, emergent saltmarsh, seagrass beds in South Bay H: Flood control; regulation/protection of fisheries, water supplies, groundwater & baseflows in the river; freshwater inflow prevents saltwater intrusion RCA: Lower Rio Grande Valley NWR; Bentsen Rio Grande SP; Santa Ana NWR; Sabal Palm Sanctuary; Boca Chica SP; S. Bay Coastal Q: Overall use; benthic macroinvertebrates; high economic value for fishing, boating & birding; important for common snook population S: Texas ayenia, piping plover, Blackfin goby, several other state threatened species; Black Mangrove Series; Texas Palmetto
2A		Lower Rio Grande/Rio Grande	From confluence with Gulf of Mexico in Cameron County upstream to Falcon Dam in Starr County/ From Roma area upstream to Falcon Dam	No documentation submitted Nominated by: FWS – Lower Rio Grande National Wildlife Refuge	S: Wild muscovy duck, hookbill kite, breeding populations of brown jay and red-billed pigeon
2B		Lower Rio Grande/Rio Grande	From confluence with Gulf of Mexico in Cameron County upstream to Falcon Dam in Starr County/ From confluence with	No documentation submitted Nominated by: FWS – Lower Rio Grande National Wildlife Refuge	S: Unique marine organisms, including blue land crab & red land crab

			Gulf of Mexico upstream to just east of Brownsville		
2C		Lower Rio Grande/ Rio Grande	From confluence with Gulf of Mexico in Cameron County upstream to Falcon Dam in Starr County/ From Rio Grande City area upstream to south of Falcon Dam	No documentation submitted Nominated by: Project Coordinator, Zapata County	
2D		Lower Rio Grande/Rio Grande	From confluence with Gulf of Mexico in Cameron County upstream to Falcon Dam in Starr County/ From confluence with Gulf of Mexico upstream to Laredo area	No documentation submitted Nominated by: Texas Shrimp Association	B: Recruitment value/ productivity of estuary, importance to marine shrimp of Laguna Madre and Gulf H: Geology/function of the Rio Grande/ Nueces Basin and the Tamaulipan Plain
3		Lower Rio Grande/Rio Grande	Rapids in 3 to 5-mile stretch, from just south of Rio Bravo in Zapata County, near Laredo	No documentation submitted Nominated by: Project Coordinator, Zapata County	H: Water-quality data indicate aeration improves water quality below rapids
4	2201	Lower Rio Grande/Arroyo Colorado	From confluence with lower Laguna Madre upstream to Harlingen area	Selection criteria from *Ecologically Significant River & Stream Segments of the Rio Grande (Region M) Regional Water Planning Area* (TPWD) Nominated by: TPWD with support from Rio Grande RWPG member on behalf of Cameron County Commissioner; and Texas Shrimp Association	B: Unique because inflow from Arroyo provides main source of freshwater to Laguna Madre; recruitment value/ productivity of estuary, importance to marine shrimp of Laguna Madre and Gulf H: Downstream flood control; regulation of baseflows; protection of fisheries, water supply, groundwater; helps prevent saltwater intrusion upstream RCA: Laguna Atascosa NWR, Goat Island Wildlife Management. Area, City of Harlingen property Q: High water quality/exceptional aquatic life/high aesthetic value S: Brown pelican, piping plover, ocelot, jaguarundi, Texas ayenia, sheep frog, common black-hawk, Coues' rice rat, and several other state threatened species
5		Lower Rio Grande/Los Olmos Creek		Only upon confirmation that stream is not intermittent	

8.2 RESERVOIR SITES

TWDB rules (31 TAC, Section 357.9) for the preparation of regional water supply plans provide that the regional water planning groups "…may recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation and the expected beneficiaries of the water supply to be developed at the site." TWDB rules further specify that the following criteria be applied to determine whether a site is unique for reservoir construction:

1. *site-specific reservoir development is recommended as a specific water management strategy or in an alternative long-term scenario in an adopted regional water plan; and,*
2. *the location, hydrologic, geologic, topographic, water availability, water quality, environmental, cultural, and current development characteristics or other pertinent factors make the site uniquely suited for:*
   a. *reservoir development to provide water supply for the current planning period; or,*
   b. *where it might reasonably be needed to meet needs beyond the 50-year planning period.*

Three reservoir sites have been considered by the Rio Grande RWPG: (1) the proposed Brownsville Weir and Reservoir; (2) the proposed Banco Morales Reservoir, and (3) the proposed Laredo Low Water Weir. Each project is briefly discussed below.

8.2.1 Brownsville Weir and Reservoir

An overview of the proposed Brownsville Weir and Reservoir is provided in Chapter 5 of this plan. The City of Brownsville Public Utilities Board (PUB) has acquired the required state water right permit and the federal Section 10/404 permit for this project and has obtained federal funding for engineering design and construction. Currently, the PUB is working with the U.S. and Mexican Sections of the International Boundary and Water Commission (IBWC) to develop an implementation plan for the project, including consideration of ownership, financing and operational issues. Implementation of the project will require approvals from the IBWC and Mexico. The PUB also is discussing a partnership with the City of Matamoros for the project whereby the two cities would share in the benefits of the project. There is currently no timetable set for this project.

The Brownsville Weir and Reservoir project is expected to provide approximately 20,000 acre-feet per year of additional dependable surface water supply for the City of Brownsville. This additional supply will play an important role in meeting Brownsville's projected water supply needs through the planning period. The development of the project is included as a recommended water supply strategy in the first (2001) Rio Grande Regional Water Plan (Region M) and in the resulting (2002) State Water Plan. It is also recommended in this Regional Plan (2010).

8.2.2 Banco Morales Reservoir

The Banco Morales Reservoir is being proposed by the Brownsville Public Utilities Board (BPUB) as a surface water development project on the Lower Rio Grande in Cameron County. This project is proposed to provide additional dependable water supply for municipal and industrial use for the City of Brownsville, by capturing and diverting "excess" flows of United States waters in the Rio Grande, as well as storing the City's existing water rights. As it stands now, the excess water is currently allowed to flow through Brownsville and into the Gulf of Mexico. It will now have a chance to be captured and stored and pumped to future users. This Project is proposed to meet the future municipal and industrial water needs of the BPUB and the Region. Existing municipal and industrial water supply sources for BPUB cannot currently satisfy the anticipated future water needs for the region.

The Banco Morales Reservoir project is expected to provide approximately 238 acre-feet per of additional dependable surface water supply for the City of Brownsville. The additional supply will play an important role in meeting Brownsville's projected supply needs through the planning period. The development of the project is included as a recommend water supply strategy for the first time in this round of planning.

8.2.3 Laredo Low Water Weir

Laredo has been investigating the feasibility of developing a low water weir on the Rio Grande approximately 200 feet downstream of the existing La Bota site. The project will not develop additional water supply. Rather, the project is proposed to improve water quality, provide a diversion location for a new regional water treatment plant, and provide hydroelectric power. Recreational amenities may also be developed. The proposed structure would be 56 feet high, which would provide a water surface elevation below the 100-year flood plain. The design and operation of the structure would not alter the normal flows of the Rio Grande. The weir would store approximately 66,007 acre-feet of water. Laredo intends to lease water rights for the initial filling of the reservoir.

At the request of Laredo, the Rio Grande RWPG has endorsed further investigation of the feasibility of the Laredo Low Water Weir. This would include more detailed evaluation of project costs, benefits, impacts, and permitting requirements.

8.2.4 Recommendations

Neither the Brownsville Weir and Reservoir, Banco Morales Reservoir, nor the Laredo Low Water Weir are recommended for designation as a unique reservoir site at this time.

8.3 REGULATIONS, ADMINISTRATIONS, AND LEGLISTALIVE RECOMMENDATIONS

Texas Water Development Board rules provide that regional water plans may include "regulatory, administrative, or legislative recommendations that the regional water planning group believes are needed and desirable to facilitate the orderly development, management, and conservation of water resources and preparation for and response to drought conditions…." [31 TAC 357.7(a)(10)]

8.3.1 Recommendations for 2010 Plan

Recommendations on State Issues

1. **The Texas Legislature should appropriate funds to the Texas Water Development Board to implement and provide assistance to water user groups in developing and implementing appropriate Advanced Water Conservation measure, including a statewide public outreach and education program.**

2. The region is projecting a shortage in water supply in the coming future. There are limitations for funding, but to overcome this, more state assistance is needed.

3. The State of Texas should consider factors other than merely population in funding the planning process in Region M because of the unique circumstances (i.e., 1944 Treaty, lowest rainfall, high tourism rates, high immigration rates) affecting water supply in the area.

4. The State should consider revising population for future planning rounds based on the most recent data available, including census data.

5. The State should consider revising its methodology towards Water User Groups that serve populations in more than one city, town, village, or unincorporated area. Further, the plan should only include Water User Groups that actually provide potable water to the populous. In the previous Regional Plan, population and water demand figures for Water Districts and Water Supply Corporations and the cities they serve were listed individually. Specifically, North Alamo Water Supply Corporation, East Rio Hondo Water Supply Corporation, Military Highway Water Supply Corporation, Valley Municipal Utility District No. 2, and Laguna Madre Water District had population and water demand projections, as did the cities they serve. This arrangement created confusion, and in some cases, double counting.

   It is proposed to list the population and water demands of cities and their residents who are served by Water Districts and Water Supply Corporations as subsidiaries of these Districts/Corporations as opposed to individual WUGs. This will allow the Regional Plan to more accurately establish population and water demand figures.

6. The State should fully fund the revision and update to the Water Availability Model to include data up to the year 2005, thereby allowing for the full

investigation of a potential drought of record in the region from the late 1990s to the early 2000s.

7. The State should consider the impacts of climate change in terms of Regional Water Planning and future water supplies.

8. The State should continue considering the allocation of Rio Grande flows upstream of Ft. Quitman in terms of treaty compliance.

9. The State should investigate the true impact and treaty compliance factors associated with the construction of an aqueduct from Falcon Reservoir to Matamoros, Tamaulipas, Mexico.

10. The State should continue financing brackish groundwater projects and seawater desalination project as means to increase water supply alternatives in the region.

11. The State should authorize the Rio Grande Watermaster to manage the Rio Grande WAM and should fully appropriate to the Texas Commission on Environmental Quality fees paid by Rio Grande water right holders as specified in Section 11.329 of the Texas Water Code for the purpose of fully funding Rio Grande Watermaster operations.

12. The State should assist in finding new technical and financial resources to help the region combat aquatic weeds and salt cedar and thus protect its water supplies. The Rio Grande RWPG joins with the Far West Texas and Plateau RWPGs to encourage funding for projects aimed at eradicating salt cedar in the Rio Grande watershed and for ongoing long-term brush management activities.

13. The State should continue providing technical and financial resources to fully develop the regional GAM.

14. The Texas Commission on Environmental Quality should provide assistance to the Rio Grande RWPG as it reviews rules on converting water rights from one use to another and considers appropriate rule amendments, if necessary.

15. Entities within the region are encouraged to cooperate to resolve water issues through such means as regional water and wastewater utilities.

16. The formation of groundwater conservation districts is encouraged as a means to protect groundwater supplies, which are increasingly being tapped as a new water supply for municipal and industrial use.

17. The State should appropriate sufficient funds to the Texas Railroad Commission to allow for capping abandoned oil and gas wells that threaten groundwater supplies.

18. The Texas Legislature should provide technical and financial assistance to implement water management strategies identified in the regional water plans.

19. The Texas Legislature should appropriate funds to continue the regional water planning process.

Recommendations on National and International Issues

1. The International Boundary and Water Commission (IBWC) should renew efforts to ensure that Mexico complies with Minute 309 and set in place means to achieve full compliance with the 1944 Treaty, including enforcement of Minute 234, which addresses the actions required of Mexico to completely eliminate water delivery deficits within specified treaty cycles. Water saved in irrigation conservation projects in Mexico will be dedicated to ensure deliveries to the Rio Grande pursuant to the 1944 Treaty under Article 4B(c) and Minute No. 234.

2. The United States and Mexico should reinforce the powers and duties of both Sections of the IBWC pursuant to Article 24(c) which provides, among other things, for the enforcement of the Treaty and other Agreement provisions that *"… each Commissioner shall invoke when necessary the jurisdiction of the Courts or other appropriate agencies of his Country to aid in the execution and enforcement of these powers and duties."*

3. The Minute 309 conservation projects funded by the North American Development Bank and other projects funded by national and international agencies to modernize and improve the facilities of irrigation districts in the Rio Grande Basin should be supported and given priority. In particular, both countries should support continued grant funding for conservation projects through the NADBank's Water Conservation Investment Fund.

4. The conservation irrigation projects are authorized through the Bureau of Reclamation for improvement to the irrigation systems of irrigation districts in the Rio Grande Basin in the United States should be supported and implemented.

5. For purposes of clarity, the IBWC should approve a Minute setting out the definition of "extraordinary drought" as that term is implicitly defined in the second subparagraph of Article 4B(d) as an event which makes it difficult for Mexico " … to make available the *run-off* of 350,000 acre feet (431,721,000 cubic meters) annually." A drought condition occurs when

there is less than 1,050,000 acre feet annually of *run-off waters* in the watersheds of the named Mexican tributaries in the 1944 Treaty, measured as water enters the Rio Grande from the named tributaries.

6. Accounting of water between the United States and Mexico pursuant to the 1944 Treaty should be consistent with the 1906 Convention, which provides that all waters measured at Fort Quitman, Texas, are 100 percent allocated to the United States. This is recommended by the "Special Study No. 1: Evaluation of Alternate Water Supply Management Strategies Regarding the use and Classification of Existing Water Rights on the Lower and Middle Rio Grande.[1]"

7. For better water management in the Lower Reach of the Rio Grande, downstream of Anzalduas Dam, both countries should reaffirm operational policies that Mexico continue to take its share of waters through the Anzalduas canal diversion at the Anzalduas Dam or account for its water at that point, including any diversions by Mexico from the proposed Brownsville Weir Project storage, to the extent of its participation in the project.

8. IBWC should convene a binational meeting of water planners and water use stakeholders in both countries within six months following completion of the annual water accounting in which an annual deficit in flows from the named Mexican tributaries in the 1944 Treaty occurs. This meeting would be designed to share data and information useful in planning for water needs and contingencies in the intermediate future.

9. IBWC should restore the Rio Grande below Fort Quitman, Texas.

10. The IBWC should assume all local and regional financial responsibility for upkeep and maintenance of El Morillo Drain.

11. IBWC should coordinate bilateral efforts to review and evaluate existing sources of data regarding groundwater development in both countries in the Rio Grande Basin below Fort Quitman to the Gulf of Mexico. This effort should be focused on the potential impact on surface water supply in the Rio Grande watershed, with the goal of pursing such actions as may be necessary to evaluate present conditions and promote programs protecting the historical surface water supply in affected regions.

12. Regional watershed planning should be encouraged on both sides of the Rio Grande throughout the basin, including efforts to promote binational coordination of long-range water plans.

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[1] Special Study No. 1 full report can be found in the appendix, as well as a brief summary can be found in section 1.13.

13. Interstate compacts between affected states in Mexico, similar to the Rio Grande Compact and Pecos River Compact between affected states in the United States, which deal with apportionment of available water supply from the Rio Grande and its tributaries to each state consistent with existing domestic and international law should be encouraged.

8.3.2 Issues Identified in 2005 Planning Process

In the second round of regional water planning, the TWDB emphasized "input from RWPGs for the policy portion of the 2007 State Water Plan" (Memo from William Mullican, then Deputy Executive Administrator, Office of Planning, July 2, 2003). The Board disseminated an "Initial List of Policy Topics" as a catalyst for discussion among the planning groups. In September 2003, Rio Grande Regional Water Planning Group members ranked each issue on the list as to level of importance in the region's water planning efforts ("not at all important," "somewhat important," important," and "extremely important").

The policy issues receiving top rankings from Rio Grande RWPG members fell into four major categories:

A. International Treaty Compliance

B. Competing Water Demands Between Agricultural & Municipal Interests
   - sustainable growth, including impacts of growth
   - assessment of the current water resources regulatory system to meet water management needs of the 21st century
   - impacts on water supply and quality resulting from conversion of agricultural lands to urban lands
   - protecting agricultural and rural water supplies, considering economic constraints and competing purposes
   - conservation of agricultural water for additional agricultural use, urban use or for environmental purposes

C. Alternative Water Supply/Water Quality
   - integrating water quality and water supply considerations
   - watershed planning/source water protection
   - sustainability and groundwater management

D. Technical & Financial Resources
   - state participation
   - potential funding sources for water supply
   - retail customer water pricing
   - incentives for planning implementation
   - improving groundwater availability data
   - education

The Rio Grande RWPG also approved a resolution encouraging the formation of groundwater conservation districts and greater oversight by of sales of groundwater produced from State-owned lands. The group also approved motions supporting the following:

- capping abandoned oil and gas wells
- improving the stretch of the Rio Grande known as the "Forgotten River"
- identifying and eradicating growing stands of salt cedar
- supporting Valley Water Summits

The Rio Grande RWPG firmly believes that these issues are tightly interconnected and that they cannot be discussed, much less resolved, in a vacuum.

Many of the issues and needs of the region arise from the fact that the Rio Grande is an international river whose waters are shared by the U.S. and Mexico. No other regional water planning area faces this reality. Water right holders in Texas lack any ready recourse to compel Mexico to observe the 1944 Treaty that apportions inflows between the countries. In addition, international protocols impact efforts to address water quality and resolve problems created by aquatic weeds, such as hydrilla and water hyacinth, and other invasive species, including salt cedar.

Although Mexico now has repaid its water debt, there are no enforcement mechanisms for preventing similar situations in the future.

Because of the unique way in which water rights are prioritized along the Rio Grande, the Mexican water debt has first and foremost directly impacted agricultural interests. However, repercussions from the debt also have affected municipal and industrial users. With the few exceptions of the Brownsville Public Utilities Board, Laguna Madre Water District (serving Port Isabel, South Padre Island and Laguna Vista) and the City of Laredo, municipal users of surface water depend on irrigation districts to pump and convey water supplies to their treatment plants. When irrigation flows are curtailed, municipalities must either find new ways to push raw water or turn to alternative sources.

Brackish groundwater resources have rapidly become a viable alternative for municipal suppliers located at a distance from the Rio Grande. In the first round of planning, the Rio Grande RWPG recommended that desalination be considered, but did not list it as a water management strategy for any water user group; in 2003, the plan was amended to incorporate desalination as a strategy for almost half of the 63 municipal water user groups in the region. Improvements in technology, coupled with the soaring cost of surface water rights, are making groundwater desalination an economical and reliable option. However, limited research has been conducted on the quality and quantity of groundwater supplies in the region. Furthermore, groundwater in certain parts of the region is threatened by abandoned uncapped oil and gas wells.

Irrigation districts also are looking to new technology and improved processes to minimize conveyance and evaporation losses attributable to an aging infrastructure. Districts do not have ready access to low-cost loans that are readily available to municipal suppliers. Several districts have secured funding from the North American Development Bank and the U.S. Bureau of Reclamation, but others cannot meet the local match requirements.

The water debt has created both challenges and opportunities for municipal and irrigation users to work together. The Rio Grande RWPG has supported initiatives such as the Valley Water Summits that bring different interests together to share problems and jointly create solutions.

The Watermaster Advisory Committee (WAC) also has proven to be an effective forum for addressing issues. Subsequent to the first planning cycle, the committee developed a rule change that freed up water in storage for irrigation use with no detriment to municipal supplies. Operations of the Rio Grande Watermaster are paid entirely by fees levied on water right holders. However, appropriations to the Watermaster are capped at a level that is significantly lower than revenues. This limits the ability of the office to provide services to meet changing needs, such as maintaining and updating the newly developed Rio Grande Water Availability Model.

Particular attention should be directed to rules pertaining to water rights. Currently, when the intended use of irrigation water rights is changed to municipal and industrial use, a conversion factor provided in 30 TAC § 303.43 is applied so that the municipal use after conversion will receive a "definite quantity of water in acre-feet per annum." This rule is consistent with the treatment of certain municipal, industrial and domestic allocations approved in the Final Judgment of the Valley Water Suit, which provided for a reserve of 60,000 AF/year to be held for domestic use and use by cities to support these allocations. This reserve was increased to 225,000 AF/year, under a conversion rule adopted by the then Texas Water Rights Commission on July 2, 1986, following the conclusion of the Middle Rio Grande Adjudication. Information developed through the WAM and as part of the Regional Planning process would indicate that this practice should be reviewed with respect to long term water management practices on the Lower and Middle Rio Grande downstream from Amistad Reservoir. Additional studies are required to analyze the long term impact of reducing authorized municipal and industrial reserves on two fronts: (1) providing a defined entitlement and (2) promoting water conservation in both Amistad and Falcon Reservoirs.

Environmental flows also have been critically impacted by the water debt and over-reliance on surface water supplies. During the second round of regional planning, the Rio Grande actually ceased flowing into the Gulf of Mexico.

As noted in Chapter 7, one possibility for maintaining and increasing environmental flows is the purchase of Rio Grande water rights by an environmental entity.

Deposited in a trust, these water rights could be managed to produce sufficient flows throughout the region. However, this option may not be viable because of the current water rights purchase and transfer structure. In addition, because of the WUG format currently being implemented by the TWDB, no option exists to formally allocate projected water supplies for environmental use. Environmental flows in the Rio Grande could be included as a separate WUG in the next round of regional planning to ensure minimums would be met in a manner consistent with all other WUGs.

International cooperation is critically needed to maintain flow levels. If the United States were to implement an environmental flow program without Mexico's participation, the desired effect would be significantly reduced.

Finally, international attention also could enhance water quality as well as safety. Lower valley water interests have been responsible for a significant portion of the construction and upkeep of El Morillo Drain, built in 1969 to divert salty water from the Rio Grande. Currently, The International Boundary and Water Commission has proposed to assume complete responsibility for the U.S. share of the upkeep, including maintenance of levees. The Rio Grande Regional Water Planning Group supports this move.

8.3.3 Recommendations from the 2005 Plan

Because issues identified during the 2005 planning process, the Rio Grande RWPG made a number of recommendations for action to address regional water needs. Some of these recommendations fall within the authority of the State of Texas; others were to be addressed through the auspices of the International Boundary and Water Commission and/or other international and federal agencies. Accordingly, the recommendations have been categorized, as follows.

Recommendations on State Issues

1. The State of Texas should consider factors other than merely population in funding the planning process in Region M because of the unique circumstances affecting water supply in the area.

2. The State should continue financing brackish groundwater projects and the demonstration seawater desalination project as means to increase water supply alternatives in the region.

3. The State should authorize the Rio Grande Watermaster to manage the Rio Grande WAM and should fully appropriate to the Texas Commission on Environmental Quality fees paid by Rio Grande water right holders as specified in Section 11.329 of the Texas Water Code for the purpose of fully funding Rio Grande Watermaster operations.

4. The State should assist in finding new technical and financial resources to help the region combat aquatic weeds and salt cedar and thus protect its water supplies. The Rio Grande RWPG joins with the Far West Texas and Plateau RWPGs to encourage funding for projects aimed at eradicating salt cedar in the Rio Grande watershed and for ongoing long-term brush management activities.

5. The State should continue providing technical and financial resources to fully develop the regional GAM.

6. The State should amend the planning process to allow for treating each irrigation district within the region as a WUG, rather than as part of "County-Other," in order to allow for development of individual water management strategies for the districts.

7. The Texas Commission on Environmental Quality should provide assistance to the Rio Grande RWPG as it reviews rules on converting water rights from one use to another and considers appropriate rule amendments, if necessary.

8. Entities within the region are encouraged to cooperate to resolve water issues through such means as regional water and wastewater utilities.

9. The formation of groundwater conservation districts is encouraged as a means to protect groundwater supplies, which are increasingly being tapped as a new water supply for municipal and industrial use.

10. The State should appropriate sufficient funds to the Texas Railroad Commission to allow for capping abandoned oil and gas wells that threatened groundwater supplies.

11. The Texas Legislature should provide technical and financial assistance to implement water management strategies identified in the regional water plans.

12. The Texas Legislature should appropriate funds to continue the regional water planning process.

13. The Texas Legislature should appropriate funds to the Texas Water Development Board to implement and provide assistance to water user groups in developing and implementing appropriate Advanced Water Conservation measures, including a statewide public outreach and education program.

Recommendations on National and International Issues

1. The International Boundary and Water Commission (IBWC) should renew efforts to ensure that Mexico complies with Minute 309 and set in place means to achieve full compliance with the 1944 Treaty, including enforcement of Minute 234, which addresses the actions required of Mexico to completely eliminate water delivery deficits within specified treaty cycles. Water saved in irrigation conservation projects in Mexico should be dedicated to ensure deliveries to the Rio Grande pursuant to the 1944 Treaty under Article 4B(c) and Minute No. 234.

2. The United States and Mexico should reinforce the powers and duties of both Sections of the IBWC pursuant to Article 24(c) which provides, among other things, for the enforcement of the Treaty and other Agreement provisions that *"… each Commissioner shall invoke when necessary the jurisdiction of the Courts or other appropriate agencies of his Country to aid in the execution and enforcement of these powers and duties."*

3. The Minute 309 conservation projects funded by the North American Development Bank and other projects funded by national and international agencies to modernize and improve the facilities of irrigation districts in the Rio Grande Basin should be supported and given priority. In particular, both countries should support continued grant funding for conservation projects through the NADBank's Water Conservation Investment Fund.

4. The conservation irrigation projects currently underway through the Bureau of Reclamation for improvement to the irrigation systems of irrigation districts in the Rio Grande Basin in the United States should be supported and implemented.

5. For purposes of clarity, the IBWC should approve a Minute setting out the definition of "extraordinary drought" as that term is implicitly defined in the second subparagraph of Article 4B(d) as an event which makes it difficult for Mexico " … to make available the *run-off* of 350,000 acre feet (431,721,000 cubic meters) annually." A drought condition occurs when there is less than 1,050,000 acre feet annually of *run-off waters* in the watersheds of the named Mexican tributaries in the 1944 Treaty, measured as water enters the Rio Grande from the named tributaries.

6. Accounting of water between the United States and Mexico pursuant to the 1944 Treaty should be consistent with the 1906 Convention, which provides that all waters measured at Fort Quitman, Texas, are 100 percent allocated to the United States.

7. For better water management in the Lower Reach of the Rio Grande, downstream of Anzalduas Dam, both countries should reaffirm operational

policies that Mexico continue to take its share of waters through the Anzalduas canal diversion at the Anzalduas Dam or account for its water at that point, including any diversions by Mexico from the proposed Brownsville Weir Project storage, to the extent of its participation in the project.

8. IBWC should convene a binational meeting of water planners and water use stakeholders in both countries within six months following completion of the annual water accounting in which an annual deficit in flows from the named Mexican tributaries in the 1944 Treaty occurs. This meeting would be designed to share data and information useful in planning for water needs and contingencies in the intermediate future.

9. IBWC should restore the Rio Grande below Fort Quitman, Texas.

10. The IBWC should assume all local and regional financial responsibility for upkeep and maintenance of El Morillo Drain.

11. IBWC should coordinate bilateral efforts to review and evaluate existing sources of data regarding groundwater development in both countries in the Rio Grande Basin below Fort Quitman to the Gulf of Mexico. This effort should be focused on the potential impact on surface water supply in the Rio Grande watershed, with the goal of pursing such actions as may be necessary to evaluate present conditions and promote programs protecting the historical surface water supply in affected regions.

12. Regional watershed planning should be encouraged on both sides of the Rio Grande throughout the basin, including efforts to promote binational coordination of long-range water plans.

13. Interstate compacts between affected states in Mexico, similar to the Rio Grande Compact and Pecos River Compact between affected states in the United States, which deal with apportionment of available water supply from the Rio Grande and its tributaries to each state consistent with existing domestic and international law should be encouraged.

8.3.4 Recommendations in 2000 Plan

In the initial round of planning that culminated with the 2000 regional plan, the Rio Grande RWPG identified 12 issues affecting water policy and planning. The group elected to make recommendations on 10 of those issues. These issues, the group's recommendations, and subsequent developments on the issues are presented in Table 8.2.

Table 8.2: RGRWPG 2000 Recommendations and Update

Issue	2000 Plan Recommendations	Status
Creation of a regional water management entity	The Texas Legislature create a regional water entity for the purposes of management of the waters of the Rio Grande, development of water conservation and water supply projects, water quality monitoring and planning, and other purposes and functions typically performed by agencies created under Article 16, Chapter 59 of the *Texas Constitution*.	The Lower Rio Grande Authority, created in 1951 reconstituted itself. Composed of irrigation districts in Cameron, Willacy, Hidalgo Counties; added nonvoting members representing municipal water interests. The LRGA was abolished in 2005 by HB 2639 Rio Grande Regional Water Authority created by SB 1902 by Sen. Lucio. Encompasses Rio Grande Regional Water Planning Area, minus City of Laredo and Jim Hogg County. Irrigation and municipal interests represented. Four vacancies remain unfilled.
Mexico's compliance with the 1944 Treaty	1. The U.S. government take all necessary and appropriate actions to ensure full compliance by Mexico with the terms of the 1944 Treaty and Minute No. 234 governing the development and use of the waters of the Rio Grande. 2. The dialogue continue between the U.S. and Mexico with regard to the development of an operating plan for Mexican tributary reservoirs that will ensure full compliance with the treaty while also optimizing the amount of water supply available to Mexico for beneficial use. 3. The U.S. Section of the International Boundary and Water Commission continue to seek and provide opportunities for direct stakeholder participation in bi-national discussions regarding the management of the waters of the Rio Grande.	1. Mexico repaid the water debt in the fall of 2005. 2. No definite plan for ensuring compliance. 3. IBWC has organized stakeholder groups, including the Lower Rio Grande Citizens' Forum (LRGCF), to act as a focal point for the exchange of information between it and local communities regarding USIBWC projects in the area. The LRGCF Board has 11 members representing diverse interests and meets approximately four times per year.
Agricultural lands preservation	Municipalities and irrigation districts in the LRGV coordinate closely on matters of urbanization and its implications for both urban and agricultural water supply infrastructure planning and development because reduction of irrigated acreage as a result of urbanization has important implications for district operations and deliveries to municipalities as well as agricultural producers.	2004 and 2005 Valley Water Summits have created opportunities for dialogue between municipalities and irrigators and new understanding of issues. The parties are working together to develop list of mutually beneficial projects.
Regionalization of water & wastewater utility services	Further regionalization of water and wastewater utility services be investigated and implemented where appropriate, because regionalization of urban water supply and/or wastewater systems offers the potential for significant cost savings in acquiring water supplies for urban use, as well as the potential for reduced costs and improved reliability of water and wastewater utility services.	Several consortia are implementing regional projects, particularly brackish groundwater desalination. These include the Southmost Regional Water Authority and projects involving North Alamo Water Supply Corp.
Irrigation district water allocation policies	Irrigation districts review their water allocation policies, procedures, and practices to facilitate water transfers among agricultural users. In addition to providing a method for equitable water distribution during periods of shortage, water allocation by irrigation districts has also enabled an active water market within the agricultural sector.	The Lower Rio Grande Authority servres as a forum for districts to work together. The LRGA created an on-line Water Market to facilitate sales of wet water and water rights among all users. The Rio Grande Regional Water Authority may continue these initiatives.
Water availability models	State funding be provided for development of a state water availability model for the Rio Grande River Basin.	The Rio Grande WAM was completed in Sept. 2004, providing important data on inflows and firm yield.
Re-channeliza-tion/ Restoration of the Rio Grande	Federal funding be provided to the IBWC for an in-depth investigation of the costs, benefits, and impacts of re-channelizing a portion of the Rio Grande upstream of the Amistad Reservoir. The proposed study would examine whether periodic removal of salt cedar and other vegetation, along with channel improvements, would	

	increase water flows in this stretch of the Rio Grande and allow passage of more flows from upstream reaches of the river.	
Desalination	The State consider funding additional research/ development of groundwater desalination projects and offer financial assistance and incentives for implementation.	TWDB has selected three groundwater desalination projects as demonstrations, including one coordinated by the North Cameron Regional WSC. Funding for the projects is expected in January 2006. The Board also funded feasibility studies for three potential seawater desalination projects, including a project of the Brownsville PUB. TWDB anticipates funding pilot plant for each of the three projects, beginning in the spring of 2006. In August 2003, the Rio Grande RWPG amended the 2001 adopted regional water plan to include brackish groundwater and seawater desalination as water management strategies.
Funding for data collection, review, reporting activities and for preparation of feasibility level studies	1. TWDB provide funding for data collection activities in rural areas, including establishing and adequately funding the collection and distribution of groundwater availability data. 2. The Legislature provide funding for the cooperative, federal-state-local program of basic water data collection, including collection, assimilation and analysis of basic data needed to assess the ground and surface water resources of each region to a 90 percent accuracy level. 3. TWDB and Texas Natural Resource Conservation Commission (now the Texas Commission on Environmental Quality) facilitate access to water data essential for local and regional planning and plan implementation purposes. 4. TWDB and TNRCC expand activities in collecting, managing, and disseminating information on groundwater conditions and aquifer characteristics. 5. SB1 be amended to allow state funding of ongoing regional data collection activities that are sponsored by RWPGs. 6. TWDB study the effects of groundwater consumption on springflow.	TWDB currently has a water-level and water-quality monitoring program that covers the entire state, including rural areas. TWDB has obtained groundwater availability models for all of the major aquifers of the state and continues to develop models for the minor aquifers. TWDB provides GAM runs to groundwater conservation districts and regional water planning groups free of charge. The Legislature provides the TWDB with funding to monitor the flow in the state's rivers in cooperation with the U.S. Geological Survey and local cooperators. However, costs have increased while state funding has remained level. TWDB has placed all regional water plans on its web page for public access, plus some information from the plan databases. TWDB plans to place most if not all information from the databases for the 2007 State Water Plan on the web. TWDB continues to strive to collect, manage, and disseminate information on the state's aquifers. Through the GAM program, TWDB has collected considerable information on the state's aquifers. TWDB is working to organize this information is geodatabases to make available over the web. TWDB has also continued to support basic research in groundwater with work on brackish groundwater, recharge, and evapotranspiration.
Modifications to planning process	1. The grass roots regional water planning process enacted by SB1 be continued with appropriate funding. 2. TWDB and TNRCC evaluate the effect of groundwater withdrawal on surface water availability and streamflows. 3. The planning process provide for consistency in whether normal water conservation assumptions should be included in the supply and demand projections, or as water management strategies for conserving/developing water supplies.	The second round of water planning has included funding of activities necessary for grass-roots participation. The planning process also must consider impacts to natural resources and the environment and must consider water quality factors in developing water management strategies. Funding for implementation continues to be an issue.

	4. The next phase of planning include the review of population estimates immediately after 2000 census results are available. 5. TWDB revise its rules for regional water planning to allow multiple options rather than a single scenario to be put forth as recommended strategies for meeting the needs of individual water user groups. 6. Water quality play a more important role in future planning efforts. 7. Wildlife and environmental water needs be established as a category of water use and be quantified by the TPWD for input into the next planning phase and that the definition of beneficial use regarding water rights permit be expanded to include usage by natural resources, wildlife, and wildlife habitat. 8. TWDB work to expedite funding for implementing strategies on a localized level.	Review completed. Environmental flows are considered in the 2006 regional water plan.

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CHAPTER 9.0: INFRASTRUCTURE FINANCING REPORT

9.1 BACKGROUND

The Infrastructure Financing Report (IFR) requirement was incorporated into the regional water planning process in response to Senate Bill 2 (77th Texas Legislature). For purposes of the IFR, each regional water planning group (RWPG) is required to determine proposed financing for all of the water management strategies that were proposed in the third round of planning. For each of these strategies, the RWPG must determine the funding needed to implement the strategy, and what types of funding are likely to be accessed.

According to TWDB guidelines, the primary objectives of the IFR are:

- To determine the number of political subdivisions with identified needs for additional water supplies that will be unable to pay for their water infrastructure needs without some form of outside financial assistance;
- To determine how much of the infrastructure costs in the regional water plans cannot be paid for solely using local utility revenue sources;
- 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.

The TWDB prepared the Infrastructure Financing Report (IFR) and Policy Statement for the Region M Regional Water Planning Group (RWPG). The list, as provided as a template by the Texas Water Development Board, was used to develop the list of water user groups in need. Names and address lists were developed for each group. A sample letter is included as Attachment 9-1.

The consultant team was in charge of sending out the surveys and attempted to contact each Water User Group (WUG) to discuss the surveys and their approach to the financing their water management strategies.

9.1.1 Findings

Information found in the template formulated by the TWDB was used to merge data into the required survey forms.

The entities were given ample time to add comments and corrections to the data gathered for this regional water plan. The survey in 2010 let the entity state what strategies were they interested in implementing in the next fifty years. At that time, they were asked how they were planning to fund it. The survey pertained more to the financing of the strategies. The data in these surveys were compiled and used for this plan. Sample letters and surveys can be found in the Attachment sections at the end of this report.

9.2 WATER USER GROUP SUMMARIES

9.2.1 Municipal Water User Groups

The majority of municipal WUGs have strategies that include urbanization, advanced water conservation measures and purchase of Rio Grande supplies. There are total of eight counties, 52 cities, and 15 water supply corporations in this regional planning area.

The RWPG sent out a survey to each of the 63 municipal and water supply districts throughout this round of planning. Samples of the surveys are attached to this chapter. The surveys were used to obtain additional information about their current thought about water planning and their involvement with the RWPG. The survey also discussed what their focus was with regard to providing water for their future. They understood that it should be their responsibility to attend public hearings and find out what is going on. This region has an estimated total capital cost of $135,447,300 for all municipal water management strategies. The total capital cost for the region is estimated to be $1,863,361,321. The acquisition of water rights through purchase has the highest yield for municipal strategies at 151,237 acre-ft. Desalination of brackish groundwater came in second with 71,700 acre-ft assigned to municipal water user groups.

9.2.1.1 Summary of Municipal Water Management Strategies

For Municipal users, the strategies recommended for this regional planning area are:

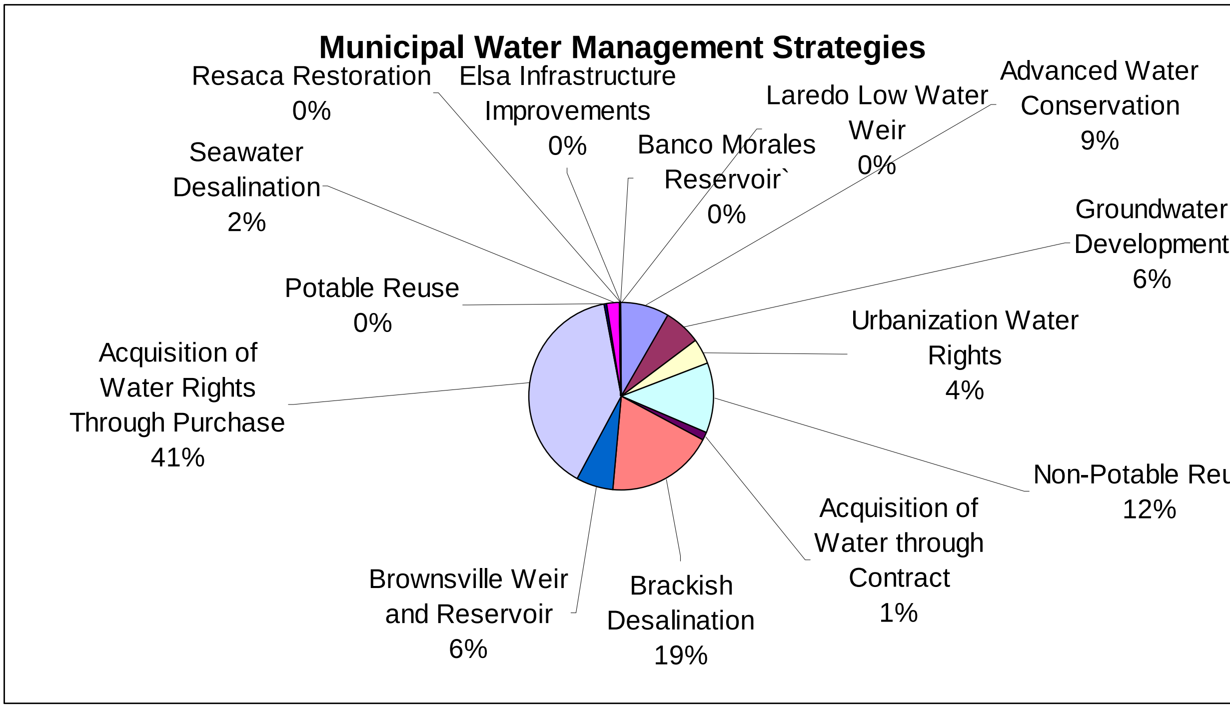
- Advanced Water Conservation;
- Potable Reuse of Reclaimed Water;
- Non-Potable Reuse of Reclaimed Water;
- Acquisition of Additional Rio Grande Water through Water Rights Purchase;
- Acquisition of Additional Rio Grande Water through Urbanization;
- Acquisition of Additional Rio Grande Water through Contract;
- Desalination of Brackish Groundwater;
- Desalination of Seawater;
- Groundwater Development;
- Brownsville Weir and Reservoir;
- Resaca Restoration;

- Laredo Low Water Weir;
- Banco Morales Reservoir; and
- Elsa Improved Infrastructure.

Table 9.1: Summary of WMS Yields & Annual Costs

Strategy	Water Supply Yield	Total Capital Cost	Total Annual Cost
Advanced Water Conservation	32,793	$22,583,710	$0
Groundwater Development	24,520	$27,474,302	$6,218,609
Acquisition of Water Rights through Urbanization	16,406	$56,167,089	$7,056,713
Non-Potable Reuse	46,382	$173,803,091	$6,839,307
Acquisition of Water through Contract	4,671	$16,263,877	$2,009,137
Brackish Desalination	71,700	$263,599,392	$33,347,670
Brownsville Weir and Reservoir	23,643	$98,411,077	$4,324,305
Acquisition of Water Rights Through Purchase	151,237	$631,081,709	$64,078,617
Potable Reuse	1,290	$7,519,850	$231,693
Seawater Desalination	7,902	$185,940,937	$8,301,920
Elsa Infrastructure Improvements	105	$8,325,386	$0
Banco Morales R	238	$25,790,900	$604,996
Resaca Restoration	877	$52,000,000	$2,229,334
Laredo Low Water Weir	0	$294,400,000	$205,000
Total	**381,764**	**$1,863,361,321**	**$135,447,300**

Figure 9.1: Municipal WMS



The following table shows how the Water User Groups in this region plan to fund the recommended strategies. The categories in Table 9.2: Summary of Funding for Municipal Strategies are types of funding available from TWDB and can be received by each WUG, if warranted.

Table 9.2: Summary of Funding for Municipal Strategies

	Total Capital Costs	Acquisition and Construction	Disadvantaged	Planning, Design, and Permitting	Excess Capacity	Rural	Other
Municipal WMS	**$1,863,361,321**	2%	73%	0%	24%	1%	3%

Below, each TWDB program available for each WUG is briefly described.

Acquisition and Construction - WIF Acquisition and Construction offers subsidized interest for all construction costs, including planning, acquisition, design, and construction.

Disadvantaged-Economically Distressed Areas Program (EDAP) - offers funding through grants and loans for service areas within a project which meet the EDAP eligibility criteria. Eligibility for the TWDB's EDAP requires that the median household income of the area to be served by the proposed project be less than 75 percent of the Texas median household income ($39,927), as shown in the 2000 Census. EDAP eligibility also requires adoption of Model Subdivision rules by the appropriate planning entities.

Planning, Design, and Permitting - this WIF-deferred program offers subsidized interest and deferral of principal and interest for up to 10 years for planning, design and permitting.

Excess Capacity – the State Participation Fund offers partial interest and principal deferral for the incremental cost of project elements, which are designed and built to serve needs beyond 10 years.

Rural - offers grants and 0% interest loans for service areas which are not in a Metropolitan Statistical Area (MSA) and in which the population does not exceed 5,000. The service areas must also meet the EAP eligibility criteria.

Listed below are descriptions of each WMS and the estimated costs associated with each project.

1. Advanced Water Conservation Measures – All municipal WUGs listed this strategy for water supply needs. All cities had a water conservation plan in place according to TCEQ regulations. The larger entities usually had a budget for information and education. McAllen has a full time staff member to implement water conservation measures.

   To achieve the estimated water savings associated with the advanced municipal water conservation scenario, a significant commitment of funding and other resources to implement the measures will be required. Cost elements of a program to achieve the estimated savings include funding for educational and public awareness activities and staff to manage and implement the various programs. It is important to note that the investment in municipal water conservation requires substantial front-end funding at the outset and for the duration of the planning period. Because the effects of conservation are incremental and build over time, the initial costs on a unit basis are relatively high at the outset and then decline significantly over time. The cost for Advanced Conservation will take into consideration the population of the region multiplied by the cost proposed for public education & school education by Best Management Practices Guide provided by TWDB which is estimated to be $5/person. The population will be multiplied by the cost of conservation education and divided by the savings of water annually for public education. The population of school age children based on the 2010 US Census will be multiplied by the cost of school conservation education and divided by the savings of water annually for school education.

   There is not a total annual cost for Advanced Water Conservation. Every WUG indicated that the extended portion strategy would have to be funded by some other source than local funds.

2. Acquisition of Water Rights Through Urbanization – Discussions with the WUGs have resulted in some confusion as to what urbanization is and how the costs were generated by the RWPG. Some entities require developers to pay the infrastructure costs to provide water required by the development of agricultural land into residential/commercial development. The process varies considerably from entity to entity. Most areas receive some sort of funds or water rights through development in the form of impact fees, direct transfer of water rights, tap-in fees or other methods of accounting for the growth within the city. Other entities receive no compensation for development and water rights are retained within the irrigation district without compensation to the city. Most of these entities indicated that they are pursuing changes in this procedure.

   Most of the WUGs in the survey did not realize that treatment costs were included in this strategy and thought it was only for the cost of the water supply to the facilities.

3. Acquisition of Water Rights Through Purchase of Additional Rio Grande Supply - The cost of water rights in this area has increased significantly over the last few years. Current costs exceed the range of $1,900 to $2,300 per acre-foot for municipal rights compared to approximately $700 per acre-foot ten years ago. Most entities have planned purchases as they need water rights.

   A total annual cost for this strategy is estimated to be $64,078,617 at a 151,237 acre-ft yield which comes out to $430 an acre-ft.

Table 9.3: Water Yield for Acquisition of Rio Grande Water Rights

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Purchase (ac-ft)	15,121	65663	7	2,226	11,149	55,060	198	1,813
Urbanization (ac-ft)	0	16,406	0	0	0	0	0	0
Contract (ac-ft)	892	2,201	0	0	235	1,338	5	0
Total:	16,013	84,270	7	2,226	11,384	56,398	203	1,813

4. Acquisition of Water Rights Through Contract – It is not possible to predict the exact cost of either future water rights purchases or the price of water provided to DMI users under contract. The specific terms of such transactions will be determined by the parties willing buyers and willing sellers, which will also dictate the specific components required to implement this strategy. However, for this planning process it is necessary to provide cost estimates for acquisition of additional Rio Grande water supplies for DMI use. Using the purchase prices for recent water transactions, the estimated cost to purchase water rights is approximated to range from $1,900 to $2,300 per acre-feet.

A total annual cost for this strategy is estimated to be $2,009,137 at a 4,671 acre-ft yield which comes out to $430 an acre-ft.

5. Non-Potable Reuse – Ten WUGs in the region listed Non-Potable Reuse as a water management strategy. They are: Brownsville, Harlingen, Laguna Madre Water District, Alamo, Edinburg, McAllen, Mission, Pharr, Rio Grande City, and Laredo. Those entities that have listed this strategy generally agreed that the costs associated with this strategy were projected to be too high. Most of these entities utilize effluent as currently treated for irrigation of golf courses or provide this water for industrial or power plant use. Many of those for whom this strategy is not listed are planning on using effluent as a strategy in the future.

   A total annual cost for this strategy is estimated to be $6,839,307 at a 46,382 acre-ft yield which comes out to $150 an acre-ft.

Table 9.4: County Yields for Non-Potable Reuse

	Cameron	Hidalgo	Jim Hogg	Maverick	Star	Webb	Willacy	Zapata
Yield (ac-ft)	3,755	29,964	0	0	125	12,523	15	0

6. Potable Reuse - Currently, only the City of Weslaco is interested in pursuing indirect potable water reuse. In 2010, their goal is to use 1 million gallons/day (1290 ac-ft/yr) of reuse water to facilitate potable water demand by blending it with raw water before it enters a treatment facility. This quantity would be available to Weslaco for the extent of the planning study.

   The cost estimates developed for the full-scale potable reuse system evaluated for the City of McAllen were reviewed for this planning effort. In 2007 dollars, capital costs of the project would be approximately $7.5 million. The total annual cost, which includes debt service (6% for 30 years) and operations and maintenance costs, is estimated to be $231,693 per year. However, it should be noted that these estimates do not include the costs associated with conventional treatment of the blended raw/reclaimed water supply. These numbers were referenced from the previous regional plan and are based on the McAllen, TX – Demonstration of ZenoGem and RO for Indirect Potable Reuse Pilot Study performed by CH2M Hill.

   A total annual cost for this strategy is estimated to be $231,693 at a 1,290 acre-ft yield which comes out to $150.45 an acre-ft.

7. Brownsville Weir and Reservoir – Of all the municipal WUGs in Region M, only the Brownsville Public Utilities Board (BPUB) listed this strategy as a long term approach to their water supply needs. In addition to other water rights, BPUB currently has authorization to divert up to 40,000 acre-feet per year of

"excess flows" from the Rio Grande under TNRCC Permit No. 1838. However, the firm yield of the project (based on hydrologic analysis for the period from 1960 to 2007) is estimated to be 20,643 acre-feet per year. This project is currently in the process of funding and environmental and international approvals.

Based on information supplied in the last regional plan, the cost estimate to construct the Brownsville Weir and Reservoir is just less than $36.2 million. TWDB guidelines require an annualized cost to construct the project to deliver water to the end user based on firm yield requirements. Assuming the firm yield from the diversion is used as the basis for providing treated water for DMI use, the following determination of unit cost was developed. Using TWDB cost estimation guidelines, the inflation adjusted annualized cost to construct, operate, and maintain the project, and provide required treatment, is approximately $3.7 million dollars per year.

A total cost for this strategy is estimated to be $4,324,305 at a 20,643 acre-ft yield which comes out to $182.90 an acre-ft.

8. Develop Local Groundwater – Twenty-four water user groups in the region listed this strategy. This is a major increase from the last round of regional planning.

   The estimated construction cost of the wellfield is about $3,265,444 (2007 dollars). The estimated construction cost for the wells (assuming depth and production rate for each well of 300 feet and 7.5 MGD). TWDB guidelines require an annualized cost to construct the project and deliver water to the end user based on yield assumptions.

   A total annual cost for this strategy is estimated to be $6,218,609at a 24,520, acre-ft yield which comes out to $214 an acre-ft.

Table 9.5: Groundwater Supply Yield

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft/yr)	2,947	9,147	73	0	4,188	8,173	0	0

9. Seawater Desalination – There are three water user groups with seawater desalination as a water management strategy. They are Laguna Madre Water District (864 acre-ft), The City of Brownsville (7,013 acre-ft), and Laguna Vista (25 acre-ft). Cost estimates were developed for a 1 million gallons per day (mgd) desalination facility near Port Isabel in 1996. Estimated total project costs are $6 million, with total annual costs of nearly $1.5 million. Based on an estimated firm yield of 1,120 acre-feet per year, the cost

estimate per acre-foot is $1,300. During a presentation, the project team for the Port of Brownsville project indicated a capital cost of $120 million with a combined debt service and operation cost of $2.50/1000 gallons or $820 per acre –foot.[1] This indicates that a larger facility is more cost effective due to economies of scale. It is also site-specific where placed in conjunction with power generation facilities will lower power costs and provide a combined water intake. It should be noted that this cost representation is only conceptual in nature. It leaves out pipelines and discharge costs that a plant would have to also take into consideration.

A total annual cost for this strategy is estimated to be $8,301,920 at a 7,902 acre-ft yield which comes out to $1,051 an acre-ft.

10. Brackish Desalination – The annual cost per acre-ft for this strategy to be implemented in this region was estimated to be at $465.10. The sizes of the brackish desalination plants in this region range from .25 MGD to 7.5 MGD[2]. Further cost data updated to include current projects completed or in the planning and design stage are summarized in the Attachment part of this plan. Costs include Well Field, Well Field Collection and Treatment Facilities. It does not include pumping and distribution costs. A major factor not included in these figures is the cost of water rights. The latest cost to purchase water rights has been approximately $2,300/acre-foot. This could be deducted from the following costs as the capital cost includes the development of the groundwater source. Costs vary due to plant size, location, and water source salinity.

Table 9.6: Water Supply Yield for Brackish Water Desalination

	Cameron	Hidalgo	Jim Hogg	Maverick	Starr	Webb	Willacy	Zapata
Yield (ac-ft)	25,069	23,066	0	641	1,498	10,100	11,326	0

A total annual cost for this strategy is estimated to be $33,347,670 at a 71,700 acre-ft yield which comes out to $465 an acre-ft.

11. Resaca Restoration - Currently only one user, Brownsville, has this as a recommended water management strategy. The total annual cost of this strategy is $2,229,334 for 877 acre-feet of yield. This comes out to be $577 an acre-ft.

12. Elsa Infrastructure Improvements - The City of Elsa is proposing a new elevated storage tank and distribution improvements to the city. The total capital cost of this $8,325,386. This will create 105 acre-feet of yield for the City of Elsa. There is no annual cost for this particular strategy.

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[1] The Future of Desalination in Texas Workshop, Austin, Texas 2003, Concept Paper Presented by Dannenbaum Engineering Co. and URS Company.

[2] Data Provided By NRS Consulting Engineers

13. Banco Morales Reservoir - Of all the municipal WUGs in Region M, Brownsville is the only WUG that lists this strategy as a long term approach to their water supply needs. This is a new WMS for this round of planning.

A total annual cost for this strategy is estimated to be $604,996 at 238 acre-feet of yield which comes out to be $182 an acre-ft.

14. Laredo Low Water Weir - The Laredo Low Water Weir does not produce a water supply yield for this project. This particular project increases the flow of the river downstream of the weir. It is estimated the total capital cost of this project is $294,400,000. Its total annual cost is estimated to be $205,000 at a 0 acre-feet of yield.

9.2.2 County Other User Groups

The County-Other groups consist of entities other than Cities within a county. These are listed as Cameron County-Other, Hidalgo County-Other, Willacy County-Other, Starr County-Other, Jim Hogg County-Other, Maverick County-Other, Webb County-Other, and Zapata County-Other. The official survey was sent to the County Judge in each of these counties.

9.2.2.1 Summary of County-Other Water Management Strategies

1. Advanced Water Conservation Measures – Of the 8 County-Other WUGs, 8 were listed as using this strategy for water supply needs. All indicated that the extended portion strategy would have to be funded by some other source than local funds.

   A total annual cost does not exist for this WMS.

2. Develop Local Groundwater – Of the 8 County-Other WUGs, 4 were listed as using this strategy for water supply needs.

A total annual cost for this strategy is estimated to be $1,793,626 for 8,344 acre-ft of yield which comes out to $214 an acre-ft.

3. Purchase Additional Rio Grande Supply - Of the 8 County-Other WUGs, 6 were listed as using this strategy for water supply needs.

A total annual cost for this strategy is estimated to be $12,218,272 at a 28,406 acre-ft yield which comes out to $430 an acre-ft.

9.2.3 Irrigation Water User Groups

The adopted plan lists irrigation groups by county without specific irrigation districts listed with needs. For each county irrigation group, two strategies are listed. These are on-farm improvements and conveyance system improvements.

Table 9.7: Summary of Irrigation Strategies

Irrigation Data			
WMS	Yield	Total Annual Cost	Unit Cost
On Farm	219,226.00	55,547,585.23	253.38
Conveyance	218,783.00	26,402,708.30	120.68
The counties that used these strategies are Willacy (Both), Starr (On-Farm), Maverick (Both), Hidalgo (Both), and Cameron (Both).			

9.2.3.1 Summary of Water Management Strategies

1. On-Farm Improvements – This strategy consists of improvements to flow measurements, installation of polypipe delivery systems, improved management and technology, installation of SCADA systems and implementation of a verification program to monitor effectiveness of the program. A wide range of comments were received from Irrigation District Mangers prior to the previous plan and this plan. It was made clear that it was not their responsibility to fund on-farm improvements. A range of affordability included the inability for the farmer to pay for any improvements to 50% of on-farm improvements. At the meeting, a reluctant consensus, representing several irrigation districts in Cameron and Hidalgo Counties, suggested that 40% of on-farm improvements could be paid for with local funds with the remaining 60% from outside sources, such as the Texas Water Development Board, the U.S. Bureau of Reclamation (Reclamation) and legislative appropriations. Based on further discussions with the irrigation districts and the RWPG, it was suggested that the affordability of irrigation improvements be changed to 10%, as many districts could not afford any improvement cost. This was recommended and approved at the RWPG.

A total annual cost for this strategy is estimated to be $55,547,585 at a 219,226 acre-ft yield which comes out to $253.38 an acre-ft. The total capital cost of this project is $194,417,692.

2. Irrigation Conveyance System Improvements - The Texas Agricultural Experiment Station (TAES) evaluated and developed water savings and cost estimates for a comprehensive program to rehabilitate and improve the management of irrigation conveyance and distribution facilities. The program

would consist of six principal components: 1) Installation of no-leak gates; 2) Installation of additional water measurement weirs; 3) Conversion of smaller concrete canals that are in poor condition to pipeline; 4) Relining of concrete-lined canals that are in poor condition; 5) Lining of smaller earthen canals constructed of more porous soils; and, 6) Implementation of verification programs to monitor and measure the effectiveness of the efficiency improvements.

Like on-farm improvements, comments varied greatly amongst the District Managers. In recent years a great deal of experience was gained in the funding of these projects. Several projects have been completed since the previous plan. The Districts that were prepared for construction, i.e. had approved Project Reports for Reclamation and subsequent Cost-Share agreements executed, were able to take advantage of funding from the North American Development Bank (NADBank) to supplement the 50% share from Reclamation. Most Districts were able to achieve at least a 90% combined funding level with federal and NADBank funds. Districts have further realized that the 50% cost share agreement with Reclamation does not mean that reimbursement will occur rapidly and actually may take several years to get reimbursement of Reclamation's share. This means that the Districts will need to finance that portion in some way in addition to their own portion. Most Districts cannot afford the construction of new facilities given the need to finance 100% of a project up-front. The addition of the NADBank funds allowed Districts to complete the projects while awaiting reimbursement. One district was unable to complete its project even with the 50% cost share from Reclamation. According to NADBank, these funds will not be used for other projects and it is not expected that additional funds will be available in the future. A summary of projects and funding levels are shown in Chapter 4, page 4-135, based on information from Sonia Kaniger of Cameron County Irrigation District 2 as of June 2010.

A general consensus was given for the ability to afford 40% financing. Discussions however indicate that even that would be far too costly for the irrigator to afford. When presented to the Region M RWPG, it was approved to use 10% affordability. Even at that, some could still not afford to implement on-farm water conservation initiatives.

A total annual cost for this strategy is estimated to be $26,402,708.30 at a 218,783 acre-ft yield which comes out to $120.68 an acre-ft. The total capital cost of this project is 130,757,978.

Table 9.8: Funding for Irrigation Strategies

Irrigation WMSs	Funded Locally	Outside Sources
On-Farm Conservation	40%	60%
Irrigation Conveyance System Improvements	10%	90%

9.2.4 Manufacturing

The Rio Grande Region, for the most part, has adequate supplies to meet manufacturing water demands. Throughout the planning period, currently available water supply for manufacturing exceeds projected water demand. However, certain local areas do have small manufacturing water supply deficits. Cameron and Hidalgo County show a water supply deficit. The shortages were assigned three water management strategies. They are Non-Potable Reuse, Expand Groundwater Wells, and Acquisition of Water Rights through the Purchase of Water Rights.

1. Non- Potable Reuse - A total annual cost for this strategy is estimated to be $454,359 at a 3,020 acre-ft yield which comes out to $150 an acre-ft.

2. Acquisition of Water Rights through the Purchase of Water Rights - A total annual cost for this strategy is estimated to be $130,759 at a 304 acre-ft yield which comes out to $430 an acre-ft.

3. Expanding Groundwater Wells - A total annual cost for this strategy is estimated to be $297,592 at a 1,200 acre-ft yield which comes out to be $214 an acre-ft.

There were no surveys sent in this category. It was assumed that manufacturing would pay what was necessary to finance their water needs.

9.2.5 Steam Electric Power

The Rio Grande Region is projected to have steam electric water supplies in excess of demand through the year 2020. After that point, demand will be slightly greater than supply, and relatively large steam electric water supply deficits will occur due to the location of available supply. Although the Rio Grande Region currently has no identified steam electric water demand needs, water shortages are projected to occur beginning in 2050 in Cameron County, in 2050 in Webb County, and in 2020 in Hidalgo County. Hidalgo County is projected to have shortages of 1,980 acre-feet in year 2020 and to continue thereafter through 2060 with a deficit of 15,183 acre-feet. Combined, the county-level steam electric power generation WUGs in Cameron, Hidalgo, and Webb counties are projected to have shortages of 11,215 acre-feet combined per year by 2050 and thereafter through 2060. Water management strategies considered potentially applicable to this need include acquisition of additional Rio Grande supplies, use of reclaimed water, and groundwater. It is recommended that all of the projected steam electric demands be met through a combination of the three listed strategies. No surveys were sent to these entities. These strategies were considered to be financed through the steam electric power companies through the cities.

1. Non- Potable Reuse - A total annual cost for this strategy is estimated to be $1,624,860 at a 10,800 acre-ft yield which comes out to $150 an acre-ft.

2. Acquisition of Water Rights through the Purchase of Water Rights - A total annual cost for this strategy is estimated to be $2,229,363 at a 5,183 acre-ft yield which comes out to $450 an acre-ft.

3. Develop Local Groundwater - A total annual cost for this strategy is estimated to be $85,769 at a 399 acre-ft yield which comes out to $214 an acre-ft.

ATTACHMENT 9-1

SAMPLE LETTER TO WATER USER GROUPS

SAMPLE LETTER SENT TO MUNICIPAL WATER SUPPLIERS IN JULY 2010

September 23, 2010

«Name»
«Title»
«WUG»
«address1»
«address2»

RE: Water Infrastructure Financing Survey

Dear «Sal»:

As part of Senate Bill 2 (SB 2, 77th Texas Legislature), the Rio Grande Regional Water Planning Group (RGRWPG) is required by the Texas Water Development Board (TWDB) to examine funding required to implement the water management strategies and projects that were identified and recommended in the Initially Prepared Plan.

Attached please find a survey to determine various issues to assist us in the planning and implementation of water management strategies for the region. The survey reviews the water management strategies outlined by the Initially Prepared Plan and we request your assistance to respond to several questions with regard to financing these strategies. This is a requirement of Senate Bill 2, and we must receive your response no later than July 30, 2010. You may either respond to the hard copy survey or the email version of the survey. You do not need to reply to both surveys.

I thank you in advance for your continued cooperation in the water planning process for our region. If you have any questions, please do not hesitate to call me at (956) 423-7409.

Sincerely,

Jacob White, P.E

ATTACHMENT 9-2

SAMPLE SURVEY FOR WATER USER GROUPS

Infrastructure Financing Survey Report

44: EAGLE PASS

As part of the regional and state water planning process, regional water planning groups recommend water supply projects for each of their respective regions. The purpose of this survey is gather information from your organization regarding how you plan to finance water supply projects recommended for the 2012 state water plan, and determine whether you intend to use financial assistance programs offered by the State of Texas and administered by the Texas Water Development Board (TWDB).

The TWDB has several funding programs for water projects identified in the 2012 state water plan. Funds are targeted toward: 1) construction of water supply projects, 2) planning and design and permitting for projects that have long development time frames meaning that construction would require 5-10 years of planning, design and permitting, and 3) projects that would be built with excess capacity intended to meet future water needs. These programs offer various attractive financing options such as subsidized interest rates, deferral of principal and interest during planning, design and permitting phase, partial deferral of interest and principal for those portions of the project which are optimally sized for future needs. Additionally, grant funding is available for those service areas which qualify as rural or economically disadvantaged. More information on these financial assistance programs (i.e., the Water Infrastructure Fund, the State Participation Fund, and the Economically Disadvantaged Areas Program) can be found at the TWDB website at:

http://www.twdb.state.tx.us/assistance/financial/financial_main.asp

Your cooperation and responses to these questions are crucial in helping the state in ensuring that our communities and our citizens have adequate water supplies. If you have any questions related to the financial programs offered by the TWDB or about the survey questions, please contact Jake White by phone at (956)423-7409 or by email at jwhite@nrsengineers.com. If you have any computer or technology related problems with the survey, please contact Wendy Barron by phone at (512) 936-0886 or by email at wendy.barron@twdb.state.tx.us.

Section 1: Project Financing Information

For project(s) identified in the State Water Plan, the TWDB has funding available for different aspects of a project. The different programs available are:

- WIF-Deferred offers subsidized interest and deferral of principal and interest for up to 10 years for planning, design and permitting costs.

- WIF-Construction offers subsidized interest for all construction costs, including planning, acquisition, design, and construction.

- State Participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

- Rural areas funding offers grants and 0% interest loans for service areas which are not in a Metropolitan Statistical Area (MSA) and in which the population does not exceed 5,000. The service area must also meet the EDAP eligibility criteria.

- Economically Distressed Areas Program (EDAP) offers funding through grants and loans for service areas within a project which meet the EDAP eligibility criteria. Eligibility for the TWDB's EDAP requires that the median household income of the area to be served by the proposed project be less than 75 percent of the Texas median household income ($39,927), as shown in the 2000 Census. EDAP eligibility also requires adoption of Model Subdivision rules by the appropriate planning entities.

6/25/2010 10:00:07 AM

Infrastructure Financing Survey Report

•State Participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

If you are interested in receiving funds from the above programs, please complete the remainder of the survey.

Please enter only the amounts you wish to receive from TWDB program in the Project Costs fields and do not enter a specific project cost more than once.

Section 2: Projects

For each of the project(s) listed below, please enter only the amounts you wish to receive from TWDB programs in the 'Cost' field and the earliest date you wish to receive these amounts. In addition, the total amount entered into all five categories cannot exceed the total cost of the project. Each of the five categories corresponds to a funding program available at the TWDB. Each of the funding programs and categories are described below.

•Planning, design, permitting: Enter costs into the 'Planning, design, permitting' category if you want to participate in the WIF-Deferred program. The WIF-Deferred program offers subsidized interest and deferral of principal and interest for up to 10 years for planning, design and permitting costs.

•Acquisition and construction: Enter costs into the 'Acquisition and construction' category if you want to participate in the WIF-Construction program. The WIF-Construction program offers subsidized interest for all construction costs, including planning, acquisition, design, and construction.

•Excess Capacity: Enter costs into the 'Excess capacity' category if you want to participate in the State Participation program. State Participating funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

•Rural: Enter costs into the 'Rural' category if you want to participate in the Rural areas funding program. Rural areas funding offers grants and 0% interest loans for service areas which are not in a Metropolitan Statistical Area (MSA) and in which the population does not exceed 5,000. The service area must also meet the EDAP eligibility criteria.

•Disadvantaged: Enter costs into the 'Disadvantaged' category if you want to participate in the Economically Distressed Areas Program (EDAP). EDAP offers funding through grants and loans for service areas within a project which meet the EDAP eligibility criteria. Eligibility for the TWDB's EDAP requires that the median household income of the area to be served by the proposed project be less than 75 percent of the Texas median household income ($39,927), as shown in the 2000 Census. EDAP eligibility also requires adoption of Model Subdivision rules by the appropriate planning entities.

53 - BRACKISH WATER DESALINATION				**$73,423.88**
Planning, design, permitting	Cost:		Year:	
Acquisition and contruction	Cost:		Year:	
Excess Capacity	Cost:		Year:	

6/25/2010 10:00:07 AM

Infrastructure Financing Survey Report

Rural	Cost:	Year:	
Disadvantaged	Cost:	Year:	
	Total:		

60 - ADVANCED WATER CONSERVATION			**$76,943.79**
Planning, design, permitting	Cost:	Year:	
Acquisition and contruction	Cost:	Year:	
Excess Capacity	Cost:	Year:	
Rural	Cost:	Year:	
Disadvantaged	Cost:	Year:	
	Total:		

Section 3: Contact Information

1. Name: __________
2. Phone Number: __________
3. Email: __________
4. Comments __________

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CHAPTER 10.0 : PUBLIC PARTICIPATION, FACILITATION AND PLAN IMPLEMENTATION ISSUES

10.1 PUBLIC PARTICIPATION

Public participation is the basis of the regional water planning process initiated by Senate Bill 2 in 1997. Under Texas Water Development Board (TWDB) rules laid out in 31 TAC §357, Regional Water Planning Groups (RWPGs) must include a broad cross-section of stakeholder groups representing communities throughout the region. Voting members of the Rio Grande Regional Water Planning Group (Rio Grande RWPG) as of May 1, 2010, are listed in Table 10.1. The group now includes a member representing the category of river authority as a result of state legislation enacted in 2003.

The Rio Grande RWPG amended its bylaws in July 2003 to allow members to serve consecutive five-year terms.

TWDB rules require RWPGs to have at least one meeting prior to preparation of the regional water plan, provide ongoing opportunities for public participation during the planning process, and hold at least one public hearing prior to adoption of the "initially prepared" regional water plan. The RWPGs are also required to comply with TWDB rules specifying how and to whom notice of public meetings and public hearings is to be provided.

As in the first cycle of regional water planning, the Rio Grande RWPG has gone well beyond minimum requirements set by the state for public participation, providing multiple opportunities for public input and for direct participation in the planning process and development of the draft plan. The group also intensified efforts in the second round of planning to ensure public involvement and participation in the process.

The Rio Grande RWPG held regular meetings throughout the planning process, generally on a monthly basis. Each meeting provided opportunity for public comment. As planning progressed, the opportunity for comment was moved from the end of the agenda to the beginning in order to better accommodate the needs of the public.

A variety of mechanisms have been used to publicize Rio Grande RWPG meetings. Media advisories are distributed via fax and e-mail to community newspapers in advance of meetings; advisories also are sent to daily newspapers and radio and television stations one to two days prior to meetings.

In addition, notices of meetings, agendas, and minutes are posted to the Rio Grande RWPG's website: www.RioGrandeWaterPlan.org. The website was developed in late 2003 as a resource for the public on issues of concern to regional water planning and information on the planning process.

A simple, easy-to-read trifold brochure about the region and the regional planning process was developed in August 2004, revised in 2010, and has been distributed at a variety of forums and through direct mail. The brochure also directs readers to the website for additional, in-depth information.

Three newsletters were published and distributed in the second round of regional water planning. The November 2002 newsletter discussed the process for the second round of regional water planning. The June 2003 newsletter focused on the plan amendment to add desalination as a water management strategy and provided details on opportunities for public review of and comment on the proposed changes. The July 2005 newsletter summarized the Initially Prepared Plan, highlighting major issues and water management strategies and cost-efficiencies. It also provided information on the public hearing to consider the plan and listed the locations, including the website, where the public could review the plan (those locations are provided in Table 10.2). The August 2005 newsletter provided a Spanish translation of the summary. These last newsletters were made available at public meetings on the Initially Prepared Plan. All four newsletters are posted on the website.

Electronic versions of the summary newsletters were made available to all regional media as a way of promoting interest in the plan. Names on the mailing list for the newsletters were compiled from previous regional water planning efforts.

Table 10.1: Voting Members of the RGRWPG

INTEREST	NAME	RESIDENT COUNTY
Public	Mary Lou Campbell* Secretary, Mercedes	Hidalgol
Counties	John Wood County Commissioner, Brownsville	Cameron
Municipalities	Roberto Gonzalez* Water Works, Eagle Pass	Maverick
	John Bruciak, General Manager Brownsville PUB, Brownsville	Cameron
	Tomas Rodriguez City of Laredo	Webb
Industries	Donald K. McGhee HydroSystems, Inc., Harlingen	Cameron
Agriculture	Robert E. Fulbright* Hinnant & Fulbright, Hebbronville	Jim Hogg
	Ray Prewett Texas Citrus Mutual, Mission	Hidalgo
Environmental	Sonia Najera The Nature Conservancy	Cameron
Small Business	Vacant	
	Carlos Garza AEC Engineering, LLC., Edinburg	Hidalgo
Electric Generating Utilities	Ella de la Rosa Magic Valley Electric Cooperative	Hidalgo

River Authorities	James Darling Rio Grande Regional Water Authority	Hidalgo
Water Districts	Sonny Hinojosa HCID No. 2, San Juan	Hidalgo
	Sonia Lambert CCID No. 2, San Benito	Cameron
Water Utilities	Charles Browning North Alamo Water Supply Corp., Edinburg	Hidalgo
Other	Glenn Jarvis, Chair* Attorney, McAllen	Hidalgo
	Gary Whittington Unifirst Linen Service, Harlingen	Cameron

*Executive Committee
Planning Group members as of February 2010.

The Executive Summary of the plan is being translated into Spanish, and will be posted on the website.

The Rio Grande RWPG and its consultant team also actively solicited comment from local entities on the basic data used to develop the plan:

- A water infrastructure financing survey and supplemental survey was mailed to each water user group (WUG) in July 2010 with follow up phone calls with each entity. The infrastructure survey was completed to determine the capability to pay for water management strategies listed in the plan. The supplemental survey was to collect input from the WUGs related to water supply issues and their strategies to solve long-term water shortages.
- Draft population and water demand projections were faxed to officials representing each city and county in the region September 2009. The faxing list included every WUG in the region. Comments were received from several of the WUGs.
- Survey Information regarding the water supply issues was mailed out to each WUG in February 2010, and follow up phone calls were made to help with participation. Very few WUGs replied before submitting of the IPP.

Members of the consultant team also made several presentations to a variety of groups with an interest in water planning, including water utility associations, citrus growers, and irrigation district boards of directors.

The Rio Grande RWPG provided extensive notice of and opportunity for public comment on the Initially Prepared Plan. As required by TWDB rule, copies of the draft plan were placed in at least one public library in each county within the regional planning area as well as in the office of the county clerk in each county within the regional planning area. Copies also were placed at the offices of councils of governments in the region, including the Lower Rio Grande Valley Development Council and the South Texas Development Council. (See Table 10.2)

A public hearing on the Initially Prepared Plan was held in Weslaco on April 21, 2010 at the Weslaco City Hall. Formal notices of the public hearing were placed in newspapers of general circulation in each county of the regional planning group. A handful of residents attended the public hearing, mostly employees of local water districts. No one from the general public chose to testify.

Although the TWDB rules stipulate only one public hearing on the draft plan, the regional planning group elected to host an additional public meeting in Laredo on April 28, 2010, at the public library. About a dozen people attended this hearing, including several employees of the Laredo Utilities Department, and the Mayor of Laredo Raul Salinas. The mayor spoke about his concern that groundwater from areas north of Laredo would be depleted. Jay Johnson Castro, the executive director of the Rio Grande International Study Center also asked several questions related to the IPP.

The extended comment period enabled further presentations at public meetings throughout the region. Instead of scheduling stand-alone meetings, the planning group was able to piggyback on opportunities provided by other policy groups. These included:

- Lower Rio Grande Development Council Board of Directors, Harlingen – July 28, 2005
- Laredo City Council, Laredo – Aug. 1, 2005
- Eagle Pass City Council, Eagle Pass – Aug. 2, 2005
- South Texas Development Council Board of Directors, Zapata – Sept. 8, 2005
- Citrus Water and Wastewater Association – April 13, 2010

All public outreach on the Initially Prepared Plan included information on procedures and deadlines for submitting comments.

Table 10.2: Opportunities for Public Review of the Draft Rio Grande Regional Water Plan

COUNTY	LOCATION
Cameron	Cameron County Clerk's Office, 964 E. Harrison, Brownsville, TX 78520
	Brownsville Public Library, 2600 Central Blvd., Browsnville, TX 78520
Hidalgo	Hidalgo County Clerk's Office, 100 N. Closner, Edinburg, TX 78539
	McAllen Memorial Library 601 N. Main, McAllen, TX 78501
Jim Hogg	Jim Hogg County Clerk's Office, 102 E. Tilley, Hebbronville, TX 78361
	Jim Hogg County Library, 210 S. Smith, Hebbronville, TX 78361
Maverick	Maverick County Clerk's Office, 500 Quarry St. Suite 2, Eagle Pass, TX 78852
	Eagle Pass Public Library, 589 Main St., Eagle Pass, TX 78852
Starr	Starr County Clerk's Office, 401 N. Britton Ave., Room 201, Rio Grande City, TX 78582
	Starr County Library, 591 E. Canales, Rio Grande City, TX 78582
Webb	Webb County Clerk's Office, 1110 Victoria St., Suite 201, Laredo, TX 78040
	Laredo Public Library, 1120 E. Calton St., Laredo, TX 78041
Willacy	Willacy County Clerk's Office, 576 W. Main St., Raymondville, TX 78580
	Reber Memorial Library, 193 N. 4th, Raymondville, TX 78580
Zapata	Zapata County Clerk's Office, 200 E. 7th Ave., Suite 138, Zapata, TX 78076
	Zapata County Library, 901 Kennedy St., Zapata, TX 78076

10.2 FACILITATION OF THE REGIONAL WATER PLANNING PROCESS

Facilitation of the regional water planning process for the Rio Grande Region has been provided by the staff of the Lower Rio Grande Valley Development Council (LRGVDC), with assistance from the consultant team. In addition to performing administrative duties relating to the management of State funds, the LRGVDC also made all arrangements for meetings of the Rio Grande RWPG, which included posting required meeting notices, preparing meeting agendas, and distributing agenda back-up materials to members of the RWPG. The LRGVDC also tape recorded all Rio Grande RWPG meetings and prepared the official meeting minutes. For non-voting Spanish-speaking members of the Rio Grande RWPG, an interpreter was available at all RWPG meetings, upon request.

The consultant team also assisted in facilitating the planning process by providing presentations of technical information at RWPG meetings and assisting in identifying key water planning and policy issues.

10.3 PLAN IMPLEMENTATION ISSUES

There are a number of key issues that will affect whether this plan is successful in achieving its primary purpose – to provide recommendations regarding strategies for meeting the near and long-term water needs of the Rio Grande Region. Many of these issues are identified and discussed in previous chapters, particularly in association with recommended water management strategies and policy issues. Generally, the key issues relating to the implementation of this plan can be grouped into three categories:

- Issues and water management strategies that require additional in-depth evaluation;
- Local buy-in and action to implement local water supply strategies; and,

- Funding for the implementation of plan recommendations.

Each of these areas of concern is briefly discussed below. No interregional conflicts have been identified in the planning process or contained in the plan.

10.3.1 Additional Planning Studies

The recommendations presented in this regional water plan are based on a reconnaissance-level evaluation of projected water demands, water supply, needs, and various strategies for meeting future needs. It is important to note that additional, more detailed feasibility-level planning will be necessary prior to implementation of the many of the recommended strategies. Also, in many cases, feasibility-level planning will need to be followed by engineering design and permitting activities. For the most part the additional planning and project development activities required for strategy implementation will be the responsibility of local water suppliers (e.g., cities, water supply corporations, and irrigation districts). However, state and/or federal technical and financial assistance would greatly facilitate timely project development and implementation.

There are a number of specific issues and water management strategies that require additional investigation and which should be considered as potential candidates for state funding prior to the first update of this regional water plan. These are:

- **Water Supply Planning for Rural Areas**. The Rio Grande RWPG recommends that future updates to the regional water plan include a thorough evaluation of water supply, projected water demands, needs, and strategies for the individual public water systems currently aggregated into the "County-Other" water user groups. This evaluation should include projected water supply needs associated with serving economically distressed areas (i.e., colonias) in the rural portions of each county.

- **Assessment of Individual Irrigation Districts**. The Rio Grande RWPG recommends that the irrigation districts be evaluated as individual water user groups to better assess their water management strategies in the future updates to the regional water plan.

- **Municipal Water Conservation Program Design**. Advanced or additional municipal water conservation measures are recommended to provide a significant contribution toward meeting projected municipal water demands. Funding is needed to support the development of a detailed program implementation plan that can serve to guide local water suppliers in the implementation of these programs. Particular attention needs to be given to developing approaches for cooperative, regional implementation of municipal water conservation programs.

- **Assessment of Non-Potable Water Reuse Opportunities**. As with conservation, non-potable reuse of reclaimed water is a key strategy recommended for meeting a portion of future municipal water needs and a portion of the projected supply needs for steam electric power generation. However, as discussed in Chapter 5 of this plan, estimates of the achievable municipal reuse potential in the Rio Grande Region are based on limited information and broad planning assumptions. For this strategy to achieve the recommended level of implementation, it is essential that a more comprehensive and thorough assessment be performed to identify feasible reuse applications. This assessment should examine each individual municipal water and wastewater utility system to characterize the quality of available wastewater effluent; identify potential users of reclaimed water within reasonable proximity to existing wastewater treatment facilities; evaluate the requirements of potential users (e.g., quantity and quality); and develop site-specific cost estimates for implementation of reuse projects.

- **Groundwater Development**. State efforts to improve data and assess groundwater availability in the Rio Grande Region should continue. Specifically, current efforts to gather additional data on the occurrence, quantity, and quality of recoverable groundwater from the Gulf Coast aquifer and to develop a new simulation model of the Gulf Coast aquifer in South Texas should be completed expeditiously. In addition, state funding should be made available for regional facility planning studies to develop regional groundwater supply projects as a substitute source of water supply for some DMI users currently using Rio Grande supplies (e.g., municipal suppliers in Willacy County). Also, the cities of Brownsville, Eagle Pass, and Laredo are encouraged to continue their local efforts to identify and develop cost-effective sources of groundwater supply.

- **Irrigation district rehabilitation**. An extensive discussion of issues associated with the implementation of irrigation conveyance and distribution efficiency improvements is provided in Chapter 5. A key issue is the need for additional, district-specific assessments to identify cost-effective improvements and to develop comprehensive rehabilitation plans. Continuing and expanded state and federal assistance, both technical and financial, is essential.

- **Use of Stormwater Runoff**. It is recommended that a study be conducted to determine the feasibility and impacts of capturing and using stormwater runoff as a supplemental water supply source in Cameron and Hidalgo counties. As described in Chapter 5, the study would investigate supply availability, potential uses, and other issues for five localized areas. The results would then be extrapolated to other areas of the two counties to develop a better estimate of the amount of stormwater that could be developed as supply source, as well as the costs of implementing the strategy on a sub-regional scale.

- **Re-channelization/Restoration of Portions of the Rio Grande**. As indicated both in Chapter 5 and Chapter 6, the Rio Grande RWPG supports the International Boundary and Water Commission's request for federal appropriations to conduct a detailed assessment of the costs, benefits, and environmental impacts of improvements to the river channel above Amistad International Reservoir. Of particular interest is the quantification of the potential water supply benefits of such a project.

- **Surface Water Availability Models**. As indicated in Chapter 6, the Rio Grande RWPG recommends that state funding be provided for the development of a water availability model for the Rio Grande watershed. In addition, the Rio Grande RWPG supports additional state funding for continued refinement of the existing Reservoir Operations Model for the Amistad/Falcon Reservoir System. Of particular interest is the expansion of the existing model to include portions of the Rio Grande watershed in Mexico that contribute inflows to the reservoir system.

- **Development of the Laredo Low Water Weir**. The Rio Grande RWPG supports Webb County's efforts to obtain funding for a detailed feasibility and environmental impact study of the proposed low-water dam.

- **Reservoir Sedimentation**. The Rio Grande RWPG recommends that a study be conducted to evaluate the technical and economic feasibility and potential environmental impacts of alternatives for the control and/or removal of sediment from the Amistad/Falcon Reservoir System

10.3.2 Local Water Supply Planning and Implementation

This regional water plan is best viewed as providing a framework for local action to implement strategies for meeting future water needs. The role of the Rio Grande RWPG is purely advisory. The RWPG has no authority to compel other entities to implement the actions recommended in this plan, nor does it have the authority or resources to undertake implementation activities on its own initiative. Rather, implementation of strategies recommended for meeting future water needs is a primary responsibility of local water suppliers, which include cities, water supply corporations, other public water supply entities, and irrigation districts. With or without outside assistance, more detailed feasibility-level planning studies and engineering design is largely the responsibility of local water suppliers. Similarly, the costs of implementing water conservation and water supply strategies will be borne largely by the ratepayers served by local water suppliers. It is therefore essential that there be a strong commitment on the part of the governing bodies and management of local water suppliers to implement the strategies recommended in this plan.

Locally, there has been a great deal of progress with stakeholders working together. The RGRWPG highly recommends that this continue to aid in the implementation of water strategies throughout the region. The re-creation of the Rio Grande Regional Water Authority (RGRWA) which has statutory authority to investigate, plan, acquire, construct, maintain, or operate any property the authority considers necessary or proper for the accomplishment of the purposes of the authority, including water treatment, wastewater treatment, water conveyance, and desalination of water" has been key. The RGRWA encompasses many of the same counties in the Rio Grande RWPG. It includes on its board representatives of each county, as well as the irrigation districts, water supply corporations, municipalities, and the general public.

Water rights conversion has been and continues to be an important issue between irrigation districts and municipalities as more irrigation land is lost to urbanization. There is no set formula for the transfer or conversion of water rights associated with this urbanization. A committee consisting of irrigation district managers and water utility managers is currently ongoing set some standards for conversion and taking into consideration each party's needs. The RGRWPG recommends that this group continue to strive for solutions.

10.3.3 Funding for Plan Implementation

The availability of and access to funding for the implementation of recommended water management strategies is crucial. Most local water suppliers in the Rio Grande Region are governmental or quasi-governmental entities (e.g., water supply corporations) that have the authority to charge and collect taxes and/or fees for the services they provide. These entities also have the ability to borrow money for the acquisition of additional water supplies and for water-related infrastructure development and rehabilitation. For the most part, the direct costs for the services provided by these entities should be borne by the individual water users through taxes and/or fees for services. However, it should be recognized that there is also an appropriate role for the state and federal governments in the financing of water conservation, water supply development, and infrastructure projects. At present, there are a number of state and federal financial assistance programs for water-related infrastructure projects that are available to municipal water suppliers. However, there are few programs that provide financial assistance to irrigation districts for infrastructure improvements. Because agricultural water conservation is a central element of this regional water plan – and is essential to maintaining the viability of this sector of the regional economy – the Rio Grande RWPG recommends that new public funding sources be developed to assist irrigation districts with the implementation of conservation programs.

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Region M Summary

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1,209,647	1,163,634	1,082,232	981,748	981,748	981,748	981,748
Current Water Supply Type	**Source**							
Total Supply (AF/yr)		**734,374**	**757,168**	**750,179**	**743,691**	**737,203**	**730,713**	**724,724**
Projected Supply Surplus/Deficit		**-475,273**	**-406,466**	**-332,053**	**-238,057**	**-244,545**	**-251,035**	**-257,024**

ation of Selected Water Management Strategies **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Conservation	219,228	$ 55,547,990.64	$ 253.38		36,528	73,085	109,614	146,144	182,698	219,228
Conveyance System Conservation	218,783	$ 26,402,732.44	$ 120.68		91,160	182,313	191,435	200,551	209,667	218,783
Total WMS Yield					127,688	255,398	301,049	346,695	392,365	438,011

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Zapata County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		7,763	6,454	6,121	5,805	5,805	5,805	5,805
Current Water Supply Type	**Source**							
Surface Water	Amistad/Falcon	3,991	3,960	3,920	3,884	3,847	3,810	3,776
Surface Water	Tributaries	0	0	0	0	0	0	0
Ground Water		0	0	0	0	0	0	0
Total Supply (AF/yr)		**3,991**	**3,960**	**3,920**	**3,884**	**3,847**	**3,810**	**3,776**
Projected Supply Surplus/Deficit		**-3,772**	**-2,494**	**-2,201**	**-1,921**	**-1,958**	**-1,995**	**-2,029**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Willacy County								
Year			**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand			58,586	59,191	60,203	60,623	60,623	60,623	60,623
Current Water Supply	**Source**								
Surface Water	AMISTAD/FALCON		34,525	34,257	33,915	33,598	33,281	32,964	32,672
Surface Water	IRRIGATION LOCAL SUPPLY		899	899	899	899	899	899	899
Ground Water	GULF COAST		30	0	0	0	0	0	0
Total Supply (AF/yr)		**0**	**35,454**	**35,156**	**34,814**	**34,497**	**34,180**	**33,863**	**33,571**
Projected Supply Surplus/Deficit			**-23,132**	**-24,035**	**-25,389**	**-26,126**	**-26,443**	**-26,760**	**-27,052**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Conservation	7,808	$ 1,978,391.04	$ 253.38		1,301	2603	3904	5205	6507	7808
Conveyance System Conservation	9,345	$ 1,127,754.60	$ 120.68		3,894	7,787	8,177	8,566	8,955	9,345

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Webb County

Year			**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand			23,723	20,507	19,548	18,654	18,654	18,654	18,654
Current Water Supply	**Source**								
Surface Water	AMISTAD/FALCON		10603	10520	10415	10318	10221	10123	10034
Surface Water	TRIBS TO RIO GRANDE		29.65	98	98	98	98	98	98
Surface Water	TRIBS TO RIO GRANDE		148.25	20	20	20	20	20	20
Surface Water	TRIBS TO RIO GRANDE		29.65	33	33	33	33	33	33
Surface Water	REUSE		795	1120	1120	1120	1120	1120	1120
Surface Water	CARRIZO-WILCOX		118.6	135	135	135	135	135	135
Ground Water	CARRIZO-WILCOX		1963	0	0	0	0	0	0
Ground Water	CARRIZO-WILCOX		1014	1043	1043	1043	1043	1043	1043
Ground Water	GULF COAST		6	47	47	47	47	47	47
Ground Water	GULF COAST		28	67	67	67	67	67	67
Ground Water	GULF COAST		56	364	364	364	364	364	364
Ground Water	OTHER AQUIFER		446	23	23	23	23	23	23
Ground Water	OTHER AQUIFER		62	32	32	32	32	32	32
Ground Water	OTHER AQUIFER		492	174	174	174	174	174	174
Total Supply (AF/yr)		**0**	**15791.2**	**13676**	**13571**	**13474**	**13377**	**13279**	**13190**
Projected Supply Surplus/Deficit			**-7,932**	**-6,831**	**-5,977**	**-5,180**	**-5,277**	**-5,375**	**-5,464**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Starr County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			30,693	31,191	30,108	29,070	29,070	29,070	29,070
Current Water Supply	**Type**								
Surface Water	AMISTAD/FALCON		15,896	15,773	15,616	15,470	15,324	15,178	15,043
Ground Water	GULF COAST		470	180	180	180	180	180	180
Ground Water	GULF COAST		1,523	576	576	576	576	576	576
Ground Water	OTHER AQUIFER		229	18	18	18	18	18	18
Ground Water	OTHER AQUIFER		1,927	5,821	5,821	5,821	5,821	5,821	5,821
Total Supply (AF/yr)		**0**	**20,045**	**22,368**	**22,211**	**22,065**	**21,919**	**21,773**	**21,638**
Projected Supply Surplus/Deficit			**-10,648**	**-8,823**	**-7,897**	**-7,005**	**-7,151**	**-7,297**	**-7,432**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Conservation	6,315	$ 1,600,094.70	$ 253.38		1,052	2105	3158	4210	5263	6315
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Maverick County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			93,145	95,040	91,693	87,863	87,863	87,863	87,863
Current Water Supply	**Source**								
Surface Water	AMISTAD/FALCON		54,176	53,755	53,219	52,722	52,224	51,727	51,268
Surface Water	REUSE		123	0	0	0	0	0	0
Surface Water	TRIBS TO RIO GRANDE		184	223	223	223	223	223	223
Surface Water	TRIBS TO RIO GRANDE		12	20	20	20	20	20	20
Ground Water	CARRIZO-WILCOX		37	729	729	729	729	729	729
Ground Water	CARRIZO-WILCOX		1,370	635	635	635	635	635	635
Ground Water	OTHER AQUIFER		879	4,224	4,224	4,224	4,224	4,224	4,224
Ground Water	OTHER AQUIFER		72	28	28	28	28	28	28
Total Supply (AF/yr)		**0**	**56,853**	**59,614**	**59,078**	**58,581**	**58,083**	**57,586**	**57,127**
Projected Supply Surplus/Deficit			**-36,292**	**-35,426**	**-32,615**	**-29,282**	**-29,780**	**-30,277**	**-30,736**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	12,918	$ 3,273,162.84	$ 253.38		2,152	4306	6459	8611	10765	12918
Conveyance System Conservation	24,944	$ 3,010,241.92	$ 120.68		10,394	20,781	21,826	22,866	23,905	24,944

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Jim Hogg County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		6,413	817	817	817	817	817	817

Current Water Supply	Source							
Ground Water	GULF COAST	4,799	735	735	735	735	735	735
Ground Water	GULF COAST	1,614	82	82	82	82	82	82
Total Supply (AF/yr)		**6,413**	**817**	**817**	**817**	**817**	**817**	**817**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			611,399	583,030	525,971	453,772	453,772	453,772	453,772
Current Water Supply	**Source**								
Surface Water	AMISTAD/FALCON		360,331	357,532	353,969	350,661	347,353	344,045	340,991
Surface Water	AMISTAD/FALCON		2,928	2,905	2,877	2,850	2,823	2,796	2,771
Surface Water	REUSE		166	4,288	4,288	4,288	4,288	4,288	4,288
Surface Water	REUSE		166	4,288	4,288	4,288	4,288	4,288	4,288
Surface Water	IRRIGATION LOCAL SUPPLY		79	79	79	79	79	79	79
Ground Water	GULF COAST		4,330	19,383	19,383	19,383	19,383	19,383	19,383
Ground Water	GULF COAST		185	1,020	1,020	1,020	1,020	1,020	1,020
Total Supply (AF/yr)		**0**	**368,185**	**389,495**	**385,904**	**382,569**	**379,234**	**375,899**	**372,820**
Projected Supply Surplus/Deficit			**-243,214**	**-193,535**	**-140,067**	**-71,203**	**-74,538**	**-77,873**	**-80,952**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	130,229	$ 32,997,424.02	$ 253.38		21,699	43,416	65,114	86,815	108,529	130,229
Conveyance System Conservation	118,959	$ 14,355,972.12	$ 120.68		49,566	99,132	104,089	109,045	114,002	118,959

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Cameron County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		377,925	367,404	347,771	325,144	325,144	325,144	325,144
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	214,002	212,340	210,224	208,259	206,295	204,330	202,516
Surface Water	AMISTAD/FALCON	10,300	10,220	10,118	10,023	9,929	9,834	9,747
Surface Water	REUSE	236	239	239	239	239	239	239
Surface Water	IRRIGATION LOCAL SUPPLY	2,610	2,610	2,610	2,610	2,610	2,610	2,610
Ground Water	GULF COAST	494	6,673	6,673	6,673	6,673	6,673	6,673
Total Supply (AF/yr)		**227,642**	**232,082**	**229,864**	**227,804**	**225,746**	**223,686**	**221,785**
Projected Supply Surplus/Deficit		**-150,283**	**-135,322**	**-117,907**	**-97,340**	**-99,398**	**-101,458**	**-103,359**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	61,958	$ 15,698,918.04	$ 253.38		10,324	20655	30979	41303	51634	61958
Conveyance System Conservation	65,535	$ 7,908,763.80	$ 120.68		27,306	54,613	57,343	60,074	62,805	65,535

WATER SUPPLY AND DEMAND ANALYSIS						
Irrigation:Willacy County-Other						
Year	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	18,890	20,251	21,051	21,051	21,051	21,051

Current Water Supply	Source	
Total Supply (AF/yr)		**0**
Projected Supply Surplus/Deficit		

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	1,520	$ 51,997.95	$ 253.38		205	467	753	1,008	1,263	1,520
Conveyance System Conservation	1,819	$ 74,117.94	$ 120.68		614	1,397	1,578	1,658	1,738	1,819

WATER SUPPLY AND DEMAND ANALYSIS						
Irrigation:Hidalgo County-Other						
Year	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	0	7,896	16,032	16,032	16,032	16,032

Current Water Supply	**Source**
Total Supply (AF/yr)	**0**
Projected Supply Surplus/Deficit	

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	5,483	$ 1,389,282.54	$ 253.38		0	2,182	2,705	3,623	4,550	5,483
Conveyance System Conservation	12,715	$ 660,360.96	$ 120.68		5,472	0	12,715	7,193	1,756	0

WATER SUPPLY AND DEMAND ANALYSIS										
Irrigation:Cameron County-Other										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand					47,343	58,946	121,875	63,456	63,456	63,456
Current Water Supply	**Source**									
Total Supply (AF/yr)		**0**								
Projected Supply Surplus/Deficit										
Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	26,171	$ 966,833.18	$ 253.38		3,816	8,339	16,444	17,618	21,913	26,171
Conveyance System Conservation	30,439	$ 1,217,990.27	$ 120.68		10,093	22,049	30,439	25,626	26,653	27,682

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County Water Irrigation District No. 3

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		9,752	7,815	5,823	4,193	4,193	4,193	4,193
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	3,760	3,935	3,899	3,864	3,830	3,796	3,765
Projected Supply Surplus/Deficit		-5,992	-3,880	-1,924	-329	-363	-397	-428

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	335	$ 63,648.62	$ 253.38		251	335	113	164	221	283
Conveyance System Conservation	764	$ 69,245.46	$ 120.68		574	764	180	206	232	259

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Bayview Irrigation District No. 11								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		17,478	15,836	14,006	12,402	12,402	12,402	12,402
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	6,526	6,653	6,590	6,531	6,472	6,413	6,358
Projected Supply Surplus/Deficit		-10,952	-9,183	-7,416	-5,871	-5,930	-5,989	-6,044

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	1,364	$ 345,505.10	$ 253.38		257	481	556	905	1,134	1,364
Conveyance System Conservation	1,442	$ 174,059.66	$ 120.68		679	1,272	1,029	1,316	1,379	1,442

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Valley Acres Irrigation District

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		15,150	15,187	15,233	15,278	15,278	15,278	15,278
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	10,373	10,576	10,475	10,381	10,287	10,193	10,106
Projected Supply Surplus/Deficit		**-4,777**	**-4,611**	**-4,758**	**-4,897**	**-4,991**	**-5,085**	**-5,172**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	3,128	$ 792,450.88	$ 253.38		276	760	1,522	2,060	2,591	3,128
Conveyance System Conservation	2,879	$ 347,408.53	$ 120.68		638	1,750	2,447	2,607	2,743	2,879

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Cameron County Irrigation District Cameron County No. 4

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		9,098	8,763	8,367	7,992	7,992	7,992	7,992
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	5,516	5,624	5,570	5,520	5,471	5,421	5,375
Projected Supply Surplus/Deficit		**-3,582**	**-3,139**	**-2,797**	**-2,472**	**-2,521**	**-2,571**	**-2,617**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	590	$ 149,600.74	$ 253.38		88	181	234	385	487	590
Conveyance System Conservation	625	$ 75,366.34	$ 120.68		232	480	433	560	592	625

WATER SUPPLY AND DEMAND ANALYSIS									
Irrigation: Cameron County Irrigation District Cameron County No. 3									
Year			**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand			74,898	69,722	63,795	58,419	58,419	58,419	58,419
Current Water Supply	**Source**								
Total Supply (AF/yr)		**0**	39,959	40,738	40,349	39,987	39,626	39,265	38,931
Projected Supply Surplus/Deficit			**-34,939**	**-28,984**	**-23,446**	**-18,432**	**-18,793**	**-19,154**	**-19,488**

Evaluation of Selected Water Management Strategies					Additional Supply by Decade					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	4,397	$ 1,114,031.02	$ 253.38		811	1,521	1,746	2,868	3,626	4,397
Conveyance System Conservation	4,651	$ 561,230.10	$ 120.68		2,144	4,021	3,232	4,171	4,411	4,651

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Cameron County Irrigation District No. 16

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		3,773	3,419	3,024	2,677	2,677	2,677	2,677
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	1,285	1,310	1,297	1,286	1,274	1,262	1,252
Projected Supply Surplus/Deficit		**-2,488**	**-2,109**	**-1,727**	**-1,391**	**-1,403**	**-1,415**	**-1,425**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	321	$ 81,460.09	$ 253.38		59	112	132	214	268	321
Conveyance System Conservation	340	$ 41,038.22	$ 120.68		156	296	244	311	326	340

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County Irrigation District No. 1

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		85,615	68,611	51,121	36,812	36,812	36,812	36,812
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	28,909	30,259	29,977	29,715	29,453	29,191	28,949
Projected Supply Surplus/Deficit		**-56,706**	**-38,352**	**-21,144**	**-7,097**	**-7,359**	**-7,621**	**-7,863**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	5,200	$ 1,317,621.72	$ 253.38		2,483	3,678	2,434	3,323	4,248	5,200
Conveyance System Conservation	8,397	$ 1,013,392.49	$ 120.68		5,672	8,397	3,891	4,174	4,463	4,750

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: United Irrigation District of Hiidalgo County								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		64,464	55,402	45,821	37,966	37,966	37,966	37,966
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	15,378	16,096	15,946	15,807	15,668	15,528	15,400
Projected Supply Surplus/Deficit		**-49,086**	**-39,306**	**-29,875**	**-22,159**	**-22,298**	**-22,438**	**-22,566**

Evaluation of Selected Water Management Strategies | **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	14,924	$ 3,781,438.59	$ 253.38		2,545	5,196	7,600	10,068	12,508	14,924
Conveyance System Conservation	13,632	$ 1,645,169.94	$ 120.68		5,813	11,865	12,149	12,647	13,139	13,632

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Hidalgo County Water Control and Improvement District No. 18								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		5,505	4,731	3,913	3,242	3,242	3,242	3,242
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	1,864	1,951	1,932	1,916	1,899	1,882	1,866
Projected Supply Surplus/Deficit		**-3,641**	**-2,780**	**-1,981**	**-1,326**	**-1,343**	**-1,360**	**-1,376**

Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	910	$ 230,579.61	$ 253.38		180	345	455	606	758	910
Conveyance System Conservation	831	$ 100,317.02	$ 120.68		411	787	727	762	796	831

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County Municipal Utility District No. 1

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		6,011	5,166	4,273	3,540	3,540	3,540	3,540
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	2,080	2,178	2,157	2,138	2,120	2,101	2,083
Projected Supply Surplus/Deficit		**-3,931**	**-2,988**	**-2,116**	**-1,402**	**-1,420**	**-1,439**	**-1,457**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	964	$ 244,152.97	$ 253.38		193	368	481	641	802	964
Conveyance System Conservation	880	$ 106,222.31	$ 120.68		442	840	769	805	843	880

WATER SUPPLY AND DEMAND ANALYSIS							
Irrigation: Hidalgo County Irrigation District No. 16							
Year	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	30,749	26,426	21,856	18,109	18,109	18,109	18,109
Current Water Supply / **Source**							
Total Supply (AF/yr) **0**	15,255	15,968	15,819	15,681	15,542	15,404	15,277
Projected Supply Surplus/Deficit	**-15,494**	**-10,458**	**-6,037**	**-2,428**	**-2,567**	**-2,705**	**-2,832**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	1,873	$ 474,565.01	$ 253.38		677	1,050	833	1,159	1,508	1,873
Conveyance System Conservation	2,398	$ 289,342.15	$ 120.68		1,547	2,398	1,331	1,456	1,584	1,711

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County Irrigation District No. 13

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		4,857	2,498	1,005	410	410	410	410
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	460	481	477	473	469	464	461
Projected Supply Surplus/Deficit		**-4,397**	**-2,017**	**-528**	**63**	**59**	**54**	**51**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	131	$ 33,087.44	$ 253.38		131	92	0	0	0	0
Conveyance System Conservation	298	$ 35,996.93	$ 120.68		298	210	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS							
Irrigation: Hidalgo County Irrigation District No. 5							
Year	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	14,135	13,464	12,643	11,796	11,796	11,796	11,796
Current Water Supply **Source**							
Total Supply (AF/yr) **0**	6,863	7,184	7,117	7,055	6,992	6,930	6,873
Projected Supply Surplus/Deficit	**-7,272**	**-6,280**	**-5,526**	**-4,741**	**-4,804**	**-4,866**	**-4,923**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	1,748	$ 442,893.83	$ 253.38		238	536	844	1,140	1,442	1,748
Conveyance System Conservation	1,597	$ 192,687.41	$ 120.68		544	1,224	1,349	1,432	1,514	1,597

WATER SUPPLY AND DEMAND ANALYSIS
Irrigation: Engleman Irrigation District

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		19,325	17,874	16,151	14,442	14,442	14,442	14,442
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	3,548	3,714	3,679	3,647	3,615	3,583	3,553
Projected Supply Surplus/Deficit		**-15,777**	**-14,160**	**-12,472**	**-10,795**	**-10,827**	**-10,859**	**-10,889**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	7,201	$ 1,824,695.77	$ 253.38		917	2,169	3,702	4,889	6,054	7,201
Conveyance System Conservation	6,578	$ 793,860.47	$ 120.68		2,094	4,953	5,919	6,141	6,359	6,578

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Santa Cruz Irrigation District No. 15								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		82,934	79,967	76,296	72,449	72,449	72,449	72,449
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	27,674	28,966	28,696	28,445	28,195	27,944	27,712
Projected Supply Surplus/Deficit		**-55,260**	**-51,001**	**-47,600**	**-44,004**	**-44,254**	**-44,505**	**-44,737**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	29,587	$ 7,496,686.09	$ 253.38		3,302	8,279	15,092	19,982	24,810	29,587
Conveyance System Conservation	27,026	$ 3,261,542.48	$ 120.68		7,542	18,904	24,126	25,099	26,061	27,026

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Hidalgo County Irrigation District No. 6								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		42,068	36,154	29,901	24,775	24,775	24,775	24,775
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	16,098	58,561	58,015	57,508	57,001	56,494	56,026
Projected Supply Surplus/Deficit		-25,970	22,407	28,114	32,733	32,226	31,719	31,251

Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Hidalgo County Irrigation District No. 2								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		103,008	82,550	61,506	44,290	44,290	44,290	44,290
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	55,948	58,561	58,015	57,508	57,001	56,494	56,026
Projected Supply Surplus/Deficit		**-47,060**	**-23,989**	**-3,491**	**13,218**	**12,711**	**12,204**	**11,736**

Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	1,553	$ 393,522.35	$ 253.38		1,553	607	0	0	0	0
Conveyance System Conservation	3,548	$ 428,126.11	$ 120.68		3,548	1,386	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS							
Irrigation: Donna Irrigation District No. 2							
Year	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	80,953	77,425	73,274	69,379	69,379	69,379	69,379
Current Water Supply / **Source**							
Total Supply (AF/yr) **0**	40,824	42,731	42,332	41,962	41,592	41,223	40,881
Projected Supply Surplus/Deficit	**-40,129**	**-34,694**	**-30,942**	**-27,417**	**-27,787**	**-28,156**	**-28,498**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	18,847	$ 4,775,478.02	$ 253.38		2,246	5,382	9,403	12,547	15,696	18,847
Conveyance System Conservation	17,216	$ 2,077,641.27	$ 120.68		5,131	12,289	15,032	15,760	16,488	17,216

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Adams Garden Irrigation District No. 19								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		18,105	18,624	19,281	19,955	19,955	19,955	19,955
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	7,338	7,481	7,409	7,343	7,277	7,210	7,149
Projected Supply Surplus/Deficit		**-10,767**	**-11,143**	**-11,872**	**-12,612**	**-12,678**	**-12,745**	**-12,806**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	2,889	$ 732,054.66	$ 253.38		312	770	1,195	1,935	2,413	2,889
Conveyance System Conservation	3,056	$ 368,796.83	$ 120.68		824	2,036	2,212	2,814	2,935	3,056

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo County Improvement District No. 19

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		4,053	2,138	841	281	281	281	281
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	6,858	7,179	7,112	7,050	6,987	6,925	6,868
Projected Supply Surplus/Deficit		**2,805**	**5,041**	**6,271**	**6,769**	**6,706**	**6,644**	**6,587**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation: Delta Lake Irrigation District								
Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		176,099	174,911	173,395	171,746	171,746	171,746	171,746
Current Water Supply	**Source**							
Total Supply (AF/yr)	0	56,798	59,451	58,897	58,382	57,867	57,352	56,877
Projected Supply Surplus/Deficit		-119,301	-115,460	-114,498	-113,364	-113,879	-114,394	-114,869

Evaluation of Selected Water Management Strategies					Additional Supply by Decade					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	49,590	$ 12,565,184.75	$ 253.38		5,357	13,488	25,313	33,507	41,593	49,590
Conveyance System Conservation	50,828	$ 6,133,908.92	$ 120.68		7,540	17,742	28,761	36,217	43,566	50,828

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Hidalgo and Cameron Counties Irrigation District No. 9

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		144,343	125,925	105,301	86,365	86,365	86,365	86,365
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	82,449	86,299	85,495	84,748	84,001	83,253	82,564
Projected Supply Surplus/Deficit		**-61,894**	**-39,626**	**-19,806**	**-1,617**	**-2,364**	**-3,112**	**-3,801**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	3,358	$ 850,973.48	$ 253.38		2,507	3,358	539	1,039	1,689	2,448
Conveyance System Conservation	7,687	$ 927,692.12	$ 120.68		5,743	7,687	862	1,308	1,778	2,241

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Cameron County Irrigation District No. 6

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		52,142	47,244	41,785	36,998	36,998	36,998	36,998
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	27,950	28,495	28,223	27,970	27,718	27,465	27,231
Projected Supply Surplus/Deficit		**-24,192**	**-18,749**	**-13,562**	**-9,028**	**-9,280**	**-9,533**	**-9,767**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	2,204	$ 558,330.30	$ 253.38		524	880	855	1,416	1,805	2,204
Conveyance System Conservation	2,331	$ 281,277.42	$ 120.68		1,387	2,326	1,583	2,060	2,195	2,331

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Brownsville Irrigation District

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		50,875	40,186	29,798	22,164	22,164	22,164	22,164
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	**10,008**	**10,203**	**10,105**	**10,015**	**9,924**	**9,834**	**9,750**
Projected Supply Surplus/Deficit		**-40,867**	**-29,983**	**-19,693**	**-12,149**	**-12,240**	**-12,330**	**-12,414**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	2,801	$ 709,645.99	$ 253.38		838	1,277	1,151	1,868	2,334	2,801
Conveyance System Conservation	3,378	$ 407,612.70	$ 120.68		2,218	3,378	2,130	2,717	2,839	2,962

WATER SUPPLY AND DEMAND ANALYSIS								
Irrigation:Harlingen Irrigation District No. 1								
Year		**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		88,128	84,479	80,175	76,127	76,127	76,127	76,127
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	**29,031**	**29,598**	**29,315**	**29,052**	**28,790**	**28,527**	**28,284**
Projected Supply Surplus/Deficit		**-59,097**	**-54,881**	**-50,860**	**-47,075**	**-47,337**	**-47,600**	**-47,843**

Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
On-Farm Water Conservation	10,794	$ 2,734,943.86	$ 253.38		1,535	3,299	4,459	7,224	9,012	10,794
Conveyance System Conservation	11,417	$ 1,377,818.75	$ 120.68		4,059	8,723	8,255	10,507	10,962	11,417

WATER SUPPLY AND DEMAND ANALYSIS

Irrigation: Cameron County Irrigation District No. 2

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		152,017	137,738	121,821	107,867	107,867	107,867	107,867
Current Water Supply	**Source**							
Total Supply (AF/yr)	**0**	**64,121**	**65,372**	**64,747**	**64,167**	**63,587**	**63,007**	**62,472**
Projected Supply Surplus/Deficit		**-87,896**	**-72,366**	**-57,074**	**-43,700**	**-44,280**	**-44,860**	**-45,395**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
On-Farm Water Conservation	10,242	$ 2,595,004.00	$ 253.38		2,024	3,702	4,140	6,757	8,493	10,242
Conveyance System Conservation	10,833	$ 1,307,319.40	$ 120.68		5,353	9,789	7,663	9,828	10,331	10,833

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Summary

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	3869	4186	4341	4433	4523	4612	4692

Current Water Supply	Source							
Total Supply (AF/yr)		**17,842**	**4,941**	**5,088**	**5,169**	**5,249**	**5,329**	**5,396**
Projected Supply Surplus/Deficit		**13,973**	**755**	**747**	**736**	**726**	**717**	**704**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Zapata County

Year	Source	2000	2010	2020	2030	2040	2050	2060
Total Water Demand		27	24	23	23	23	23	23
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	135	134	132	131	130	129	127
Groundwater	OTHER AQUIFER	1,000	0	0	0	0	0	0
Total Supply (AF/yr)		**1,135**	**134**	**132**	**131**	**130**	**129**	**127**
Projected Supply Surplus/Deficit		**1,108**	**110**	**109**	**108**	**107**	**106**	**104**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Willacy County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		6	6	6	6	6	6	6

Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	0	0	0	0	0	0	0
Ground Water	GULF COAST	30	6	6	6	6	6	6
Total Supply (AF/yr)		**30**	**6**	**6**	**6**	**6**	**6**	**6**
Projected Supply Surplus/Deficit		**24**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Webb County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1262	1204	1192	1189	1187	1185	1180
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	228	226	224	222	220	218	216
Surface Water	AMISTAD/FALCON	313	311	308	305	302	299	297
Surface Water	AMISTAD/FALCON	111	110	109	108	107	106	104
Ground Water	CARRIZO-WILCOX	6,046	360	357	356	356	355	354
Ground Water	CARRIZO-WILCOX	3,122	158	156	156	155	155	154
Ground Water	GULF COAST	120	126	124	124	124	124	123
Ground Water	GULF COAST	518	96	95	95	95	95	94
Ground Water	GULF COAST	103	55	54	54	54	54	54
Ground Water	OTHER AQUIFER	9	60	60	59	59	59	59
Ground Water	OTHER AQUIFER	1	46	46	46	45	45	45
Ground Water	OTHER AQUIFER	10	26	26	26	26	26	26
Total Supply (AF/yr)		**10,581**	**1,574**	**1,559**	**1,551**	**1,543**	**1,536**	**1,526**
Projected Supply Surplus/Deficit		**9,319**	**370**	**367**	**362**	**356**	**351**	**346**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Starr County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1203	1315	1355	1373	1390	1407	1426
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	12	11	11	11	11	11	11
Surface Water	AMISTAD/FALCON	9	9	9.11787	8.70996	8.71814	8.71727	8.30135
Ground Water	GULF COAST	775	700.7	721.63	730.73	739.83	748.93	759.85
Ground Water	GULF COAST	502	495.95	511.42	518.7	525.07	531.44	537.81
Ground Water	OTHER AQUIFER	229	69.3	71.37	72.27	73.17	74.07	75.15
Ground Water	OTHER AQUIFER	771	49.05	50.58	51.3	51.93	52.56	53.19
Total Supply (AF/yr)		**2298**	**1335**	**1375.12**	**1392.71**	**1409.72**	**1426.72**	**1445.3**
Projected Supply Surplus/Deficit		**1095**	**20**	**20.1179**	**19.71**	**19.7181**	**19.7173**	**19.3014**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Maverick County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		140	156	162	166	169	172	175
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	35	35	35	34	34	34	33
Ground Water	CARRIZO-WILCOX	61	55	57	59	60	61	62
Ground Water	CARRIZO-WILCOX	55	24	26	26	27	27	28
Ground Water	OTHER AQUIFER	387	53	55	56	57	58	59
Ground Water	OTHER AQUIFER	55	24	25	25	25	26	26
Total Supply (AF/yr)		**593**	**191**	**197**	**200**	**203**	**206**	**208**
Projected Supply Surplus/Deficit		**453**	**35**	**35**	**34**	**34**	**34**	**33**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Jim Hogg County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		27	33	36	37	38	39	40
Current Water Supply	**Source**							
Ground Water	GULF COAST	1,140	37	37	37	37	37	37
Ground Water	GULF COAST	160	4	4	4	4	4	4
Total Supply (AF/yr)		**1,300**	**41**	**41**	**41**	**41**	**41**	**41**
Projected Supply Surplus/Deficit		**1,273**	**8**	**5**	**4**	**3**	**2**	**1**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Hidalgo County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1196	1442	1561	1633	1704	1774	1836
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	174	183	182	181	179	177	175
Surface Water	AMISTAD/FALCON	33	23	22	21	21	21	20
Ground Water	GULF COAST	928	1,291	1,398	1,462	1,526	1,589	1,644
Ground Water	GULF COAST	272	151	163	171	178	185	192
Total Supply (AF/yr)		**1,407**	**1,648**	**1,765**	**1,835**	**1,904**	**1,972**	**2,031**
Projected Supply Surplus/Deficit		**211**	**206**	**204**	**202**	**200**	**198**	**195**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Mining: Cameron County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		8	6	6	6	6	6	6
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	4	4	4	4	4	4	4
Ground Water	GULF COAST	494	8	8	8	8	8	8
Total Supply (AF/yr)		**498**	**12**	**12**	**12**	**12**	**12**	**12**
Projected Supply Surplus/Deficit		**490**	**6**	**6**	**6**	**6**	**6**	**6**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Summary

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	6780	13463	16864	19716	23192	27430	32598

Current Water Supply

	2000	2010	2020	2030	2040	2050	2060
Total Supply (AF/yr)	**21,883**	**16,216**	**16,216**	**16,216**	**16,216**	**16,216**	**16,216**
Projected Supply Surplus/Deficit	**0**	**2,753**	**-649**	**-3,501**	**-6,977**	**-11,215**	**-16,383**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 432.71		0	0	0	0	27	144
Advanced Water Conservation Measures	0	$ -	$ 56.31		0	0	0	0	0	0
Non-Potable Water Re-use	10,800	$ 5,038,036.03	$ 466.48		0	1,000	2,000	4,000	7,250	10,800
Potable Water Re-use	0	$ -	$ 716.71		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 584.94		0	0	0	0	0	0
Acqusition of Water Rights:					0	0	0	0	0	0
Purchase	5,183	$ 4,053,280.94	$ 782.03		0	980	2,374	3,291	3,847	5,183
Urbanization	0	$ -	$ 641.62		0	0	0	0	0	0
Contract		$ -	$ 533.68		0	0	0	0	0	0
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 775.06		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,322.96		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Zapata County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0

Current Water Supply

	2000	2010	2020	2030	2040	2050	2060
Total Supply (AF/yr)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 432.71		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ 56.31		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 466.48		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 716.71		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 584.94		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 782.03		0	0	0	0	0	0
Urbanization	0	$ -	$ 641.62		0	0	0	0	0	0
Contract		$ -	$ 533.68							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 775.06		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,322.96		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Willacy County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0
Current Water Supply							
Total Supply (AF/yr)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 432.71		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ 56.31		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 466.48		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 716.71		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 584.94		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 782.03		0	0	0	0	0	0
Urbanization	0	$ -	$ 641.62		0	0	0	0	0	0
Contract		$ -	$ 533.68							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 775.06		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,322.96		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Webb County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			1795	1492	1190	1391	1636	1935	2300
Current Water Supply	**Water Right #**	**Source**							
Surface Water	2727	AMISTAD/FALCON	2,195	1,645	1,645	1,645	1,645	1,645	1,645
Total Supply (AF/yr)			**2,195**	**1,645**	**1,645**	**1,645**	**1,645**	**1,645**	**1,645**
Projected Supply Surplus/Deficit			**400**	**153**	**455**	**254**	**9**	**-291**	**-656**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	256	$ 55,029.76	$ 214.96		0	0	0	0	91	256
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	400	$ 60,180.00	$ 150.45		0	0	0	0	200	400
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Starr County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0
Current Water Supply							
Total Supply (AF/yr)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Maverick County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0
Current Water Supply							
Total Supply (AF/yr)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Jim Hogg County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0
Current Water Supply							
Total Supply (AF/yr)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

Steam Electric: Hidalgo County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		3487	10355	14151	16545	19462	23018	27354
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	6,243	5,941	5,941	5,941	5,941	5,941	5,941
Surface Water	REUSE	9,856	5,040	5,040	5,040	5,040	5,040	5,040
Ground Water	GULF COAST	1,190	1,190	1,190	1,190	1,190	1,190	1,190
Total Supply (AF/yr)		**17,289**	**12,171**	**12,171**	**12,171**	**12,171**	**12,171**	**12,171**
Projected Supply Surplus/Deficit		**13,802**	**1,816**	**-1,980**	**-4,374**	**-7,291**	**-10,847**	**-15,183**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	10,000	$ 1,504,500.00	$ 150.45		0	1000	2000	4000	7000	10000
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	5,183	$ 2,229,363.79	$ 430.13		0	980	2374	3291	3847	5183
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Steam Electric: Cameron County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			1498	1616	1523	1780	2094	2477	2944
Current Water Supply	**Water Right #**	**Source**							
Surface Water	841	AMISTAD/FALCON	2400	2400	2400	2400	2400	2400	2400
Total Supply (AF/yr)	**2400**		**2400**	**2400**	**2400**	**2400**	**2400**	**2400**	**2400**
Projected Supply Surplus/Deficit			**902**	**784**	**877**	**620**	**306**	**-77**	**-544**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	144	$ 30,954.24	$ 214.96		0	0	0	0	27	144
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	400	$ 60,180.00	$ 150.45		0	0	0	0	50	400
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock Summary

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		5,817	5,817	5,817	5,817	5,817	5,817	5,817
Current Water Supply	**Source**							
Total Supply (AF/yr)		**24,588**	**5,817**	**5,817**	**5,817**	**5,817**	**5,817**	**5,817**
Projected Supply Surplus/Deficit		**18,771**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Zapata County

Year	Source	2000	2010	2020	2030	2040	2050	2060
Total Water Demand		474	474	474	474	474	474	474
Current Water Supply	**Source**							
Surface Water	LIVESTOCK LOCAL SUPPLY	446	0	0	0	0	0	0
Ground Water	OTHER AQUIFER	80	474	474	474	474	474	474
Total Supply (AF/yr)		**526**	**474**	**474**	**474**	**474**	**474**	**474**
Projected Supply Surplus/Deficit		**52**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Willacy County

Year	Source	2000	2010	2020	2030	2040	2050	2060
Total Water Demand		151	151	151	151	151	151	151
Current Water Supply	**Source**							
Ground Water	Gulf Coast	240	151	151	151	151	151	151
Total Supply (AF/yr)		**240**	**151**	**151**	**151**	**151**	**151**	**151**
Projected Supply Surplus/Deficit		**89**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Webb County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1,513	1,513	1,513	1,513	1,513	1,513	1,513

Current Water Supply	Source							
Surface Water	LIVESTOCK LOCAL SUPPLY	313	0	0	0	0	0	0
Ground Water	GULF COAST	37	153	153	153	153	153	153
Ground Water	GULF COAST	159	21	21	21	21	21	21
Ground Water	GULF COAST	37	174	174	174	174	174	174
Ground Water	CARRIZO-WILCOX	11,170	440	440	440	440	440	440
Ground Water	CARRIZO-WILCOX	5,768	499	499	499	499	499	499
Ground Water	OTHER AQUIFER	36	73	73	73	73	73	73
Ground Water	OTHER AQUIFER	5	70	70	70	70	70	70
Ground Water	OTHER AQUIFER	39	83	83	83	83	83	83
Total Supply (AF/yr)		**17,564**	**1,513**	**1,513**	**1,513**	**1,513**	**1,513**	**1,513**
Projected Supply Surplus/Deficit		**16,051**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Starr County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1,117	1,117	1,117	1,117	1,117	1,117	1,117
Current Water Supply	**Source**							
Surface Water	LIVESTOCK LOCAL SUPPLY	679	0	0	0	0	0	0
Surface Water	LIVESTOCK LOCAL SUPPLY	37	0	0	0	0	0	0
Ground Water	GULF COAST	399	224	224	224	224	224	224
Ground Water	GULF COAST	259	793	793	793	793	793	793
Ground Water	OTHER AQUIFER	2	22	22	22	22	22	22
Ground Water	OTHER AQUIFER	8	78	78	78	78	78	78
Total Supply (AF/yr)		**1,384**	**1,117**	**1,117**	**1,117**	**1,117**	**1,117**	**1,117**
Projected Supply Surplus/Deficit		**267**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Maverick County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		260	260	260	260	260	260	260
Current Water Supply	**Source**							
Surface Water	LIVESTOCK LOCAL SUPPLY	761	0	0	0	0	0	0
Surface Water	LIVESTOCK LOCAL SUPPLY	436	0	0	0	0	0	0
Ground Water	CARRIZO-WILCOX	95	1	1	1	1	1	1
Ground Water	CARRIZO-WILCOX	87	80	80	80	80	80	80
Ground Water	OTHER AQUIFER	141	103	103	103	103	103	103
Ground Water	OTHER AQUIFER	19	76	76	76	76	76	76
Total Supply (AF/yr)		**1,539**	**260**	**260**	**260**	**260**	**260**	**260**
Projected Supply Surplus/Deficit		**1,279**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	104	$ 44,733.52	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Jim Hogg County

Year	Source	2000	2010	2020	2030	2040	2050	2060
Total Water Demand		518	518	518	518	518	518	518
Current Water Supply	**Source**							
Surface Water	LIVESTOCK LOCAL SUPPLY	120	0	0	0	0	0	0
Surface Water	LIVESTOCK LOCAL SUPPLY	139	0	0	0	0	0	0
Ground Water	GULF COAST	636	383	383	383	383	383	383
Ground Water	GULF COAST	89	135	135	135	135	135	135
Total Supply (AF/yr)		**984**	**518**	**518**	**518**	**518**	**518**	**518**
Projected Supply Surplus/Deficit		**466**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

Livestock: Hidalgo County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		681	681	681	681	681	681	681
Current Water Supply	**Supply**							
Surface Water	LIVESTOCK LOCAL SUPPLY	725	0	0	0	0	0	0
Surface Water	LIVESTOCK LOCAL SUPPLY	38	0	0	0	0	0	0
Ground Water	GULF COAST	71	647	647	647	647	647	647
Ground Water	GULF COAST	21	34	34	34	34	34	34
Total Supply (AF/yr)		**855**	**681**	**681**	**681**	**681**	**681**	**681**
Projected Supply Surplus/Deficit		**174**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Livestock: Cameron County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		1,103	1,103	1,103	1,103	1,103	1,103	1,103
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	73	0	0	0	0	0	0
Surface Water	LIVESTOCK LOCAL SUPPLY	826	0	0	0	0	0	0
Ground Water	GULF COAST	597	1103	1103	1103	1103	1103	1103
Total Supply (AF/yr)		**1496**	**1103**	**1103**	**1103**	**1103**	**1103**	**1103**
Projected Supply Surplus/Deficit		**393**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Summary

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	6,208	7,509	8,274	8,966	9,654	10,256	11,059

Current Water Supply	**Source**							
Total Supply (AF/yr)		**7,517**	**6,550**	**6,553**	**6,556**	**6,559**	**6,561**	**6,564**
Projected Supply Surplus/Deficit		**0**	**-959**	**-1,721**	**-2,410**	**-3,095**	**-3,695**	**-4,495**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		1,000	1,000	1,000	1,000	1,100	1,200
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	3,020	$ 454,359.00	$ 150.45		811	1,245	1,638	2,027	2,464	3,020
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	304	$ 130,759.52	$ 430.13		110	110	110	110	165	304
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Zapata County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0

Current Water Supply	Source							
Total Supply (AF/yr)		0	0	0	0	0	0	0
Projected Supply Surplus/Deficit		0	0	0	0	0	0	0

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Willacy County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		25	25	25	25	25	25	25
Current Water Supply	**Supple**							
Surface Water	AMISTAD/FALCON	0	0	0	0	0	0	0
Surface Water*	OTHER LOCAL SUPPLY	0	0	0	0	0	0	0
Total Supply (AF/yr)		**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit		**-25**	**-25**	**-25**	**-25**	**-25**	**-25**	**-25**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	15	$ 2,256.75	$ 150.45		15	15	15	15	15	15
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	10	$ 4,301.30	$ 430.13		10	10	10	10	10	10
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Webb County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		23	28	31	34	37	39	42
Current Water Supply	**Supply**							
Surface Water	AMISTAD/FALCON	43.4145	0	0	0	0	0	0
Ground Water	OTHER AQUIFER	4	2.74393	3.04287	3.33693	3.63274	3.82508	4.11875
Ground Water	OTHER AQUIFER	1	4.11165	4.55012	4.99202	5.43113	5.72607	6.16722
Ground Water	OTHER AQUIFER	5	21.1444	23.407	25.6711	27.9361	29.4488	31.714
Total Supply (AF/yr)		**53.4145**	**28**	**31**	**34**	**37**	**39**	**42**
Projected Supply Surplus/Deficit		**30**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Starr County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0

Current Water Supply	Source							
Total Supply (AF/yr)		**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Maverick County

Year			2000	2010	2020	2030	2040	2050	2060
Total Water Demand			56	64	69	73	77	80	85
Current Water Supply	**Water Right #'s**	**Source**							
Surface Water	116	AMISTAD/FALCON	76	114	114	114	114	114	114
Total Supply (AF/yr)			**76**	**114**	**114**	**114**	**114**	**114**	**114**
Projected Supply Surplus/Deficit			**20**	**50**	**45**	**41**	**37**	**34**	**29**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Jim Hogg County

Year	2000	2010	2020	2030	2040	2050	2060
Total Water Demand	0	0	0	0	0	0	0

Current Water Supply	**Source**							
Total Supply (AF/yr)		**0**	**0**	**0**	**0**	**0**	**0**	**0**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Hidalgo County

Year		2000	2010	2020	2030	2040	2050	2060
Total Water Demand		2,674	3,236	3,559	3,851	4,143	4,403	4,742
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	3,718	3,240	3,240	3,240	3,240	3,240	3,240
Ground Water	GULF COAST	60	908	908	908	908	908	908
Ground Water	GULF COAST	17	0	0	0	0	0	0
Total Supply (AF/yr)		**3,795**	**4,148**	**4,148**	**4,148**	**4,148**	**4,148**	**4,148**
Projected Supply Surplus/Deficit		**1,121**	**912**	**589**	**297**	**5**	**-255**	**-594**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	200	$ 42,992.00	$ 214.96		0	0	0	0	100	200
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	200	$ 30,090.00	$ 150.45		0	0	0	0	100	200
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	194	$ 83,445.22	$ 430.13		0	0	0	0	55	194
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
					912	589	297	5	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Manufacturing: Cameron County

Year	Source	2000	2010	2020	2030	2040	2050	2060
Total Water Demand		3,430	4,156	4,590	4,983	5,372	5,709	6,165
Current Water Supply	**Source**							
Surface Water	AMISTAD/FALCON	1,354	20	20	20	20	20	20
Surface Water	INDIRECT REUSE	2,239	2,240	2,240	2,240	2,240	2,240	2,240
Total Supply (AF/yr)		**3,593**	**2,260**	**2,260**	**2,260**	**2,260**	**2,260**	**2,260**
Projected Supply Surplus/Deficit		**163**	**-1,896**	**-2,330**	**-2,723**	**-3,112**	**-3,449**	**-3,905**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	1,000	$ 214,960.00	$ 214.96		1,000	1000	1000	1000	1000	1000
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	2,805	$ 422,012.25	$ 150.45		796	1230	1623	2012	2349	2805
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	100	$ 43,013.00	$ 430.13		100	100	100	100	100	100
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13							
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
					0	0	0	0	0	0

DBWUGI	wug_name	wug_rwpg	wug_basi	wug_county	city_id	PCS_2010	PCS_2020	PCS_2030	PCS_2040	PCS_2050	PCS_2060	CNWD_2010	CNWD_2020	CNWD_2030	CNWD_204	CNWD_20	CNWD_2060
2544	BROWNSVILLE	M	N-RG	CAMERON	0080	966.94	1869.22	3027.98	3801.12	4657.38	5170.53	44963	53688	62505	71704	80854	89888
2545	BROWNSVILLE	M	RG	CAMERON	0080	7.5	14.51	23.5	29.49	36.14	40.12	349	417	485	556	627	696
2546	COMBES	M	N-RG	CAMERON	0690	17.3	36.85	52.24	70.23	84.79	93.5	208	229	256	281	309	341
2587	COUNTY-OTHER	M	N-RG	CAMERON	0757	252.08	462.12	653.62	875.23	1046.65	1140.3	6957	7798	8693	9555	10466	11403
2588	COUNTY-OTHER	M	RG	CAMERON	0757	0.46	0.84	1.19	1.59	1.89	2.07	13	14	16	17	19	21
3759	EAST RIO HONDO WSC	M	N-RG	CAMERON	4099	111.48	236.75	334.25	491.25	574	652.71	2408	3107	3862	4555	5323	6052
3761	EL JARDIN	M	N-RG	CAMERON	4103	60.48	120.48	181.26	233	290.87	325.75	1899	2319	2755	3198	3636	4072
3762	EL JARDIN	M	RG	CAMERON	4103	0.34	0.68	1.03	1.32	1.64	1.84	11	13	16	18	20	23
2553	HARLINGEN	M	N-RG	CAMERON	0265	299.32	600.43	970.87	1300.37	1555.37	1694.84	11795	13306	14814	16364	17998	19662
3754	INDIAN LAKE	M	N-RG	CAMERON	1026	3.13	6.79	10.47	13.56	17.04	19.06	49	57	66	76	85	95
2622	IRRIGATION	M	N-RG	CAMERON	1004							352707	333861	312137	312137	312137	312137
2623	IRRIGATION	M	RG	CAMERON	1004							14697	13910	13007	13007	13007	13007
2556	LA FERIA	M	N-RG	CAMERON	0333	53.46	99.78	146.73	187	231.77	259.52	855	1031	1214	1403	1587	1777
3764	LAGUNA MADRE WD	M	N-RG	CAMERON	4224	34.61	76.67	102.26	149.06	178.82	207.13	2310	3386	4516	5622	6744	7812
2560	LAGUNA VISTA	M	N-RG	CAMERON	0788	12.18	27.41	40.44	51.67	64.16	71.94	329	399	476	554	633	713
2633	LIVESTOCK	M	N-RG	CAMERON	1005							1048	1048	1048	1048	1048	1048
2634	LIVESTOCK	M	RG	CAMERON	1005							55	55	55	55	55	55
2562	LOS FRESNOS	M	N-RG	CAMERON	0369	29.79	59.87	100.75	136.81	160.28	182.61	767	1008	1247	1490	1745	1988
3755	LOS INDIOS	M	N-RG	CAMERON	1040	7.94	15.26	24.61	30.78	37.61	41.68	230	271	311	354	396	439
2602	MANUFACTURING	M	N-RG	CAMERON	1001							4156	4590	4983	5372	5709	6165
3765	MILITARY HIGHWAY WSC	M	N-RG	CAMERON	4255	63.16	124.22	203.71	258.03	318.32	355.21	1465	1755	2037	2344	2645	2951
3766	MILITARY HIGHWAY WSC	M	RG	CAMERON	4255	0.91	1.78	2.92	3.7	4.56	5.08	21	25	29	34	38	42
2609	MINING	M	N-RG	CAMERON	1003							6	6	6	6	6	6
3771	OLMITO WSC	M	N-RG	CAMERON	4292	40.67	80	118.68	164.07	194.64	223.71	952	1314	1691	2060	2444	2809
2567	PALM VALLEY	M	N-RG	CAMERON	0793	7.85	13.55	20.02	27.26	31.1	32.92	412	407	400	393	389	387
3772	PALM VALLEY ESTATES UD	M	N-RG	CAMERON	4295	1.54	3.48	5.51	8.01	9.28	10.49	85	108	132	155	180	203
2570	PORT ISABEL	M	N-RG	CAMERON	0477	23.67	44.87	69.21	96.59	111.15	117.93	2645	2846	3052	3254	3470	3681
2571	PRIMERA	M	N-RG	CAMERON	0735	23.18	42.51	67.36	84.49	103.39	115.2	609	732	856	989	1121	1255
2573	RANCHO VIEJO	M	N-RG	CAMERON	0943	11.94	28.45	41.43	56.61	66.61	76.12	320	311	305	297	295	292
2576	RIO HONDO	M	N-RG	CAMERON	0503	11.75	20.28	29.99	40.84	46.61	49.33	429	459	490	520	556	593
2578	SAN BENITO	M	N-RG	CAMERON	0532	120.63	239.93	385.33	513.33	611.29	663.79	4916	5484	6050	6630	7241	7863
2581	SANTA ROSA	M	N-RG	CAMERON	0541	19.45	41.82	59.72	80.72	97.86	108.25	331	376	429	478	531	588
2583	SOUTH PADRE ISLAND	M	N-RG	CAMERON	0805	21.53	40.61	60.14	77.05	95.86	107.64	2504	3136	3789	4443	5095	5722
2606	STEAM ELECTRIC POWER	M	N-RG	CAMERON	1002							1616	1523	1780	2094	2477	2944
3775	VALLEY MUD #2	M	N-RG	CAMERON	4369	3.58	7.16	10.75	14.33	16.72	16.72	734	731	727	724	721	721
3776	VALLEY MUD #2	M	RG	CAMERON	4369	0.6	1.21	1.81	2.42	2.82	2.82	124	123	123	122	122	122
2542	ALAMO	M	N-RG	HIDALGO	0003	93.71	220.39	364.57	502.72	609.36	718.75	2319	3022	3808	4675	5667	6684
2543	ALTON	M	N-RG	HIDALGO	0675	55.3	121.64	192.19	256.59	333.96	387.03	3346	4153	5061	6056	7135	8268
2589	COUNTY-OTHER	M	N-RG	HIDALGO	0757	424.61	922.64	1493.86	2048.57	2491.34	2945.55	9341	12340	15686	19368	23554	27849
2590	COUNTY-OTHER	M	RG	HIDALGO	0757	24.77	54.7	89.48	123.54	150.96	179.11	545	732	940	1168	1427	1693
2547	DONNA	M	N-RG	HIDALGO	0168	75.08	149.61	242.87	329.3	401.53	447.47	2461	2755	3073	3431	3843	4293
2549	EDCOUCH	M	N-RG	HIDALGO	0178	21.16	43.22	65.3	85.86	103.32	114.94	540	599	666	743	831	927
2550	EDINBURG	M	N-RG	HIDALGO	0182	362.88	751.56	1060.93	1581.57	1892.73	2211.93	9227	11617	14414	17248	20594	24023
2552	ELSA	M	N-RG	HIDALGO	0190	19.62	48.42	73.4	101.38	116.17	123.35	1181	1237	1306	1380	1476	1582
2555	HIDALGO	M	N-RG	HIDALGO	0275	47.81	100.28	176.37	250.35	307.07	365.26	1070	1455	1868	2323	2844	3378
3750	HIDALGO	M	RG	HIDALGO	0275	1.96	4.12	7.25	10.29	12.62	15.01	44	60	77	95	117	139
3763	HIDALGO COUNTY MUD #1	M	N-RG	HIDALGO	4204	29.57	66.99	100.17	141.12	173.68	207.08	1703	2387	3161	3994	4915	5860
2624	IRRIGATION	M	N-RG	HIDALGO	1004							560291	505458	436074	436074	436074	436074
2625	IRRIGATION	M	RG	HIDALGO	1004							22739	20513	17698	17698	17698	17698
2558	LA JOYA	M	RG	HIDALGO	0336	6.59	12.59	20.47	28.22	35.13	39.99	314	365	419	480	549	625
3751	LA JOYA	M	N-RG	HIDALGO	0336	15.59	29.77	48.37	66.69	83.02	94.5	133	154	177	203	232	265
2559	LA VILLA	M	N-RG	HIDALGO	0349	5.85	10.23	14.62	19	21.93	21.93	244	242	241	239	239	242
2635	LIVESTOCK	M	N-RG	HIDALGO	1005							647	647	647	647	647	647
2636	LIVESTOCK	M	RG	HIDALGO	1005							34	34	34	34	34	34
2603	MANUFACTURING	M	N-RG	HIDALGO	1001							3236	3559	3851	4143	4403	4742
2564	MCALLEN	M	N-RG	HIDALGO	0376	571.01	1362.32	2011.35	2814.13	3522.53	4008.68	29797	34925	40898	47254	54356	61877
3752	MCALLEN	M	RG	HIDALGO	0376	0.08	0.18	0.27	0.38	0.47	0.52	4	5	5	6	7	8
2565	MERCEDES	M	N-RG	HIDALGO	0397	65.17	139.75	206.63	282.92	326.45	350.38	2055	2163	2298	2440	2634	2852
3767	MILITARY HIGHWAY WSC	M	N-RG	HIDALGO	4255	57.47	107.96	173.12	217.97	270.59	305.93	1333	1525	1731	1980	2248	2542
3768	MILITARY HIGHWAY WSC	M	RG	HIDALGO	4255	0.58	1.08	1.74	2.19	2.72	3.07	13	15	17	20	23	26
2610	MINING	M	N-RG	HIDALGO	1003							1291	1398	1462	1526	1589	1644
2611	MINING	M	RG	HIDALGO	1003							151	163	171	178	185	192
2566	MISSION	M	N-RG	HIDALGO	0408	342.51	712.87	1121.9	1645.99	1973.34	2309.15	11065	14063	17419	20960	25064	29269
3769	NORTH ALAMO WSC	M	N-RG	HIDALGO	4273	641.5	1377.96	2214.67	3022.03	3661.94	4318.38	11675	15158	19046	23352	28297	33369
3756	PALMHURST	M	N-RG	HIDALGO	1051	10.24	15.83	22.1	28.87	36.27	43.87	1157	1789	2497	3263	4099	4957
2568	PALMVIEW	M	N-RG	HIDALGO	0794	28.04	58.95	90.85	131.12	160.93	191.52	869	1199	1570	1967	2414	2873
3757	PENITAS	M	N-RG	HIDALGO	1052	4.04	8.34	14.39	19.41	21.72	22.57	157	160	161	165	171	180
2569	PHARR	M	N-RG	HIDALGO	0463	333.64	669	1025.53	1353.35	1744.8	2020.17	9420	11550	13948	16595	19445	22491
2572	PROGRESO	M	N-RG	HIDALGO	0941	21.33	45.35	78.85	109.11	129.86	151.14	576	717	867	1037	1234	1436
2579	SAN JUAN	M	N-RG	HIDALGO	0536	218.84	484.64	794.09	1097.62	1342.4	1593.51	3501	4665	5956	7384	9031	10720
3774	SHARYLAND WSC	M	N-RG	HIDALGO	4333	142.86	285.71	465.29	685.24	891.94	995.83	4893	5469	6095	6747	7492	8365
2607	STEAM ELECTRIC POWER	M	N-RG	HIDALGO	1002							10355	14151	16545	19462	23018	27354
2584	SULLIVAN CITY	M	RG	HIDALGO	0966	30.96	65.55	93.93	141.49	170.64	200.55	526	672	845	1016	1226	1440
2585	WESLACO	M	N-RG	HIDALGO	0638	172.94	357.73	546.34	724.96	879.22	984.34	5901	6658	7523	8481	9566	10731
2591	COUNTY-OTHER	M	N-RG	JIM HOGG	0757	3.33	7.13	10.31	13.64	14.47	13.93	137	143	147	150	148	142
2592	COUNTY-OTHER	M	RG	JIM HOGG	0757	0.38	0.82	1.17	1.55	1.65	1.58	16	16	17	17	17	16
2554	HEBBRONVILLE	M	N-RG	JIM HOGG	0268	16.01	39.97	59.97	81.1	86.39	83.15	731	759	780	792	778	748
2626	IRRIGATION	M	N-RG	JIM HOGG	1004							817	817	817	817	817	817
2637	LIVESTOCK	M	N-RG	JIM HOGG	1005							383	383	383	383	383	383
2638	LIVESTOCK	M	RG	JIM HOGG	1005							135	135	135	135	135	135
2612	MINING	M	N-RG	JIM HOGG	1003							33	36	37	38	39	40
2593	COUNTY-OTHER	M	NUECES	MAVERICK	0757	0.22	0.46	0.7	0.87	1.06	1.13	5	6	7	8	9	9
2594	COUNTY-OTHER	M	RG	MAVERICK	0757	112.24	241.53	365.38	458.79	557.82	600.95	2722	3243	3735	4175	4564	4917
2548	EAGLE PASS	M	RG	MAVERICK	0173	79.98	198.12	298.56	405.64	454.09	468.09	5429	5743	6069	6358	6693	7020
3760	EL INDIO WSC	M	RG	MAVERICK	4102	39.17	69.43	107.01	135.99	166.78	180.73	1253	1567	1855	2108	2335	2530
2627	IRRIGATION	M	NUECES	MAVERICK	1004							3897	3760	3602	3602	3602	3602
2628	IRRIGATION	M	RG	MAVERICK	1004							91143	87933	84261	84261	84261	84261
2639	LIVESTOCK	M	NUECES	MAVERICK	1005							104	104	104	104	104	104
2640	LIVESTOCK	M	RG	MAVERICK	1005							156	156	156	156	156	156
2604	MANUFACTURING	M	RG	MAVERICK	1001							64	69	73	77	80	85
2613	MINING	M	NUECES	MAVERICK	1003							108	112	115	117	119	121
2614	MINING	M	RG	MAVERICK	1003							48	50	51	52	53	54
2595	COUNTY-OTHER	M	N-RG	STARR	0757	6.59	14.47	22.52	29.39	37.08	41.62	242	298	355	414	472	530
2596	COUNTY-OTHER	M	RG	STARR	0757	162.9	358	556.86	726.89	916.84	1029.36	5986	7365	8786	10249	11669	13101
2629	IRRIGATION	M	RG	STARR	1004							31191	30108	29070	29070	29070	29070
2557	LA GRULLA	M	RG	STARR	0335	4.07	8.14	12.21	16.28	18.99	18.99	867	919	976	1038	1104	1175
2641	LIVESTOCK	M	N-RG	STARR	1005							246	246	246	246	246	246
2642	LIVESTOCK	M	RG	STARR	1005							871	871	871	871	871	871
2615	MINING	M	N-RG	STARR	1003							770	793	803	813	823	835
2616	MINING	M	RG	STARR	1003							545	562	570	577	584	591
2575	RIO GRANDE CITY	M	RG	STARR	0502	58.52	127.94	173.95	244.51	282.83	301.55	2962	3234	3545	3840	4171	4513
3773	RIO WSC	M	RG	STARR	4319	13.18	30.33	43.2	64.77	75.37	85.56	484	624	772	913	1063	1206
2577	ROMA CITY	M	RG	STARR	0515	62.15	127.81	192.3	250.1	295.15	321.22	2946	3333	3737	4156	4585	5017
2597	COUNTY-OTHER	M	NUECES	WEBB	0757	3.36	7.82	12.44	16.88	20.75	23.46	136	155	175	199	225	255
2598	COUNTY-OTHER	M	N-RG	WEBB	0757	5.03	11.7	18.61	25.26	31.07	35.14	204	231	262	297	337	382
2599	COUNTY-OTHER	M	RG	WEBB	0757	25.88	60.18	95.7	129.94	159.75	180.69	1048	1189	1349	1529	1734	1962
2551	EL CENIZO	M	RG	WEBB	0770	26.57	58.67	93.03	137.24	171.02	206.72	671	968	1302	1664	2074	2506
2630	IRRIGATION	M	RG	WEBB	1004							20507	19548	18654	18654	18654	18654
2561	LAREDO	M	RG	WEBB	0347	1050.35	2709.65	4239.39	5694.74	7442.28	8741.38	51467	65032	80548	97846	116596	136948
2643	LIVESTOCK	M	NUECES	WEBB	1005							666	666	666	666	666	666
2644	LIVESTOCK	M	N-RG	WEBB	1005							91	91	91	91	91	91
2645	LIVESTOCK	M	RG	WEBB	1005							756	756	756	756	756	756
2605	MANUFACTURING	M	RG	WEBB	1001							28	31	34	37	39	42
2617	MINING	M	NUECES	WEBB	1003							546	541	539	539	538	536
2618	MINING	M	N-RG	WEBB	1003							419	415	414	413	412	410
2619	MINING	M	RG	WEBB	1003							239	236	236	235	235	234
3758	RIO BRAVO	M	RG	WEBB	1055	46.59	90.69	153.27	215.12	264.12	315.87	1090	1490	1924	2409	2958	3538
2608	STEAM ELECTRIC POWER	M	RG	WEBB	1002							1492	1190	1391	1636	1935	2300
3777	WEBB COUNTY WATER UTILITY	M	RG	WEBB	4376	7.43	14.77	25.29	35.81	44.23	53.13	239	336	441	559	690	829
2600	COUNTY-OTHER	M	N-RG	WILLACY	0757	1.29	2.59	3.88	5.18	6.04	6.02	215	213	212	211	210	209
2631	IRRIGATION	M	N-RG	WILLACY	1004							59191	60203	60623	60623	60623	60623
2646	LIVESTOCK	M	N-RG	WILLACY	1005							151	151	151	151	151	151
2563	LYFORD	M	N-RG	WILLACY	0373	9.37	17.31	25.91	34.92	38.52	38.97	333	351	368	382	398	412
3831	MANUFACTURING	M	N-RG	WILLACY	1001							25	25	25	25	25	25
2620	MINING	M	N-RG	WILLACY	1003							6	6	6	6	6	6
3770	NORTH ALAMO WSC	M	N-RG	WILLACY	4273	40.25	77.5	111.8	136.18	145.16	149.6	733	853	961	1052	1122	1156
2574	RAYMONDVILLE	M	N-RG	WILLACY	0495	45.12	81.56	119.9	159.41	174.26	175.54	1681	1701	1715	1717	1730	1743
2580	SAN PERLITA	M	N-RG	WILLACY	0956	3.35	6.37	9.76	13.38	14.93	15.18	105	112	117	120	124	126
3778	SEBASTIAN MUD	M	N-RG	WILLACY	4410	11.41	24.72	38.04	49.15	56.12	57.83	256	297	333	362	382	393
2601	COUNTY-OTHER	M	RG	ZAPATA	0757	20.54	38.18	60.75	87.54	98	105.72	1232	1514	1792	2048	2293	2474
2632	IRRIGATION	M	RG	ZAPATA	1004							6454	6121	5805	5805	5805	5805
2647	LIVESTOCK	M	RG	ZAPATA	1005							474	474	474	474	474	474
2621	MINING	M	RG	ZAPATA	1003							24	23	23	23	23	23
2586	ZAPATA	M	RG	ZAPATA	0672	16.32	32.64	48.95	65.27	76.15	76.15	1033	1017	1001	985	974	974

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2544	BROWNSVILLE	M	N-RG	CAMERON	0080	138646	179054	216587	255477	294353	333360	370578
2545	BROWNSVILLE	M	RG	CAMERON	0080	1076	1390	1681	1983	2284	2587	2875
2546	COMBES	M	N-RG	CAMERON	0690	2553	3089	3655	4240	4823	5407	5962
2587	COUNTY-OTHER	M	N-RG	CAMERON	0757	38801	45008	51569	58351	65113	71876	78307
2588	COUNTY-OTHER	M	RG	CAMERON	0757	71	82	94	106	118	130	142
3759	EAST RIO HONDO WSC	M	N-RG	CAMERON	4099	13741	19904	26420	33155	39869	46585	52973
3761	EL JARDIN	M	N-RG	CAMERON	4103	8294	10798	13445	16182	18910	21639	24234
3762	EL JARDIN	M	RG	CAMERON	4103	47	61	76	92	107	122	137
2553	HARLINGEN	M	N-RG	CAMERON	0265	57564	69214	79581	90333	101090	111896	122218
3754	INDIAN LAKE	M	N-RG	CAMERON	1026	541	699	866	1039	1211	1383	1547
2556	LA FERIA	M	N-RG	CAMERON	0333	6115	7954	9898	11908	13912	15916	17822
3764	LAGUNA MADRE WD	M	N-RG	CAMERON	4224	4242	7725	11408	15215	19010	22806	26416
2560	LAGUNA VISTA	M	N-RG	CAMERON	0788	1658	2651	3314	4008	4705	5413	6094
2562	LOS FRESNOS	M	N-RG	CAMERON	0369	4512	6649	8908	11243	13571	15899	18114
3755	LOS INDIOS	M	N-RG	CAMERON	1040	1149	1418	1703	1997	2290	2583	2862
3765	MILITARY HIGHWAY WSC	M	N-RG	CAMERON	4255	8834	11278	13862	16533	19196	21860	24393
3766	MILITARY HIGHWAY WSC	M	RG	CAMERON	4255	127	162	199	237	275	313	349
3771	OLMITO WSC	M	N-RG	CAMERON	4292	4479	7261	10203	13244	16275	19307	22191
2567	PALM VALLEY	M	N-RG	CAMERON	0793	1298	1,400	1,400	1,400	1,400	1,400	1,400
3772	PALM VALLEY ESTATES UD	M	N-RG	CAMERON	4295	250	344	444	547	650	753	851
2570	PORT ISABEL	M	N-RG	CAMERON	0477	4865	5282	5723	6179	6633	7088	7520
2571	PRIMERA	M	N-RG	CAMERON	0735	2723	3973	4871	5806	6748	7699	8613
2573	RANCHO VIEJO	M	N-RG	CAMERON	0943	1754	2,300	2,350	2,400	2,450	2,500	2,550
2576	RIO HONDO	M	N-RG	CAMERON	0503	1942	2223	2419	2623	2829	3037	3238
2578	SAN BENITO	M	N-RG	CAMERON	0532	23444	26922	30599	34400	38189	41979	45584
2581	SANTA ROSA	M	N-RG	CAMERON	0541	2833	3472	4148	4847	5543	6240	6903
2583	SOUTH PADRE ISLAND	M	N-RG	CAMERON	0805	2422	3203	4028	4881	5732	6583	7392
3775	VALLEY MUD #2	M	N-RG	CAMERON	4369	1066	1066	1066	1066	1066	1066	1066
3776	VALLEY MUD #2	M	RG	CAMERON	4369	180	180	180	180	180	180	180
2542	ALAMO	M	N-RG	HIDALGO	0003	14760	20915	28107	36163	44880	54400	64166
2543	ALTON	M	N-RG	HIDALGO	0675	4384	12342	15513	19064	22907	27104	31411
2589	COUNTY-OTHER	M	N-RG	HIDALGO	0757	57825	75813	102960	133363	166259	202193	239056
2590	COUNTY-OTHER	M	RG	HIDALGO	0757	2983	4422	6104	7988	10026	12252	14536
2547	DONNA	M	N-RG	HIDALGO	0168	14768	17830	20419	23311	26435	29839	33325
2549	EDCOUCH	M	N-RG	HIDALGO	0178	3342	4076	4659	5311	6013	6778	7562
2550	EDINBURG	M	N-RG	HIDALGO	0182	48465	71940	92789	116092	141263	168699	196813
2552	ELSA	M	N-RG	HIDALGO	0190	5549	6267	6710	7204	7736	8313	8904
2555	HIDALGO	M	N-RG	HIDALGO	0275	7033	11215	15599	20507	25814	31606	37546
3750	HIDALGO	M	RG	HIDALGO	0275	289	460	641	843	1061	1299	1543
3763	HIDALGO COUNTY MUD #1	M	N-RG	HIDALGO	4204	3400	5280	7476	9936	12598	15505	18487
2558	LA JOYA	M	RG	HIDALGO	0336	982	1282	1536	1820	2127	2461	2803
3751	LA JOYA	M	N-RG	HIDALGO	0336	2321	3030	3631	4302	5027	5817	6625
2559	LA VILLA	M	N-RG	HIDALGO	0349	1305	1361	1374	1389	1405	1422	1439
2564	MCALLEN	M	N-RG	HIDALGO	0376	106400	132249	158025	186864	218039	252051	286921
3752	MCALLEN	M	RG	HIDALGO	0376	14	18	21	25	29	33	38
2565	MERCEDES	M	N-RG	HIDALGO	0397	13649	15775	17129	18636	20260	22023	23827
3767	MILITARY HIGHWAY WSC	M	N-RG	HIDALGO	4255	8731	10261	12048	14050	16216	18582	21009
3768	MILITARY HIGHWAY WSC	M	RG	HIDALGO	4255	88	103	121	141	163	187	211
2566	MISSION	M	N-RG	HIDALGO	0408	45408	68351	88532	111086	135447	161998	189204
3769	NORTH ALAMO WSC	M	N-RG	HIDALGO	4273	80960	114538	153770	197713	245263	297197	350473
3756	PALMHURST	M	N-RG	HIDALGO	1051	4872	9144	14136	19727	25777	32384	39162
2568	PALMVIEW	M	N-RG	HIDALGO	0794	4107	6258	8771	11586	14632	17959	21372
3757	PENITAS	M	N-RG	HIDALGO	1052	1167	1261	1316	1376	1441	1511	1584
2569	PHARR	M	N-RG	HIDALGO	0463	46660	65969	82640	101269	121386	143309	165772
2572	PROGRESO	M	N-RG	HIDALGO	0941	4851	6348	8097	10056	12176	14491	16866
2579	SAN JUAN	M	N-RG	HIDALGO	0536	26229	39074	54082	70892	89081	108947	129327
3774	SHARYLAND WSC	M	N-RG	HIDALGO	4333	27988	31885	36438	41538	47057	53085	59268
2584	SULLIVAN CITY	M	RG	HIDALGO	0966	3998	5528	7315	9317	11483	13849	16276
2585	WESLACO	M	N-RG	HIDALGO	0638	26935	32862	37961	43658	49811	56516	63385
2591	COUNTY-OTHER	M	N-RG	JIM HOGG	0757	703	744	796	837	870	861	829
2592	COUNTY-OTHER	M	RG	JIM HOGG	0757	80	85	91	95	99	98	94
2554	HEBBRONVILLE	M	N-RG	JIM HOGG	0268	4498	4764	5098	5354	5569	5509	5302
2593	COUNTY-OTHER	M	NUECES	MAVERICK	0757	37	48	59	69	78	86	92
2594	COUNTY-OTHER	M	RG	MAVERICK	0757	19612	25050	30803	36243	40958	45272	48772
2548	EAGLE PASS	M	RG	MAVERICK	0173	22413	26160	28212	30238	32116	33937	35559
3760	EL INDIO WSC	M	RG	MAVERICK	4102	5235	6994	8855	10615	12140	13536	14668
2595	COUNTY-OTHER	M	N-RG	STARR	0757	1118	1470	1846	2234	2624	3009	3378
2596	COUNTY-OTHER	M	RG	STARR	0757	27652	36356	45658	55237	64893	74409	83541
2557	LA GRULLA	M	RG	STARR	0335	1211	1640	1746	1862	1985	2116	2249
2575	RIO GRANDE CITY	M	RG	STARR	0502	11923	14982	16674	18447	20259	22090	23878
3773	RIO WSC	M	RG	STARR	4319	2076	2942	3868	4821	5782	6729	7638
2577	ROMA CITY	M	RG	STARR	0515	9617	11989	13791	15661	17559	19449	21277
2597	COUNTY-OTHER	M	NUECES	WEBB	0757	646	751	873	1010	1159	1323	1496
2598	COUNTY-OTHER	M	N-RG	WEBB	0757	968	1123	1306	1510	1735	1981	2241
2599	COUNTY-OTHER	M	RG	WEBB	0757	4978	5777	6716	7767	8923	10187	11522
2551	EL CENIZO	M	RG	WEBB	0770	3545	5929	8729	11865	15315	19085	23068
2561	LAREDO	M	RG	WEBB	0347	176576	234423	302377	378468	462176	553670	650317
3758	RIO BRAVO	M	RG	WEBB	1055	5553	8318	11566	15203	19205	23579	28199
3777	WEBB COUNTY WATER UTILITY	M	RG	WEBB	4376	851	1326	1884	2509	3197	3949	4743
2600	COUNTY-OTHER	M	N-RG	WILLACY	0757	385	385	385	385	385	385	384
2563	LYFORD	M	N-RG	WILLACY	0373	1973	2335	2512	2684	2839	2972	3076
3770	NORTH ALAMO WSC	M	N-RG	WILLACY	4273	5696	7187	8649	9981	11052	11781	12141
2574	RAYMONDVILLE	M	N-RG	WILLACY	0495	9733	10071	10402	10704	10947	11112	11194
2580	SAN PERLITA	M	N-RG	WILLACY	0956	680	747	812	871	919	952	968
3778	SEBASTIAN MUD	M	N-RG	WILLACY	4410	1615	2038	2452	2830	3134	3340	3442
2601	COUNTY-OTHER	M	RG	ZAPATA	0757	7326	9169	11361	13559	15630	17498	18877
2586	ZAPATA	M	RG	ZAPATA	0672	4856	4856	4856	4856	4856	4856	4856

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2544	BROWNSVILLE	M	N-RG	CAMERON	0080	35564	45930	55557	65533	75505	85511	95058	
2545	BROWNSVILLE	M	RG	CAMERON	0080	276	357	431	509	586	664	737	
2546	COMBES	M	N-RG	CAMERON	0690	186	225	266	309	351	394	434	
2587	COUNTY-OTHER	M	N-RG	CAMERON	0757	6215	7209	8260	9347	10430	11513	12543	
2588	COUNTY-OTHER	M	RG	CAMERON	0757	11	13	15	17	19	21	23	
3759	EAST RIO HONDO WSC	M	N-RG	CAMERON	4099	1739	2519	3344	4197	5046	5897	6705	
3761	EL JARDIN	M	N-RG	CAMERON	4103	1505	1959	2440	2936	3431	3927	4398	
3762	EL JARDIN	M	RG	CAMERON	4103	9	11	14	17	19	22	25	
2553	HARLINGEN	M	N-RG	CAMERON	0265	10059	12095	13906	15785	17665	19553	21357	
3754	INDIAN LAKE	M	N-RG	CAMERON	1026	40	52	64	77	90	102	114	
2622	IRRIGATION	M	N-RG	CAMERON	1004	160435	352707	333861	312137	312137	312137	312137	
2623	IRRIGATION	M	RG	CAMERON	1004	6685	14697	13910	13007	13007	13007	13007	
2556	LA FERIA	M	N-RG	CAMERON	0333	699	909	1131	1361	1590	1818	2036	
3764	LAGUNA MADRE WD	M	N-RG	CAMERON	4224	1288	2345	3463	4619	5771	6923	8019	
2560	LAGUNA VISTA	M	N-RG	CAMERON	0788	214	341	427	516	606	697	785	
2633	LIVESTOCK	M	N-RG	CAMERON	1005	1048	1048	1048	1048	1048	1048	1048	
2634	LIVESTOCK	M	RG	CAMERON	1005	55	55	55	55	55	55	55	
2562	LOS FRESNOS	M	N-RG	CAMERON	0369	541	797	1068	1348	1627	1906	2171	
3755	LOS INDIOS	M	N-RG	CAMERON	1040	193	238	286	336	385	434	481	
2602	MANUFACTURING	M	N-RG	CAMERON	1001	3430	4156	4590	4983	5372	5709	6165	
3765	MILITARY HIGHWAY WSC	M	N-RG	CAMERON	4255	1197	1529	1879	2241	2602	2963	3306	
3766	MILITARY HIGHWAY WSC	M	RG	CAMERON	4255	17	22	27	32	37	42	47	
2609	MINING	M	N-RG	CAMERON	1003	8	6	6	6	6	6	6	
3771	OLMITO WSC	M	N-RG	CAMERON	4292	612	992	1394	1810	2224	2638	3033	
2567	PALM VALLEY	M	N-RG	CAMERON	0793	390	420	420	420	420	420	420	
3772	PALM VALLEY ESTATES UD	M	N-RG	CAMERON	4295	63	86	111	137	163	189	214	
2570	PORT ISABEL	M	N-RG	CAMERON	0477	2458	2668	2891	3122	3351	3581	3799	
2571	PRIMERA	M	N-RG	CAMERON	0735	433	632	775	924	1073	1225	1370	
2573	RANCHO VIEJO	M	N-RG	CAMERON	0943	253	332	340	347	354	361	368	
2576	RIO HONDO	M	N-RG	CAMERON	0503	385	441	480	520	561	602	642	
2578	SAN BENITO	M	N-RG	CAMERON	0532	4386	5036	5724	6435	7144	7853	8527	
2581	SANTA ROSA	M	N-RG	CAMERON	0541	286	350	418	489	559	629	696	
2583	SOUTH PADRE ISLAND	M	N-RG	CAMERON	0805	1910	2526	3176	3849	4520	5191	5829	
2606	STEAM ELECTRIC POWER	M	N-RG	CAMERON	1002	1498	1616	1523	1780	2094	2477	2944	
3775	VALLEY MUD #2	M	N-RG	CAMERON	4369	738	738	738	738	738	738	738	
3776	VALLEY MUD #2	M	RG	CAMERON	4369	125	125	125	125	125	125	125	
2542	ALAMO	M	N-RG	HIDALGO	0003	1703	2413	3243	4172	5178	6276	7403	
2543	ALTON	M	N-RG	HIDALGO	0675	1208	3401	4275	5253	6312	7469	8655	
2589	COUNTY-OTHER	M	N-RG	HIDALGO	0757	7449	9766	13263	17179	21417	26046	30794	
2590	COUNTY-OTHER	M	RG	HIDALGO	0757	384	570	786	1029	1292	1578	1872	
2547	DONNA	M	N-RG	HIDALGO	0168	2101	2536	2905	3316	3761	4245	4741	
2549	EDCOUCH	M	N-RG	HIDALGO	0178	460	562	642	732	828	934	1042	
2550	EDINBURG	M	N-RG	HIDALGO	0182	6460	9589	12369	15475	18830	22487	26235	
2552	ELSA	M	N-RG	HIDALGO	0190	1063	1200	1285	1380	1482	1592	1706	
2555	HIDALGO	M	N-RG	HIDALGO	0275	701	1118	1555	2044	2573	3151	3743	
3750	HIDALGO	M	RG	HIDALGO	0275	29	46	64	84	106	130	154	
3763	HIDALGO COUNTY MUD #1	M	N-RG	HIDALGO	4204	1116	1733	2454	3261	4135	5089	6067	
2624	IRRIGATION	M	N-RG	HIDALGO	1004	570471	560291	505458	436074	436074	436074	436074	
2625	IRRIGATION	M	RG	HIDALGO	1004	23152	22739	20513	17698	17698	17698	17698	
2558	LA JOYA	M	RG	HIDALGO	0336	107	329	395	467	546	632	720	
3751	LA JOYA	M	N-RG	HIDALGO	0336	252	139	167	198	231	267	305	
2559	LA VILLA	M	N-RG	HIDALGO	0349	240	250	252	255	258	261	264	
2635	LIVESTOCK	M	N-RG	HIDALGO	1005	647	647	647	647	647	647	647	
2636	LIVESTOCK	M	RG	HIDALGO	1005	34	34	34	34	34	34	34	
2603	MANUFACTURING	M	N-RG	HIDALGO	1001	2674	3236	3559	3851	4143	4403	4742	
2564	MCALLEN	M	N-RG	HIDALGO	0376	24433	30368	36287	42909	50068	57878	65886	
3752	MCALLEN	M	RG	HIDALGO	0376	3	4	5	6	7	8	9	
2565	MERCEDES	M	N-RG	HIDALGO	0397	1835	2120	2302	2505	2723	2960	3203	
3767	MILITARY HIGHWAY WSC	M	N-RG	HIDALGO	4255	1183	1391	1633	1904	2198	2519	2848	
3768	MILITARY HIGHWAY WSC	M	RG	HIDALGO	4255	12	14	16	19	22	25	29	
2610	MINING	M	N-RG	HIDALGO	1003	1071	1291	1398	1462	1526	1589	1644	
2611	MINING	M	RG	HIDALGO	1003	125	151	163	171	178	185	192	
2566	MISSION	M	N-RG	HIDALGO	0408	7579	11408	14776	18540	22606	27038	31578	
3769	NORTH ALAMO WSC	M	N-RG	HIDALGO	4273	8706	12317	16535	21261	26374	31959	37688	
3756	PALMHURST	M	N-RG	HIDALGO	1051	622	1168	1805	2519	3292	4135	5001	
2568	PALMVIEW	M	N-RG	HIDALGO	0794	589	897	1258	1661	2098	2575	3064	
3757	PENITAS	M	N-RG	HIDALGO	1052	149	161	168	176	184	193	202	
2569	PHARR	M	N-RG	HIDALGO	0463	6899	9754	12219	14974	17948	21190	24511	
2572	PROGRESO	M	N-RG	HIDALGO	0941	456	597	762	946	1146	1363	1587	
2579	SAN JUAN	M	N-RG	HIDALGO	0536	2497	3720	5149	6750	8482	10373	12314	
3774	SHARYLAND WSC	M	N-RG	HIDALGO	4333	4420	5036	5755	6561	7432	8384	9361	
2607	STEAM ELECTRIC POWER	M	N-RG	HIDALGO	1002	3487	10355	14151	16545	19462	23018	27354	
2584	SULLIVAN CITY	M	RG	HIDALGO	0966	403	557	737	939	1158	1396	1641	
2585	WESLACO	M	N-RG	HIDALGO	0638	4978	6074	7016	8069	9206	10445	11715	
2591	COUNTY-OTHER	M	N-RG	JIM HOGG	0757	132	140	150	158	164	162	156	
2592	COUNTY-OTHER	M	RG	JIM HOGG	0757	15	16	17	18	19	18	18	
2554	HEBBRONVILLE	M	N-RG	JIM HOGG	0268	705	747	799	840	873	864	831	
2626	IRRIGATION	M	N-RG	JIM HOGG	1004	817	817	817	817	817	817	817	
2637	LIVESTOCK	M	N-RG	JIM HOGG	1005	383	383	383	383	383	383	383	
2638	LIVESTOCK	M	RG	JIM HOGG	1005	135	135	135	135	135	135	135	
2612	MINING	M	N-RG	JIM HOGG	1003	27	33	36	37	38	39	40	
2593	COUNTY-OTHER	M	NUECES	MAVERICK	0757	4	5	7	8	9	10	10	
2594	COUNTY-OTHER	M	RG	MAVERICK	0757	2219	2834	3485	4100	4634	5122	5518	
2548	EAGLE PASS	M	RG	MAVERICK	0173	4720	5509	5941	6368	6763	7147	7488	
3760	EL INDIO WSC	M	RG	MAVERICK	4102	968	1293	1637	1962	2244	2502	2711	
2627	IRRIGATION	M	NUECES	MAVERICK	1004	4274	3897	3760	3602	3602	3602	3602	
2628	IRRIGATION	M	RG	MAVERICK	1004	99964	91143	87933	84261	84261	84261	84261	
2639	LIVESTOCK	M	NUECES	MAVERICK	1005	104	104	104	104	104	104	104	
2640	LIVESTOCK	M	RG	MAVERICK	1005	156	156	156	156	156	156	156	
2604	MANUFACTURING	M	RG	MAVERICK	1001	56	64	69	73	77	80	85	
2613	MINING	M	NUECES	MAVERICK	1003	97	108	112	115	117	119	121	
2614	MINING	M	RG	MAVERICK	1003	43	48	50	51	52	53	54	
2595	COUNTY-OTHER	M	N-RG	STARR	0757	189	249	312	378	444	509	571	
2596	COUNTY-OTHER	M	RG	STARR	0757	4677	6149	7723	9343	10976	12586	14130	
2629	IRRIGATION	M	RG	STARR	1004	10366	31191	30108	29070	29070	29070	29070	
2557	LA GRULLA	M	RG	STARR	0335	643	871	927	989	1054	1123	1194	
2641	LIVESTOCK	M	N-RG	STARR	1005	246	246	246	246	246	246	246	
2642	LIVESTOCK	M	RG	STARR	1005	871	871	871	871	871	871	871	
2615	MINING	M	N-RG	STARR	1003	704	770	793	803	813	823	835	
2616	MINING	M	RG	STARR	1003	499	545	562	570	577	584	591	
2575	RIO GRANDE CITY	M	RG	STARR	0502	2404	3021	3362	3719	4085	4454	4814	
3773	RIO WSC	M	RG	STARR	4319	351	498	654	815	978	1138	1292	
2577	ROMA CITY	M	RG	STARR	0515	2413	3008	3460	3930	4406	4880	5339	
2597	COUNTY-OTHER	M	NUECES	WEBB	0757	120	140	162	188	216	246	278	
2598	COUNTY-OTHER	M	N-RG	WEBB	0757	180	209	243	281	323	368	417	
2599	COUNTY-OTHER	M	RG	WEBB	0757	926	1074	1249	1444	1659	1894	2142	
2551	EL CENIZO	M	RG	WEBB	0770	417	697	1027	1396	1801	2245	2713	
2630	IRRIGATION	M	RG	WEBB	1004	4137	20507	19548	18654	18654	18654	18654	
2561	LAREDO	M	RG	WEBB	0347	39558	52517	67741	84788	103541	124038	145690	
2643	LIVESTOCK	M	NUECES	WEBB	1005	666	666	666	666	666	666	666	
2644	LIVESTOCK	M	N-RG	WEBB	1005	91	91	91	91	91	91	91	
2645	LIVESTOCK	M	RG	WEBB	1005	756	756	756	756	756	756	756	
2605	MANUFACTURING	M	RG	WEBB	1001	23	28	31	34	37	39	42	
2617	MINING	M	NUECES	WEBB	1003	573	546	541	539	539	538	536	
2618	MINING	M	N-RG	WEBB	1003	439	419	415	414	413	412	410	
2619	MINING	M	RG	WEBB	1003	250	239	236	236	235	235	234	
3758	RIO BRAVO	M	RG	WEBB	1055	759	1137	1581	2078	2625	3222	3854	
2608	STEAM ELECTRIC POWER	M	RG	WEBB	1002	1795	1492	1190	1391	1636	1935	2300	
3777	WEBB COUNTY WATER UTILITY	M	RG	WEBB	4376	158	247	350	467	594	734	882	
2600	COUNTY-OTHER	M	N-RG	WILLACY	0757	216	216	216	216	216	216	215	
2631	IRRIGATION	M	N-RG	WILLACY	1004	27024	59191	60203	60623	60623	60623	60623	
2646	LIVESTOCK	M	N-RG	WILLACY	1005	151	151	151	151	151	151	151	
2563	LYFORD	M	N-RG	WILLACY	0373	290	343	369	394	417	436	451	
3831	MANUFACTURING	M	N-RG	WILLACY	1001	25	25	25	25	25	25	25	
2620	MINING	M	N-RG	WILLACY	1003	6	6	6	6	6	6	6	
3770	NORTH ALAMO WSC	M	N-RG	WILLACY	4273	613	773	930	1073	1188	1267	1306	
2574	RAYMONDVILLE	M	N-RG	WILLACY	0495	1668	1726	1783	1834	1876	1904	1918	
2580	SAN PERLITA	M	N-RG	WILLACY	0956	99	109	118	127	134	139	141	
3778	SEBASTIAN MUD	M	N-RG	WILLACY	4410	212	267	321	371	411	438	451	
2601	COUNTY-OTHER	M	RG	ZAPATA	0757	1001	1253	1553	1853	2136	2391	2580	
2632	IRRIGATION	M	RG	ZAPATA	1004	2265	6454	6121	5805	5805	5805	5805	
2647	LIVESTOCK	M	RG	ZAPATA	1005	474	474	474	474	474	474	474	
2621	MINING	M	RG	ZAPATA	1003	27	24	23	23	23	23	23	
2586	ZAPATA	M	RG	ZAPATA	0672	1050	1050	1050	1050	1050	1050	1050	

WATER SUPPLY AND DEMAND ANALYSIS

Municipal County Breakdown (ac-ft/yr)

WMS	Cameron County	Hidalgo	Jim Hogg	Maverick	Star	Webb	Willacy	Zapata	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)
Additional Groundwater	1,803	8,947	65	0	4,188	7,918	0	0	22,921	$ 4,927,098.16	$ 214.96
Advanced Water Conservation Measures	4,810	22,290	7	341	810	4,371	79	85	32,793	$ -	$ -
Non-Potable Water Re-use	550	19,764	0	0	125	12,123	0	0	32,562	$ 4,898,952.90	$ 150.45
Potable Water Re-use	0	1,290	0	0	0	0	0	0	1,290	$ 194,080.50	$ 150.45
Brownsville Weir and Reservoir	23,643	0	0	0	0	0	0	0	23,643	$ 4,324,304.70	$ 182.90
Acquisition of Water Rights:											
Purchase	15,021	60,286	7	2,226	11,149	55,060	188	1,813	145,751	$ 62,691,684.07	$ 430.13
Urbanization	0	16,406	0	0	0	0	0	0	16,406	$ 7,056,712.78	$ 430.13
Contract	892	2,201	0	0	235	1,338	5	0	4,671	$ 2,008,922.17	$ 430.13
Desalination:											
Brackish Groundwater Desalination	25,069	23,066	0	641	1,498	10,100	11,326	0	71,700	$ 33,347,670.00	$ 465.10
Seawater Desalination	7,902	0	0	0	0	0	0	0	7,902	$ 8,301,920.22	$ 1,050.61
Banco Morales Reservoir	238	0	0	0	0	0	0	0			$ 2,542.00
Resaca Restoration	877	0	0	0	0	0	0	0			$ 4,825.00
Laredo Low Water Weir	0	0	0	0	0	0	0	0			$ 4,460.00
Proposed Elsa Tank	0	105	0	0	0	0	0	0			
Totals:	**80,805**	**154,355**	**79**	**3,208**	**18,005**	**90,910**	**11,598**	**1,898**	**359,638**	**$ 127,751,345.50**	**$ 15,331.86**

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Zapata County

Year			2010	2020	2030	2040	2050	2060
Total Population		7,326	9,169	11,361	13,559	15,630	17,498	18,877
Total Water Demand			1,253	1,553	1,853	2,136	2,391	2,580
Plumbing Code Fixture Replacement (ac-ft)			21	38	61	88	98	106
Net Water Demand (ac-ft)			**1,232**	**1,515**	**1,792**	**2,048**	**2,293**	**2,474**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		661	661	661	661	661	661
OTHER AQUIFER	Ground Water		0	0	0	0	0	0
Total Supply (AF/yr)			**661**	**661**	**661**	**661**	**661**	**661**
Projected Supply Surplus/Deficit			**-571**	**-854**	**-1,131**	**-1,387**	**-1,632**	**-1,813**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	85	$ -	$ -		14	30	46	61	75	85
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,813	$ 779,825.69	$ 430.13		571	853	1,131	1,387	1,632	1,813
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	585	883	1,177	1,448	1,707	1,898
Surplus/Deficit after WMS's	13	29	46	61	75	85

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Willacy County

Year	Type		2010	2020	2030	2040	2050	2060
Total Population		385	385	385	385	385	385	384
Total Water Demand			216	216	216	216	216	215
Plumbing Code Fixture Replacement (ac-ft)			1	3	4	5	6	6
Net Water Demand (ac-ft)			**215**	**213**	**212**	**211**	**210**	**209**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		698	579	471	370	267	267
Total Supply (AF/yr)			**698**	**579**	**471**	**370**	**267**	**267**
Projected Supply Surplus/Deficit			**483**	**365**	**259**	**159**	**57**	**58**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	0	0	0	0	0	0
Surplus/Deficit after WMS's	483	365	259	159	57	58

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Webb County

Year			**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population		6,592	7,651	8,895	10,287	11,817	13,491	15,259
Total Water Demand			1,423	1,654	1,913	2,198	2,508	2,837
Plumbing Code Fixture Replacement (ac-ft)			34	80	127	172	212	239
Net Water Demand (ac-ft)			**1389**	**1574**	**1786**	**2026**	**2296**	**2598**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		0	0	0	0	0	0
AMISTAD/FALCON	Surface Water		0	0	0	0	0	0
AMISTAD/FALCON	Surface Water		1	1	1	1	1	1
CARRIZO-WILCOX	Ground Water		77	77	77	77	77	77
CARRIZO-WILCOX	Ground Water		115	115	115	116	116	116
CARRIZO-WILCOX	Ground Water		593	593	594	595	595	596
GULF COAST	Ground Water		27	27	27	27	27	27
GULF COAST	Ground Water		40	40	40	40	40	40
GULF COAST	Ground Water		207	207	207	207	207	208
OTHER AQUIFER	Ground Water		13	13	13	13	13	13
OTHER AQUIFER	Ground Water		19	19	19	19	19	19
OTHER AQUIFER	Ground Water		99	99	99	99	99	99
Total Supply (AF/yr)			**1,191**	**1,191**	**1,192**	**1,194**	**1,194**	**1,196**
Projected Supply Surplus/Deficit			**-197**	**-384**	**-594**	**-831**	**-1,102**	**-1,403**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96							
Advanced Water Conservation Measures	529	$ -	$ -		74	144	224	313	416	529
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	874	$ 375,933.62	$ 430.13		123	240	370	518	686	874
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	197	384	594	831	1,102	1,403
Surplus/Deficit after WMS's	0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Starr County

Year			**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population		28,770	37,826	47,504	57,471	67,517	77,418	86,919
Total Water Demand			6,228	7,663	9,141	10,663	12,141	13,631
Plumbing Code Fixture Replacement (ac-ft)			169	372	579	756	954	1071
Net Water Demand (ac-ft)			**6,228**	**7,663**	**9,141**	**10,663**	**12,141**	**13,631**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		30	30	30	30	30	30
AMISTAD/FALCON	Surface Water		751	751	751	751	751	751
OTHER AQUIFER	Ground Water		3	3	3	3	3	3
GULF COAST	Ground Water		275	403	533	656	748	748
GULF COAST	Ground Water		473	420	327	247	146	70
GULF COAST	Ground Water		74	74	74	74	74	74
Total Supply (AF/yr)			**1,606**	**1,681**	**1,718**	**1,761**	**1,752**	**1,676**
Projected Supply Surplus/Deficit			**-4,622**	**-6,057**	**-7,535**	**-9,057**	**-10,535**	**-12,025**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	3,890	$ 836,194.40	$ 214.96		1,580	3195	2869	3557	3826	3890
Advanced Water Conservation Measures	430	$ -	$ -		67	139	212	286	360	430
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	7,886	$ 3,392,005.18	$ 430.13		3,041	2786	4,553	5334	6,512	7886
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	4,688	6,120	7,634	9,177	10,698	12,206
Surplus/Deficit after WMS's	66	63	99	120	163	181

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Maverick County

Year	Type		2010	2020	2030	2040	2050	2060
Total Population		19,649	25,098	30,862	36,312	41,036	45,358	48,864
Total Water Demand			2,727	3,249	3,742	4,183	4,573	4,926
Plumbing Code Fixture Replacement (ac-ft)			112	242	366	460	559	602
Net Water Demand (ac-ft)			**2,727**	**3,249**	**3,742**	**4,183**	**4,573**	**4,926**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		2,174	2,174	2,174	2,174	2,174	2,174
CARRIZO-WILCOX	Ground Water		1	1	1	1	1	1
CARRIZO-WILCOX	Ground Water		267	267	267	267	267	267
OTHER AQUIFER	Ground Water		1	1	1	1	1	1
OTHER AQUIFER	Ground Water		257	257	257	257	257	257
Total Supply (AF/yr)			**2,700**	**2,700**	**2,700**	**2,700**	**2,700**	**2,700**
Projected Supply Surplus/Deficit			**-27**	**-549**	**-1,042**	**-1,483**	**-1,873**	**-2,226**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	216	$ -	$ -		40	83	123	158	190	216
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	2,226	$ 957,469.38	$ 430.13		27	549	1042	1483	1,873	2226
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	67	632	1,165	1,641	2,063	2,442
Surplus/Deficit after WMS's	40	83	123	158	190	216

WATER SUPPLY AND DEMAND ANALYSIS							
County-Other: Jim Hogg County							
Year			**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population		783	829	887	932	969	959	923
Total Water Demand			153	159	164	167	165	158
Plumbing Code Fixture Replacement (ac-ft)			4	8	11	15	16	16
Net Water Demand (ac-ft)			**153**	**159**	**164**	**167**	**165**	**158**
Current Water Supply	**Type**							
GULF COAST	Ground Water		77	77	77	77	77	77
GULF COAST	Ground Water		9	9	9	9	9	9
Total Supply (AF/yr)			**86**	**86**	**86**	**86**	**86**	**86**
Projected Supply Surplus/Deficit			**-67**	**-73**	**-78**	**-81**	**-79**	**-72**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	73	$ 15,692.08	$ 214.96		60	66	70	73	71	65
Advanced Water Conservation Measures	1	$ -	$ -		0	1	1	1	1	1
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	8	$ 3,441.04	$ 430.13		7	7	8	8	8	7
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	67	74	79	82	80	73
Surplus/Deficit after WMS's	0	1	1	1	1	1

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Hidalgo County

Year			**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population		60,808	80,235	109,064	141,351	176,285	214,445	253,592
Total Water Demand			10,336	14,049	18,208	22,709	27,624	32,666
Plumbing Code Fixture Replacement (ac-ft)			449	977	1,583	2,172	2,642	3,125
Net Water Demand (ac-ft)			**9,886**	**13,072**	**16,626**	**20,536**	**24,981**	**29,542**

Current Water Supply	**Type**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
AMISTAD/FALCON	Surface Water	8,827	8,714	8,612	8,515	8,418	8,327
AMISTAD/FALCON	Surface Water	465	459	453	448	443	438
GULF COAST	Ground Water	1,589	1,447	1,299	1,131	939	743
GULF COAST	Ground Water	93	86	78	68	57	45
Total Supply (AF/yr)		**10,974**	**10,706**	**10,442**	**10,163**	**9,857**	**9,553**
Projected Supply Surplus/Deficit		**1,088**	**-2,366**	**-6,184**	**-10,374**	**-15,124**	**-19,989**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	4,389	$ 943,459.44	$ 214.96		0	1089	1887	3861	4098	4389
Advanced Water Conservation Measures	1,425	$ -	$ -		144	357	595	854	1,136	1,425
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	15,600	$ 6,710,028.00	$ 430.13		0	1277	4297	6512	11,026	15600
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
	144	2,723	6,779	11,227	16,260	21,414
Surplus/Deficit after WMS's	1,232	357	595	853	1,136	1,425

WATER SUPPLY AND DEMAND ANALYSIS

County-Other: Cameron County

Year	Type		2010	2020	2030	2040	2050	2060
Total Population		38,872	45,090	51,663	58,457	65,231	72,006	78,449
Total Water Demand			7,222	8,275	9,364	10,449	11,534	12,566
Plumbing Code Fixture Replacement (ac-ft)			253	463	655	877	1,049	1,142
Net Water Demand (ac-ft)			**6,970**	**7,812**	**8,709**	**9,572**	**10,485**	**11,424**
Current Water Supply	**Type**							
AMISTAD/FALCON	Surface Water		13,090	13,078	13,068	13,059	13,052	13,047
OTHER LOCAL SUPPLY*	Surface Water		0	0	0	0	0	0
GULF COAST	Ground Water		2,519	2,478	2,439	2,396	2,354	2,311
GULF COAST	Ground Water		5	5	4	4	4	4
Total Supply (AF/yr)			**15,614**	**15,561**	**15,511**	**15,459**	**15,410**	**15,362**
Projected Supply Surplus/Deficit			**8,644**	**7,749**	**6,802**	**5,887**	**4,925**	**3,938**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	293	$ -	$ -		46	95	145	195	245	293
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Although there are water rights located on water courses in this basin other than the Rio Grande, these water rights are based to a large extent on irrigation return flows with poor water quality, therefore, the available supply has been set to zero.

	2010	2020	2030	2040	2050	2060
	46	95	145	195	245	293
Surplus/Deficit after WMS's	8,690	7,844	6,947	6,082	5,170	4,231

WATER SUPPLY AND DEMAND ANALYSIS										
CITY OF BROWNSVILLE										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				139722	180,444	218,268	257,460	296,637	335,947	373,453
Total Water Demand (ac-ft)					46,287	55,988	66,042	76,091	86,175	95,795
Plumbing Code Fixture Replacement (ac-ft)					974	1,884	3,051	3,831	4,694	5,212
Net Water Demand (ac-ft)					**45,312**	**54,105**	**62,990**	**72,260**	**81,481**	**90,584**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	865	29,285	MUNI		29,286	29,286	29,286	29,285	29,286	29,285
Groundwater-SRWA		7,800	GW		7,800	7,800	7,800	7,800	7,800	7,800
Total Supply (AF/yr)		**37,085**			**37,086**	**37,086**	**37,086**	**37,085**	**37,086**	**37,085**
Projected Supply Surplus/Deficit					**-8,226**	**-17,019**	**-25,904**	**-35,175**	**-44,395**	**-53,499**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	1,000	$ 214,960.00	$ 214.96		0	1000	1000	1000	1000	1000
Advanced Water Conservation Measures	2,162	$ -	$ -		253	521	798	1074	1350	2162
Non-Potable Water Re-use	500	$ 75,225.00	$ 150.45		0	500	500	500	500	500
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	20,643	$ 3,775,604.70	$ 182.90		20,643	20,643	20,643	20,643	20,643	23,643
Acquisition of Water Rights:										
Purchase	1,923	$ 827,139.99	$ 430.13		0	0	0	0	0	1923
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	129	$ 55,486.77	$ 430.13		0	0	0	0	0	129
Desalination:										
Brackish Groundwater Desalination	17,129	$ 7,966,697.90	$ 465.10		8,414	8,417	8,420	8,424	16,828	17,129
Seawater Desalination	7,013	$ 7,367,927.93	$ 1,050.61		0	0	0	5,600	5,600	7,013
Banco Morales Reservoir	238	$ 604,996.00	$ 2,542.00		238	238	238	238	238	238
Resaca Restoration	877	$ 4,231,525.00	$ 4,825.00		877	877	877	877	877	877
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

COMBES

Year					2010	2020	2030	2040	2050	2060
Total Population				2553	3,089	3,655	4,240	4,823	5,407	5,962
Total Water Demand					225	266	309	351	394	434
Plumbing Code Fixture Replacement (ac-ft)					17.3	36.85	52.24	70.23	84.79	93.5
Net Water Demand (ac-ft)					208	229	256	281	309	341
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	831	429.6	MUNI		430	430	430	430	430	430
Total Supply (AF/yr)		**429.6**			**430**	**430**	**430**	**430**	**430**	**430**
Projected Supply Surplus/Deficit					**222**	**201**	**174**	**149**	**121**	**89**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	25	$ -	$ -		4	8	12	17	21	25
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	25	$ 11,627.50	$ 465.10		0	25	25	25	25	25
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
					226	234	211	190	167	139

*City of Harlingen

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	447	434	385	339	287	227

WATER SUPPLY AND DEMAND ANALYSIS

E. RIO HONDO WSC

Year		2010	2020	2030	2040	2050	2060
Total Population	13741	19,904	26,420	33,155	39,869	46,585	52,973
Total Water Demand		2519	3344	4197	5046	5897	6705
Plumbing Code Fixture Replacement (ac-ft)		111	237	334	491	574	653
Net Water Demand (ac-ft)		2408	3107	3862	4555	5323	6052

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	73, 284, 296, 838, 841, 625, 3269, 692	5,046	MUNI	5,046	5,046	5,046	5,046	5,046	5,046
Groundwater		0	GW						
Total Supply (AF/yr)		**5,046**		**5,046**	**5,046**	**5,046**	**5,046**	**5,046**	**5,046**
Projected Supply Surplus/Deficit				**2,638**	**1,939**	**1,184**	**491**	**-277**	**-1,006**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	243	$ -	$ -		0	46	94	144	193	243
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	95	$ 40,862.35	$ 430.13		0	0	0	0	95	95
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	5	$ 2,150.65	$ 430.13		0	0	0	0	5	5
Desalination:										
Brackish Groundwater Desalination	906	$ 421,380.60	$ 465.10		100	100	100	100	177	906
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					2,738	2,085	1,378	735	193	243

WATER SUPPLY AND DEMAND ANALYSIS

EL JARDIN

Year		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population	8341	10,859	13,521	16,274	19,017	21,761	24,371
Total Water Demand		1,970	2,454	2,953	3,450	3,949	4,423
Plumbing Code Fixture Replacement (ac-ft)		61	121	182	234	293	328
Net Water Demand (ac-ft)		**1,910**	**2,332**	**2,771**	**3,216**	**3,656**	**4,095**

Current Water Supply	**Water Right Number**	**Amount**	**Type**						
Amistad-Falcon Water Right/Contracts*	843	1,600	MUNI	1,600	1,600	1,600	1,600	1,600	1,600
Groundwater		0	GW						
Total Supply (AF/yr)		**1,600**		**1,600**	**1,600**	**1,600**	**1,600**	**1,600**	**1,600**
Projected Supply Surplus/Deficit				**-310**	**-732**	**-1,171**	**-1,616**	**-2,056**	**-2,495**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	119	$ -	$ -		19	38	59	79	99	119
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	2,370	$ 1,019,515.63	$ 430.13		294	696	1,112	1,535	1,953	2,370
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	125	$ 53,658.72	$ 430.13		15	37	59	81	103	125
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Brownsville Irrigation District

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	18	39	59	79	99	119

WATER SUPPLY AND DEMAND ANALYSIS

HARLINGEN

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				57564	69214	79581	90333	101090	111896	122218
Total Water Demand					12,095	13,906	15,785	17,665	19,553	21,357
Plumbing Code Fixture Replacement (ac-ft)					299	600	971	1,300	1,555	1,695
Net Water Demand (ac-ft)					**11,795**	**13,306**	**14,814**	**16,364**	**17,998**	**19,662**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	223, 831, 840, 5254	16,621.0	MUNI		16,621	16,621	16,621	16,621	16,621	16,621
Groundwater		0.0	GW							
Total Supply (AF/yr)		**16,621.0**			16,621	16,621	16,621	16,621	16,621	16,621
Projected Supply Surplus/Deficit					**4,826**	**3,315**	**1,807**	**257**	**-1,377**	**-3,041**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	968	$ -	$ -		68	141	215	290	691	968
Non-Potable Water Re-use	25	$ 3,761.25	$ 150.45		0	0	0	0	25	25
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	125	$ 53,766.25	$ 430.13		0	0	0	0	75	125
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination*	1,923	$ 894,387.30	$ 465.10		0	25	25	25	586	1923
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
*Future Development of Desal. Plant or Wholesale Purchase					68	166	240	315	1,377	3,041
Surplus/Deficit after WMS's					4,894	3,481	2,047	572	0	0

WATER SUPPLY AND DEMAND ANALYSIS

INDIAN LAKE

Year					2010	2020	2030	2040	2050	2060
Total Population				541	699	866	1,039	1,211	1,383	1,547
Total Water Demand					52	64	77	90	102	114
Plumbing Code Fixture Replacement (ac-ft)					3	7	10	14	17	19
Net Water Demand (ac-ft)					**49**	**57**	**66**	**76**	**85**	**95**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	various WRs	30.7	MUNI		31	31	31	31	31	31
Groundwater										
Total Supply (AF/yr)		**30.7**			**31**	**31**	**31**	**31**	**31**	**31**
Projected Supply Surplus/Deficit					**-18**	**-26**	**-35**	**-45**	**-54**	**-64**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	7	$ -	$ -		1	2	4	5	6	7
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	64	$ 29,766.40	$ 465.10		18	27	36	46	54	64
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*supplied by ERHWSC

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1	3	4	6	6	7

WATER SUPPLY AND DEMAND ANALYSIS

LA FERIA

Year		2010	2020	2030	2040	2050	2060
Total Population	6115	7,954	9,898	11,908	13,912	15,916	17,822
Total Water Demand		909	1,131	1,361	1,590	1,818	2,036
Plumbing Code Fixture Replacement (ac-ft)		53	100	147	187	232	260
Net Water Demand (ac-ft)		**855**	**1,031**	**1,214**	**1,403**	**1,587**	**1,777**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	803	2,400.0	MUNI	2,400	2400	2400	2400	2400	2400
Groundwater			GW						
Total Supply (AF/yr)		**2,400.0**		**2,400**	**2,400**	**2,400**	**2,400**	**2,400**	**2,400**
Projected Supply Surplus/Deficit				**1,545**	**1,369**	**1,186**	**997**	**813**	**623**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	10	$ 2,149.60	$ 214.96		0	10	10	10	10	10
Advanced Water Conservation Measures	77	$ -	$ -		14	18	33	48	62	77
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	100	$ 43,013.00	$ 430.13		0	100	100	100	100	100
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination*	180	$ 83,718.00	$ 465.10		0	180	180	180	180	180
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* supplied by La Feria ID Cameron Cty No. 3

*Informed NRS through survey that they are looking into Brackish Desal. as a water supply

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1,559	1,677	1,509	1,335	1,165	990

WATER SUPPLY AND DEMAND ANALYSIS										
LAGUNA MADRE										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				4242	7,725	11,408	15,215	19,010	22,806	26,416
Total Water Demand					2,345	3,463	4,619	5,771	6,923	8,019
Plumbing Code Fixture Replacement (ac-ft)					35	77	102	149	179	207
Net Water Demand (ac-ft)					**2,310**	**3,386**	**4,516**	**5,622**	**6,744**	**7,812**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	850, 5127	7,480.4	MUNI		3,948	3,948	3,948	3,948	3,948	3,948
Groundwater		0.0	GW							
Total Supply (AF/yr)*		7,480.4								
Contracts to Laguna Vista, South Padre, and Port Isabel**		3532								
Total Supply minus contracts		**3948**			**3,948**	**3,948**	**3,948**	**3,948**	**3,948**	**3,948**
Projected Supply Surplus/Deficit					**1,638**	**562**	**-568**	**-1,674**	**-2,796**	**-3,864**
Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	164	$ -	$ -		26	53	81	109	137	164
Non-Potable Water Re-use	50	$ 7,522.50	$ 150.45		50	50	50	50	25	25
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	900	$ 387,117.00	$ 430.13		0	0	48	188	425	900
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	50	$ 21,506.50	$ 430.13		0	0	2	12	25	50
Desalination:										
Brackish Groundwater Desalination	2,000	$ 930,200.00	$ 465.10		100	100	400	1000	1500	2,000
Seawater Desalination	864	$ 907,727.04	$ 1,050.61		100	100	118	424	796	864
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

***Projected supply for 2010-2060 excludes amounts supplied to Laguna Vista, Port Isabel, and South Padre**
****Based on amounts supplied in 2003**

Surplus/Deficit after WMS's	1,914	865	131	110	113	139

WATER SUPPLY AND DEMAND ANALYSIS

LAGUNA VISTA

Year					2010	2020	2030	2040	2050	2060
Total Population				1658	2,651	3,314	4,008	4,705	5,413	6,094
Total Water Demand					341	427	516	606	697	785
Plumbing Code Fixture Replacement (ac-ft)					12	27	40	52	64	72
Net Water Demand (ac-ft)					**329**	**399**	**476**	**554**	**633**	**713**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	850, 5127	1,022.0	MUNI		1,022	1,022	1,022	1,022	1,022	1,022
Groundwater		0.0	GW							
		0.0								
Total Supply (AF/yr)**		**1,022.0**			**1,022**	**1,022**	**1,022**	**1,022**	**1,022**	**1,022**
Projected Supply Surplus/Deficit					**693**	**623**	**546**	**468**	**389**	**309**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	24	$ -	$ -		4	8	12	16	20	24
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	25	$ 26,265.25	$ 1,050.61		25	25	25	25	25	25
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* Supplied by Laguna Madre WD water rights
** Supply based on amount of water supplied in 2003

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	722	656	583	509	434	358

WATER SUPPLY AND DEMAND ANALYSIS

LOS FRESNOS

Year		2010	2020	2030	2040	2050	2060
Total Population	4512	6,649	8,908	11,243	13,571	15,899	18,114
Total Water Demand		797	1,068	1,348	1,627	1,906	2,171
Plumbing Code Fixture Replacement (ac-ft)		29.79	59.87	100.75	136.81	160.28	182.61
Net Water Demand (ac-ft)		**767**	**1,008**	**1,247**	**1,490**	**1,745**	**1,988**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	853	911.7	MUNI	1102	1102	1102	1102	1102	1102
Groundwater		190.0	GW						
Total Supply (AF/yr)		**1,101.7**		**1,102**	**1,102**	**1,102**	**1,102**	**1,102**	**1,102**
Projected Supply Surplus/Deficit				**335**	**94**	**-145**	**-388**	**-643**	**-886**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	101	$ -	$ -		16	32	50	67	84	101
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	997	$ 463,704.70	$ 465.10		0	0	206	474	740	997
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	350	126	110	153	181	211

WATER SUPPLY AND DEMAND ANALYSIS										
LOS INDIOS										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				1149	1,418	1,703	1,997	2,290	2,583	2,862
Total Water Demand					238	286	336	385	434	481
Plumbing Code Fixture Replacement (ac-ft)					8	15	25	31	38	42
Net Water Demand (ac-ft)					**230**	**271**	**311**	**354**	**396**	**439**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*		0.0	MUNI							
Groundwater		230.0	GW		230	271	311	354	396	439
Total Supply (AF/yr)**		**230.0**			**230**	**271**	**311**	**354**	**396**	**439**
Projected Supply Surplus/Deficit					**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	13	$ -	$ -		2	4	6	8	11	13
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by MHWSC
**Projected supply based on MHWSC meeting demand through 2060

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	2	4	6	8	11	13

WATER SUPPLY AND DEMAND ANALYSIS

MILITARY HIGHWAY WSC

Year	Water Right Number	Amount	Type		2010	2020	2030	2040	2050	2060
Total Population				8961	11,440	14,061	16,770	19,471	22,173	24,742
Total Water Demand					1551	1906	2273	2639	3005	3353
Plumbing Code Fixture Replacement (ac-ft)					64	126	207	262	323	360
Net Water Demand (ac-ft)					**1,486**	**1,780**	**2,066**	**2,378**	**2,683**	**2,993**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	284, 285, 286, 831	0.0	MUNI		0	0	0	0	0	0
Groundwater		3,422.0	GW		2,282	2,623	2,804	3,034	3,222	3,422
Supplied to Los Indios					230	271	311	354	396	439
Supplied to Progresso					576	717	867	1,037	1,234	1,436
Total Supply (AF/yr)		3,422.0								
Total Supply (AF/yr) less contracts*					**1,476**	**1,635**	**1,626**	**1,643**	**1,592**	**1,547**
Projected SupplySurplus/Deficit					**-10**	**-145**	**-440**	**-735**	**-1,091**	**-1,446**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	625	$ 134,350.00	$ 214.96		0	125	250	375	500	625
Advanced Water Conservation Measures	61	$ -	$ -		10	20	30	40	51	61
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	700	$ 301,091.00	$ 430.13		0	0	150	300	500	700
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	60	$ 25,807.80	$ 430.13		0	0	10	20	40	60
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
*Available to meet customers other than Los Indios and Progresso	10	145	440	735	1,091	1,446
Surplus/Deficit after WMS's	0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS										
OLMITO WSC										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				4479	7,261	10,203	13,244	16,275	19,307	22,191
Total Water Demand					992	1,394	1,810	2,224	2,638	3,033
Plumbing Code Fixture Replacement (ac-ft)					41	80	119	164	195	224
Net Water Demand (ac-ft)					**952**	**1,314**	**1,691**	**2,060**	**2,444**	**2,809**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	854	995.7	MUNI		996	996	996	996	996	996
Groundwater		0.0	GW							
Total Supply (AF/yr)		**995.7**			**996**	**996**	**996**	**996**	**996**	**996**
Projected Supply Surplus/Deficit					**44**	**-318**	**-695**	**-1,064**	**-1,448**	**-1,813**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	131	$ -	$ -		21	42	65	87	110	131
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,723	$ 741,243.03	$ 430.13		0	303	661	1,011	1,376	1,723
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	91	$ 39,012.79	$ 430.13		0	16	35	53	72	91
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					65	43	66	87	110	132

WATER SUPPLY AND DEMAND ANALYSIS

PALM VALLEY

Year		2010	2020	2030	2040	2050	2060
Total Population	1298	1,400	1,400	1,400	1,400	1,400	1,400
Total Water Demand		420	420	420	420	420	420
Plumbing Code Fixture Replacement (ac-ft)		8	14	20	27	31	33
Net Water Demand (ac-ft)		**412**	**407**	**400**	**393**	**389**	**387**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *	809	331.0	MUNI	331	331	331	331	331	331
Groundwater			GW						
Total Supply (AF/yr)		**331.0**		**331**	**331**	**331**	**331**	**331**	**331**
Projected Supply Surplus/Deficit				**-81**	**-76**	**-69**	**-62**	**-58**	**-56**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	1	$ -	$ -		1	1	1	1	1	1
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	255	$ 109,511.10	$ 430.13		78	116	151	185	220	255
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	13	$ 5,763.74	$ 430.13		4	6	8	10	12	13
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Palm Valley UD and Harlingen ID water right

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	2	47	91	134	175	213

WATER SUPPLY AND DEMAND ANALYSIS

PALM VALLEY ESTATES UD

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				250	344	444	547	650	753	851
Total Water Demand					86	111	137	163	189	214
Plumbing Code Fixture Replacement (ac-ft)					2	3	6	8	9	10
Net Water Demand (ac-ft)					**85**	**108**	**132**	**155**	**180**	**203**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	831	100.0	MUNI		81	94	104	112	119	125
Groundwater		0.0	GW							
Total Supply (AF/yr)		**100.0**			**81**	**94**	**104**	**112**	**119**	**125**
Projected Supply Surplus/Deficit					**-4**	**-14**	**-28**	**-43**	**-61**	**-78**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	4	$ -	$ -		1	1	2	3	4	4
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	75	$ 32,259.75	$ 430.13		3	12	27	41	57	75
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	4	$ 1,720.52	$ 430.13		0	2	1	2	3	4
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* Supplied by Harlingen ID water right

Surplus/Deficit after WMS's	2010	2020	2030	2040	2050	2060
	0	1	2	3	3	5

WATER SUPPLY AND DEMAND ANALYSIS

PORT ISABEL

Year		2010	2020	2030	2040	2050	2060
Total Population	4865	5,282	5,723	6,179	6,633	7,088	7,520
Total Water Demand		2,668	2,891	3,122	3,351	3,581	3,799
Plumbing Code Fixture Replacement (ac-ft)		24	45	69	97	111	118
Net Water Demand (ac-ft)		**2,645**	**2,846**	**3,052**	**3,254**	**3,470**	**3,681**

Current Water Supply	**Water Right Number**	**Amount**	**Type**						
Amistad-Falcon Water Right/Contracts *	850	756.0	MUNI	756	756	756	756	756	756
Groundwater		0.0	GW						
Total Supply (AF/yr)**		**756.0**		**756**	**756**	**756**	**756**	**756**	**756**
Projected Supply Surplus/Deficit				**-1,889**	**-2,090**	**-2,296**	**-2,498**	**-2,714**	**-2,925**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	20	$ -	$ -		3	6	10	13	16	20
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,389	$ 597,407.56	$ 430.13		897	993	1,091	1,187	1,289	1,389
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	73	$ 31,442.50	$ 430.13		47	52	57	62	68	73
Desalination:										
Brackish Groundwater Desalination	1,463	$ 680,441.30	$ 465.10		944	1045	1149	1249	1357	1463
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* Supplied by Laguna Madre WD water rights
** Supply based on amount of water supplied in 2003

Surplus/Deficit after WMS's	2	6	11	13	16	20

WATER SUPPLY AND DEMAND ANALYSIS										
PRIMERA										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				2723	3,973	4,871	5,806	6,748	7,699	8,613
Total Water Demand					632	775	924	1073	1225	1370
Plumbing Code Fixture Replacement (ac-ft)					23	43	67	84	103	115
Net Water Demand (ac-ft)					**609**	**732**	**856**	**989**	**1,121**	**1,255**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	855, 831	400.0	MUNI		400	400	400	400	400	400
Groundwater		0.0	GW							
Total Supply (AF/yr)		**400.0**			**400**	**400**	**400**	**400**	**400**	**400**
Projected Supply Surplus/Deficit					**-209**	**-332**	**-456**	**-589**	**-721**	**-855**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	168	$ 36,113.28	$ 214.96		70	90	120	158	158	168
Advanced Water Conservation Measures	150	$ -	$ -		57	88	107	137	147	150
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	339	$ 145,814.07	$ 430.13		31	68	95	123	211	339
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	85	$ 36,561.05	$ 430.13		0	16	40	60	82	85
Desalination:										
Brackish Groundwater Desalination	124	$ 57,672.40	$ 465.10		51	70	95	111	124	113
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*City of Primera water right, and Harlingen ID contract

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	0	0	1	0	1	0

WATER SUPPLY AND DEMAND ANALYSIS

RANCHO VIEJO

Year					2010	2020	2030	2040	2050	2060
Total Population				1754	2,300	2,350	2,400	2,450	2,500	2,550
Total Water Demand					332	340	347	354	361	368
Plumbing Code Fixture Replacement (ac-ft)					12	28	41	57	67	76
Net Water Demand (ac-ft)					**320**	**311**	**305**	**297**	**295**	**292**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	202	See Valley MUD #2	MUNI		827	827	827	827	827	827
Groundwater: SRWA + VMUD2 Contracts			GW		355	355	355	355	355	355
Total Supply (AF/yr)					**1,182**	**1,182**	**1,182**	**1,182**	**1,182**	**1,182**
Projected Supply Surplus/Deficit**					**862**	**871**	**877**	**885**	**887**	**890**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	6	$ -	$ -		4	4	5	5	6	6
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* Supplied Valley MUD #2 water right
**Surplus/Deficit based on Valley MUD supplying demand through 2060

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	866	875	881	890	892	896

WATER SUPPLY AND DEMAND ANALYSIS

RIO HONDO

Year					2010	2020	2030	2040	2050	2060
Total Population				1942	2,223	2,419	2,623	2,829	3,037	3,238
Total Water Demand					441	480	520	561	602	642
Plumbing Code Fixture Replacement (ac-ft)					12	20	30	41	47	49
Net Water Demand (ac-ft)					**429**	**459**	**490**	**520**	**556**	**593**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	841	890.0	MUNI		890	890	890	890	890	890
Groundwater		0.0	GW							
Total Supply (AF/yr)		**890.0**			**890**	**890**	**890**	**890**	**890**	**890**
Projected Supply Surplus/Deficit					**461**	**431**	**400**	**370**	**334**	**297**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	10	$ -	$ -		2	4	5	7	8	10
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		200	200	200	200	200	200
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					663	635	605	577	542	507

WATER SUPPLY AND DEMAND ANALYSIS

SAN BENITO

Year		2010	2020	2030	2040	2050	2060
Total Population	23444	26,922	30,599	34,400	38,189	41,979	45,584
Total Water Demand		5,036	5,724	6,435	7,144	7,853	8,527
Plumbing Code Fixture Replacement (ac-ft)		121	240	385	513	611	664
Net Water Demand (ac-ft)		**4,916**	**5,484**	**6,050**	**6,630**	**7,241**	**7,863**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *	841	7,032.0	MUNI	7,032	7,032	7,032	7,032	7,032	7,032
Groundwater		0.0	GW						
Total Supply (AF/yr)		**7,032.0**		**7,032**	**7,032**	**7,032**	**7,032**	**7,032**	**7,032**
Projected Supply Surplus/Deficit				**2,116**	**1,548**	**982**	**402**	**-209**	**-831**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	164	$ -	$ -		26	53	81	109	137	164
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	789	$ 339,566.13	$ 430.13		0	0	0	0	200	789.45
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	42	$ 17,871.90	$ 430.13		0	0	0	0	11	41.55
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Cameron County ID #2

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	2,142	1,601	1,063	511	139	164

WATER SUPPLY AND DEMAND ANALYSIS

SANTA ROSA

Year		2010	2020	2030	2040	2050	2060
Total Population	2833	3,472	4,148	4,847	5,543	6,240	6,903
Total Water Demand		350	418	489	559	629	696
Plumbing Code Fixture Replacement (ac-ft)		19	42	60	81	98	108
Net Water Demand (ac-ft)		**331**	**376**	**429**	**478**	**531**	**588**

Current Water Supply	Water Right Number	Amount	Type						
Amistad-Falcon Water Right/Contracts *	803	900.0	MUNI	900	900	900	900	900	900
Groundwater		0.0	GW						
Total Supply (AF/yr)		**900.0**		**900**	**900**	**900**	**900**	**900**	**900**
Projected Supply Surplus/Deficit				**569**	**524**	**471**	**422**	**369**	**312**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	30	$ -	$ -		5	10	15	20	25	30
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied through LaFeria, Cameron County ID #2

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	574	534	486	442	394	342

WATER SUPPLY AND DEMAND ANALYSIS

SOUTH PADRE ISLAND

					2010	2020	2030	2040	2050	2060
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				2422	3,203	4,028	4,881	5,732	6,583	7,392
Total Water Demand					2,526	3,176	3,849	4,520	5,191	5,829
Plumbing Code Fixture Replacement (ac-ft)					22	41	60	77	96	108
Net Water Demand (ac-ft)					**2,504**	**3,136**	**3,789**	**4,443**	**5,095**	**5,722**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	850	1,754.0	MUNI		1,754	1754	1754	1754	1754	1754
Groundwater		0.0	GW							
Total Supply (AF/yr)		**1,754.0**			**1,754**	**1,754**	**1,754**	**1,754**	**1,754**	**1,754**
Projected Supply Surplus/Deficit					**-750**	**-1,382**	**-2,035**	**-2,689**	**-3,341**	**-3,968**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	37	$ -	$ -		6	12	18	24	31	37
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	3,769	$ 1,621,009.42	$ 430.13		713	1,312	1,933	2,555	3,174	3,769
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	198	$ 85,316.29	$ 430.13		38	69	102	134	167	198
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

* Supplied by Laguna Madre WD water rights
** Supply based on amount of water supplied in 2003

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	7	11	18	24	31	36

WATER SUPPLY AND DEMAND ANALYSIS

VALLEY MUD #2

Year		2010	2020	2030	2040	2050	2060
Total Population	1246	1,246	1,246	1,246	1,246	1,246	1,246
Total Water Demand		863	863	863	863	863	863
Plumbing Code Fixture Replacement (ac-ft)		4	8	13	17	20	20
Net Water Demand (ac-ft)		**858**	**854**	**850**	**846**	**843**	**843**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts	own WR		MUNI	656	576	491	408	321	238
Groundwater: SRWA + VMUD2			GW	353	310	264	220	173	129
Total Supply (AF/yr)				**1,009**	**886**	**755**	**628**	**494**	**367**
Projected Supply Surplus/Deficit				**151**	**32**	**-95**	**-218**	**-349**	**-476**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	269	$ 115,704.97	$ 430.13		0	268	269	269	269	269
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	17	$ 7,312.21	$ 430.13		0	6	8	11	14	17
Desalination:										
Brackish Groundwater Desalination	269	$ 125,111.90	$ 465.10		0	268	269	269	269	269
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	151	574	451	331	203	79

WATER SUPPLY AND DEMAND ANALYSIS

ALAMO

Year		2010	2020	2030	2040	2050	2060
Total Population	14760	20,915	28,107	36,163	44,880	54,400	64,166
Total Water Demand		2,413	3,243	4,172	5,178	6,276	7,403
Plumbing Code Fixture Replacement (ac-ft)		94	220	365	503	609	719
Net Water Demand (ac-ft)		**2,319**	**3,022**	**3,808**	**4,675**	**5,667**	**6,684**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	808	1,917.0	MUNI	1,917	1,917	1,917	1,917	1,917	1,917
Groundwater		343.0	GW	343	343	343	343	343	343
Total Supply (AF/yr)		**2,260.0**		**2,260**	**2,260**	**2,260**	**2,260**	**2,260**	**2,260**
Projected Supply Surplus/Deficit				**-59**	**-762**	**-1,548**	**-2,415**	**-3,407**	**-4,424**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	225	$ -	$ -		25	25	25	25	125	225
Non-Potable Water Re-use	500	$ 75,225.00	$ 150.45		34	150	225	300	400	500
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	471	$ 202,591.23	$ 430.13		0	100	200	277	381	471
Urbanization	2,100	$ 903,273.00	$ 430.13		0	400	800	1,330	1,700	2,100
Contract	24	$ 10,323.12	$ 430.13		0	5	10	14	19	24
Desalination:	0				0	0	0	0	0	0
Brackish Groundwater Desalination	1,304	$ 606,490.40	$ 465.10		0	83	288	469	882	1304
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Hidalgo County ID #2
*Current Policy of HCID#2 is to transfer water rights when land is excluded from the district at no charge.

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	0	1	0	0	100	200

WATER SUPPLY AND DEMAND ANALYSIS

ALTON

Year		2010	2020	2030	2040	2050	2060
Total Population	4384	12,342	15,513	19,064	22,907	27,104	31,411
Total Water Demand		3,401	4,275	5,253	6,312	7,469	8,655
Plumbing Code Fixture Replacement (ac-ft)		55	122	192	257	334	387
Net Water Demand (ac-ft)		**3,346**	**4,153**	**5,061**	**6,056**	**7,135**	**8,268**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *	809	3,346.0	MUNI	3,346	4,153	2,615	2,637	2,653	2,666
Groundwater		0.0	GW						
Total Supply (AF/yr)		**3,346.0**		**3,346**	**4,153**	**2,615**	**2,637**	**2,653**	**2,666**
Projected Supply Surplus/Deficit				**0**	**0**	**-2,446**	**-3,419**	**-4,482**	**-5,602**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	5,602	$ -	$ -		59	82	2,446	3,419	4,482	5,602
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Sharyland WSC

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	59	82	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

DONNA

Year					2010	2020	2030	2040	2050	2060
Total Population				14768	17,830	20,419	23,311	26,435	29,839	33,325
Total Water Demand					2536	2905	3316	3761	4245	4741
Plumbing Code Fixture Replacement (ac-ft)					75	150	243	329	402	447
Net Water Demand (ac-ft)					**2,461**	**2,755**	**3,073**	**3,431**	**3,843**	**4,293**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	805	4,190.0	MUNI		4,190	4190	4190	4190	4190	4190
Groundwater		0.0	GW							
Total Supply (AF/yr)		**4,190.0**			**4,190**	**4,190**	**4,190**	**4,190**	**4,190**	**4,190**
Projected Supply Surplus/Deficit					**1,729**	**1,435**	**1,117**	**759**	**347**	**-103**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	25	$ 5,374.00	$ 214.96		0	25	25	25	25	25
Advanced Water Conservation Measures	118	$ -	$ -		15	32	51	72	95	118
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	50	$ 23,255.00	$ 465.10		0	50	50	50	50	50
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Planned to interconnect with NAWSC's Brackish Desalination Plant

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1,744	1,542	1,243	906	517	90

WATER SUPPLY AND DEMAND ANALYSIS

EDCOUCH

Year					2010	2020	2030	2040	2050	2060
Total Population				3342	4,076	4,659	5,311	6,013	6,778	7,562
Total Water Demand					562	642	732	828	934	1,042
Plumbing Code Fixture Replacement (ac-ft)					21	43	65	86	103	115
Net Water Demand (ac-ft)					**540**	**599**	**666**	**743**	**831**	**927**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*		411.0	MUNI		411	411	411	411	411	411
Groundwater		0.0	GW							
Total Supply (AF/yr)		**411.0**			**411**	**411**	**411**	**411**	**411**	**411**
Projected Supply Surplus/Deficit					**-129**	**-188**	**-255**	**-332**	**-420**	**-516**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	156	$ -	$ -		65	70	81	86	121	156
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	360	$ 154,846.80	$ 430.13		65	118	175	246	299	360
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Hidalgo County ID #9
*Amount is from Survey in 2010

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1	0	1	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

EDINBURG

Year					2010	2020	2030	2040	2050	2060
Total Population				48465	71,940	92,789	116,092	141,263	168,699	196,813
Total Water Demand					9,589	12,369	15,475	18,830	22,487	26,235
Plumbing Code Fixture Replacement (ac-ft)					363	752	1,061	1,582	1,893	2,212
Net Water Demand (ac-ft)					**9,227**	**11,617**	**14,414**	**17,248**	**20,594**	**24,023**

Current Water Supply	Water Right Number	Amount	Type		2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	801, 816	7,981.3	MUNI		7981	7981	7981	7981	7981	7981
Groundwater		0.0	GW							
Re-use		7,461.5			7,462	7,462	7,462	7,462	7,462	7,462
Total Supply (AF/yr)		**15,442.9**			**15,443**	**15,443**	**15,443**	**15,443**	**15,443**	**15,443**
Projected Supply Surplus/Deficit					**6,216**	**3,826**	**1,029**	**-1,805**	**-5,151**	**-8,580**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	1,097	$ -	$ -		74	328	500	686	889	1,097
Non-Potable Water Re-use	4,000	$ 601,800.00	$ 150.45		0	0	500	1,500	3,000	4,000
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	6,619	$ 2,847,030.47	$ 430.13		0	0	1,631	3,114	4,591	6,619
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by HCID #1

WATER SUPPLY AND DEMAND ANALYSIS

ELSA

Year		2010	2020	2030	2040	2050	2060
Total Population	5549	6,267	6,710	7,204	7,736	8,313	8,904
Total Water Demand		1,200	1,285	1,380	1,482	1,592	1,706
Plumbing Code Fixture Replacement (ac-ft)		20	48	73	101	116	123
Net Water Demand (ac-ft)		**1,181**	**1,237**	**1,306**	**1,380**	**1,476**	**1,582**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *	812	1,840.0	MUNI	1,840	1,840	1,840	1,840	1,840	1,840
Groundwater		0.0	GW						
Contracts									
Total Supply (AF/yr)		**1,840.0**		**1,840**	**1,840**	**1,840**	**1,840**	**1,840**	**1,840**
Projected Supply Surplus/Deficit				**659**	**603**	**534**	**460**	**364**	**258**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	17	$ -	$ -		2	5	7	10	14	17
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	50	$ 21,506.50	$ 430.13		0	0	0	0	50	50
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	100	$ 46,510.00	$ 465.10		0	100	100	100	100	100
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	105	$ -			105	105	105	105	105	105

*Supplied by HCCID #9

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	766	813	746	675	633	530

WATER SUPPLY AND DEMAND ANALYSIS

HIDALGO

					2010	2020	2030	2040	2050	2060
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				7322	11,675	16,240	21,350	26,875	32,905	39,089
Total Water Demand					1,164	1,619	2,128	2,679	3,281	3,897
Plumbing Code Fixture Replacement (ac-ft)					50	104	184	261	320	380
Net Water Demand (ac-ft)					**1,114**	**1,515**	**1,945**	**2,418**	**2,961**	**3,517**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	857	12.5	MUNI		13	13	13	13	13	13
Groundwater		826.0	GW		1,693	1,693	1,693	1,693	1,693	1,693
Total Supply (AF/yr)		**838.5**			**1,706**	**1,706**	**1,706**	**1,706**	**1,706**	**1,706**
Projected Supply Surplus/Deficit					**592**	**191**	**-240**	**-713**	**-1,256**	**-1,812**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	656	$ 141,013.76	$ 214.96		112	253	354	454	555	656
Advanced Water Conservation Measures	235	$ -	$ -		32	66	104	145	189	235
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	973	$ 418,516.49	$ 430.13		0	0	0	154	558	973
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	51	$ 21,936.63	$ 430.13		0	0	0	8	29	51
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					736	510	219	49	76	104

WATER SUPPLY AND DEMAND ANALYSIS

HIDALGO COUNTY MUD #1

Year		2010	2020	2030	2040	2050	2060
Total Population	3400	5,280	7,476	9,936	12,598	15,505	18,487
Total Water Demand		1,733	2,454	3,261	4,135	5,089	6,067
Plumbing Code Fixture Replacement (ac-ft)		30	67	100	141	174	207
Net Water Demand (ac-ft)		**1,703**	**2,387**	**3,161**	**3,994**	**4,915**	**5,860**

Current Water Supply	Water Right Number	Amount	Type						
Amistad-Falcon Water Right/Contracts	543-001,833-000,833-001,543-022,319-022	573	MUNI	573	573	573	573	573	573
Groundwater		0.0	GW						
Contracts									
Total Supply (AF/yr)		**573.0**		**573**	**573**	**573**	**573**	**573**	**573**
Projected Supply Surplus/Deficit				**-1,130**	**-1,814**	**-2,588**	**-3,421**	**-4,342**	**-5,287**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	112	$ -	$ -		14	30	48	68	89	112
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	4,901	$ 2,108,153.16	$ 430.13		1,051	1,684	2,401	3,173	4,026	4,901
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	274	$ 117,769.59	$ 430.13		66	100	139	181	227	274
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					1	0	0	1	0	0

WATER SUPPLY AND DEMAND ANALYSIS

LA JOYA

Year					2010	2020	2030	2040	2050	2060
Total Population				3303	4,312	5,167	6,122	7,154	8,278	9,428
Total Water Demand					468	562	665	777	899	1,025
Plumbing Code Fixture Replacement (ac-ft)					22	42	69	95	118	134
Net Water Demand (ac-ft)					**447**	**519**	**596**	**683**	**781**	**890**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	864, 802	512.5	MUNI		512	512	512	512	512	512
Groundwater		0.0	GW							
Total Supply (AF/yr)		**512.5**			**512**	**512**	**512**	**512**	**512**	**512**
Projected Supply Surplus/Deficit					**65**	**-7**	**-84**	**-171**	**-269**	**-378**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	73	$ -	$ -		7	14	21	49	62	73
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	185	$ 79,574.05	$ 430.13		0	0	0	2	87	185
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	120	$ 55,812.00	$ 465.10		50	50	100	120	120	120
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Village of LaJoya water right and HCID #16 water right

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	122	57	37	0	0	0

LA VILLA

Year					2010	2020	2030	2040	2050	2060
Total Population				1305	1,361	1,374	1,389	1,405	1,422	1,439
Total Water Demand					250	252	255	258	261	264
Plumbing Code Fixture Replacement (ac-ft)					6	10	15	19	22	22
Net Water Demand (ac-ft)					**244**	**242**	**241**	**239**	**239**	**242**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	812	500.0	MUNI		500	500	500	500	500	500
Groundwater		0.0	GW							
Total Supply (AF/yr)		**500.0**			**500**	**500**	**500**	**500**	**500**	**500**
Projected Supply Surplus/Deficit					**256**	**258**	**259**	**261**	**261**	**258**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	1	$ -	$ -		0	1	1	1	1	1
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by HCCID #9

Surplus/Deficit after WMS's	2010	2020	2030	2040	2050	2060
	256	259	260	262	262	259

WATER SUPPLY AND DEMAND ANALYSIS

MCALLEN

Year					2010	2020	2030	2040	2050	2060
Total Population				106414	132,267	158,046	186,889	218,068	252,084	286,959
Total Water Demand					30,372	36,292	42,915	50,075	57,886	65,895
Plumbing Code Fixture Replacement (ac-ft)					571	1,363	2,012	2,815	3,523	4,009
Net Water Demand (ac-ft)					**29,801**	**34,930**	**40,903**	**47,260**	**54,363**	**61,885**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	343, 846, 848, 808	33,548.8	MUNI		32,428	32,428	32,428	32,428	32,428	32,428
Groundwater		0.0	GW							
Contract to Edinburg		1,120.0								
Total Supply (AF/yr)		**32,428.8**			**32,428**	**32,428**	**32,428**	**32,428**	**32,428**	**32,428**
Projected Supply Surplus/Deficit					**2,627**	**-2,502**	**-8,475**	**-14,832**	**-21,935**	**-29,457**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	1,543	$ 331,683.28	$ 214.96		0	0	487	619	945	1,543
Advanced Water Conservation Measures	3,423	$ -	$ -		191	382	925	1,250	2,177	3,423
Non-Potable Water Re-use	9,893	$ 1,488,401.85	$ 150.45		0	0	0	2,349	5,578	9,893
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	7,345	$ 3,159,304.85	$ 430.13		0	1	999	4,085	5,721	7,345
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	432	$ 185,816.16	$ 430.13		0	0	225	329	393	432
Desalination:										
Brackish Groundwater Desalination	8,821	$ 4,102,647.10	$ 465.10		3,360	3360	6139	6600	8121	8821
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					6,178	1,241	300	400	1,000	2,000

WATER SUPPLY AND DEMAND ANALYSIS

MERCEDES

Year					2010	2020	2030	2040	2050	2060
Total Population				13649	15,775	17,129	18,636	20,260	22,023	23,827
Total Water Demand					2,120	2,302	2,505	2,723	2,960	3,203
Plumbing Code Fixture Replacement (ac-ft)					65	140	207	283	326	350
Net Water Demand (ac-ft)					**2,055**	**2,163**	**2,298**	**2,440**	**2,634**	**2,852**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	823, 812	3,595.0	MUNI		3,595	3,595	3,595	3,595	3,595	3,595
Groundwater		1,691.0	GW		1,691	1,691	1,691	1,691	1,691	1,691
Total Supply (AF/yr)		**5,286.0**			**5,286**	**5,286**	**5,286**	**5,286**	**5,286**	**5,286**
Projected Supply Surplus/Deficit					**3,231**	**3,123**	**2,988**	**2,846**	**2,652**	**2,434**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	560	$ 120,377.60	$ 214.96		0	560	560	560	560	560
Advanced Water Conservation Measures	53	$ -	$ -		7	14	23	32	43	53
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	560	$ 260,456.00	$ 465.10		560	560	560	560	560	560
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					3,798	4,257	4,131	3,998	3,815	3,607

WATER SUPPLY /		
MILITARY		
Year		
Total Population		
Total Water Demand		
Plumbing Code Fixture Replacement (ac-ft)		
Net Water Demand (ac-ft)		
Current Water Supply	**Water Right Number**	**Amount**
Amistad-Falcon Water Right/Contracts		
Groundwater		
Total Supply (AF/yr)		0.0
Projected SupplySurplus/Deficit		
Evaluation of Selected Water Management Strategies		

Strategy	Yield (AF/yr)	Total Annual Cost
Additional Groundwater	625	$ 134,350.00
Advanced Water Conservation Measures	56	$ -
Non-Potable Water Re-use	0	$ -
Potable Water Re-use	0	$ -
Brownsville Weir and Reservoir	0	$ -
Acquisition of Water Rights:		
Purchase	789	$ 339,372.57
Urbanization	0	$ -
Contract	18	$ 7,742.34
Desalination:		
Brackish Groundwater Desalination	0	$ -
Seawater Desalination	0	$ -
Banco Morales Reservoir	0	$ -

Resaca Restoration	0	$	-
Laredo Low Water Weir	0	$	-
Proposed Elsa Tank	0	$	-

Surplus/Deficit after WMS's

AND DEMAND ANALYSIS

HIGHWAY WSC

		2010	2020	2030	2040	2050	2060
		10,364	12,169	14,191	16,379	18,769	21,220
		1405	1649	1923	2220	2544	2877
		58	109	175	220	273	309
		1,346	**1,540**	**1,748**	**2,000**	**2,271**	**2,568**
Type							
MUNI		0	0	0	0	0	0
GW		1,338	1,397	1,326	1,220	1,147	1,080
		1,338	**1,397**	**1,326**	**1,220**	**1,147**	**1,080**
		-8	**-143**	**-422**	**-780**	**-1,124**	**-1,488**

Additional Supply by Decade

Unit Cost ($)		2010	2020	2030	2040	2050	2060
$ 214.96		0	125	250	375	500	625
$ -		8	18	28	38	47	56
$ 150.45		0	0	0	0	0	0
$ 150.45		0	0	0	0	0	0
$ 182.90		0	0	0	0	0	0
$ 430.13		0	0	139	353	561	789
$ 430.13		0	0	0	0	0	0
$ 430.13		0	0	5	14	16	18
$ 465.10		0	0	0	0	0	0
$ 1,050.61		0	0	0	0	0	0
$ 2,542.00		0	0	0	0	0	0

$ 4,825.00		0	0	0	0	0	0
$ 4,460.00		0	0	0	0	0	0
		0	0	0	0	0	0

0 0 0 0 0 0

WATER SUPPLY AND DEMAND ANALYSIS

MISSION

Year		2010	2020	2030	2040	2050	2060
Total Population	45408	68,351	88,532	111,086	135,447	161,998	189,204
Total Water Demand		11408	14776	18540	22606	27038	31578
Plumbing Code Fixture Replacement (ac-ft)		343	713	1122	1646	1973	2309
Net Water Demand (ac-ft)		**11,065**	**14,063**	**17,419**	**20,960**	**25,064**	**29,269**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*	806, 828, 849, 846	9,594.5	MUNI	9,595	9595	9595	9595	9595	9595
Groundwater		0.0	GW						
Total Supply (AF/yr)		**9,594.5**		**9,595**	**9,595**	**9,595**	**9,595**	**9,595**	**9,595**
Projected Supply Surplus/Deficit				**-1,470**	**-4,468**	**-7,824**	**-11,365**	**-15,469**	**-19,674**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	2,135	$ -	$ -		260	637	598	789	1,394	2,135
Non-Potable Water Re-use	5,321	$ 800,544.45	$ 150.45		352	839	1,765	2,780	3,909	5,321
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	12,118	$ 5,212,315.34	$ 430.13		299	2,633	4,901	7,236	10,014	12,118
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	560	$ 260,456.00	$ 465.10		560	560	560	560	560	560
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*City of Mission and United ID

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1	201	0	0	408	460

WATER SUPPLY AND DEMAND ANALYSIS

NORTH ALAMO WSC (Hidalgo County)

Year					2010	2020	2030	2040	2050	2060
Total Population				80960	114,538	153,770	197,713	245,263	297,197	350,473
Total Water Demand					12,317	16,535	21,261	26,374	31,959	37,688
Plumbing Code Fixture Replacement (ac-ft)					642	1,378	2,215	3,022	3,662	4,318
Net Water Demand (ac-ft)					**11,675**	**15,158**	**19,046**	**23,352**	**28,297**	**33,369**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	240, 461, 804, 805, 808, 808, 816		MUNI		19400	19520	19627	19728	19831	19927
Groundwater			GW		1,258	1,265	1,272	1,279	1,286	1,292
Contracts										
Total Supply (AF/yr)					**20,658**	**20,785**	**20,899**	**21,007**	**21,117**	**21,219**
Projected Supply Surplus/Deficit*					**8,983**	**5,627**	**1,853**	**-2,345**	**-7,180**	**-12,150**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	4,000	$ -	$ -		248	538	863	1,215	3,098	4,000
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	902	$ 387,977.26	$ 430.13		0	0	0	0	0	902
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	48	$ 20,646.24	$ 430.13		0	0	0	0	0	48
Desalination:										
Brackish Groundwater Desalination	11,201	$ 5,209,585.10	$ 465.10		11,201	11201	11201	11201	11201	11201
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Based on water supply available for Hidalgo Cty only

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	20,432	17,366	13,917	10,071	7,119	4,001

WATER SUPPLY AND DEMAND ANALYSIS

PALMHURST

Year		2010	2020	2030	2040	2050	2060
Total Population	4872	9,144	14,136	19,727	25,777	32,384	39,162
Total Water Demand		1,168	1,805	2,519	3,292	4,135	5,001
Plumbing Code Fixture Replacement (ac-ft)		10	16	22	29	36	44
Net Water Demand (ac-ft)		**1,157**	**1,789**	**2,497**	**3,263**	**4,099**	**4,957**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *		1,157.0	MUNI	1,157	1789	2706	2967	3170	3324
Groundwater		0.0	GW						
Contracts									
Total Supply (AF/yr)				**1,157**	**1,789**	**2,706**	**2,967**	**3,170**	**3,324**
Projected Supply Surplus/Deficit				**0**	**0**	**209**	**-296**	**-929**	**-1,633**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	254	$ -	$ -		32	68	110	155	203	254
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,551	$ 667,282.18	$ 430.13		0	0	0	281	883	1,551
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	82	$ 35,120.11	$ 430.13		0	0	0	15	46	82
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Sharyland WSC

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	32	68	319	155	203	254

WATER SUPPLY AND DEMAND ANALYSIS

PALMVIEW

Year					2010	2020	2030	2040	2050	2060
Total Population				4107	6,258	8,771	11,586	14,632	17,959	21,372
Total Water Demand					897	1,258	1,661	2,098	2,575	3,064
Plumbing Code Fixture Replacement (ac-ft)					28	59	91	131	161	192
Net Water Demand (ac-ft)					**869**	**1,199**	**1,570**	**1,967**	**2,414**	**2,873**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*		869.0	MUNI		869	1199	1570	1967	1967	1967
Groundwater		0.0	GW							
Total Supply (AF/yr)**		**869.0**			**869**	**1,199**	**1,570**	**1,967**	**1,967**	**1,967**
Projected Supply Surplus/Deficit					**0**	**0**	**0**	**0**	**-447**	**-906**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	128	$ -	$ -		16	34	55	78	102	128
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	860	$ 369,911.80	$ 430.13		0	0	0	0	425	860
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	45	$ 19,484.89	$ 430.13		0	0	0	0	22	45
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by LaJoya WSC
**Total supply based on LaJoya WSC's water supply

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	16	34	55	78	102	127

WATER SUPPLY AND DEMAND ANALYSIS

PENITAS

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				1167	1,261	1,316	1,376	1,441	1,511	1,584
Total Water Demand					161	168	176	184	193	202
Plumbing Code Fixture Replacement (ac-ft)					4	8	14	19	22	23
Net Water Demand (ac-ft)					**157**	**160**	**161**	**165**	**171**	**180**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	860, Various	162.5	MUNI		162	**163**	**163**	**164**	**164**	**164**
Groundwater		0.0	GW							
Total Supply (AF/yr)		**162.5**			**162**	**163**	**163**	**164**	**164**	**164**
Projected Supply Surplus/Deficit					**5**	**3**	**2**	**-1**	**-7**	**-16**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	16	$ -	$ -		1	1	2	2	7	16
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					6	4	4	1	0	0

WATER SUPPLY AND DEMAND ANALYSIS

PHARR

Year		2010	2020	2030	2040	2050	2060
Total Population	46660	65,969	82,640	101,269	121,386	143,309	165,772
Total Water Demand		9,754	12,219	14,974	17,948	21,190	24,511
Plumbing Code Fixture Replacement (ac-ft)		334	669	1,026	1,353	1,745	2,020
Net Water Demand (ac-ft)		**9,420**	**11,550**	**13,948**	**16,595**	**19,445**	**22,491**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts	808, 874	8,676.0	MUNI	8,676	8676	8676	8676	8676	8676
Groundwater		1,120.0	GW	1,120	1,120	1,120	1,120	1,120	1,120
Contracts									
Total Supply (AF/yr)		**9,796.0**		**9,796**	**9,796**	**9,796**	**9,796**	**9,796**	**9,796**
Projected Supply Surplus/Deficit				**376**	**-1,754**	**-4,152**	**-6,799**	**-9,649**	**-12,695**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	250	$ 53,740.00	$ 214.96		100	150	175	200	225	250
Advanced Water Conservation Measures	943	$ -	$ -		143	392	478	589	798	943
Non-Potable Water Re-use	50	$ 7,522.50	$ 150.45		50	50	50	50	50	50
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	8,676	$ 3,731,807.88	$ 430.13		0	698	2478	4721	7086	8895
Urbanization	2,003	$ 861,550.39	$ 430.13		0	400	766	928	1,067	2,003
Contract	554	$ 238,292.02	$ 430.13		0	89	205	311	423	554
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	669	25	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

PROGRESSO

Year		2010	2020	2030	2040	2050	2060
Total Population	4851	6,348	8,097	10,056	12,176	14,491	16,866
Total Water Demand		597	762	946	1,146	1,363	1,587
Plumbing Code Fixture Replacement (ac-ft)		21	45	79	109	130	151
Net Water Demand (ac-ft)		**576**	**717**	**867**	**1,037**	**1,234**	**1,436**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts*		All supply is GW from MHWSC	MUNI						
Groundwater	576		GW	576	717	867	1,037	1,234	1,436
Total Supply (AF/yr)**				**576**	**717**	**867**	**1,037**	**1,234**	**1,436**
Projected Supply Surplus/Deficit				**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	89	$ -	$ -		11	24	38	54	71	89
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by MHWSC
**Total Supply based on meeting demands through 2060

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	11	24	38	54	71	89

WATER SUPPLY AND DEMAND ANALYSIS										
SAN JUAN										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				26229	39,074	54,082	70,892	89,081	108,947	129,327
Total Water Demand					3,720	5,149	6,750	8,482	10,373	12,314
Plumbing Code Fixture Replacement (ac-ft)					219	485	794	1,098	1,342	1,594
Net Water Demand (ac-ft)					**3,501**	**4,665**	**5,956**	**7,384**	**9,031**	**10,720**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	808, 873	3,023.3	MUNI		3,023	3023	3023	3023	3023	3023
Groundwater		0.0	GW							
Total Supply (AF/yr)		**3,023.3**			**3,023**	**3,023**	**3,023**	**3,023**	**3,023**	**3,023**
Projected Supply Surplus/Deficit					**-478**	**-1,642**	**-2,933**	**-4,361**	**-6,008**	**-7,697**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	762	$ -	$ -		95	206	330	465	612	762
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	7,312	$ 3,145,175.08	$ 430.13		454	1,560	2,786	4,143	5,708	7,312
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	385	$ 165,535.53	$ 430.13		24	82	147	218	300	385
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*City of San Juan and HID #2 water rights

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	95	206	330	465	612	762

WATER SUPPLY AND DEMAND ANALYSIS										
SHARYLAND WSC										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				27988	31,885	36,438	41,538	47,057	53,085	59,268
Total Water Demand					5,036	5,755	6,561	7,432	8,384	9,361
Plumbing Code Fixture Replacement (ac-ft)					143	286	465	685	892	996
Net Water Demand (ac-ft)					**4,893**	**5,469**	**6,095**	**6,747**	**7,492**	**8,365**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	809, 816, 846	12,139.6	MUNI		6,517	5078	5698	5416	5196	5030
Groundwater		0.0	GW							
Contract to Edinburg, Palmhurst, Alton		5,623.0								
Total Supply (AF/yr)		**6,516.6**			**6,517**	**5,078**	**5,698**	**5,416**	**5,196**	**5,030**
Projected Supply Surplus/Deficit					**1,624**	**-391**	**-397**	**-1,331**	**-2,296**	**-3,335**

Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	231	$ -	$ -		29	62	100	141	186	231
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	3,168	$ 1,362,759.37	$ 430.13		0	372.4	377.15	1264.45	2181.2	3168.25
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	167	$ 71,724.18	$ 430.13		0	19.6	19.85	66.55	114.8	166.75
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					1,653	63	100	141	186	231

WATER SUPPLY AND DEMAND ANALYSIS

SULLIVAN CITY

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				3998	5,528	7,315	9,317	11,483	13,849	16,276
Total Water Demand					557	737	939	1,158	1,396	1,641
Plumbing Code Fixture Replacement (ac-ft)					31	66	94	141	171	201
Net Water Demand (ac-ft)					**526**	**672**	**845**	**1,016**	**1,226**	**1,440**

Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	859, 521	685.0	MUNI		685	**858**	**1029**	**1029**	**1029**	**1029**
Groundwater		0.0	GW							
Total Supply (AF/yr)		**685.0**			**685**	**858**	**1,029**	**1,029**	**1,029**	**1,029**
Projected Supply Surplus/Deficit					**159**	**186**	**184**	**13**	**-197**	**-411**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	91	$ -	$ -		11	25	39	55	73	91
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	390	$ 167,750.70	$ 430.13		0	0	0	0	186	390
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	21	$ 9,032.73	$ 430.13		0	0	0	0	10	21
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by LaJoya WSC

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	170	211	223	68	72	91

WATER SUPPLY AND DEMAND ANALYSIS

WESLACO

Year	Water Right Number	Amount	Type		2010	2020	2030	2040	2050	2060
Total Population				26935	32,862	37,961	43,658	49,811	56,516	63,385
Total Water Demand					6,074	7,016	8,069	9,206	10,445	11,715
Plumbing Code Fixture Replacement (ac-ft)					173	358	546	725	879	984
Net Water Demand (ac-ft)					**5,901**	**6,658**	**7,523**	**8,481**	**9,566**	**10,731**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	824	5,976.0	MUNI		5,976	5,976	5,976	5,976	5,976	5,976
Groundwater		968.0	GW		968	968	968	968	968	968
Total Supply (AF/yr)		**6,944.0**			**6,944**	**6,944**	**6,944**	**6,944**	**6,944**	**6,944**
Projected Supply Surplus/Deficit					**1,043**	**286**	**-579**	**-1,537**	**-2,622**	**-3,787**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	899	$ 193,249.04	$ 214.96		0	0	0	100	429	899
Advanced Water Conservation Measures	1,048	$ -	$ -		44	82	124	217	793	1,048
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	1,290	$ 194,080.50	$ 150.45		1,120	1120	1120	1120	1150	1290
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	100	$ 43,013.00	$ 430.13		0	0	0	0	0	100
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	100	$ 43,013.00	$ 430.13		0	0	0	0	0	100
Desalination:										
Brackish Groundwater Desalination	350	$ 162,785.00	$ 465.10		100	100	100	100	250	350
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

***City of Weslaco and HCCID #9 water rights**

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	2,307	1,588	765	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

HEBBRONVILLE

Year					2010	2020	2030	2040	2050	2060
Total Population				4498	4,764	5,098	5,354	5,569	5,509	5,302
Total Water Demand					747	799	840	873	864	831
Plumbing Code Fixture Replacement (ac-ft)					16	40	60	81	86	83
Net Water Demand (ac-ft)					**731**	**759**	**780**	**792**	**778**	**748**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts			MUNI							
Groundwater*		900.0	GW		900	900	900	900	900	900
Total Supply (AF/yr)		**900.0**			**900**	**900**	**900**	**900**	**900**	**900**
Projected Supply Surplus/Deficit					**169**	**141**	**120**	**108**	**122**	**152**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	8	$ -	$ -		2	4	6	8	7	6
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Based on well capacity of 0.8 MGD

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	171	145	126	116	129	158

WATER SUPPLY AND DEMAND ANALYSIS

EAGLE PASS

Year					2010	2020	2030	2040	2050	2060
Total Population				22413	26,160	28,212	30,238	32,116	33,937	35,559
Total Water Demand					5,509	5,941	6,368	6,763	7,147	7,488
Plumbing Code Fixture Replacement (ac-ft)					80	198	299	406	454	468
Net Water Demand (ac-ft)					**5,429**	**5,743**	**6,069**	**6,358**	**6,693**	**7,020**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	3998, 2671	8,667.0	MUNI		7,414	**7414**	**7414**	**7414**	**7414**	**7414**
Groundwater		0.0	GW							
Contract to El Indio WSC		1,253.0								
Total Supply (AF/yr)		**7,414.0**			**7,414**	**7,414**	**7,414**	**7,414**	**7,414**	**7,414**
Projected Supply Surplus/Deficit					**1,985**	**1,671**	**1,345**	**1,056**	**721**	**394**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	55	$ -	$ -		10	21	31	40	48	55
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination**	641	$ 298,129.10	$ 465.10		0	260	260	260	272	641
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*City of Eagle Pass and Maverick County WID water rights

** Desal as an option in the future as indicated in survey

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	1,995	1,952	1,636	1,356	1,041	1,090

WATER SUPPLY AND DEMAND ANALYSIS

EL INDIO WSC

Year		2010	2020	2030	2040	2050	2060
Total Population	5235	6,994	8,855	10,615	12,140	13,536	14,668
Total Water Demand		1,293	1,637	1,962	2,244	2,502	2,711
Plumbing Code Fixture Replacement (ac-ft)		39	69	107	136	167	181
Net Water Demand (ac-ft)		**1,253**	**1,567**	**1,855**	**2,108**	**2,335**	**2,530**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts		1,253.0	MUNI	1,253	1567	1855	2108	2335	2530
Groundwater		0.0	GW						
Total Supply (AF/yr)		**1,253.0**		**1,253**	**1,567**	**1,855**	**2,108**	**2,335**	**2,530**
Projected Supply Surplus/Deficit				**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	70	$ -	$ -		13	27	40	51	61	70
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1	$ 430.13	$ 430.13		1	1	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ 21.51	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	14	28	40	51	61	70

WATER SUPPLY AND DEMAND ANALYSIS

LA GRULLA

Year					2010	2020	2030	2040	2050	2060
Total Population				1211	1,640	1,746	1,862	1,985	2,116	2,249
Total Water Demand					871	927	989	1,054	1,123	1,194
Plumbing Code Fixture Replacement (ac-ft)					4	8	12	16	19	19
Net Water Demand (ac-ft)					**867**	**919**	**976**	**1,038**	**1,104**	**1,175**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	863	522.1	MUNI		522	522	522	522	522	522
Groundwater		0.0	GW							
Total Supply (AF/yr)		**522.1**			**522**	**522**	**522**	**522**	**522**	**522**
Projected Supply Surplus/Deficit					**-345**	**-397**	**-454**	**-516**	**-582**	**-653**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	183	$ 39,337.68	$ 214.96		50	75	112	155	159	183
Advanced Water Conservation Measures	64	$ -	$ -		20	25	30	35	56	64
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	304	$ 130,759.52	$ 430.13		243	252	259	270	279	304
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	102	$ 43,873.26	$ 430.13		32	45	54	56	88	102
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					0	0	1	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

RIO GRANDE CITY

					2010	2020	2030	2040	2050	2060
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				11923	14,982	16,674	18,447	20,259	22,090	23,878
Total Water Demand					3,021	3,362	3,719	4,085	4,454	4,814
Plumbing Code Fixture Replacement (ac-ft)					59	128	174	245	283	302
Net Water Demand (ac-ft)					**2,962**	**3,234**	**3,545**	**3,840**	**4,171**	**4,513**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	851	2,736.0	MUNI		2,479	2479	2479	2479	2479	2479
Groundwater		0.0	GW							
Contracts to El Tanque, El Salz, Rio WSC		257.2								
Total Supply (AF/yr)		**2,478.8**			**2,479**	**2,479**	**2,479**	**2,479**	**2,479**	**2,479**
Projected Supply Surplus/Deficit					**-483**	**-755**	**-1,066**	**-1,361**	**-1,692**	**-2,034**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	115	$ 24,720.40	$ 214.96		0	10	50	50	87	115
Advanced Water Conservation Measures	155	$ -	$ -		23	35	48	78	120	155
Non-Potable Water Re-use	125	$ 18,806.25	$ 150.45		0	10	50	60	87	125
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	141	$ 60,648.33	$ 430.13		5	14	24	50	84	141
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	1,498	$ 696,719.80	$ 465.10		560	1120	1120	1123	1314	1498
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					105	434	226	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

RIO WSC

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				2076	2,942	3,868	4,821	5,782	6,729	7,638
Total Water Demand					498	654	815	978	1,138	1,292
Plumbing Code Fixture Replacement (ac-ft)					13	30	43	65	75	86
Net Water Demand (ac-ft)					**484**	**624**	**772**	**913**	**1,063**	**1,206**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	339, 851	310.0	MUNI		310	310	310	310	310	310
Groundwater		0.0	GW							
Total Supply (AF/yr)		**310.0**			**310**	**310**	**310**	**310**	**310**	**310**
Projected Supply Surplus/Deficit					**-174**	**-314**	**-462**	**-603**	**-753**	**-896**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	41	$ -	$ -		6	13	20	27	34	41
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	851	$ 366,126.66	$ 430.13		166	298	439	573	715	851
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	45	$ 19,269.82	$ 430.13		9	16	23	30	38	45
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Rio WSC water right and contract from Rio Grande City

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	7	13	20	27	34	41

WATER SUPPLY AND DEMAND ANALYSIS

ROMA CITY

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				9617	11,989	13,791	15,661	17,559	19,449	21,277
Total Water Demand					3,008	3,460	3,930	4,406	4,880	5,339
Plumbing Code Fixture Replacement (ac-ft)					62	128	192	250	295	321
Net Water Demand (ac-ft)					**2,946**	**3,333**	**3,737**	**4,156**	**4,585**	**5,017**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	730, 814	2,841.2	MUNI		2,842	**2842**	**2842**	**2842**	**2842**	**2842**
Groundwater		0.0	GW							
Total Supply (AF/yr)		**2,841.2**			**2,842**	**2,842**	**2,842**	**2,842**	**2,842**	**2,842**
Projected Supply Surplus/Deficit					**-104**	**-491**	**-895**	**-1,314**	**-1,743**	**-2,175**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	120	$ -	$ -		39	61	75	80	104	120
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,967	$ 846,065.71	$ 430.13		65	410	784	1183	1564	1967
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	88	$ 37,851.44	$ 430.13		0	20	36	51	75	88
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

Surplus/Deficit after WMS's	2010	2020	2030	2040	2050	2060
	0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

EL CENIZO

Year					2010	2020	2030	2040	2050	2060
Total Population				3545	5,929	8,729	11,865	15,315	19,085	23,068
Total Water Demand					697	1,027	1,396	1,801	2,245	2,713
Plumbing Code Fixture Replacement (ac-ft)					27	59	93	137	171	207
Net Water Demand (ac-ft)					**671**	**968**	**1,302**	**1,664**	**2,074**	**2,506**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	2720	879.9	MUNI		880	910	927	938	946	952
Groundwater		0.0	GW							
Total Supply (AF/yr)**		**879.9**			**880**	**910**	**927**	**938**	**946**	**952**
Projected Supply Surplus/Deficit					**209**	**-58**	**-375**	**-726**	**-1,128**	**-1,554**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	144	$ -	$ -		18	38	62	87	115	144
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	1,476	$ 635,000.92	$ 430.13		0	56.05	357.2	688.75	1071.6	1476.3
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	78	$ 33,421.10	$ 430.13		0	2.95	18.8	36.25	56.4	77.7
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Webb County Water Utility
**Projected supply based on Webb County Water Utility supply

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	227	39	63	86	115	144

WATER SUPPLY AND DEMAND ANALYSIS

LAREDO

Year				2000	2010	2020	2030	2040	2050	2060
Total Population				176,576	234,423	302,377	378,468	462,176	553,670	650,317
Total Water Demand					52,517	67,741	84,788	103,541	124,038	145,690
Plumbing Code Fixture Replacement (ac-ft)					1,050	2,710	4,239	5,695	7,442	8,741
Net Water Demand (ac-ft)					**51,467**	**65,032**	**80,548**	**97,846**	**116,596**	**136,948**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	3997	46,037.1	MUNI		46,037	46037	46037	46037	46037	46037
Groundwater		137.0	GW		462.0	3,409.0	5,723.0	6,296.0	6,296.0	6,296.0
Total Supply (AF/yr)		**46,174.1**			**46,499**	**49,446**	**51,760**	**52,333**	**52,333**	**52,333**
Projected Supply Surplus/Deficit					**-4,968**	**-15,586**	**-28,788**	**-45,513**	**-64,263**	**-84,615**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	7,920	$ 1,702,483.20	$ 214.96		800	799	7,920	7,920	7,919	7,918
Advanced Water Conservation Measures	3,502	$ -	$ -		428	930	1,493	2,111	2,788	3,502
Non-Potable Water Re-use	12,123	$ 1,823,905.35	$ 150.45		1,120	5,600	5,600	6,521	6,522	12,123
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	49,863	$ 21,447,572.19	$ 430.13		1,425	2,524	7,766	18,367	36,313	49,863
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	1,109	$ 477,014.17	$ 430.13		75	133	409	494	621	1,109
Desalination:										
Brackish Groundwater Desalination	10,100	$ 4,697,510.00	$ 465.10		1,120	5,600	5,600	10,100	10,100	10,100
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

RIO BRAVO

Year					2010	2020	2030	2040	2050	2060
Total Population				5553	8,318	11,566	15,203	19,205	23,579	28,199
Total Water Demand					1,137	1,581	2,078	2,625	3,222	3,854
Plumbing Code Fixture Replacement (ac-ft)					47	91	153	215	264	316
Net Water Demand (ac-ft)					**1,090**	**1,490**	**1,924**	**2,409**	**2,958**	**3,538**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts*	2720	1,234.4	MUNI		**1,234**	**1,205**	**1,188**	**1,177**	**1,169**	**1,164**
Groundwater		0.0	GW							
Contracts										
Total Supply (AF/yr)		**1,234.4**			**1,234**	**1,205**	**1,188**	**1,177**	**1,169**	**1,164**
Projected Supply Surplus/Deficit*					**144**	**-285**	**-736**	**-1,232**	**-1,789**	**-2,374**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	167	$ -	$ -		20	44	71	101	133	167
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	2,256	$ 970,480.81	$ 430.13		0	270.75	700.15	1171.35	1699.55	2256.25
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	119	$ 51,077.94	$ 430.13		0	14.25	36.85	61.65	89.45	118.75
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Webb County Water Utility

**Projected supply based on Webb County Water Utility supply

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	164	44	72	102	133	168

WATER SUPPLY AND DEMAND ANALYSIS

WEBB COUNTY WATER UTILITY

Year		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population	851	1,326	1,884	2,509	3,197	3,949	4,743
Total Water Demand		247	350	467	594	734	882
Plumbing Code Fixture Replacement (ac-ft)		7	15	25	36	44	53
Net Water Demand (ac-ft)		**239**	**336**	**441**	**559**	**690**	**829**

Current Water Supply	**Water Right Number**	**Amount**	**Type**						
Amistad-Falcon Water Right/Contracts	2720	2,311.1	MUNI	197	196	196	196	196	196
Groundwater		0.0	GW						
Contract to Rio Bravo and El Cenizo		2,114.0							
Total Supply (AF/yr)		**197.1**		**197**	**196**	**196**	**196**	**196**	**196**
Projected Supply Surplus/Deficit				**-42**	**-140**	**-245**	**-363**	**-494**	**-633**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	29	$ -	$ -		4	8	12	17	23	29
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	591	$ 254,206.83	$ 430.13		41	132	234	334	459	591
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	32	$ 13,764.16	$ 430.13		2	7	12	18	25	32
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

Surplus/Deficit after WMS's 5 7 13 6 13 19

WATER SUPPLY AND DEMAND ANALYSIS

LYFORD

Year		2010	2020	2030	2040	2050	2060
Total Population	1973	2,335	2,512	2,684	2,839	2,972	3,076
Total Water Demand		343	369	394	417	436	451
Plumbing Code Fixture Replacement (ac-ft)		9	17	26	35	39	39
Net Water Demand (ac-ft)		**333**	**351**	**368**	**382**	**398**	**412**

Current Water Supply	Water Right Number	Amount	Type	2010	2020	2030	2040	2050	2060
Amistad-Falcon Water Right/Contracts *	811, 821	980.3	MUNI	980	980	980	980	980	980
Groundwater		0.0	GW						
Total Supply (AF/yr)		**980.3**		**980**	**980**	**980**	**980**	**980**	**980**
Projected Supply Surplus/Deficit				**647**	**629**	**612**	**598**	**582**	**568**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	4	$ -	$ -		1	2	3	3	4	4
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	100	$ 43,013.00	$ 430.13		0	100	100	100	100	100
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination*	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Delta Lake ID
*Interconnect with Willacy Desal. Plant

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	648	731	715	701	686	672

WATER SUPPLY AND DEMAND ANALYSIS

NORTH ALAMO WSC (Willacy County)

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				5696	7,187	8,649	9,981	11,052	11,781	12,141
Total Water Demand					773	930	1,073	1,188	1,267	1,306
Plumbing Code Fixture Replacement (ac-ft)					40	78	112	136	145	150
Net Water Demand (ac-ft)					**733**	**853**	**961**	**1,052**	**1,122**	**1,156**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts			MUNI		1,217	1098	991	889	786	690
Groundwater			GW		79	71	64	58	51	51
Total Supply (AF/yr)		**1,296.2**			**1,296**	**1,169**	**1,055**	**947**	**837**	**741**
Projected Supply Surplus/Deficit*					**563**	**316**	**94**	**-105**	**-285**	**-415**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	48	$ -	$ -		11	22	32	40	45	48
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	11,201	$ 5,209,585.10	$ 465.10		11,201	11201	11201	11201	11201	11201
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Based on water available for Willacy County only

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	11,775	11,539	11,327	11,136	10,961	10,834

WATER SUPPLY AND DEMAND ANALYSIS

RAYMONDVILLE

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				9733	10,071	10,402	10,704	10,947	11,112	11,194
Total Water Demand					1,726	1,783	1,834	1,876	1,904	1,918
Plumbing Code Fixture Replacement (ac-ft)					**45**	**82**	**120**	**159**	**174**	**176**
Net Water Demand (ac-ft)					1,681	1,701	1,715	1,717	1,730	1,743
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	811	5,670.0	MUNI		5,670	5670	5670	5670	5670	5670
Groundwater		0.0	GW							
Total Supply (AF/yr)		**5,670.0**			**5,670**	**5,670**	**5,670**	**5,670**	**5,670**	**5,670**
Projected Supply Surplus/Deficit					**3,989**	**3,969**	**3,955**	**3,953**	**3,940**	**3,927**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	11	$ -	$ -		2	5	7	9	10	11
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination*	100	$ 46,510.00	$ 465.10		0	100	100	100	100	100
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by Delta Lake ID
*Interconnect with Willacy Desal. Plant

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	3,991	4,074	4,062	4,062	4,050	4,038

WATER SUPPLY AND DEMAND ANALYSIS										
SAN PERLITA										
Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				680	747	812	871	919	952	968
Total Water Demand					109	118	127	134	139	141
Plumbing Code Fixture Replacement (ac-ft)					3	6	10	13	15	15
Net Water Demand (ac-ft)					**105**	**112**	**117**	**120**	**124**	**126**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *		120.0	MUNI		120	120	120	120	120	120
Groundwater		0.0	GW							
Total Supply (AF/yr)		**120.0**			**120**	**120**	**120**	**120**	**120**	**120**
Projected Supply Surplus/Deficit					**15**	**8**	**3**	**0**	**-4**	**-6**
Evaluation of Selected Water Management Strategies					**Additional Supply by Decade**					
Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	2	$ -	$ -		0	1	1	2	2	2
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination*	25	$ 11,627.50	$ 465.10		25	25	25	25	25	25
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

*Supplied by NAWSC
*Interconnect with NAWSC Desal. Plant

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	40	34	29	27	23	21

WATER SUPPLY AND DEMAND ANALYSIS

SEBASTIAN MUD

Year					**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Population				1615	2,038	2,452	2,830	3,134	3,340	3,442
Total Water Demand					267	321	371	411	438	451
Plumbing Code Fixture Replacement (ac-ft)					11	25	38	49	56	58
Net Water Demand (ac-ft)					**256**	**297**	**333**	**362**	**382**	**393**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts *	803	300.0	MUNI		300	300	300	300	300	300
Groundwater		0.0	GW							
Total Supply (AF/yr)		**300.0**			**300**	**300**	**300**	**300**	**300**	**300**
Projected Supply Surplus/Deficit					**44**	**3**	**-33**	**-62**	**-82**	**-93**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	14	$ -	$ -		3	6	9	11	13	14
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	88	$ 38,001.99	$ 430.13		0	0	31.35	58.9	77.9	88.35
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	5	$ 2,000.10	$ 430.13		0	0	1.65	3.1	4.1	4.65
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0

***Supplied by LaFeria ID, CCID #3**

	2010	2020	2030	2040	2050	2060
Surplus/Deficit after WMS's	47	9	9	11	13	14

WATER SUPPLY AND DEMAND ANALYSIS

ZAPATA

Year					2010	2020	2030	2040	2050	2060
Total Population				4856	4,856	4,856	4,856	4,856	4,856	4,856
Total Water Demand					1,050	1,050	1,050	1,050	1,050	1,050
Plumbing Code Fixture Replacement (ac-ft)					16	33	49	65	76	76
Net Water Demand (ac-ft)					**1,033**	**1,017**	**1,001**	**985**	**974**	**974**
Current Water Supply	**Water Right Number**	**Amount**	**Type**							
Amistad-Falcon Water Right/Contracts	803, 2804, 2806	1,905.2	MUNI		1,905	1905	1905	1905	1905	1905
Groundwater		0.0	GW							
Total Supply (AF/yr)		**1,905.2**			**1,905**	**1,905**	**1,905**	**1,905**	**1,905**	**1,905**
Projected Supply Surplus/Deficit					**872**	**888**	**904**	**920**	**931**	**931**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acquisition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract	0	$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
Surplus/Deficit after WMS's					872	888	904	920	931	931

WATER SUPPLY AND DEMAND ANALYSIS

Wholesale Water Providers: Summary

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		241723	241688	241688	241689	241688	241695
Current Water Supply	**Source**						
Total Supply (AF/yr)		**281,320**	**234,839**	**234,839**	**234,842**	**234,840**	**234,847**
Projected Supply Surplus/Deficit		**39,597**	**-6,849**	**-6,849**	**-6,847**	**-6,848**	**-6,848**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	150	350	588	875	1450
Advanced Water Conservation Measures	2,878	$ -	$ -		381	815	1,290	1,795	2,334	2,878
Non-Potable Water Re-use	17,734	$ 2,668,080.30	$ 150.45		0	447	4047	7950	13128	17734
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	12,608	$ 5,423,079.04	$ 430.13		0	955	2864	5796	8290	12608
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	50	151	305	434	661
Desalination:										
Brackish Groundwater Desalination	20,642	$ 9,600,594.20	$ 465.10		18,189	18742	19042	19642	20142	20642
Seawater Desalination	864	$ 907,727.04	$ 1,050.61		100	100	118	424	796	864
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
On-Farm Conservation	100	$ 25,338.00	$ 253.38		100	100	100	100	100	100
Conveyance System Conservation	100	$ 12,068.00	$ 120.68		100	100	100	100	100	100

WATER SUPPLY AND DEMAND ANALYSIS

Brownsville Irrigation District

Year		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		6105	6071	6071	6071	6071	6071
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	6,071	6071	6071	6072	6072	6071
Ground Water	GULF COAST	39	39	39	39	39	39
Total Supply (AF/yr)		**6,110**	**6,110**	**6,110**	**6,111**	**6,111**	**6,110**
Projected Supply Surplus/Deficit		**5**	**39**	**39**	**40**	**40**	**39**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:	0									
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
On-Farm Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Brownsville Irrigation District

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		15198	15198	15198	15198	15198	15198
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	15,198	15198	15198	15198	15198	15198
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**15,198**	**15,198**	**15,198**	**15,198**	**15,198**	**15,198**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:	0									
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0
Laredo Low Water Weir	0	$ -	$ 4,460.00		0	0	0	0	0	0
Proposed Elsa Tank	0	$ -			0	0	0	0	0	0
On-Farm Conservation	0	$ -	$ 253.38		0	0	0	0	0	0
Conveyance System Conservation	0	$ -	$ 120.68		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Delta Lake Municipal Authority

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		8200	8200	8200	8200	8200	8200
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	8,200	8200	8200	8200	8200	8200
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**8,200**	**8,200**	**8,200**	**8,200**	**8,200**	**8,200**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:	0									
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Donna Irrigation District Hidalgo County #1

Year	Source	2010	2020	2030	2040	2050	2060
Total Water Demand		6880	6880	6880	6880	6880	6880
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	18,980	6880	6880	6880	6880	6880
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**18,980**	**6,880**	**6,880**	**6,880**	**6,880**	**6,880**
Projected Supply Surplus/Deficit		**12,100**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:	0									
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Eagle Pass

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		7707	7707	7707	7707	7707	7707

Current Water Supply	Source						
Surface Water	AMISTAD/FALCON	7,707	7707	7707	7707	7707	7707
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**7,707**	**7,707**	**7,707**	**7,707**	**7,707**	**7,707**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	55	$ -	$ -		10	21	31	40	48	55
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:	0									
Brackish Groundwater Desalination	260	$ 120,926.00	$ 465.10		0	260	260	260	260	260
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Harlingen

Year	Source	2010	2020	2030	2040	2050	2060
Total Water Demand		19238	19238	19238	19238	19238	19238
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	19,238	19238	19238	19238	19238	19238
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**19,238**	**19,238**	**19,238**	**19,238**	**19,238**	**19,238**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	435	$ -	$ -		68	141	215	290	364	435
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	50	$ 21,506.50	$ 430.13		0	0	0	0	50	50
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	25	$ 11,627.50	$ 465.10		0	25	25	25	25	25
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo County Irrigation District #6

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		8291	8291	8291	8291	8291	8291
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	8,291	8291	8291	8291	8291	8291
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**8,291**	**8,291**	**8,291**	**8,291**	**8,291**	**8,291**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo County WCID #1

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		1437	1437	1437	1437	1437	1437
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	1,437	1437	1437	1437	1437	1437
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**1,437**	**1,437**	**1,437**	**1,437**	**1,437**	**1,437**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo County WCID #16

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		1047	1047	1047	1047	1047	1047
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	1,047	1047	1047	1047	1047	1047
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**1,047**	**1,047**	**1,047**	**1,047**	**1,047**	**1,047**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo County WCID #2

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		24667	24667	24667	24667	24667	24667
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	59,047	24667	24667	24667	24667	24667
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**59,047**	**24,667**	**24,667**	**24,667**	**24,667**	**24,667**
Projected Supply Surplus/Deficit		**34,380**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo County WCID #3

Year	Source	2010	2020	2030	2040	2050	2060
Total Water Demand		13980	13980	13980	13980	13980	13980
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	13,980	13980	13980	13980	13980	13980
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**13,980**	**13,980**	**13,980**	**13,980**	**13,980**	**13,980**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Hidalgo-Cameron WCID #9

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		11500	11500	11500	11500	11500	11500
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	11,500	11500	11500	11500	11500	11500
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**11,500**	**11,500**	**11,500**	**11,500**	**11,500**	**11,500**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

La Feria WCID #3

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		4852	4852	4852	4852	4852	4852
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	4,852	4852	4852	4852	4852	4852
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**4,852**	**4,852**	**4,852**	**4,852**	**4,852**	**4,852**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SU

Year

Total Water Demand

Current Water Supply

Surface Water
Ground Water

Total Supply (AF/yr)

Projected Supply Surplus/Deficit

Evaluation of Selected Water Management Strategies

Strategy	Yield (AF/yr)
Additional Groundwater	0
Advanced Water Conservation Measures	0
Non-Potable Water Re-use	0
Potable Water Re-use	0
Brownsville Weir and Reservoir	0
Acqusition of Water Rights:	
Purchase	0
Urbanization	0
Contract	
Desalination:	
Brackish Groundwater Desalination	0
Seawater Desalination	0
Banco Morales Reservoir	0
Resaca Restoration	0
Laredo Low Water Weir	0
Proposed Elsa Tank	0
On-Farm Conservation	0
Conveyance System Conservation	0

JPPLY AND DEMAND ANALYSIS

La Joya WSC

	2010	2020	2030	2040
	1554	2057	2599	2996

Source				
AMISTAD/FALCON	1,554	2057	2599	2996
GULF COAST	0	0	0	0
	1,554	**2,057**	**2,599**	**2,996**
	0	**0**	**0**	**0**

Additional Supply by De

Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040
$ -	$ 214.96		0	0	0	0
$ -	$ -		0	0	0	0
$ -	$ 150.45		0	0	0	0
$ -	$ 150.45		0	0	0	0
$ -	$ 182.90		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 465.10		0	0	0	0
$ -	$ 1,050.61		0	0	0	0
$ -	$ 2,542.00		0	0	0	0
$ -	$ 4,825.00		0	0	0	0
$ -	$ 4,460.00		0	0	0	0
$ -			0	0	0	0
$ -	$ 253.38		0	0	0	0
$ -	$ 120.68		0	0	0	0

2050	2060
2996	2996
2996	2996
0	0
2,996	**2,996**
0	**0**

ecade

2050	2060
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0

WATER SUPPLY AND DEMAND ANALYSIS

Laguna Madre WD

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		7480	7480	7480	7480	7480	7480
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	7,480	7480	7480	7480	7480	7480
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**7,480**	**7,480**	**7,480**	**7,480**	**7,480**	**7,480**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	164	$ -	$ -		26	53	81	109	137	164
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	950	$ 408,623.50	$ 430.13		0	0	48	238	475	950
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	2	12	25	50
Desalination:										
Brackish Groundwater Desalination	2,000	$ 930,200.00	$ 465.10		100	100	400	1,000	1,500	2,000
Seawater Desalination	864	$ 907,727.04	$ 1,050.61		100	100	118	424	796	864
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

McAllen

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		33548	33548	33548	33548	33548	33548
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	33,548	33548	33548	33548	33548	33548
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**33,548**	**33,548**	**33,548**	**33,548**	**33,548**	**33,548**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	150	350	588	875	1,450
Advanced Water Conservation Measures	164	$ -	$ -		26	53	81	109	137	164
Non-Potable Water Re-use	17,734	$ 2,668,080.30	$ 150.45		0	447	4,047	7,950	13,128	17,734
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	7,221	$ 3,105,968.73	$ 430.13		0	499	2,280	4,085	5,321	7,221
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	26	120	215	280	380
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SU

Year

Total Water Demand

Current Water Supply

Surface Water
Ground Water

Total Supply (AF/yr)

Projected Supply Surplus/Deficit

Evaluation of Selected Water Management Strategies

Strategy	Yield (AF/yr)
Additional Groundwater	0
Advanced Water Conservation Measures	0
Non-Potable Water Re-use	0
Potable Water Re-use	0
Brownsville Weir and Reservoir	0
Acqusition of Water Rights:	
Purchase	0
Urbanization	0
Contract	
Desalination:	
Brackish Groundwater Desalination	0
Seawater Desalination	0
Banco Morales Reservoir	0
Resaca Restoration	0
Laredo Low Water Weir	0
Proposed Elsa Tank	0
On-Farm Conservation	0
Conveyance System Conservation	0

JPPLY AND DEMAND ANALYSIS

Military Highway WSC

	2010	2020	2030	2040	2050
	3620	4020	4130	4254	4369

Source					
AMISTAD/FALCON					
GULF COAST	3,620	4020	4130	4254	4369
	3,620	**4,020**	**4,130**	**4,254**	**4,369**
	0	**0**	**0**	**0**	**0**

Additional Supply by Decade

Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050
$ -	$ 214.96		0	0	0	0	0
$ -	$ -		0	0	0	0	0
$ -	$ 150.45		0	0	0	0	0
$ -	$ 150.45		0	0	0	0	0
$ -	$ 182.90		0	0	0	0	0
$ -	$ 430.13		0	0	0	0	0
$ -	$ 430.13		0	0	0	0	0
$ -	$ 430.13		0	0	0	0	0
$ -	$ 465.10		0	0	0	0	0
$ -	$ 1,050.61		0	0	0	0	0
$ -	$ 2,542.00		0	0	0	0	0
$ -	$ 4,825.00		0	0	0	0	0
$ -	$ 4,460.00		0	0	0	0	0
$ -			0	0	0	0	0
$ -	$ 253.38		0	0	0	0	0
$ -	$ 120.68		0	0	0	0	0

2060
4502
4502
4,502
0
2060
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WATER SUPPLY AND DEMAND ANALYSIS

North Alamo WSC

Year		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand		22218	22218	22218	22218	22218	22224
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	22,218	22218	22218	22218	22218	22224
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**22,218**	**22,218**	**22,218**	**22,218**	**22,218**	**22,224**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	**Yield (AF/yr)**	**Total Annual Cost**	**Unit Cost ($)**		**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	1,993	$ -	$ -		248	538	863	1,215	1,599	1,993
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	902	$ 387,977.26	$ 430.13		0	0	0	0	0	902
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	48
Desalination:										
Brackish Groundwater Desalination	11,201	$ 5,209,585.10	$ 465.10		11,201	11,201	11,201	11,201	11,201	11,201
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Sharyland WSC

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		12140	12139	12139	12140	12139	12140
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	12,140	12139	12139	12140	12139	12140
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**12,140**	**12,139**	**12,139**	**12,140**	**12,139**	**12,140**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	231	$ -	$ -		29	62	100	141	186	231
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	3,168	$ 1,362,651.84	$ 430.13		0	343	377	1,264	2,181	3,168
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	18	20	67	115	167
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS						
Southmost Regional Water Authority						
Year	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Total Water Demand	11844	11844	11844	11844	11844	11844

Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	0	0	0	0	0	0
Ground Water	GULF COAST	4,956	4956	4956	4956	4956	4956
Total Supply (AF/yr)		**4,956**	**4,956**	**4,956**	**4,956**	**4,956**	**4,956**
Projected Supply Surplus/Deficit		**-6,888**	**-6,888**	**-6,888**	**-6,888**	**-6,888**	**-6,888**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	6,888	$ 3,203,608.80	$ 465.10		6,888	6,888	6,888	6,888	6,888	6,888
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

United Irrigation District

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		24009	24009	24009	24009	24009	24009
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	24009	24009	24009	24009	24009	24009
Ground Water	GULF COAST	0	0	0	0	0	0
Total Supply (AF/yr)		**24,009**	**24,009**	**24,009**	**24,009**	**24,009**	**24,009**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**0**	**0**	**0**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	0	$ -	$ 430.13		0	0	0	0	0	0
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	0	0	0	0	0
Desalination:										
Brackish Groundwater Desalination	0	$ -	$ 465.10		0	0	0	0	0	0
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SUPPLY AND DEMAND ANALYSIS

Valley MUD #2

Year		2010	2020	2030	2040	2050	2060
Total Water Demand		1382	1382	1382	1382	1382	1382
Current Water Supply	**Source**						
Surface Water	AMISTAD/FALCON	898	898	899	899	898	898
Ground Water	GULF COAST	484	484	483	484	484	485
Total Supply (AF/yr)		**1,382**	**1,382**	**1,382**	**1,383**	**1,382**	**1,383**
Projected Supply Surplus/Deficit		**0**	**0**	**0**	**1**	**0**	**1**

Evaluation of Selected Water Management Strategies — **Additional Supply by Decade**

Strategy	Yield (AF/yr)	Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040	2050	2060
Additional Groundwater	0	$ -	$ 214.96		0	0	0	0	0	0
Advanced Water Conservation Measures	0	$ -	$ -		0	0	0	0	0	0
Non-Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Potable Water Re-use	0	$ -	$ 150.45		0	0	0	0	0	0
Brownsville Weir and Reservoir	0	$ -	$ 182.90		0	0	0	0	0	0
Acqusition of Water Rights:										
Purchase	317	$ 136,351.21	$ 430.13		0	113	159	209	263	317
Urbanization	0	$ -	$ 430.13		0	0	0	0	0	0
Contract		$ -	$ 430.13		0	6	9	11	14	16
Desalination:										
Brackish Groundwater Desalination	268	$ 124,646.80	$ 465.10		0	268	268	268	268	268
Seawater Desalination	0	$ -	$ 1,050.61		0	0	0	0	0	0
Banco Morales Reservoir	0	$ -	$ 2,542.00		0	0	0	0	0	0
Resaca Restoration	0	$ -	$ 4,825.00		0	0	0	0	0	0

WATER SU
W

Year

Total Water Demand

Current Water Supply
Surface Water
Ground Water
Total Supply (AF/yr)
Projected Supply Surplus/Deficit

Evaluation of Selected Water Management Strategies

Strategy	Yield (AF/yr)
Additional Groundwater	0
Advanced Water Conservation Measures	0
Non-Potable Water Re-use	0
Potable Water Re-use	0
Brownsville Weir and Reservoir	0
Acqusition of Water Rights:	
Purchase	0
Urbanization	0
Contract	
Desalination:	
Brackish Groundwater Desalination	0
Seawater Desalination	0
Banco Morales Reservoir	0
Resaca Restoration	0
Laredo Low Water Weir	0
Proposed Elsa Tank	0
On-Farm Conservation	0
Conveyance System Conservation	0

JPPLY AND DEMAND ANALYSIS

ebb County Water Utility

	2010	2020	2030	2040
	2311	2311	2311	2311

Source	2010	2020	2030	2040
AMISTAD/FALCON	2311	2311	2311	2311
GULF COAST	0	0	0	0
	2,311	**2,311**	**2,311**	**2,311**
	0	**0**	**0**	**0**

Additional Supply by De

Total Annual Cost	Unit Cost ($)		2010	2020	2030	2040
$ -	$ 214.96		0	0	0	0
$ -	$ -		0	0	0	0
$ -	$ 150.45		0	0	0	0
$ -	$ 150.45		0	0	0	0
$ -	$ 182.90		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 430.13		0	0	0	0
$ -	$ 465.10		0	0	0	0
$ -	$ 1,050.61		0	0	0	0
$ -	$ 2,542.00		0	0	0	0
$ -	$ 4,825.00		0	0	0	0
$ -	$ 4,460.00		0	0	0	0
$ -			0	0	0	0
$ -	$ 253.38		0	0	0	0
$ -	$ 120.68		0	0	0	0

2050	2060
2311	2312

2311	2312
0	0
2,311	**2,312**
0	**0**

ecade

2050	2060
0	0
0	0
0	0
0	0
0	0

0	0
0	0
0	0

0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
	Use Types: 1 = muni; 2 =industrial; 3 = irrigation; 4 =mining; 11 = Domestic and livestock; 5 = hydroelectric; 6 = Navigation; 7 = Recreation; 8 = Other; 9 = Recharge; 13 = Storage				
66	EAST RIO HONDO WSC	Cameron	17.59	23	1
67	EAST RIO HONDO WSC	Cameron	40	23	1
72	FALCON RURAL WSC	Cameron	85	23	1
73	EAST RIO HONDO WSC	Cameron	70	23	1
81	LA JOYA WSC	Cameron	750.0525	23	1
151	BOCA CHICA WATER SUPPLY INC	Cameron	20	23	1
202	VALLEY MUD 2	Cameron	898	23	1
217	LEONEL BAZAN	Cameron	7.52	23	1
223	CITY OF HARLINGEN	Cameron	162	23	1
284	EAST RIO HONDO WSC	Cameron	75	23	1
296	EAST RIO HONDO WSC	Cameron	21.3	23	1
339	RIO WSC	Cameron		23	1
461	NORTH ALAMO WSC	Cameron		23	1
461	EPHRAIM L BLOCK	Cameron	62.5	23	1
625	ARROYO WSC	Cameron	60	23	1
817	SANTA MARIA ID CAMERON CO 4	Cameron	60	23	1
821	CITY OF LYFORD	Cameron	370.325	23	1
831	HARLINGEN IRR DIST	Cameron	18320	23	1
831	MILITARY HIGHWAY WSC	Cameron	613.63315	23	1
831	CITY OF HARLINGEN WATERWORKS SYSTEM	Cameron	1875	23	1
838	CAMERON CO WID #16	Cameron	189	23	1
838	EAST RIO HONDO WSC	Cameron	515	23	1
838	EAST RIO HONDO WSC	Cameron	1337.262	23	1
840	CITY OF HARLINGEN	Cameron	131.1725	23	1
841	CAMERON CO IRR DIST NO 2	Cameron	5500	23	1
841	CAMERON CO IRR DIST NO 2	Cameron	4767.5	23	1
841	CAMERON CO IRR DIST NO 2	Cameron	890	23	1
841	CAMERON CO IRR DIST NO 2	Cameron	750	23	1
841	EAST RIO HONDO WSC	Cameron	750	23	1
843	BROWNSVILLE IRRIGATION DISTRICT	Cameron	6071	23	1
850	LAGUNA MADRE WATER DISTRICT	Cameron	3450.348	23	1
850	LAGUNA MADRE WATER DISTRICT	Cameron	3750	23	1
853	CITY OF LOS FRESNOS	Cameron	911.6546	23	1
854	OLMITO WATER SUPPLY CORP	Cameron	995.71	23	1
855	TOWN OF PRIMERA	Cameron	400	23	1
865	BROWNSVILLE PUBLIC UTIL BOARD	Cameron	29285.111	23	1
1980	BROWNSVILLE PUBLIC UTIL BOARD	Cameron	40000	23	1
3269	U S IMMIGRATION-NATURALIZATION	Cameron	268	23	1
4548	BAYVIEW IRR DIST 11	Cameron	45	22	1
5127	LAGUNA MADRE WATER DISTRICT	Cameron	180	22	1
240	NORTH ALAMO WSC	Hidalgo	5991.17	23	1
240	NORTH ALAMO WSC	Hidalgo	260	23	1
284	MILITARY HIGHWAY WSC	Hidalgo	164	23	1
285	MILITARY HIGHWAY WSC	Hidalgo	260	23	1
286	MILITARY HIGHWAY WSC	Hidalgo	66	23	1
339	RIO WSC	Hidalgo	200	23	1
353	MCALLEN, CITY OF	Hidalgo	678.84	23	1
461	NORTH ALAMO WSC	Hidalgo	3750	23	1
521	LA JOYA WSC	Hidalgo	250	23	1
543	HIDALGO COUNTY MUD NO. 1	Hidalgo	84.0425	23	1

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
582	FALCON RURAL WSC	Hidalgo	85	23	1
582	RIO WSC	Hidalgo	79	23	1
801	CITY OF EDINBURG	Hidalgo	2591.32	23	1
802	HIDALGO COUNTY IRR DIST 16	Hidalgo	1500	23	1
803	LA FERIA ID CAMERON CO 3	Hidalgo	1800	23	1
803	LA FERIA ID CAMERON CO 3	Hidalgo	900	23	1
803	LA FERIA ID CAMERON CO 3	Hidalgo	300	23	1
805	DONNA ID HIDALGO CO 1	Hidalgo	4190	23	1
806	CITY OF MISSION	Hidalgo	1169.54	23	1
808	HIDALGO CO IRR DIST 2	Hidalgo	11777.5	23	1
808	CITY OF PHARR	Hidalgo	1764	23	1
808	NORTH ALAMO WSC	Hidalgo	1198	23	1
809	ENGLEMAN IRRIGATION DISTRICT	Hidalgo	518.475	23	1
809	PALM VALLEY EST UTILITY DIST	Hidalgo	312.5	23	1
809	SHARYLAND WSC	Hidalgo	5583.4783	23	1
809	SHARYLAND WSC	Hidalgo	566.158	23	1
811	DELTA LAKE IRR DIST	Hidalgo	610	23	1
811	DELTA LAKE IRR DIST	Hidalgo	600	23	1
811	DELTA LAKE IRR DIST	Hidalgo	5670	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	1500	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	2580	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	5240	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	1340	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	1840	23	1
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	500	23	1
816	HIDALGO CO IRR DIST 1	Hidalgo	5390	23	1
816	HIDALGO CO IRR DIST 1	Hidalgo	625	23	1
821	CITY OF LYFORD	Hidalgo		23	1
823	MERCEDES, CITY OF	Hidalgo	1015	23	1
824	CITY OF WESLACO	Hidalgo	736.25	23	1
828	HIDALGO CO IRR DIST NO 6	Hidalgo	5816	23	1
828	CITY OF MISSION	Hidalgo	1250	23	1
833	HIDALGO CO MUD 1	Hidalgo	300	23	1
835	CALPINE CONSTR FINANCE CO LP	Hidalgo	250	23	1
846	UNITED IRRIGATION DISTRICT	Hidalgo	5000	23	1
846	UNITED IRRIGATION DISTRICT	Hidalgo	8125	23	1
846	UNITED IRRIGATION DISTRICT	Hidalgo	1190	23	1
848	HIDALGO CO WID 3	Hidalgo	5000	23	1
848	HIDALGO CO WID 3	Hidalgo	8980	23	1
849	UNITED IRRIGATION DISTRICT	Hidalgo	5300	23	1
852	TOWN OF LA BLANCA	Hidalgo	12.5	23	1
857	TOWN OF HIDALGO	Hidalgo	12.5	23	1
858	TOWN OF LOS EBANOS	Hidalgo	12.5	23	1
859	TOWN OF SULLIVAN CITY	Hidalgo	12.5	23	1
860	TOWN OF PENITAS	Hidalgo	12.5	23	1
864	VILLAGE OF LA JOYA	Hidalgo	12.5	23	1
873	CITY OF SAN JUAN	Hidalgo	316.275	23	1
874	CITY OF PHARR	Hidalgo	1083.88	23	1
3268	U S DEPT AGRI - ANIMAL & PLANT	Hidalgo	100	23	1
3998	CITY OF EAGLE PASS	Maverick	7707.4252	23	1
108	UNION WSC	Starr	75.5	23	1
232	UNION WSC	Starr	100	23	1

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
251	UNION WSC	Starr	125	23	1
284	UNION WSC	Starr	51.25	23	1
339	RIO WSC	Starr		23	1
521	LA JOYA WSC	Starr		23	1
603	FALCON RURAL WSC	Starr	10	23	1
640	UNION WATER SUPPLY CORP	Starr	79.49	23	1
646	FALCON RURAL WSC	Starr	10	23	1
673	FALCON RURAL WSC	Starr	20	23	1
675	FALCON RURAL WSC	Starr	14	23	1
699	FALCON RURAL WSC	Starr	25	23	1
730	CITY OF ROMA	Starr	7.38	23	1
814	CITY OF ROMA	Starr	2833.8	23	1
851	STARR CO WCID 2 MUD	Starr	2982.606	23	1
861	TOWN OF FRONTON	Starr	12.5	23	1
862	TOWN OF GARCENO	Starr	12.5	23	1
863	CITY OF LA GRULLA	Starr	522.0532	23	1
2428	A C DURIVAGE ET UX	Webb	0.5	23	1
2435	CLARENCE HOLT ET UX	Webb	0.5	23	1
2720	COUNTY OF WEBB	Webb	307	23	1
2720	COUNTY OF WEBB	Webb	2004.067	23	1
3997	LAREDO, CITY OF	Webb	42711.2138	23	1
3997	LAREDO, CITY OF	Webb		23	1
3997	LAREDO, CITY OF	Webb		23	1
3997	LAREDO, CITY OF	Webb	3325.875	23	1
7	PORT MANSFIELD PUD	Willacy	50	23	1
7	LEONEL BAZAN	Willacy	23.2	23	1
32	SUNNYDEW W S C	Willacy	4	23	1
138	SUNNYDEW WATER SUPPLY CORP	Willacy	50	23	1
201	PORT MANSFIELD PUD	Willacy	100	23	1
201	WILLACY CO NAVIGATION DIST	Willacy	100	23	1
461	NORTH ALAMO WSC	Willacy		23	1
248	MARY JANE COX GREEN	Zapata	5.5	23	1
339	RIO WSC	Zapata		23	1
346	SIESTA SHORES WCID	Zapata	165	23	1
461	SIESTA SHORES INC	Zapata	62.5	23	1
803	ZAPATA CO WCID	Zapata	105	23	1
2423	ALBERT J LONG	Zapata	0.5	23	1
2426	DONALD L HAYES	Zapata	0.5	23	1
2426	LENDOL C BARKER	Zapata	0.5	23	1
2430	RICHARD GARZA ET UX	Zapata	1	23	1
2719	HOWARD R LIETZ ET UX	Zapata	5	23	1
2752	FAR POINT ESTATE	Zapata	3	23	1
2785	SAN YGNACIO MUD	Zapata	233.75	23	1
2801	BEULAH M BALLARD	Zapata	9.5	23	1
2801	ORVILLE BALLARD	Zapata	0.5	23	1
2803	DELUXE HOMES INC	Zapata	4	23	1
2804	ZAPATA COUNTY WATER WORKS	Zapata	1784.2	23	1
2806	ZAPATA COUNTY WATER WORKS	Zapata	16	23	1
2807	JAMES W. WOLFE	Zapata	3	23	1
2808	DAVID G DELORME ET UX	Zapata	7.7	23	1
2809	DAVID G DELORME ET UX	Zapata	8	23	1
2810	JUAN A GUEVARA ET UX	Zapata	1	23	1

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3270	INTERNATL BOUNDARY & WTR COMM	Zapata	150	23	1
625	ARROYO WSC	Cameron		23	2
829	CAMERON CO IRR DIST NO 6	Cameron	20	23	2
838	EAST RIO HONDO WSC	Cameron		23	2
841	CAMERON CO IRR DIST NO 2	Cameron	2400	23	2
854	OLMITO WATER SUPPLY CORP	Cameron		23	2
865	BROWNSVILLE PUBLIC UTIL BOARD	Cameron		23	2
1980	BROWNSVILLE PUBLIC UTIL BOARD	Cameron		23	2
4550	HARLINGEN SHRIMP FARMS LTD	Cameron	35970	22	2
5254	CITY OF HARLINGEN	Cameron	2240	22	2
27	AEP TEXAS CENTRAL COMPANY	Hidalgo	600	23	2
294	AEP TEXAS CENTRAL COMPANY	Hidalgo	375	23	2
313	HIDALGO, COUNTY OF	Hidalgo	15.255	23	2
806	CITY OF MISSION	Hidalgo		23	2
807	VALLEY ACRES IRRIGATION DIST	Hidalgo	200	23	2
808	HIDALGO CO IRR DIST 2	Hidalgo	13273	23	2
809	SHARYLAND WSC	Hidalgo		23	2
816	HIDALGO CO IRR DIST 1	Hidalgo		23	2
816	HIDALGO CO IRR DIST 1	Hidalgo		23	2
828	HIDALGO CO IRR DIST NO 6	Hidalgo		23	2
835	CALPINE CONSTR FINANCE CO LP	Hidalgo		23	2
841	AEP TEXAS CENTRAL COMPANY	Hidalgo	1500	23	2
844	TEXAS DEPT OF TRANSPORTATION	Hidalgo	2124.253	23	2
846	UNITED IRRIGATION DISTRICT	Hidalgo		23	2
846	UNITED IRRIGATION DISTRICT	Hidalgo		23	2
870	TEXAS PLASTICS INC	Hidalgo	100	23	2
3268	U S DEPT AGRI - ANIMAL & PLANT	Hidalgo	500	23	2
4520	VALLEY ACRES IRRIGATION DIST	Hidalgo	300	22	2
116	DOS REPUBLICAS COAL PARTNERSHP	Maverick	113.62	23	2
2720	COUNTY OF WEBB	Webb		23	2
2727	AEP TEXAS CENTRAL COMPANY	Webb	1644.5	23	2
2727	AEP TEXAS CENTRAL COMPANY	Webb		23	2
3997	LAREDO, CITY OF	Webb		23	2
4533	TEXAS UNITED FISHERIES INC	Willacy	3250	22	2
10	EL SABINO INC	Cameron	368.415	23	3
12	PLAYA DEL RIO INC	Cameron	162.5	23	3
14	JAMES S BENSON	Cameron	150	23	3
19	JOE DAVIS BALLENGER	Cameron	98.75	23	3
20	EZEQUIEL CORTEZ	Cameron	1.804	23	3
20	RAUL C CORTEZ	Cameron	17.198	23	3
20	JOSE A GOMEZ ET AL	Cameron	12.048	23	3
20	CARLOS MARTINEZ ET UX	Cameron	0.798	23	3
20	SANTIAGO CORTEZ ET UX	Cameron	1.382	23	3
20	MID-STATE HOMES INC	Cameron	0.381	23	3
20	PEDRO CORTEZ ET UX	Cameron	0.444	23	3
20	JOSE A CORTEZ ET UX	Cameron	0.635	23	3
20	JUAN FRANCISCO RUIZ ET UX	Cameron	19.103	23	3
20	ROBERTA S CISNEROS	Cameron	13.81	23	3
20	ENRIQUE PENA	Cameron	16.201	23	3
20	DAVID CHARLES HINKEL ET UX	Cameron	16.201	23	3
20	ELISEO RUIZ ET UX	Cameron	25.854	23	3
20	STEPHEN G FIEDLER ET UX	Cameron	12.047	23	3

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20	JOSE CARDENAS	Cameron	12.048	23	3
20	ROMULO CASTILLO ET UX	Cameron	13.807	23	3
20	PEDRO A LOPEZ	Cameron	13.972	23	3
20	BOONE LA GRANGE	Cameron	13.813	23	3
20	ERNESTO S DAVILA DDS	Cameron	16.204	23	3
20	DANIEL GUSTAFSON	Cameron	6.675	23	3
21	ANTONIO M DIAZ JR	Cameron	87.675	23	3
22	EDUARDO BENAVIDES	Cameron	63.5	23	3
24	CHARLES SHOFNER	Cameron	1630	23	3
25	ESTATE OF RUBY O BENSON	Cameron	1036	23	3
29	MIGUEL A ORTIZ ET AL	Cameron	335	23	3
30	TERESA C GUERRA RESIDUARY TRST	Cameron	362.5	23	3
31	ALFREDO CANTU ET AL	Cameron	17.75	23	3
32	JESUS M CASTELLANO ET UX	Cameron	64.1	23	3
33	CARLOS ALONZO LOZANO ET AL	Cameron	283.863	23	3
33	RAUL TIJERINA JR ET AL	Cameron	190.487	23	3
34	F D CATHCART III	Cameron	275	23	3
35	TOMAS GARCIA ET UX	Cameron	153.488	23	3
35	JESUS A ZAVALETA ET UX	Cameron	153.488	23	3
35	ADRIANNA LAURA GARCIA ET AL	Cameron	76.744	23	3
35	VIDAL LONGORIA MD	Cameron	31.28	23	3
36	JESUS CASTELLANO	Cameron	111.312	23	3
36	MANUELA CAVAZOS ESCAMILLA	Cameron	14.344	23	3
36	JOSEFA CAVAZOS MONTEMAYOR	Cameron	8.606	23	3
37	MADEIRA PROPERTIES LTD	Cameron	231.25	23	3
38	SAUL FRED GARZA	Cameron	1.775	23	3
38	ROEL R RODRIGUEZ	Cameron	1.775	23	3
39	LEONEL GARZA JR ET AL	Cameron	95	23	3
40	RAUL CAVAZOS	Cameron	425	23	3
42	LA GRULLA, CITY OF	Cameron	32.775	23	3
42	ESTATE OF HOWARD K CUMMINS	Cameron	1.9	23	3
44	ROMEO R ESPARZA	Cameron	372.17	23	3
44	MARIA GUADALUPE OCAMPO ESPARZA	Cameron	87.345	23	3
46	SERVANDO DE LA GARZA	Cameron	52.5	23	3
47	MARIA DEL SOCORRO H DEL BOSQUE	Cameron	21.3	23	3
48	MATEO CORTEZ JR	Cameron	40	23	3
49	BELIA R COY ET AL	Cameron	112.5	23	3
51	CAMERON CO IRR DIST 2	Cameron	13.725	23	3
52	ARNOLDO GEORGE	Cameron	13.125	23	3
54	ESPERANZA G DE LA ROSA ET VIR	Cameron	70	23	3
55	ESTATE OF AMELIA VERA DE LEON	Cameron	17.5	23	3
56	ESTATE OF AMELIA VERA DE LEON	Cameron	225	23	3
57	ESTATE OF AMELIA VERA DE LEON	Cameron	55	23	3
58	AMELIA V DE LEON	Cameron	200	23	3
59	AMELIA V DE LEON	Cameron	150	23	3
62	MANUEL DOMINGUEZ	Cameron	9.25	23	3
63	FRANCIS L PHILLIPP ET UX	Cameron	229.475	23	3
64	ALBERTO G GARZA JR ET UX	Cameron	125	23	3
65	THELMA A DAWSON	Cameron	1829.825	23	3
65	THELMA A DAWSON TRUSTEE	Cameron	45.175	23	3
66	ENCANTADA FARMING INTERESTS INC	Cameron	182.95	23	3
66	ALBERTO G GARZA JR ET UX	Cameron	71.75	23	3

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67	JOSE M ESCAMILLA ET AL	Cameron	30.14	23	3
67	RENE L ESCAMILLA	Cameron	28.85	23	3
68	LIEVEN J VAN RIET	Cameron	28.894	23	3
68	J D ESPARZA	Cameron	69.731	23	3
69	THE NATURE CONSERVANCY	Cameron	50	23	3
71	ISRAEL LIZKA ET AL	Cameron	297.5	23	3
72	RICARDO ORTIZ	Cameron	116.714	23	3
72	MIGUEL A ORTIZ	Cameron	383.7875	23	3
72	MIGUEL ORTIZ ET UX	Cameron	133.7875	23	3
72	VALLEY MUD #2	Cameron	6011.25	23	3
72	FREEDOM PROPERTIES OF TX INC	Cameron	315.85	23	3
73	RICARDO ORTIZ	Cameron	217.862	23	3
73	MIGUEL A ORTIZ	Cameron	655.4125	23	3
73	MIGUEL A ORTIZ ET UX	Cameron	318.6365	23	3
73	VALLEY MUNICIPAL UTILITY DISTRICT NO 2	Cameron	91.375	23	3
75	THE NATURE CONSERVANCY	Cameron	240.375	23	3
75	THE NATURE CONSERVANCY	Cameron	18.625	23	3
76	ESTATE OF ENRIQUE GALVAN	Cameron	236.2	23	3
77	J A GARCIA JR ET AL	Cameron	107.5	23	3
78	AMELIA LONGORIA ET AL	Cameron	13.175	23	3
78	RICARDO EVERETT ET AL	Cameron	17.625	23	3
79	HORACIO GARCIA	Cameron	40	23	3
80	LUCINDA GARCIA ET AL	Cameron	205	23	3
80	OMADEE BARTON GARCIA ET AL	Cameron		23	3
80	JOSE GUADALUPE GARCIA ET AL	Cameron		23	3
82	JORGE J GARCIA ET UX	Cameron	62.5	23	3
83	JORGE J GARCIA ET UX	Cameron	62.5	23	3
84	RAMIRO S GARCIA ET UX	Cameron	45	23	3
85	ABELARDO RIVERA ET AL	Cameron	62.5	23	3
87	JESUS GARZA	Cameron	68.77	23	3
87	BELEN GARZA CAVAZOS ET VIR	Cameron	5.83	23	3
87	IDOLINA GARZA WEAVER ET VIR	Cameron	4.3	23	3
87	VALERIANO HERNANDEZ	Cameron	4.3	23	3
87	GONZALO GARZA	Cameron	4.3	23	3
88	MARIA LINDA GARZA	Cameron	22	23	3
89	FIRST ORO MANAGEMENT INC	Cameron	387.5	23	3
90	EDUARDO GAVITO ET AL	Cameron	312.5	23	3
90	PATRICIA NYE HARDING ET AL	Cameron	150	23	3
91	JOSEFA T CASTELLANO	Cameron	49.76	23	3
91	LEAL'S FARM INC	Cameron	196.74	23	3
92	PAUL ALEXANDER WEAVER JR	Cameron	12.5	23	3
96	GLOOR DEVELOPMENT CORP	Cameron	49.25	23	3
97	MARIA COY DE GOMEZ	Cameron	77.5	23	3
98	JUAN FERMIN LEAL ET AL	Cameron	35	23	3
100	MARIA COY GOMEZ ET AL	Cameron	87.5	23	3
101	JOHN BECKER TRUSTEE	Cameron	247.5	23	3
103	CAYETANO GONZALEZ	Cameron	37.5	23	3
105	PINE TREE CONSERVATION SOCIETY	Cameron	547.5	23	3
106	EST OF WALTER M JEFFORDS JR ET AL CO-TI	Cameron	1975	23	3
107	DULANEY FARMS LTD	Cameron	250	23	3
109	CHARLES L SHOFNER	Cameron	375	23	3
111	HERBERT M WILLIAMS TRUSTEE	Cameron	8.1265	23	3

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111	JOSE G GARZA ET UX	Cameron	26.4565	23	3
111	GRACE SUMMERFIELD-KLINKHAMER	Cameron	2.077	23	3
114	LUISA P LEAL ET AL	Cameron	62.5	23	3
115	LLOYD E HORN ET UX	Cameron	65	23	3
117	RANKIN COMPANY	Cameron	125	23	3
117	GHONSHAM SOOKNANDAN	Cameron		23	3
117	WALTER L BEEGLE ET UX	Cameron		23	3
119	KINCANNON FARMS PARTNERSHIP	Cameron	1493.75	23	3
120	PLAYA WSC	Cameron	115	23	3
121	ROBERT C WELLS	Cameron	105	23	3
123	ESTATE OF MARGARET D HOLLON ET AL	Cameron	232.88	23	3
123	ROBERT R MATHERS	Cameron		23	3
123	WORLD RADIO MISSIONARY FELLOWSHIP INC	Cameron	7.32	23	3
126	U S FISH & WILDLIFE SERVICE	Cameron	19837.0886	23	3
126	U S FISH & WILDLIFE SERVICE	Cameron	1848.365	23	3
127	VIDAL LONGORIA	Cameron	187.5	23	3
130	VIDAL LONGORIA	Cameron	192.5	23	3
131	JOSE LOPEZ	Cameron	139.75	23	3
135	MATHERS BROTHERS FARMS INC	Cameron	1127.835	23	3
137	NCNB TEXAS NATIONAL BANK	Cameron	50	23	3
137	F E BUTLER TRUSTEE	Cameron	150	23	3
139	WALTER M JEFFORDS JR EST ET AL	Cameron	187.5	23	3
139	WALTER M JEFFORDS JR ESTATE	Cameron	62.5	23	3
139	BRADLEY NORDYKE ET UX	Cameron	187.02	23	3
140	GLORIA SAENZ	Cameron	212.5	23	3
141	WALTER M JEFFORDS JR ESTATE	Cameron	591.6675	23	3
141	TEXAS PARKS & WILDLIFE DEPT	Cameron	295.8325	23	3
142	UNVERIFIED OWNERS,OTHER AMTS COMBINE	Cameron	6.3405	23	3
144	UNITED STATES DEPT OF INTERIOR	Cameron	31.1041	23	3
144	RICKARD PAUL EKSTROM ET UX	Cameron	18.8959	23	3
145	ESTATE OF WALTER M JEFFORDS JR	Cameron	1018	23	3
147	UNITED STATES DEPT OF INTERIOR	Cameron	12.9	23	3
148	BERNADETTE M OESER	Cameron	52.5	23	3
149	JOAQUIN ALMAZAN	Cameron	21.25	23	3
150	GREGORIO TORRES ET AL	Cameron	2.5	23	3
151	VISTA DEL MAR IRRIGATION CO	Cameron	7.5	23	3
152	EUFEMIA C ORIVE	Cameron	11.05	23	3
153	MADEIRA PROPERTIES LTD	Cameron	375	23	3
154	ENRIQUE PENA	Cameron	25	23	3
156	UNITED STATES DEPT OF INTERIOR	Cameron	51.5	23	3
156	DE ESTHER BRABANT ET AL	Cameron	11	23	3
159	MARIA T POPE ET AL	Cameron	387.5	23	3
160	ESTATE OF ALBERTO EUGENIO ROCK	Cameron	75	23	3
163	THE NATURE CONSERVANCY	Cameron	690	23	3
166	GONZALES FAMILY PARTNERSHIP	Cameron	82.5	23	3
167	ABEL GONZALES DBA/G&T PAVING COMPANY	Cameron	110	23	3
169	UNITED STATES DEPT OF INTERIOR	Cameron	125	23	3
170	ALBERTO GARZA JR	Cameron	23	23	3
170	JORGE LUIS RODRIGUEZ	Cameron	2	23	3
171	ARNOLDO GEORGE	Cameron	35.725	23	3
172	ESTATE OF WALTER M JEFFORDS JR	Cameron	250	23	3
173	LAVERNE SUMNER ET UX	Cameron	200	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
174	ROBERT MATHERS	Cameron	344.725	23	3
174	JOSE ANTONIO NEGRETE	Cameron	74.75	23	3
175	LAVERNE SUMNER ET UX	Cameron	225	23	3
176	GREGORY P SCHREIBER ET UX	Cameron	80	23	3
177	KENNETH K SHIMOTSU ET UX	Cameron	95	23	3
179	LOUISE SMITH ET AL	Cameron	35	23	3
180	ROBERT MATHERS	Cameron	132.5	23	3
182	EDMUNDO SOSA	Cameron	50	23	3
183	THE NATURE CONSERVANCY	Cameron	480.025	23	3
184	JESUS QUINTANILLA JR	Cameron	119.83	23	3
186	MANUEL A TAMEZ	Cameron	14.75	23	3
187	VIDAL LONGORIA	Cameron	118.3	23	3
188	MITSUYE TANAMACHI TRUSTEE	Cameron	17.5	23	3
189	HARRY H SHIMOTSU ET UX	Cameron	1242.5	23	3
190	E D PALMER ET UX	Cameron	65.575	23	3
192	MARIA ALICE T SANCHEZ	Cameron	41.67	23	3
193	RAUL TIJERINA SR ET AL	Cameron	257.5	23	3
195	ADELA T TATUM	Cameron	57.19	23	3
196	NINFA T GARCIA ET AL	Cameron	12.9	23	3
197	NINFA T GARCIA ET AL	Cameron	12.9	23	3
198	GERTRUDIS G TREVINO ET AL	Cameron	37.5	23	3
199	JOSE I TREVINO ET AL	Cameron	217.5	23	3
203	JESSE L VAN WINKLE	Cameron	80	23	3
204	GAYLE CAMPBELL TRUSTEE	Cameron	62.5	23	3
205	GENEVIEVE VAUGHAN	Cameron	64.075	23	3
205	NATIONAL AUDUBON SOCIETY INC	Cameron	1185.925	23	3
206	JUAN F LEAL ET AL	Cameron	225	23	3
207	GLOOR DEVELOPMENT CORP	Cameron	0.75	23	3
208	WILLIAM A FAULK	Cameron	38.18	23	3
209	BRENDA E WATERS TRUSTEE	Cameron	360	23	3
210	L & L FARMS	Cameron	325	23	3
210	BORZYNSKI BROTHERS	Cameron	175	23	3
212	JOE ROY WEAVER	Cameron	12.5	23	3
213	SAM R SPARKS INC	Cameron	887.7563	23	3
213	SAM R SPARKS INC	Cameron	3199.875	23	3
214	MANUEL WEAVER	Cameron	10	23	3
217	ESTATE OF CATARINA W CAVAZOS	Cameron	8.03	23	3
218	JAIME MARTINEZ ET AL	Cameron	21.25	23	3
218	TONY WEAVER ET UX	Cameron	24	23	3
219	D & D FARMS	Cameron	26.725	23	3
220	MILTON K WEIKEL ET AL	Cameron	400	23	3
221	ROBERT C WELLS	Cameron	535.325	23	3
221	MICHAEL F SCAIEF	Cameron	75	23	3
222	JAY LARRY WELLS ET AL	Cameron	153.425	23	3
224	JAMES ALEXANDER WELLS ET AL	Cameron	20	23	3
225	MILTON E WENTZ SR ET UX	Cameron	500	23	3
226	DULANEY FARMS LTD	Cameron	1000	23	3
231	DAVID A HANAWA ET AL	Cameron	20	23	3
232	WILLIAM A FAULK TRUSTEE	Cameron	250	23	3
234	ALBERTO ZEPEDA ET AL	Cameron	175	23	3
235	CARLOS E ZEPEDA JR ET UX	Cameron	100	23	3
236	PEDRO ZEPEDA	Cameron	4.81	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
236	ROY ZEPEDA ET AL	Cameron	26.14	23	3
239	JUDITH ANN FOLEY PRUKOP	Cameron	14.1	23	3
239	GAYLE CAMPBELL TRUSTEE	Cameron	10	23	3
241	MICHAEL FREDERICK BARREDA ET UX	Cameron	37.5	23	3
243	DIANA INEZ SANTISO DEL RIO	Cameron	920.9875	23	3
244	LAURA WOLF BAUER	Cameron	292.5	23	3
249	ESTATE OF RUBY O BENSON	Cameron	197.5	23	3
251	AGNES O BROWNE TRUSTEE ET AL	Cameron	490	23	3
252	AGNES O BROWNE TRUSTEE ET AL	Cameron	269.588	23	3
254	RITA FAY SCHRIEBER	Cameron	175.05	23	3
257	CITY OF ROMA	Cameron	112.5	23	3
258	CITY OF ROMA	Cameron	235.75	23	3
259	LEE R STEVENS	Cameron	7.5	23	3
260	CITY OF ROMA	Cameron	212.5	23	3
261	CITY OF RIO GRANDE	Cameron	45.78	23	3
261	RICARDO BALLI ET AL	Cameron	5.72	23	3
262	LUCIANO ORTIZ CANTU ET AL	Cameron	33.125	23	3
263	NORMAN D FLADOS ET UX	Cameron	253.925	23	3
263	DOLORES FLADOS	Cameron	253.925	23	3
263	SAN BENITO INTL BRIDGE CO	Cameron	17.15	23	3
264	SOLTEX DEVELOPMENT INC	Cameron	15	23	3
265	JUAN SOLIS JR ET AL	Cameron	11	23	3
265	SHARYLAND WSC	Cameron	117	23	3
266	KURTIS E HOPPERSTAD ET UX	Cameron	21.925	23	3
268	DULANEY FARMS LTD	Cameron	1000	23	3
270	ALEIDA GARCIA AGADO ET AL	Cameron	36.426	23	3
275	THE ESTATE OF FRANCISCO A GARCIA	Cameron	225	23	3
275	NORMAN FLADOS ET AL	Cameron	112.5	23	3
275	MILITARY HIGHWAY WSC	Cameron	22.5	23	3
276	CELIA E GARCIA	Cameron	1.7	23	3
276	JUAN GARCIA ET AL	Cameron	3.425	23	3
276	GUADALUPE GARCIA	Cameron	1.7	23	3
276	FRUCTUOSO GARCIA	Cameron	1.7	23	3
276	MARGARITA AND HUMBERTO GARCIA	Cameron	1.7	23	3
276	GUADALUPE GARCIA ET AL	Cameron	4.225	23	3
277	ESTATE OF MARIA T GARCIA	Cameron	35.69	23	3
277	SHARYLAND WSC	Cameron	83.32	23	3
277	GARZA & GARZA	Cameron	40.99	23	3
278	ELECTRIC GIN CO OF SAN BENITO	Cameron	132.5	23	3
279	EL RANCHO POTRERO DEV CO INC	Cameron	156.5	23	3
281	TEOFILO HECTOR FLORES JR ET UX	Cameron	106.375	23	3
282	JANET DWIRE MATHIS	Cameron	14.33	23	3
284	REINALDO SANTIAGO SANTISO	Cameron	240.2125	23	3
285	SOLTEX DEVELOPMENT INC	Cameron	125.55	23	3
285	SHARYLAND WSC	Cameron	8.675	23	3
285	ALFONSO CORTEZ	Cameron	1.95	23	3
285	LUCIO TORRES JR	Cameron	0.48	23	3
287	DONALD F PHILLIPP	Cameron	255.75	23	3
288	MARTHA M AND JAMES D RUSSELL	Cameron	9145.875	23	3
288	MADEIRA PROPERTIES LTD	Cameron	2654.125	23	3
289	REINALDO SANTIAGO SANTISO	Cameron	373.094	23	3
289	DIANA SANTISO DEL RIO	Cameron	348.094	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
289	RENE MALDONADO ET UX	Cameron	12.5	23	3
289	FERNANDO BECERRA ET UX	Cameron	1.34	23	3
290	STEVEN HUGH SHIMOTSU ET AL	Cameron	17.5	23	3
291	PAUL L SLADEK	Cameron	151.875	23	3
292	PAUL L SLADEK	Cameron	496.025	23	3
293	KO-MAR CONSTRUCTION CO INC	Cameron	153.7	23	3
295	ESTATE OF RAUL Z TREVINO ET AL	Cameron	70.17	23	3
296	CARL L BAUER ET AL	Cameron	959.215	23	3
297	CORONADO COMPANY LLC	Cameron	1492.25	23	3
315	PLAYA W S C	Cameron	119.475	23	3
415	MADEIRA PROPERTIES LTD	Cameron	326.3	23	3
817	SANTA MARIA ID CAMERON CO 4	Cameron	10182.5	23	3
829	CAMERON CO IRR DIST NO 6	Cameron	52141.925	23	3
831	HARLINGEN IRR DIST	Cameron	93857.5	23	3
831	HARLINGEN IRR DIST	Cameron	4375	23	3
834	CAMERON CO WID 10	Cameron	8587.5	23	3
834	CITY OF HARLINGEN WATERWORKS	Cameron	1625	23	3
835	BAYVIEW IRR DIST 11	Cameron	17478.025	23	3
838	CAMERON CO WID #16	Cameron	3712.5	23	3
839	LMB PARTNERSHIP LTD	Cameron	625	23	3
840	ADAMS GARDENS IRR DIST 19	Cameron	18737.655	23	3
841	CAMERON CO IRR DIST NO 2	Cameron	147823.65	23	3
843	BROWNSVILLE IRRIGATION DISTRICT	Cameron	33949.45	23	3
843	BROWNSVILLE IRRIGATION DISTRICT	Cameron	926.55	23	3
844	TEXAS DEPT OF TRANSPORTATION	Cameron		23	3
865	BROWNSVILLE PUBLIC UTIL BOARD	Cameron	1782.5	23	3
878	DR VIDAL LONGORIA	Cameron	287.5	23	3
1462	STUART DODDS SHOEMAKER	Cameron	300	22	3
3281	U S DEPT AGRICULTURE-SCI	Cameron	208	23	3
4360	LELAND L WESTPHALL	Cameron	117	23	3
4525	SPARKS FAMILY PARTNERSHIP LTD	Cameron	1080.68	22	3
4526	LA FERIA ID, CAMERON CO 3	Cameron	1806	22	3
4527	ADAMS GARDENS ID NO. 19	Cameron	50	22	3
4529	ALDEN N JOHNSON	Cameron	390	22	3
4530	PHILLIP OXFORD	Cameron	64.2	22	3
4534	JOHN A ABBOTT	Cameron	324.5	22	3
4535	PORT OF HARLINGEN AUTHORITY	Cameron	63.65	22	3
4537	HARLINGEN ID CAMERON CO NO 1	Cameron	3656	22	3
4540	CAMERON CO ID 2	Cameron		22	3
4541	JOSE LUIS SAENZ ET UX	Cameron	1560	22	3
4541	RUSSELL & TRACY LTD PARTNERSHIP	Cameron	1040	22	3
4542	CAMERON CO WCID 6	Cameron	2269.37	22	3
4544	MATT F GORGES	Cameron	728.35	22	3
4544	UNITED STATES DEPT OF INTERIOR	Cameron	771.65	22	3
4545	QUERENCIA LAND & CATTLE CO	Cameron	1225	22	3
4547	CAMERON CO WID 10	Cameron	300	22	3
4548	BAYVIEW IRR DIST 11	Cameron	1455	22	3
4549	DULANEY FARMS LTD	Cameron	3600	22	3
4552	CAMERON CO WID 16	Cameron	300	22	3
4553	UNITED STATES DEPT OF INTERIOR	Cameron	3459	22	3
4554	BROWNSVILLE IRR & DRAIN DIST	Cameron	1200	22	3
5004	RUSSELL PLANTATION LT PARTNER	Cameron	300	22	3

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5011	MILTON E WENTZ JR ET AL	Cameron	1100	22	3
5040	LMB CORPORATION	Cameron	395	22	3
5135	VALLEY MUD 2	Cameron	165	22	3
5212	STUART DODDS SHOEMAKER	Cameron	3	22	3
248	GAYLE CAMPBELL TRUSTEE	Hidalgo	11	23	3
248	JESSE RAY RUSSELL PARTNERSHIP	Hidalgo	11	23	3
248	EDUARDO GONZALEZ	Hidalgo	11	23	3
248	JULIE G UHLHORN EXEC & TRUSTEE	Hidalgo	375	23	3
294	FELIPE GALVAN TRUSTEE	Hidalgo	250	23	3
301	ESTATE OF WILLIAM HENRY DRAWE	Hidalgo	128.25	23	3
301	ESTATE OF WILLIAM HENRY DRAWE	Hidalgo	857.5	23	3
302	CITY OF HIDALGO	Hidalgo	311.25	23	3
302	HIDALGO CO IRR DIST NO 2	Hidalgo	9.086	23	3
303	ROBERT S KENT ET UX	Hidalgo	228.75	23	3
303	EL PACIFICO LTD	Hidalgo	137.75	23	3
304	DANIEL E ARNOLD	Hidalgo	338.225	23	3
310	CLIFFORD L KLINCK III	Hidalgo	41.9	23	3
311	MARIA GUADALUPE HERNANDEZ	Hidalgo	17.5	23	3
312	B D SPILLAR ET UX	Hidalgo	11.25	23	3
312	LMB CORPORATION	Hidalgo	24.07	23	3
312	TEXAS DEPT OF TRANSPORTATION	Hidalgo	2.017	23	3
312	GMCFJS (GM CADLE & FJ SMITH)	Hidalgo	43.813	23	3
314	NORTH WARE ROAD INVESTMENT GRP	Hidalgo	482.5	23	3
316	J C TREVINO JR	Hidalgo	95	23	3
317	RIVER FARMS PARTNERSHIP	Hidalgo	1325	23	3
318	MOORE & SONS FARMS INC ET AL	Hidalgo	500.175	23	3
319	LA JOYA WSC	Hidalgo	0.575	23	3
319	PABLO TREVINO ET UX	Hidalgo	61.975	23	3
319	PABLO TREVINO ET UX	Hidalgo	62.95	23	3
319	HEATH, STUART & SCHNEIDER INC	Hidalgo	49.433	23	3
319	PORFIRIO TIJERINA JR ET UX	Hidalgo	25.342	23	3
319	PORFIRIO TIJERINA JR ET UX	Hidalgo	12.879	23	3
319	HARSHA PUTTAGUNTA ET UX	Hidalgo	18.6	23	3
319	TOMAS CEDILLO JR ET UX	Hidalgo	9.8	23	3
319	RODOLFO TREVINO ET UX	Hidalgo	10.725	23	3
319	LEONEL BAZAN	Hidalgo	12.525	23	3
319	ROBERT C ETTINGER	Hidalgo	12.525	23	3
319	DONALD P SOBOCINSKI ET AL	Hidalgo	12.525	23	3
319	EMERALD BAY CORPORATION	Hidalgo	12.745	23	3
319	RICK MARTIN	Hidalgo	49.105	23	3
319	RICHARD A GARZA	Hidalgo	12.6	23	3
319	HOMER WELLS	Hidalgo	12.425	23	3
319	REV. JOHN J FISHER	Hidalgo	15.75	23	3
319	ST. LOMITA GROVE COMPANY	Hidalgo	12.7	23	3
319	RICHARD A MARTIN ET UX	Hidalgo	25.2	23	3
328	ALEJANDRO PEREZ ET UX	Hidalgo	1.525	23	3
332	SHARYLAND CORPORATION	Hidalgo	2592.125	23	3
332	SHARYLAND CORPORATION	Hidalgo	330.7	23	3
333	MONICA RIVERA	Hidalgo	0.75	23	3
333	VALENTIN TREVINO GARCIA	Hidalgo	0.8	23	3
333	ISMAEL VELA	Hidalgo	0.55	23	3
335	ALMA P ALANIZ	Hidalgo	2.3	23	3

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335	CALIXTO RIVERA ET UX	Hidalgo	10	23	3
336	LUIS D ALVAREZ	Hidalgo	27.5	23	3
337	TEJAS LAND & CATTLE CO	Hidalgo	590.187	23	3
338	TEXAS PARKS & WILDLIFE DEPT	Hidalgo	255	23	3
339	RUFINO GARZA ET AL	Hidalgo	937.5	23	3
340	RANDALL LANCE BARNES	Hidalgo	702.8	23	3
345	ART W BECKWITH ET UX	Hidalgo	500	23	3
346	GERALD E BELL ET AL	Hidalgo	1047.75	23	3
346	BELL GRAIN INC	Hidalgo	112.5	23	3
349	W G BELL JR	Hidalgo	1875	23	3
349	CONLY BELL TRUSTEE	Hidalgo		23	3
349	W G BELL JR	Hidalgo	216.375	23	3
349	CONLY BELL TRUSTEE	Hidalgo		23	3
351	BALLARD BENNETT	Hidalgo	300	23	3
352	MICHAELENE E KUBY ET AL	Hidalgo	87.5	23	3
353	MCALLEN TRADE ZONE INC	Hidalgo	50	23	3
355	OTTO BOEHMER ET UX	Hidalgo	50	23	3
356	DORA B RODRIQUEZ ET AL	Hidalgo	107.5	23	3
359	SAM J BREWSTER TRUSTEE	Hidalgo	65	23	3
361	ESTATE OF E F DAVIS JR	Hidalgo	250	23	3
362	DON BURRHUS	Hidalgo	42.5	23	3
363	OTTO BOEHMER ET UX	Hidalgo	75	23	3
364	SHARYLAND CORPORATION	Hidalgo	30	23	3
365	JOSE CANTU ET AL	Hidalgo	44.225	23	3
365	DAVID A DAVILA	Hidalgo	30.35	23	3
365	ESTATE OF ANGELITA CANTU DE LOZANO	Hidalgo	12.1	23	3
366	TROPHY INTERNATIONAL INC	Hidalgo	30.275	23	3
367	MRS OLETA CARPENTER	Hidalgo	500	23	3
370	JOSE ALFREDO CAVAZOS ET AL	Hidalgo	162.5	23	3
372	OFELIA D CHAPA	Hidalgo	75	23	3
373	CONCEPCION CHAPA ESTATE	Hidalgo	27.5	23	3
374	MARIO CHAPA	Hidalgo	52.5	23	3
377	BLANCA CHAPA PINNER	Hidalgo	6.48	23	3
377	BLANCA CHAPA PINNER ET VIR	Hidalgo	13.5	23	3
377	TRUSTEE OF THE RAFAELA G CHAPA TRUST	Hidalgo	8.8	23	3
377	OCTAVIO A CHAPA	Hidalgo	8.8	23	3
377	ALBERTO X CHAPA	Hidalgo	8.8	23	3
377	ALBERTO X CHAPA ET UX	Hidalgo	2.32	23	3
378	MARTHA L C DE LORENZO ET AL	Hidalgo	63	23	3
379	TELESFORO CISNEROS SR	Hidalgo	4.5	23	3
380	TELESFORO CISNEROS JR	Hidalgo	4.475	23	3
381	RIO PROPERTIES INC	Hidalgo	232.45	23	3
383	CAPOTE FARMS INC	Hidalgo	550	23	3
386	HIROCHI J DATE ET AL	Hidalgo	75	23	3
389	JOSE DE LA FUENTE ET AL	Hidalgo	25	23	3
393	ESTEBAN DE LA ROSA ET AL	Hidalgo	32.5	23	3
394	AMELIA V DE LEON	Hidalgo	75	23	3
399	CHARLES E PRATT ET AL	Hidalgo	1990.235	23	3
399	CHARLES E PRATT ET AL	Hidalgo	575	23	3
399	CLUB MARK CORPORATION	Hidalgo	225	23	3
400	DIXIE MORTGAGE LOAN CO	Hidalgo	29.1	23	3
400	DIXIE MORTGAGE LOAN CO ET AL	Hidalgo	96.325	23	3

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400	COLLECTING BANK NA	Hidalgo	32.9805	23	3
400	SHIN FOUNDATION I LTD	Hidalgo	499.51	23	3
401	JOSEPHINE DOFFING	Hidalgo	625	23	3
402	ARLENE LUNA	Hidalgo	12.5	23	3
403	SHARON BOEHMER	Hidalgo	12.5	23	3
404	GENEVIEVE T DOUGHERTY TR #2	Hidalgo	20	23	3
408	MAY DOUGHERTY KING ET AL	Hidalgo	87.5	23	3
410	ESTATE OF JAMES R DOUGHERTY III	Hidalgo	179.75	23	3
411	EDINBURG IMPROVEMENT ASSN	Hidalgo	712.5	23	3
411	EDINBURG IMPROVEMENT ASSN	Hidalgo	70	23	3
412	EDINBURG FOUNDATION INC	Hidalgo	86	23	3
412	JAMES P HOFFMAN	Hidalgo	34	23	3
413	ELENA S MONTALVO	Hidalgo	65	23	3
414	O D EMERY JR ET AL	Hidalgo	582.5	23	3
415	BILL BURNS	Hidalgo	3155.3	23	3
416	LUTHER E BRADFORD ET UX	Hidalgo	215.9125	23	3
418	JAMES L PAWLIK ET AL	Hidalgo	732.5	23	3
419	HECTOR FARIAS ET UX	Hidalgo	3.35	23	3
419	JULIAN OLGUIN ET UX	Hidalgo	1.65	23	3
420	JESSE RAY RUSSELL PARTNERSHIP	Hidalgo	504.375	23	3
420	LYDIA A FERNANDEZ	Hidalgo	129.15	23	3
420	ERNESTO M FERNANDEZ ET AL	Hidalgo	318.7	23	3
420	ERNESTO M FERNANDEZ	Hidalgo	24.221	23	3
420	SANTIAGO G FERNANDEZ	Hidalgo	28.25	23	3
420	GUADALUPE A FERNANDEZ	Hidalgo	28.25	23	3
420	AMADOR T FERNANDEZ	Hidalgo	28.25	23	3
420	GUADALUPE A FERNANDEZ ET AL	Hidalgo	47.5	23	3
420	JAMES MICHAEL FERNANDEZ	Hidalgo	15.85	23	3
420	B & P BRIDGE CO	Hidalgo	4.029	23	3
421	BILL L BURNS	Hidalgo	595.115	23	3
421	A A MARTIN ET UX	Hidalgo	30.75	23	3
421	RICHARD DAVIDSON	Hidalgo	31.275	23	3
421	E R NORMAN & H B WHITE	Hidalgo	40.405	23	3
421	GEORGE GARCIA ET UX	Hidalgo	2.5	23	3
421	JOSE RUIZ ET UX	Hidalgo	2.5	23	3
421	RENE RECIO VERA ET UX	Hidalgo	2.5	23	3
421	GAYLE CAMPBELL TRUSTEE	Hidalgo	6.25	23	3
421	NICOLAS R CANCINO ET UX	Hidalgo	2.55	23	3
422	GUADALUPE A FERNANDEZ TRUSTEE	Hidalgo	1250	23	3
423	V C CATTLE COMPANY INC	Hidalgo	2125	23	3
424	ERASMO S FLORES ET AL	Hidalgo	15	23	3
427	THE FORDYCE COMPANY	Hidalgo	62.5	23	3
429	TEXAS GLOBAL ENTERPRISES INC	Hidalgo	22.5	23	3
432	HIDALGO CO IRR DIST 5	Hidalgo	402.5	23	3
434	FULLER FARMS	Hidalgo	870.298	23	3
435	WILLIAM J THOMAS ET AL	Hidalgo	106.875	23	3
436	GENEVIEVE T DOUGHERTY TRUST #2	Hidalgo	126.25	23	3
436	WILLIAM J THOMAS ET AL	Hidalgo	61.25	23	3
438	RAFAEL GARCIA SR ET AL	Hidalgo	18.527	23	3
441	ABUNDIO GARZA JR	Hidalgo	21.5	23	3
441	BERTHA G LONGORIA	Hidalgo	10.75	23	3
441	DAVID ARCHIE LEAL	Hidalgo	15	23	3

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441	LINDA ANNETTE C GARZA ET AL	Hidalgo	10.75	23	3
441	YOLANDA STILLMAN TRUSTEE	Hidalgo	10.75	23	3
441	EDUARDO J LONGORIA	Hidalgo	6.25	23	3
442	RICHARD B DRAWE ET AL	Hidalgo	112.5	23	3
443	AMELIA C GARZA	Hidalgo	42.5	23	3
447	SIGIFREDO GARZA ET UX	Hidalgo	85	23	3
448	TRAVIS NEWSOM	Hidalgo	2.039	23	3
448	PETER BOSCH	Hidalgo	2.039	23	3
449	JOSE C GARZA	Hidalgo	57.5	23	3
450	PEDRO RUIZ ET UX	Hidalgo	40	23	3
450	JOSE HINOJOSA JR ET UX	Hidalgo	5	23	3
450	MARCELA GARCIA	Hidalgo	10	23	3
451	OLGA ALANIZ	Hidalgo	5	23	3
452	HESTER ALMON GEORGE ESTATE	Hidalgo	58.75	23	3
454	HENRY KAWAHATA	Hidalgo	319.275	23	3
455	ANGEL SALINAS ET UX	Hidalgo	0.675	23	3
455	OCTAVIO ESTEBAN SALINAS	Hidalgo	0.35	23	3
455	ROBERT MONTALVO JR ET AL	Hidalgo	0.45	23	3
456	ANITA GUERRA	Hidalgo	44.375	23	3
457	MAURO L REYNA	Hidalgo	17.5	23	3
458	MARTIANO HANDY ET VIR	Hidalgo	6.587	23	3
458	ERNESTINA H BRIONES	Hidalgo	6.588	23	3
459	MRS E JOLENE GUSTAFSON	Hidalgo	1686.15	23	3
462	VERNON B HILL	Hidalgo	17	23	3
463	KENNETH WILKINS	Hidalgo	75.3075	23	3
463	TOM WILKINS	Hidalgo	30	23	3
464	DELTA LAKE IRRIGATION DISTRICT	Hidalgo	202.5	23	3
464	JOEL LOPEZ	Hidalgo	51.375	23	3
466	APOLONIO JACKSON	Hidalgo	82.5	23	3
468	SAM J BREWSTER	Hidalgo	27.5	23	3
469	JOHN T SULLIVAN	Hidalgo	18.75	23	3
470	ROGELIO JIMENEZ	Hidalgo	47.5	23	3
472	HENRY KAWAHATA	Hidalgo	656.75	23	3
473	JAMES L PAWLIK ET AL	Hidalgo	1088.725	23	3
477	N H KITAYAMA	Hidalgo	428.5	23	3
479	F E KNAPP & J A KNAPP	Hidalgo	638.225	23	3
480	KRENMUELLER FARMS	Hidalgo	3250	23	3
480	KRENMUELLER FARMS	Hidalgo	102.5	23	3
482	ALEJANDRO JAMES LEO ET AL	Hidalgo	45	23	3
484	A E LONGORIA ET AL	Hidalgo	517.5	23	3
489	G A MARTINEZ	Hidalgo	150	23	3
492	JOSE RAMIREZ JR ET AL	Hidalgo	290.625	23	3
493	C F SPIKES	Hidalgo	2.5	23	3
496	R E RATCLIFF	Hidalgo	85	23	3
502	JOSE F MARTINEZ JR	Hidalgo	162.5	23	3
506	MOORE & SONS FARMS INC	Hidalgo	743.8	23	3
507	JOSE MARIA MORA JR	Hidalgo	41.675	23	3
507	CONSUELO MORA DOMINGUEZ	Hidalgo	41.675	23	3
507	MARIA VICTORIA MORA BALLI	Hidalgo	41.65	23	3
509	ANDREA JACKSON VDA DE MUNOZ	Hidalgo	65.5	23	3
509	SAM J BREWSTER	Hidalgo	27	23	3
510	HERMILIO BAZAN ET UX	Hidalgo	30	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
512	E I FOSMIRE	Hidalgo	2.5	23	3
512	MCALLEN TRADE ZONE INC	Hidalgo	100	23	3
512	PARKER HANNIFIN CORPORATION	Hidalgo	100	23	3
512	MCALLEN INDUSTRIAL AUTH INC	Hidalgo	92.5	23	3
514	GRACE NEUHAUS RICHARDS TRUST	Hidalgo	16	23	3
518	BENZAMIN D OLIVAREZ ET AL	Hidalgo	217.075	23	3
521	R L DIAZ ET UX	Hidalgo	25	23	3
522	WILLARD O FIKE ET UX	Hidalgo	100.15	23	3
523	ROBERT EUGENE PAWLIK ET AL	Hidalgo	265	23	3
524	JOHN D PAWLIK ET AL	Hidalgo	1250	23	3
529	MRS BERTICE P BURRHUS	Hidalgo	32.5	23	3
530	TROPHY INTERNATIONAL INC	Hidalgo	173.012	23	3
530	ELDA BELINDA REYNA ET AL	Hidalgo	42.985	23	3
530	L S & V DISTRIBUTING CO	Hidalgo	5.205	23	3
534	JOE H RAMON TRUSTEE	Hidalgo	97.725	23	3
535	HUBERT E & HAROLD RHODES	Hidalgo	85	23	3
536	JOE H RAMON TRUSTEE	Hidalgo	92.5	23	3
537	RIO BANCO FARMS	Hidalgo	10	23	3
538	MHW OPERATIONS LTD ET AL	Hidalgo	2692.15	23	3
539	MISS CRISOLFA RIVAS	Hidalgo	82.5	23	3
541	FIKE FARMS	Hidalgo	97.725	23	3
543	HEATH STUART & SCHNEIDER INC	Hidalgo	50.242	23	3
543	PORFIRIO TIJERINA JR ET UX	Hidalgo	12.879	23	3
543	HARSHA PUTTAGUNTA ET UX	Hidalgo	18.9	23	3
543	TOMAS CEDILLO JR ET UX	Hidalgo	9.95	23	3
543	RODOLFO TREVINO ET UX	Hidalgo	10.9	23	3
543	LEONEL BAZAN	Hidalgo	12.725	23	3
543	ROBERT C ETTINGER	Hidalgo	12.725	23	3
543	DONALD P SOBOCINSKI ET AL	Hidalgo	12.725	23	3
543	EMERALD BAY CORPORATION	Hidalgo	12.955	23	3
543	RICK MARTIN	Hidalgo	49.895	23	3
543	RICHARD A GARZA	Hidalgo	12.825	23	3
543	HOMER WELLS	Hidalgo	12.625	23	3
543	REV JOHN J FISHER	Hidalgo	16	23	3
543	ST LOMITA GROVE COMPANY	Hidalgo	12.925	23	3
543	RICHARD A MARTIN ET UX	Hidalgo	25.6	23	3
544	MITSURU SAKAI	Hidalgo	200	23	3
545	ROSE MARIE SAKAI TRUSTEE	Hidalgo	605	23	3
553	FRANK SCHUSTER FARMS INC	Hidalgo	125	23	3
554	FRANK SCHUSTER FARMS INC	Hidalgo	1413.5	23	3
554	FRANK SCHUSTER FARMS INC	Hidalgo	102.5	23	3
554	FRANK SCHUSTER FARMS INC	Hidalgo	125	23	3
555	SANTA MARIA LTD	Hidalgo	480.5	23	3
558	CROW GRAVEL CO	Hidalgo	119.03	23	3
558	JON E LORING	Hidalgo	19.426	23	3
559	CROW GRAVEL COMPANY	Hidalgo	24.625	23	3
560	SHARYLAND WSC	Hidalgo	251.875	23	3
561	G SUEYASU	Hidalgo	191.075	23	3
562	JANE T SULLIVAN	Hidalgo	35	23	3
563	MCALLEN TRADE ZONE INC	Hidalgo	50	23	3
564	TEXAS PLANT FOOD COMPANY INC	Hidalgo	12.5	23	3
565	THE THEIMER TRUSTS	Hidalgo	1125	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
566	IGNACIO TREVINO ESTATE	Hidalgo	81.5	23	3
568	ANN MOORE ET AL	Hidalgo	3.226	23	3
571	VALLEY ONIONS INC	Hidalgo	446.25	23	3
573	FRANCISCA RECIO DE VELA ET AL	Hidalgo	469.9	23	3
573	LAURO G GUERRA	Hidalgo	49.935	23	3
573	A L MARTINEZ	Hidalgo	9.807	23	3
573	CITY OF SAN JUAN	Hidalgo	73.418	23	3
576	COUNTY OF HIDALGO	Hidalgo	4.6	23	3
577	MARY JANE SOBEL	Hidalgo	237.76	23	3
577	JOHN CHARLES ANDERSON	Hidalgo	113.88	23	3
577	DAGOBERTO TREVINO	Hidalgo	453.36	23	3
578	MARY JANE SOBEL	Hidalgo	544.1	23	3
578	JOHN CHARLES ANDERSON ET AL	Hidalgo	310.9	23	3
579	SHARON REES WAITE ET AL	Hidalgo	1447.5	23	3
580	INO G WEISKE	Hidalgo	65	23	3
580	SOPHIE FOLEY	Hidalgo	10	23	3
581	INO G WEISKE	Hidalgo	25	23	3
582	KVS FAMILY LIMITED PARTNERSHIP	Hidalgo	312.5	23	3
584	TEXAS YOUTH COMMISSION	Hidalgo	225.96	23	3
584	NICOLAS MOLINA JR	Hidalgo	8.27	23	3
584	JOE H RAMON	Hidalgo	8.27	23	3
587	ELLA G WOOD	Hidalgo	95.98	23	3
587	LIEVEN J VAN RIET	Hidalgo	111.52	23	3
595	SANTOS VILLARREAL ET UX	Hidalgo	55	23	3
769	J G ROLANDO RUIZ	Hidalgo		23	3
802	HIDALGO COUNTY IRR DIST 16	Hidalgo	30748.85	23	3
803	LA FERIA ID CAMERON CO 3	Hidalgo	75625.925	23	3
803	CITY OF ROMA	Hidalgo	551.4	23	3
804	SANTA CRUZ IRR DIST 15	Hidalgo	77180	23	3
804	SANTA CRUZ IRR DIST 15	Hidalgo	4827.5	23	3
805	DONNA ID HIDALGO CO 1	Hidalgo	94063.6	23	3
806	HIDALGO CO WCID 19	Hidalgo	9437.57	23	3
807	VALLEY ACRES IRRIGATION DIST	Hidalgo	16124.25	23	3
808	HIDALGO CO IRR DIST 2	Hidalgo	137675	23	3
809	ENGLEMAN IRRIGATION DISTRICT	Hidalgo	18994.35	23	3
809	DELTA LAKE IRRIGATION DIST	Hidalgo	50	23	3
810	HIDALGO COUNTY IRR DIST 13	Hidalgo	4856.85	23	3
811	DELTA LAKE IRR DIST	Hidalgo	174776.375	23	3
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	177151.625	23	3
813	HIDALGO CO IRR DIST 5	Hidalgo	14234.625	23	3
815	TOWN OF PROGRESO	Hidalgo	173.7	23	3
816	HIDALGO CO IRR DIST 1	Hidalgo	85615	23	3
820	NORTH ALAMO WSC	Hidalgo	25	23	3
825	CITY OF EDCOUCH	Hidalgo	225.925	23	3
826	CITY OF ELSA	Hidalgo	697.6	23	3
827	CITY OF LA VILLA	Hidalgo	62.5	23	3
828	HIDALGO CO IRR DIST NO 6	Hidalgo	36513	23	3
832	HIDALGO CO WCID 18 PHARR	Hidalgo	5505.15	23	3
833	HIDALGO CO MUD 1	Hidalgo	1120.25	23	3
844	TEXAS DEPT OF TRANSPORTATION	Hidalgo	16.125	23	3
844	TEXAS DEPT OF TRANSPORTATION	Hidalgo	152.625	23	3
845	CITY OF MISSION	Hidalgo	429.325	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
847	UNITED IRRIGATION DISTRICT	Hidalgo	57374.3142	23	3
848	HIDALGO CO WID 3	Hidalgo	9752.6	23	3
866	SOUTHMOST SCD & WIL-HID SCD	Hidalgo	200	23	3
867	TEXAS A & I UNIV CITRUS CENTER	Hidalgo	400	23	3
868	TEXAS AGRICULTURAL EXP STA 15	Hidalgo	390	23	3
875	CITY OF DONNA	Hidalgo	480	23	3
876	M L BRADY ESTATE	Hidalgo	86.25	23	3
877	ALFONSO MARIO CHAPA JR	Hidalgo	5	23	3
3192	HIDALGO CO IRR DIST 1	Hidalgo		23	3
3271	UNITED STATES DEPT OF INTERIOR	Hidalgo	2935	23	3
4520	VALLEY ACRES IRRIGATION DIST	Hidalgo	4700	22	3
4521	J R WADE FARMS INC	Hidalgo	1952.44	22	3
4522	BEN E. BEARDEN	Hidalgo	414	22	3
4524	ENGLEMAN IRRIGATION DIST	Hidalgo	254.5	22	3
5045	MARY LENA BECKWITH ET AL	Hidalgo	128	22	3
5300	S R S FARMS, A	Hidalgo	100	22	3
124	CITY OF EAGLE PASS	Maverick	22.5	23	3
2688	MAVERICK CO WCID 1	Maverick	725	23	3
2688	MAVERICK CO WCID 1	Maverick	270	23	3
2688	LA GRULLA, CITY OF	Maverick	15	23	3
2688	SNOWMASS INC	Maverick	1384.5	23	3
2688	SNOWMASS INC	Maverick	417.8955	23	3
2689	EDGAR B KINCAID ESTATE ET AL	Maverick	20	23	3
2691	ESTATE OF CHARLES S RITCHIE	Maverick	9.42	23	3
2691	E W RITCHIE JR	Maverick	132.42	23	3
2691	FANNIE RITCHIE MONDRAGON	Maverick	92.72	23	3
2691	MILDRED GOODSON	Maverick	92.72	23	3
2691	GRACIELA JUNE HEREDIA GONZALEZ	Maverick	92.72	23	3
2692	WILLIAM H GEORGE JR	Maverick	310	23	3
3998	CITY OF EAGLE PASS	Maverick	53	23	3
8	BrAZOS ELECTRIC POWER COOP INC	Starr	20	23	3
36	STARR PRODUCE COMPANY	Starr	93.2	23	3
138	L & L FARMS	Starr	4.6	23	3
138	CHARLES WHITTLE	Starr	5	23	3
138	SOUTH PADRE DEVELOPMENT INC	Starr	1394.25	23	3
138	UNITED STATES FISH & WILDLIFE SERVICE	Starr	377.9	23	3
190	STARR PRODUCE COMPANY	Starr	2488.11	23	3
190	CITY OF LA GRULLA	Starr	35	23	3
211	CLEMMACO LTD	Starr	21.798	23	3
239	OSBALDO A SAENZ	Starr	7.075	23	3
239	OSBALDO A SAENZ	Starr	20	23	3
246	SIXTO R SALINAS ET UX	Starr	11.487	23	3
570	ELMORE & STAHL INC ET AL	Starr	1631.462	23	3
598	TEXAS DEPT OF TRANSPORTATION	Starr	10.405	23	3
599	E & S FARMS	Starr	500	23	3
601	ANNETTE KATZ COTTINGHAM ET AL	Starr	1287	23	3
601	ANNETTE KATZ COTTINGHAM ET AL	Starr	1029.98	23	3
602	JESUS ALVAREZ ET UX	Starr	12.5	23	3
605	SERVANDO DE LA GARZA	Starr	50	23	3
606	ARTURO GARZA	Starr	21.05	23	3
607	GUADALUPE ALVAREZ ET AL	Starr	40	23	3
609	RIQUERIO ALVAREZ	Starr	7.5	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
610	SABINO ALVAREZ ET AL	Starr	29.55	23	3
611	CIRIO C ROSA	Starr	5	23	3
614	MANUEL JAVIER BARRERA	Starr	45	23	3
615	RENE E BARRERA	Starr	20	23	3
616	ROSENDO GUERRA BARRERA	Starr	21.1	23	3
616	DIONICIA G GUTIERREZ ET AL	Starr	103.9	23	3
616	JOSE LUIS GARZA ET AL	Starr	187.5	23	3
616	RIO WATER SUPPLY CORPORATION	Starr	62.5	23	3
618	RUPERTO BALDEMAR ESCOBAR	Starr	112.5	23	3
619	JOEL ALVAREZ	Starr	10	23	3
621	PEDRO CASTILLO ESTATE	Starr	30	23	3
623	PEDRO A CHAPA ET UX	Starr	58.9	23	3
624	RAFAELA G CHAPA	Starr	23.7057	23	3
624	BLAS VILLARREAL JR	Starr	12.877	23	3
624	OSCAR JESUS VILLARREAL	Starr	12.877	23	3
624	BELINDA RODRIQUEZ ET AL	Starr	12.877	23	3
624	BLAS CHAPA	Starr	7.939	23	3
624	DORA CHAPA	Starr	2.1334	23	3
624	MARCELO CHAPA	Starr	2.1334	23	3
624	GILBERTO CHAPA ET AL	Starr	2.1334	23	3
624	MOISES CHAPA ET AL	Starr	2.1334	23	3
624	MARIA C MONTALVO	Starr	3.6907	23	3
624	JUANITA A MUNOZ	Starr	10	23	3
625	SHEERIN CHILDRENS TRUST	Starr	30.25	23	3
625	SHARYLAND WSC	Starr	282.05	23	3
625	HAROLD MUNAL	Starr	30.2	23	3
626	SINFORIANA G DOYNO ET AL	Starr	75	23	3
627	E & S FARMS	Starr	500	23	3
631	ARTURO GARZA ESCOBAR	Starr	25	23	3
632	ELOY ERASMO ESCOBAR	Starr	17.5	23	3
634	HERALDO ESCOBAR	Starr	62.5	23	3
635	FRONTON COOPERATIVE IRRIGATION	Starr	1445	23	3
636	WILLIAM J THOMAS ET AL	Starr	97.5	23	3
638	MARIA S PECK ET AL	Starr	750	23	3
639	EULOGIO & TOMAS GARCIA	Starr	20	23	3
641	FRANCISCO E GARCIA	Starr	137.5	23	3
644	JUAN DE DIOS GARCIA HEIRS	Starr	25	23	3
645	OLIVIA GARCIA DE RAMOS ET AL	Starr	275	23	3
648	PEDRO LONGORIA ET AL	Starr	288.79	23	3
651	MARCOS L GARZA ET AL	Starr	37.5	23	3
652	STARR-CAMARGO BRIDGE COMPANY	Starr	15.15	23	3
652	RAFAEL PENA ET UX	Starr	2.9	23	3
652	FRANCISCO GARZA ET UX	Starr	4.125	23	3
655	JUAN GARZA	Starr	9.875	23	3
656	JULIAN GARZA ET UX	Starr	150	23	3
657	FLAVIA GARZA MUNOZ	Starr	25	23	3
658	RENE G SMITH ET AL	Starr	26.175	23	3
659	TOMAS VALADEZ ET AL	Starr	70	23	3
660	BANNWORTHS INC	Starr	30	23	3
661	MARCOS L GARZA ET AL	Starr	87.5	23	3
662	FRANCISCO G VILLARREAL	Starr	25	23	3
663	SANTOS GARZA	Starr	25	23	3

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664	SILVESTRE G GARZA	Starr	9.875	23	3
665	ROGERIO GARZA ET AL	Starr	17.2	23	3
665	ROBERTO LUIS NARANJO	Starr	7.8	23	3
667	WILFRIDO GARZA	Starr	19.5	23	3
670	RAUL GONZALEZ	Starr	37.5	23	3
672	ELOY VERA	Starr	172.5	23	3
674	EULALIO GONZALEZ ET AL	Starr	27.775	23	3
678	SILVESTRE GARZA GONZALEZ	Starr	77	23	3
679	GRIFFIN & BRAND OF MCALLEN INC	Starr	882.342	23	3
679	ARTHUR E BECKWITH	Starr	82.45	23	3
679	BRAND CHRISTIAN YOUTH CAMP INC	Starr	217.458	23	3
679	TROPHY INTERNATIONAL INC	Starr	1487.4925	23	3
680	AUGUSTIN & ASCENCION B GUERRA	Starr	12.75	23	3
682	JOSE ROEL GONZALEZ	Starr	2.417	23	3
682	MARTIN GUERRA	Starr	0.083	23	3
683	FIDENCIO GUERRA	Starr	4.025	23	3
685	H P GUERRA JR ET AL	Starr	8.75	23	3
686	H P GUERRA JR	Starr	32.5	23	3
687	J C GUERRA	Starr	152.55	23	3
688	JOEL GUERRA ET AL	Starr	282.5	23	3
689	JOSE MARIA GUERRA ET AL	Starr	87.5	23	3
690	J H GUERRA ESTATE ET AL	Starr	655	23	3
693	SILVINA SOLIS HINOJOSA ET AL	Starr	80.02	23	3
693	GAYLE CAMPBELL TRUSTEE	Starr	1.19	23	3
696	NATALIA L HINOJOSA ESTATE	Starr	92.5	23	3
697	HUBERT R HUDSON ET AL	Starr	250	23	3
698	EDUARDO R IZAGUIRRE ET AL	Starr	32.5	23	3
704	LUIS GUERRA	Starr	33.35	23	3
704	RAFAEL PENA ET AL	Starr	33.35	23	3
706	SERAFIN GUERRERO ET AL	Starr	37.5	23	3
706	HORTENSIA G MARGO TRUSTEE	Starr	2.5	23	3
707	IGNACIA GUTIERREZ	Starr	35	23	3
708	ADOLFO PENA JR ET AL	Starr	37.5	23	3
709	ESTATE OF OLIVIA L GUTIERREZ	Starr	70	23	3
710	ESTATE OF OLIVIA L. GUTIERREZ	Starr	30	23	3
711	STARR PRODUCE COMPANY	Starr	822.175	23	3
711	STARR PRODUCE COMPANY	Starr	857.795	23	3
711	SHEERIN CHILDRENS TRUST	Starr	2085	23	3
711	RIO GRANDE CITY PUD	Starr	22.83	23	3
711	RIO WATER SUPPLY CORPORATION	Starr	12	23	3
711	CITY OF LA GRULLA	Starr	23	23	3
712	BOONE LA GRANGE	Starr	37.5	23	3
713	BOONE LA GRANGE ET AL	Starr	33.064	23	3
714	LIEVEN J VAN RIET MD	Starr	112.375	23	3
715	A E LONGORIA ET AL	Starr	347.5	23	3
716	PEDRO LOPEZ SR ESTATE	Starr	96.55	23	3
716	ENCARNACION SAENZ ET UX	Starr		23	3
716	JACINTO LEONIDES LOPEZ ET AL	Starr		23	3
716	PEDRO JUSTINO LOPEZ ET UX	Starr		23	3
716	ORRIS HOLLAND	Starr		23	3
716	ENCARNACION SAENZ JR	Starr		23	3
716	BANNWORTHS INC	Starr		23	3

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719	MARY LUND MCCALL ET AL	Starr	60	23	3
720	MARGO BROTHERS	Starr	887.5	23	3
722	STEPHANIE MARTINEZ	Starr	30	23	3
726	HORTENSIA G MARGO TRUSTEE	Starr	207.5	23	3
727	ROEL ANGEL MOLINA ET AL	Starr	95	23	3
727	RENE MOLINA	Starr	10	23	3
727	TOMAS MOLINA	Starr	2.5	23	3
727	MARTIN MOLINA	Starr	2.5	23	3
728	RENE MOLINA	Starr	28.75	23	3
729	RENE MOLINA ET AL	Starr	297.5	23	3
730	KENNETH GILLHESPY	Starr	9.25	23	3
730	RAFAELA T BARRERA	Starr	9.25	23	3
731	CESARIO MONTALVO ET AL	Starr	37.5	23	3
732	CITY OF ROMA	Starr	27.5	23	3
733	REYNALDO MORENO ET AL	Starr	44.35	23	3
736	DOMINGO MUNIZ ET AL	Starr	30	23	3
737	LIBRADA P MUNIZ	Starr	19.25	23	3
737	JUAN MUNIZ ESTATE	Starr		23	3
738	NOE MUNIZ	Starr	59.7	23	3
741	BANNWORTHS INC	Starr	111.575	23	3
741	GAYLE CAMPBELL TRUSTEE	Starr	15.8375	23	3
741	ORRIS HOLLAND	Starr	15.8375	23	3
742	PABLO A RAMIREZ INC	Starr	220	23	3
743	CIRIO CONRADO ROSA ET UX	Starr	17.5	23	3
744	ANGELICA P FIERROS ET AL	Starr	205	23	3
745	EUGENIO PEREZ ESTATE	Starr	25	23	3
747	CLEMMACO LTD	Starr	12.5	23	3
747	RICHARD L MARGO	Starr	12.5	23	3
748	JOSE ALVAREZ	Starr	22.5	23	3
749	SEVERO PEREZ ET UX	Starr	10	23	3
750	BOONE LA GRANGE	Starr	25.53	23	3
752	DOMINGO PORRAS ET AL	Starr	9.525	23	3
753	MANUEL PORRAS ET AL	Starr	250	23	3
754	MANUEL PORRAS	Starr	34.05	23	3
755	ROEL ROBERTO RAMIREZ	Starr	192.5	23	3
757	IDOLINA MUNOZ RAMON	Starr	7.5	23	3
758	LEONARD J KOBERNAT ET AL	Starr	87.5	23	3
759	JOSE REYES	Starr	10.775	23	3
760	ROSALIO REYES	Starr	25	23	3
762	TEXAS PARKS & WILDLIFE DEPT	Starr	50	23	3
763	CONRADO RODRIGUEZ ET AL	Starr	30	23	3
765	AMERICO ELOY GARCIA ET AL	Starr	70	23	3
766	BIG RIVER DAIRIES INC	Starr	4.58	23	3
766	BENANCIO RODRIGUEZ ET AL	Starr	0.76	23	3
766	MANUEL REYES	Starr	1.71	23	3
767	STARR PRODUCE COMPANY	Starr	5415.586	23	3
767	STARR PRODUCE COMPANY	Starr	1146.22	23	3
767	SALVADOR GARCIA JR	Starr	59	23	3
768	MARIA LUISA BARRERA	Starr	100	23	3
769	J G ROLANDO RUIZ	Starr	15	23	3
771	EVANGELINA P SALINAS ET VIR	Starr	45	23	3
772	MARTIN CRUZ LUERA	Starr	125	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
773	JOSE G SANDOVAL	Starr	2.5	23	3
774	EVERARDO GARCIA JR ET UX	Starr	50	23	3
775	NAPOLEON SEPULVEDA ET AL	Starr	34.65	23	3
776	PABLO SEPULVEDA	Starr	5.55	23	3
777	STARR PRODUCE CO	Starr	3264.125	23	3
777	RIO WATER SUPPLY CORPORATION	Starr	131.25	23	3
777	UNITED STATES DEPT OF INTERIOR	Starr	354.625	23	3
778	JOHN A SHUFORD ET UX	Starr	500	23	3
778	STARR PRODUCE COMPANY	Starr	30	23	3
779	BENANCIO RODRIGUEZ ET AL	Starr	0.8	23	3
779	BIG RIVER DAIRIES INC	Starr	4.79	23	3
779	MANUEL REYES	Starr	1.78	23	3
780	RENE G SMITH	Starr	118.75	23	3
784	NARCISO SOLIS HEIRS	Starr	62.5	23	3
786	RAFAEL VALADEZ SOTO ESTATE	Starr	15	23	3
787	STARR PRODUCE COMPANY	Starr	1250	23	3
788	JOEL F SALINAS ET UX	Starr	21.25	23	3
789	J E TREVINO ET AL	Starr	55	23	3
794	DESIDERIO VERA	Starr	7.5	23	3
797	JOSE G VILLARREAL ET UX	Starr	87.5	23	3
798	JESUS L VILLARREAL	Starr	100	23	3
799	AMERICO ELOY GARCIA	Starr	28	23	3
799	MARTA R SEPULVEDA ET AL	Starr	22	23	3
844	TEXAS DEPT OF TRANSPORTATION	Starr		23	3
4556	SANTANA CARRERA ESTATE	Starr	193	23	3
4557	BANNWORTHS INC	Starr	200	23	3
770	ARTURO VOLPE ET UX	Webb	125	23	3
2421	BRASK-DUMONT RANCH	Webb	3071	23	3
2421	BRASK-DUMONT RANCH	Webb	119	23	3
2421	J E BRAVO	Webb	1	23	3
2421	ADAM VOLPE	Webb	37	23	3
2421	ADAM VOLPE	Webb	13	23	3
2422	LAWRENCE A MANN TRUSTEE	Webb	118	23	3
2422	CYRIA O CONVERSE	Webb	3	23	3
2422	LEONEL GONZALES	Webb	10	23	3
2422	JAIME A GONZALEZ JR	Webb	2	23	3
2422	PATRICIA B SANDITEN	Webb	52	23	3
2422	RICHARD E HAYNES ET AL	Webb	5	23	3
2422	VIMOSA II	Webb	94	23	3
2424	ALBERT & FRANCES MUEHSAM	Webb	1	23	3
2425	GAYLEN GILBREATH	Webb	1	23	3
2427	PARIS A MIMS ET UX	Webb	1	23	3
2432	THEODORE C MILLER	Webb	1	23	3
2433	C E & EVELYN DEYO	Webb	1	23	3
2434	CHARLES WALTER & RUTH WALTER	Webb	1	23	3
2435	LAM INVESTMENTS CO	Webb	1	23	3
2435	T C MILLER	Webb	0.69	23	3
2435	T C MILLER	Webb	0.31	23	3
2435	JAVIER REYES ET UX	Webb	1	23	3
2435	JOSEPH E MILLS	Webb	0.75	23	3
2435	JOSEPH E MILLS	Webb	0.25	23	3
2435	M L CAVE ET UX	Webb	1	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
2435	FREDERICK J KILIAN ET UX	Webb	1	23	3
2435	ROCK H WILKINSON ET UX	Webb	1	23	3
2435	ANTONIO CARLOS LOPEZ	Webb	4	23	3
2435	ROMEO R RAMIREZ	Webb	1	23	3
2435	RAUL R ESPARZA	Webb	1	23	3
2435	DAN AUGUST RICHTER	Webb	1	23	3
2435	MONTE E MCDANIEL	Webb	1	23	3
2435	LEYENDECKER MATERIALS INC	Webb	10	23	3
2695	TED S. SCIBIENSKI	Webb	2554	23	3
2696	5D INC	Webb	990	23	3
2697	FRED M BRUNI	Webb	225	23	3
2698	MANDEL PROPERTIES LTD	Webb	580	23	3
2699	MAURICE M ALEXANDER ET AL	Webb	450	23	3
2700	WILLIAM CLARENCE BARFIELD ET AL	Webb	20.373	23	3
2700	GARY WAYNE WILKINSON ET UX	Webb	14.426	23	3
2700	CITY READY MIX INC	Webb	35.574	23	3
2703	GARY WAYNE WILKINSON ET UX	Webb	33.3	23	3
2704	ARMADILLO CONSTRUCTION CO INC	Webb	42	23	3
2704	JAMES HAYNES JR	Webb	20	23	3
2704	INTERNATIONAL BANK OF COMMERCE	Webb	20	23	3
2704	PATRICIA B SANDITEN	Webb	8.5	23	3
2704	ARTURO VOLPE	Webb	15	23	3
2705	HAIZLIP RANCH LP	Webb	120	23	3
2706	BEN-HUR ENTERPRISES LTD	Webb	382	23	3
2710	NIXON RANCH PARTNERSHIP	Webb	80	23	3
2711	FLORENCE G ARCE	Webb	80.667	23	3
2711	JAVIER E GARZA ET AL	Webb	36.035	23	3
2712	JULIA B MULLER RUHLMAN	Webb	264	23	3
2712	JULIA B MULLER RUHLMAN	Webb	145	23	3
2713	ROBERT MULLER LTD	Webb	336	23	3
2713	ROBERT MULLER LTD	Webb	304	23	3
2713	ALBERT F MULLER JR	Webb	264	23	3
2714	BARBARA T FASKEN	Webb	2220	23	3
2714	BARBARA T FASKEN	Webb		23	3
2715	MINES ROAD DEVELOPMENT L C	Webb	175	23	3
2721	KILLAM DEVELOPMENT CORP	Webb	337	23	3
2724	RODOLFO V SOLIS	Webb	25	23	3
2727	AEP TEXAS CENTRAL COMPANY	Webb		23	3
2733	ANZON INC	Webb	24	23	3
2735	UNITED STATES DEPT OF LABOR	Webb	11.512	23	3
2742	LAREDO MUNIC JR COLLEGE DIST	Webb	31	23	3
2743	RANDOLPH SLAUGHTER ET AL	Webb	56	23	3
2744	COUNTY OF WEBB	Webb	600	23	3
2746	SACRED HEART CHILDRENS HOME	Webb	28.5	23	3
2748	FRANCIS RICHTER FARM PARTNERS	Webb	100	23	3
2750	M C PROPERTIES PARTNERSHIP	Webb	75	23	3
2751	J C TREVINO JR	Webb	254	23	3
2753	PABLO HERNANDEZ	Webb	19	23	3
2754	MARTHA CADENA	Webb	12	23	3
2755	CASSO LTD	Webb	250	23	3
2756	MICHAEL ALLEN MACMAHON ET AL	Webb	255	23	3
2757	HORACIO ACEVEDO ET AL	Webb	260	23	3

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
2758	VERA W HAERING	Webb	248	23	3
2759	CARLOS Y BENAVIDES JR ET AL	Webb	500	23	3
2759	WINFIELD LTD	Webb	112	23	3
2759	KILLAM DEVELOPMENT CORPORATION	Webb	500	23	3
2760	CLOTILDE E VALLS ET AL	Webb	50	23	3
2761	WILLIAM H MCKENDRICK III	Webb	166.65	23	3
2761	WILLIAM H MCKENDRICK III	Webb	49.995	23	3
2761	ALBERT F MULLER JR	Webb	47.5	23	3
2761	ALBERT F MULLER JR	Webb	14.25	23	3
2761	ROSA E MCKENDRICK TRUSTEE	Webb	47.5	23	3
2761	ROSA E MCKENDRICK TRUSTEE	Webb	14.25	23	3
2762	SALINAS INVESTMENTS	Webb	88	23	3
2763	LAREDO NATIONAL BANK TRUSTEE	Webb	1500	23	3
2764	H B O'KEEFE ESTATE	Webb	700	23	3
2766	RICARDO DE ANDA TRUSTEE	Webb	20	23	3
2767	GAYLE CAMPBELL TRUSTEE	Webb	180	23	3
2768	LASKER O'KEEFE HEREFORD	Webb	1350	23	3
2769	CLARK FARMS LTD	Webb	1101	23	3
2771	AGUSTIN VELA	Webb	9	23	3
2772	RANCHO BLANCO CORPORATION	Webb	900	23	3
2772	RANCHO BLANCO CORPORATION	Webb	2812	23	3
2773	MARY H MILLER	Webb	311	23	3
2774	ANA ALICIA PENA BECERRA ET AL	Webb	207	23	3
2774	JESUS ENRIQUE BRIONES	Webb	207	23	3
2774	GERALDINE MCCANN SISCO	Webb	207	23	3
2774	ENRIQUETA L ZIMMERMAN	Webb	207	23	3
2782	ANTONIO R SANCHEZ, ESTATE OF	Webb	80	23	3
2812	SHERRY R LEWIS ET AL	Webb	50	23	3
3910	VAQUILLAS RANCH CO LTD	Webb	200	21	3
2	MRS E JOLENE GUSTAFSON	Willacy	164.8	23	3
3	DELTA LAKE IRRIGATION DISTRICT	Willacy	250	23	3
4	GLEN REGENSCHEID ET UX	Willacy	2.5	23	3
7	BILLIE P BROWN	Willacy	242.5	23	3
8	ROY DAVID PENA ET UX	Willacy	5	23	3
138	SUNNYDEW WATER SUPPLY CORP	Willacy	5	23	3
226	SUNNY DEW WSC	Willacy	5	23	3
822	CITY OF RAYMONDVILLE	Willacy	223.95	23	3
4531	LLOYD FUNK ET AL	Willacy	3640	22	3
4532	D L SMITH JR ET AL	Willacy	187.5	22	3
4533	LLOYD BENTSEN ET AL	Willacy	6889	22	3
844	TEXAS DEPT OF TRANSPORTATION	Zapata		23	3
2429	STRAUD B JACOBS ET UX	Zapata	1	23	3
2431	TROY D WELDON ET UX	Zapata	2	23	3
2652	GREGORIO DAMIAN GOMEZ ET UX	Zapata	6	23	3
2658	SALVADOR GARCIA	Zapata	58	23	3
2718	C O RIVES	Zapata	0.226	23	3
2718	BARTON E ANDERSON ET UX	Zapata	0.774	23	3
2725	CYRUS B. REYNOLDS ET UX	Zapata	5	23	3
2736	JOEL RUIZ ET UX	Zapata	4	23	3
2775	ROBERTO J VIDAURRI	Zapata	260.2	23	3
2775	MARIA LUISA VIDAURRI STOTT	Zapata	250.2	23	3
2775	GERARDO VIDAURRI ET AL	Zapata	260.2	23	3

Water right description

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
2775	ROSEMARIE ANN GEARY	Zapata	104.08	23	3
2775	FRANCIS MATTHEW HERBST JR	Zapata	99.08	23	3
2775	MARY JOSEPHINE H GARCIA	Zapata	104.08	23	3
2775	EDWARD JAMES HERBST	Zapata	104.08	23	3
2775	ALFREDO JOSEPH HERBST	Zapata	104.08	23	3
2776	TEXAS A&M UNIVERSITY SYSTEM	Zapata	1353	23	3
2777	FENDER EXPLORATION & PRODUCTION CO LI	Zapata	1279	23	3
2778	KNAPP-SHERRILL CO	Zapata	75	23	3
2778	KNAPP-SHERRILL CO	Zapata	2036	23	3
2779	LARRY G HANCOCK	Zapata	122	23	3
2780	LANNIE MECOM	Zapata	1025	23	3
2781	FERNANDO GUTIERREZ ET AL	Zapata	51	23	3
2781	CESAR A MORALES ET UX	Zapata	5	23	3
2782	ANTONIO R SANCHEZ, ESTATE OF	Zapata	130	23	3
2782	M C PROPERTIES PARTNERSHIP	Zapata	254.22	23	3
2782	M C PROPERTIES PARTNERSHIP	Zapata	358.78	23	3
2783	HUGO A GUTIERREZ JR TRUSTEE	Zapata	28.68	23	3
2784	DELFINO LOZANO JR ET AL	Zapata	171	23	3
2786	EL CAMPO FARM COMPANY	Zapata	829	23	3
2787	OSCAR O LOPEZ	Zapata	30	23	3
2788	GUADALUPE MARTINEZ ET AL	Zapata	168	23	3
2791	MARIA EVA URIBE RAMIREZ	Zapata	86	23	3
2793	JORGE & IRMA URIBE	Zapata	76	23	3
2794	HAGCO BUILDING SYSTEMS INC ET AL	Zapata	221	23	3
2797	ANTONIO RAMIREZ ET AL	Zapata	7.03	23	3
2797	GUADALUPE TREVINO ET AL	Zapata	18.05	23	3
2797	JUAN FRANCISCO RAMIREZ ET AL	Zapata	8.63	23	3
2799	AMANDA G RASH ET AL	Zapata	305.76	23	3
2800	JOSE F GUTIERREZ SR ET AL	Zapata	56	23	3
2800	HOMERO ELIZONDO ET UX	Zapata	3	23	3
2804	ELENA F STOKES	Zapata	4.75	23	3
3313	RAMIRO V MARTINEZ	Zapata	140	23	3
285	MICHAEL A MACMAHON	Cameron	9.62	23	4
742	PABLO A RAMIREZ INC	Cameron		23	4
2700	DOUGLAS M BRICE	Cameron		23	4
2708	JOEL RUIZ ET UX	Cameron		23	4
339	RUFINO GARZA ET AL	Hidalgo	125	23	4
421	LUCIO E GONZALEZ JR	Hidalgo	5	23	4
742	PABLO A RAMIREZ INC	Hidalgo		23	4
802	HIDALGO COUNTY IRR DIST 16	Hidalgo	200	23	4
808	HIDALGO CO IRR DIST 2	Hidalgo	100	23	4
848	HIDALGO CO WID 3	Hidalgo	100	23	4
2700	DOUGLAS M BRICE	Hidalgo		23	4
2708	JOEL RUIZ ET UX	Hidalgo		23	4
2688	KATHRYN RITCHIE COTTER ET AL	Maverick	10	23	4
2690	ALAMO CONCRETE PRODUCTS LTD	Maverick	78	23	4
2691	MILDRED GOODSON	Maverick		23	4
2700	DOUGLAS M BRICE	Maverick		23	4
2706	DE LOS SANTOS READY MIX	Maverick	2	23	4
633	ROSITA GRAVEL INC	Starr	22.5	23	4
742	PABLO A RAMIREZ INC	Starr	30	23	4
2700	DOUGLAS M BRICE	Starr		23	4

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
2708	JOEL RUIZ ET UX	Starr		23	4
2422	CHRISTINE MCKEE	Webb	1	23	4
2422	HACHAR REAL ESTATE COMPANY	Webb	23	23	4
2698	MANDEL PROPERTIES LTD	Webb	100	23	4
2699	MAURICE M ALEXANDER ET AL	Webb	30	23	4
2699	LAREDO SAND & GRAVEL CO	Webb	20	23	4
2700	CITY READY MIX INC	Webb	100	23	4
2700	DOUGLAS M BRICE	Webb	131.557	23	4
2704	J & B CONTRACTORS INC	Webb	2	23	4
2706	BEN-HUR ENTERPRISES LTD	Webb		23	4
2708	JOEL RUIZ ET UX	Webb		23	4
2714	BARBARA T FASKEN	Webb	200	23	4
2727	AEP TEXAS CENTRAL COMPANY	Webb		23	4
2734	RODOLFO GARCIA	Webb	75	23	4
2742	RODOLFO GARCIA	Webb	62	23	4
2747	UNION PACIFIC OIL & GAS CO	Webb	5	23	4
2747	ALICE SOUTHERN EQUIP SERVICE	Webb	145	23	4
2747	ALICE SOUTHERN EQUIP SERVICE	Webb	175	23	4
2756	MICHAEL ALLEN MACMAHON ET AL	Webb	120	23	4
2761	WILLIAM H MCKENDRICK III	Webb	8.3325	23	4
2761	ALBERT F MULLER JR	Webb	2.375	23	4
2761	ROSA E MCKENDRICK TRUSTEE	Webb	2.375	23	4
2764	H B O'KEEFE ESTATE	Webb	100	23	4
2769	CLARK FARMS LTD	Webb	45	23	4
2772	RANCHO BLANCO CORPORATION	Webb	300	23	4
2812	LOUIS C LECHENGER ET AL	Webb	20	23	4
742	PABLO A RAMIREZ INC	Willacy		23	4
2708	JOEL RUIZ ET UX	Willacy		23	4
68	KCS RESOURCES INC	Zapata	25	23	4
215	JAMES C GUERRA ET AL	Zapata	12.5	23	4
487	ANTONIO R SANCHEZ SR ESTATE	Zapata	50	23	4
487	ANTONIO R SANCHEZ SR ESTATE	Zapata	50.425	23	4
742	PABLO A RAMIREZ INC	Zapata		23	4
2700	DOUGLAS M BRICE	Zapata		23	4
2708	JOEL RUIZ ET UX	Zapata	20	23	4
2775	ROBERTO J VIDAURRI	Zapata		23	4
2775	MARIA LUISA VIDAURRI STOTT	Zapata	10	23	4
2775	ROSEMARIE ANN GEARY	Zapata		23	4
2775	FRANCIS MATTHEW HERBST JR	Zapata	5	23	4
2777	FENDER EXPLORATION & PRODUCTION CO LI	Zapata	20	23	4
2779	LARRY G HANCOCK	Zapata	80	23	4
2780	LANNIE MECOM	Zapata	25	23	4
2786	EL CAMPO FARM COMPANY	Zapata	25	23	4
2791	MARIA EVA URIBE RAMIREZ	Zapata	10	23	4
2799	UNICO CONSTRUCTION CO	Zapata	11.24	23	4
5066	SOUTH TEXAS ELECTRIC CO-OP INC	Starr	1200000	23	5
5066	MEDINA ELECTRIC CO-OP INC	Starr		23	5
126	U S FISH & WILDLIFE SERVICE	Cameron		23	7
4323	CASTRO DEVELOPMENT CO INC	Cameron		22	7
4323	J M HEANER DEVELOPMENT INC	Cameron		22	7
4536	TOWN OF RIO HONDO	Cameron		22	7
4539	UNITED STATES DEPT OF INTERIOR	Cameron		22	7

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
4543	THOMAS H SWEENEY JR ET AL	Cameron		22	7
2076	UNITED STATES DEPT OF INTERIOR	Hidalgo	1000	23	7
2691	MILDRED GOODSON	Maverick		23	7
3525	WINN EXPLORATION CO INC	Maverick		23	7
2772	RANCHO BLANCO CORPORATION	Webb		23	7
3732	RADCLIFFE KILLAM ET AL	Webb		23	7
4538	CAMERON CO IRR DIST NO 2	Cameron		22	8
4539	UNITED STATES DEPT OF INTERIOR	Cameron	7000	22	8
4539	UNITED STATES DEPT OF INTERIOR	Cameron		22	8
4543	THOMAS H SWEENEY JR ET AL	Cameron		22	8
4551	LAGUNA MADRE WATER DISTRICT	Cameron		22	8
4555	BROWNSVILLE PUBLIC UTIL BOARD	Cameron		22	8
5019	UT - PAN AM UNIVERSITY	Cameron	13.44	22	8
4523	HIDALGO CO IRR DIST 1	Hidalgo		22	8
2694	BRISCOE RANCH INC	Webb	50	23	8
831	HARLINGEN IRR DIST	Cameron	4692	23	11
850	LAGUNA MADRE WATER DISTRICT	Cameron	100	23	11
4543	THOMAS H SWEENEY JR ET AL	Cameron	3300	22	11
4544	UNITED STATES DEPT OF INTERIOR	Cameron		22	11
802	HIDALGO COUNTY IRR DIST 16	Hidalgo	100	23	11
803	LA FERIA ID CAMERON CO 3	Hidalgo	2152	23	11
804	SANTA CRUZ IRR DIST 15	Hidalgo	120	23	11
805	DONNA ID HIDALGO CO 1	Hidalgo	2690	23	11
809	ENGLEMAN IRRIGATION DISTRICT	Hidalgo	80	23	11
811	DELTA LAKE IRR DIST	Hidalgo	1320	23	11
812	HIDALGO & CAMERON CO WCID NO 9	Hidalgo	4163	23	11
816	HIDALGO CO IRR DIST 1	Hidalgo	1220	23	11
846	UNITED IRRIGATION DISTRICT	Hidalgo		23	11
116	DOS REPUBLICAS COAL PARTNERSHP	Maverick	125	23	11
3525	WINN EXPLORATION CO INC	Maverick		23	11
5201	COMANCHE MAVERICK RANCH INVESTMENTS	Maverick		21	11
5640	RIO BRAVO LAND CO	Maverick		23	11
5640	RIO BRAVO LAND CO	Maverick		23	11
5640	RIO BRAVO LAND CO	Maverick		23	11
5654	BRISCOE RANCH INC	Maverick		23	11
5657	ROBERT B GOLDSBURY	Maverick		23	11
5668	WALTER UMPHREY	Maverick		23	11
3732	RADCLIFFE KILLAM ET AL	Webb		23	11
3929	VAQUILLAS RANCH CO LTD	Webb		23	11
5653	BRISCOE RANCH INC	Webb		21	11
5653	BRISCOE RANCH INC	Webb		21	11
5653	BRISCOE RANCH INC	Webb		21	11
5653	BRISCOE RANCH INC	Webb		21	11
5653	BRISCOE RANCH INC	Webb		21	11
5653	BRISCOE RANCH INC	Webb		21	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11

WR Number	Owner Name	County	Amount in Ac-Ft/Yr	Basin	Use
5654	BRISCOE RANCH INC	Webb		23	11
5654	BRISCOE RANCH INC	Webb		23	11
5660	ROBERT B NUNLEY JR ET AL	Webb		21	11
5660	ROBERT B NUNLEY JR ET AL	Webb		21	11
5660	ROBERT B NUNLEY JR ET AL	Webb		21	11
5649	HINNANT & FULBRIGHT LTD	Zapata		23	11
5649	HINNANT & FULBRIGHT LTD	Zapata		23	11
4412	BOCA CHICA WATER SUPPLY INC	Cameron		23	13
5259	BROWNSVILLE PUBLIC UTIL BOARD	Cameron		23	13
	Domestic	20062			
	Municipal	305997.1178			
	Industrial	64625.628			
		390684.7458			

FINAL REPORT

Study No. 1

Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing Water Rights on the Lower and Middle Rio Grande

Rio Grande Regional Water Planning Study
1st Phase, 3rd Round of Regional Planning

August 28, 2009

prepared for

Rio Grande Regional Planning Group

prepared by

TRC/Brandes
Austin, Texas

STATE OF TEXAS
ROBERT J. BRANDES
39120
REGISTERED PROFESSIONAL ENGINEER

8-28-09

Executive Summary

This study has been undertaken by TRC/Brandes as a subcontractor to NRS Consulting Engineers, the primary consultant to the Rio Grande Regional Planning Group for development and preparation of the Rio Grande Regional Water Plan. This work is part of the first phase of the third round of Regional Water Planning that is administered and conducted by the Texas Water Development Board pursuant to authorization in Senate Bill 1 as passed by the 75th Texas Legislature in 1997.

The primary purpose of this study was to investigate the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependent on Amistad and Falcon Reservoirs for their supply. These implications relate primarily to changes in the available water supply from Amistad and Falcon Reservoirs for the different types of water users and uses that might occur as a result of implementing different water management and allocation strategies as may be considered by the Rio Grande Regional Planning Group (RPG).

The Rio Grande Water Availability Model (WAM) developed by the Texas Commission on Environmental Quality (TCEQ) was used extensively in this study to evaluate the effects of potential changes in various aspects of the existing Rio Grande Operating Rules. Specifically, simulations and analyses have been undertaken to investigate the impacts on water availability and the reliability of Amistad-Falcon water supplies of different assumptions regarding changes in future demands from irrigation to all municipal use, modifications to storage allocations in Amistad and Falcon Reservoirs for irrigation and mining water rights and for the domestic-municipal-industrial (DMI) reserve, classifying all municipal water rights the same as Class A irrigation and mining rights with similar water allocation procedures, and modifications to the accounting procedures used by the International Boundary and Water Commission (IBWC) for allotting flows in the Rio Grande at Fort Quitman between the Untied States and Mexico.

Significant findings and recommendations of this study include the following:

- The 2010 firm annual yield of the Amistad-Falcon reservoir system for the United States (Texas water rights) with all water used for municipal purposes is 1,131,500 acre-feet/year, an increase of almost 120,000 acre-feet/year over the Unites States' share of the yield of the reservoir system with the current mix of municipal, industrial, irrigation, mining and other uses under current operating procedures for the Lower and Middle Rio Grande water rights.
- Based on the United States' share of the estimated firm yield of the Amistad-Falcon reservoir system, the projected municipal demands over the next 50 years along the Lower and Middle Rio Grande as presented in the 2006 Rio Grande Regional Plan (about 626,000 acre-feet/year in 2060) can be fully satisfied by converting irrigation/mining water rights to municipal use.

- The historical hydrologic data set incorporated in the TCEQ's current version of the Rio Grande WAM extends from 1940 through 2000, which ends in the middle of what appears to be the critical drought of record for the Lower and Middle Rio Grande; the hydrologic inputs to the WAM should be extended at least through 2005 in order to be able to simulate and analyze the entire 1990s-2000s critical drought period and the associated extreme low-flow conditions when evaluating water availability.

- Modifications to TCEQ's existing Rio Grande Operating Rules regarding storage limits in Amistad and Falcon Reservoirs for irrigation and mining water rights and for the DMI reserve does not result in any appreciable changes in the reliability of the water supply for these rights from the Amistad-Falcon reservoir system.

- Reclassification of all existing municipal water rights on the Lower and Middle Rio Grande to the same as Class A irrigation and mining rights with similar water allocation procedures does not result in any appreciable changes in the reliability of the water supply for these rights from the Amistad-Falcon reservoir system.

- Revising current IBWC water ownership accounting procedures to allot 100% of the flow in the Rio Grande at Fort Quitman to the United States (as stipulated in the 1906 Convention) instead of the 50/50 split with Mexico (as is the current IBWC practice purportedly in accordance with the provisions of the 1944 Treaty) would increase the United States' share of the firm yield of the Amistad-Falcon reservoir system from approximately 1,012,081 acre-feet/year to 1,028,631 acre-feet/year, or about 16,550 acre-feet/year (~1.6%), and this change in current procedures should be pursued.

- Results from the various WAM simulations and analyses performed in this study were discussed and examined by the Rio Grande RPG, and it was generally determined that further evaluations to investigate the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system and Amistad and Falcon Reservoirs as potential water supply strategies in the context of regional water planning were not warranted at this time and should not be pursued.

- Based on the findings herein, it is recommended that further analyses not be undertaken as part of this study with regard to investigating the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system and Amistad and Falcon Reservoirs as potential water supply strategies in the context of regional water planning.

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1.0 Purpose of Study

1.1 Purpose Statement

The primary purpose of this study was to investigate the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande that are dependent on Amistad and Falcon Reservoirs for their supply as potential water supply strategies in the context of regional water planning that may be considered by the Rio Grande Regional Planning Group (RPG). These implications relate primarily to any changes in the available water supply from Amistad and Falcon Reservoirs for the different types of water users and uses that might occur as a result of implementing such changes in current methods or procedures.

1.2 Rio Grande Water Rights

Water rights on the Rio Grande that are dependent upon Falcon and Amistad Reservoirs for their supply are unique in Texas because of the manner in which they are allocated water under the State's rules, particularly during dry periods. Rather than being subject to the prior appropriation doctrine like all other water rights in Texas whereby allocations of available supplies are based on the relative dates when individual water rights were issued or recognized by the State ("first in time, first in right"), the Lower and Middle Rio Grande water rights are allocated water based on their designated type of use and their authorized annual diversion amount. This class-based system of water rights originated on the Lower Rio Grande below Falcon Reservoir with the decision of the Thirteenth Court of Civil Appeals in the 1969 landmark case styled "State of Texas, et al. vs. Hidalgo County Water Control and Improvement District No. 18, et al.", which is commonly referred to as the Valley Water Case.

Under the Court's decision, municipal water use, which includes use for domestic, industrial, manufacturing, and steam electric power generation purposes, was granted the highest water supply priority and was assured of a firm supply of stored water[1]. A weighted priority system was devised for allocating the remaining supply of stored water to irrigation (and mining) uses.[2] Two classes of irrigation and mining water rights (Class A and Class B) ultimately were established to reflect the nature of a water right claim as filed with the Court and the extent to which the historical usage under a particular water right could be documented and verified during the adjudication process. These two classes of irrigation and mining rights also served as the basis for differentiating the rates at which stored water was to be credited or allocated to individual reservoir storage accounts. Currently, Class A irrigation and mining rights are allocated water at a rate 1.7 times greater than the Class B irrigation and mining rights. Although this weighted priority system for irrigation and mining water users generally has little significance during years when water is abundant, its effect in water-short years is to distribute

[1] In this report, references to "Municipal" water rights or usage also include "Domestic", "Industrial", "Manufacturing", and "Steam Electric Power Generation" water rights or usage.

[2] In this report, references to "Irrigation" water rights or usage also include "Mining" water rights or usage.

the overall shortage among all irrigation and mining water users, with the Class B water rights experiencing the greater shortages.

In 1982, water rights in the Middle Rio Grande Basin; i.e., from Falcon Reservoir upstream to Amistad Reservoir, were adjudicated pursuant to Title 2, Subtitle B, Chapter 11, Subchapter G of the Texas Water Code. As a result of these proceedings, those water users located along the Middle Rio Grande that were dependent upon water stored in Amistad or Falcon Reservoirs were assigned water rights based on the same allocation and accounting principles established in the Valley Water Case. Water users located on tributaries within the Middle Rio Grande Basin were assigned water rights based on the prior appropriation doctrine, with priorities senior to those associated with the water rights dependent on Amistad and Falcon Reservoirs.

It should be noted that all water rights located in Texas within the Rio Grande Basin upstream of Amistad Reservoir (Upper Rio Grande Basin) are subject to the prior appropriation doctrine regardless of type of use. The authorized diversion amounts and priority dates for these upper basin water rights have been determined through adjudication proceedings conducted by the TCEQ and it predecessor agencies; all Upper Rio Grande water rights are senior in priority to those on the Lower and Middle Rio Grande. These upper basin water rights are not the subject of the studies reported herein.

1.3 Rio Grande Operating Rules

As a result of the Valley Water Case, rules have been adopted by the State's water agencies, now the Texas Commission on Environmental Quality (TCEQ), that regulate the operation of the Lower and Middle Rio Grande system and the allocation of water stored in Amistad and Falcon Reservoirs among all Texas users[3]. The rules applied by the TCEQ in administering mainstem water rights on the Lower and Middle Rio Grande affect not only the amount of water that can be diverted from the Rio Grande, but also the operation of the conservation pools in Amistad and Falcon Reservoirs. The current rules provide a reserve of 225,000 acre-feet of storage in Amistad and Falcon Reservoirs for domestic, municipal, and industrial uses, which is referred to as the "DMI reserve" or the "municipal pool". An operating reserve of 75,000 acre-feet also is established to provide for: (1) loss of water by seepage, evaporation and conveyance; (2) emergency requirements; and, (3) adjustments of amounts in storage, as may be necessary by finalization of provisional United States-Mexico water ownership computations made by the International Boundary and Water Commission (IBWC). Under certain conditions of low inflows to the reservoirs, the operating reserve can fall below 75,000 acre-feet, but it cannot be reduced to less than zero.

The TCEQ Rio Grande Watermaster administers the water allocations to municipal/domestic, industrial, agricultural and other user storage accounts for the combined United States storage in Amistad and Falcon Reservoirs. Such allocations are based on the United States' share of water considered to be "usable storage" in the combined reservoirs, as reported by the IBWC on the last Saturday of each month. Usable storage is defined as the total amount of United States water stored in the conservation pools of the reservoirs less dead storage, which currently is assumed

[3] "Chapter 303: Operation of the Rio Grande"; 31 Texas Administrative Code, §§ 303.1-303.93; Rules of the Texas Commission on Environmental Quality; October 26, 2006; Austin, Texas.

by the Rio Grande Watermaster to be 4,600 acre-feet. To determine the quantities of water to be allocated to the specified reserves and accounts each month, the following computations are made by the Watermaster:

1) From the amount of water in usable storage, 225,000 acre-feet are deducted to re-establish the reserve for domestic, municipal, and industrial uses, i.e., the DMI or municipal pool;
2) From the remaining storage, the total end-of-month account balances for all Lower and Middle Rio Grande irrigation and mining water rights (allottees) are deducted; and,
3) From the remaining storage, 75,000 acre-feet are deducted to establish the operating reserve for the system.

After the above computations are made, the remaining storage, if any, is allocated to the irrigation and mining accounts. The total allotment for irrigation and mining uses is divided into the Class A and Class B water rights categories. Class A rights receive 1.7 times as much water as that allotted to Class B rights. An irrigation allottee cannot accumulate in storage more than 1.41 times its annual authorized diversion right; this quantity is referred to in this study as the "Storage Factor". If an allottee does not beneficially use water for two consecutive years, its account is reduced to zero until such time as the allottee advises the Watermaster that water is again needed.

If there is not sufficient water in storage in Step 3 above to maintain the operating reserve at a level greater than zero, then the TCEQ rules authorize the Watermaster to make negative allocations of water (on a pro rata basis) from the irrigation and mining accounts containing water at the time in sufficient amounts to reestablish the operating reserve capacity to at least 48,000 acre-feet. When the operating reserve has been restored to 75,000 acre-feet as inflows continue to be stored in Amistad and Falcon Reservoirs, and sufficient water is available, all accounts from which water had been deducted through negative allocations are restored to the amount of water in each account prior to the negative allocation period, and any new allotments are made in accordance with the normal procedures described above.

An important aspect of the class-based water rights system for the Lower and Middle Rio Grande, and the subject of some of the analyses reported herein, is the manner in which water rights are converted from one type of use to another. Because the allocation procedures are different among the different types of water rights, i.e., among DMI, Class A irrigation and Class B irrigation rights, there are specific rules in place that adjust or modify how much water can be used, or diverted, annually when one type of water right is converted to another type. With expanded urbanization and development throughout the Lower and Middle Rio Grande Basins and with the population in these areas rapidly growing, the demand for municipal water is steadily increasing; hence, the typical conversion of existing water rights is from either Class A or Class B irrigation use to municipal use.

Under current TCEQ rules, when a Class A irrigation (or mining) water right is converted to municipal use, the authorized annual diversion amount of the right, expressed in acre-feet/year, is reduced to one-half (0.5) of the amount originally authorized to be used for irrigation. Similarly, when a Class B irrigation (or mining) water right is converted to municipal use, the authorized annual diversion amount of the right is reduced to four-tenths (0.4) of the amount originally authorized to be used for irrigation. Once an irrigation or mining water right has been amended and converted to a municipal priority, the water right then is allocated stored water in accordance with the normal procedures used for all other municipal (DMI) water rights, i.e., the right assumes the highest priority for allocations.

1.4 Study Rationale

At issue with regard to the studies reported herein is whether the current water supply management rules and the associated water allocation procedures for the Lower and Middle Rio Grande are appropriate considering that 50 to 60 years from now a substantial portion of the water supply from Amistad and Falcon Reservoirs will be used for municipal purposes, rather than irrigation. It could be that alternative procedures for managing the overall reservoir system water supply and/or for allocating water to the different types of water rights may be more desirable from the standpoint of providing more reliable and equitable supplies of water from the reservoirs for all users. Such alternative procedures could represent water supply strategies that the Rio Grande Regional Planning Group may want to consider for recommendation to TCEQ as modifications to the current Rio Grande Operating Rules.

As of May 28, 2008, the total authorized annual diversions, expressed in acre-feet/year, for water rights on the Lower and Middle Rio Grande were distributed among the different types of water rights as indicated in the following table (Rio Grande Watermaster, 2008a):

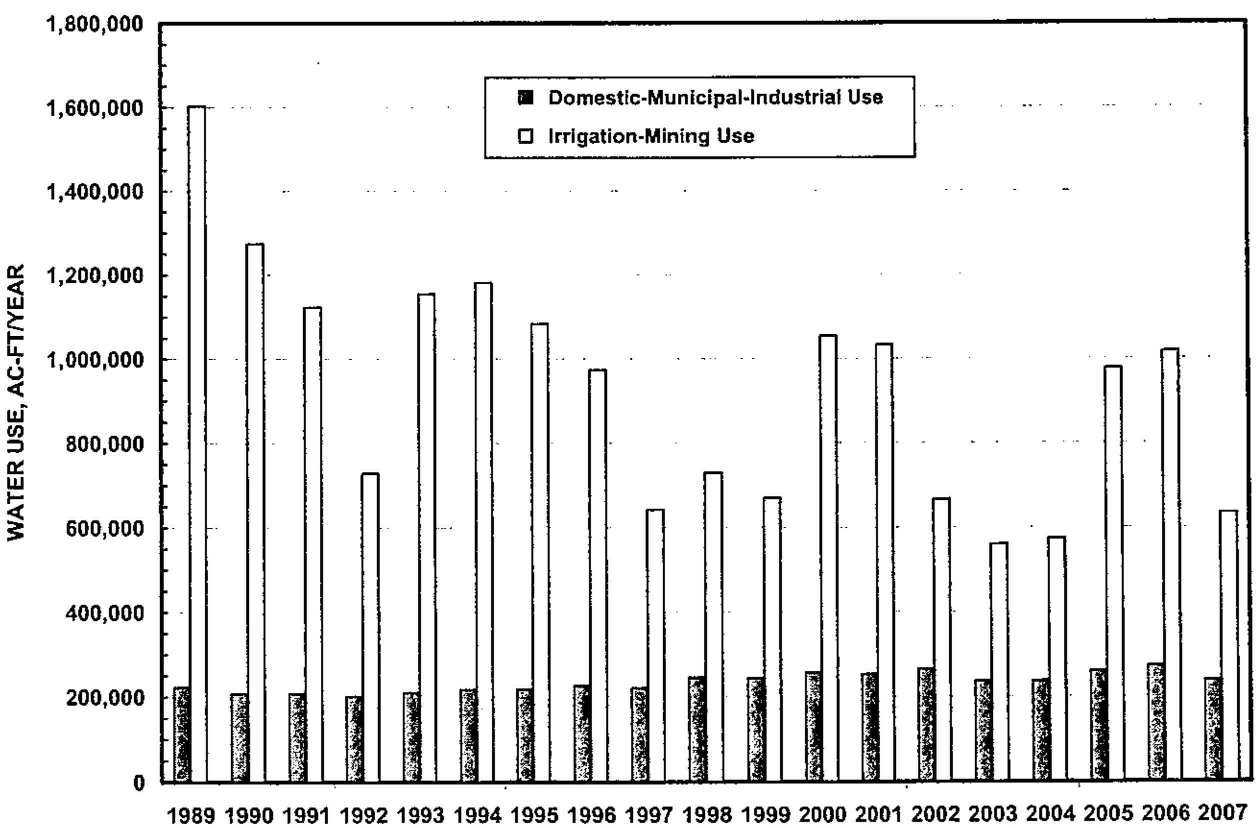
TABLE 1-1 AUTHORIZED ANNUAL DIVERSIONS FOR TEXAS WATER RIGHTS ON THE LOWER AND MIDDLE RIO GRANDE (Acre-Feet/Year)

Lower Rio Grande			1,876,237	88 %
Domestic-Municipal-Industrial Rights	244,149	13 %		
Class A Irrigation/Mining Rights	1,452,758	78 %		
Class B Irrigation/Mining Rights	161,459	9 %		
Middle Rio Grande			234,313	12 %
Domestic-Municipal-Industrial Rights	76,634	29 %		
Class A Irrigation/Mining Rights	162,152	62 %		
Class A Municipal Rights	2,145	1 %		
Class B Irrigation/Mining Rights	19,432	7 %		
Lower and Middle Rio Grande			2,118,729	100 %
Domestic-Municipal-Industrial Rights	320,783	15 %		
Class A Irrigation/Mining Rights	1,614,910	76 %		
Class A Municipal Rights	2,145	0.1 %		
Class B Irrigation/Mining Rights	180,891	9 %		

It is apparent that by far most of the existing water rights on the Lower and Middle Rio Grande are authorized for irrigation use (85%). As shown above, total annual diversions of approximately 1.8 million acre-feet are authorized for irrigation use. Considering that the current TCEQ Rio Grande Operating Rules limit the amount of water that each irrigation (and mining) water right can store in its account in Amistad and Falcon Reservoir to 1.41 times its annual diversion authorization, the total amount of water that can be stored in the reservoir by all esisting irrigation and mining water rights at any given time based on the above quantities is 2,532,079 acre-feet, i.e., 1.41 x 1,795,801 acre-feet.

Historical annual water use by domestic, municipal and industrial water rights and by irrigation and mining water rights from Amistad and Falcon Reservoirs over the period 1989 through 2007 is illustrated graphically in Figure 1-1 (Rio Grande Watermaster, 2008b). As shown, the combined use for DMI purposes has gradually risen over this 19-year period and currently is on the order of about 260,000 acre-feet/year. The average annual use for irrigation and mining during this period was approximately 940,000 acre-feet/year, and as noted, the annual usage has varied considerably primarily in response to seasonal and annual rainfall conditions and available storage in Amistad and Falcon Reservoirs. The maximum usage for irrigation and mining purposes was about 1.6 million acre-feet in 1989, and the lowest annual use reported was about 560,000 acre-feet in 2003.

FIGURE 1-1 HISTORICAL WATER USE BY LOWER AND MIDDLE RIO GRANDE WATER RIGHTS



international agreements between the United States and Mexico regarding the ownership of the water flowing in the Rio Grande are incorporated into the model. These agreements include the 1944 Treaty, which addresses the ownership of water downstream of Fort Quitman, Texas, and the 1906 Convention, which divides the water between the United States and Mexico above Fort Quitman. One of the most important aspects of this process involves the transfer of ownership of Mexican water from certain Mexican tributaries of the Rio Grande to the United States. This ownership transfer stems from a provision of the 1944 Treaty which states that one-third of the flow reaching the Rio Grande from Mexico through the Rio Conchos, Arroyo de las Vacas, Rio San Diego, Rio San Rodrigo, Rio Escondido, and Rio Salado must be transferred to United States ownership in the river. Consistent with current accounting procedures, this is accomplished in the WAM after all of Mexico's demands and reservoirs on these tributaries have been satisfied to the extent water is available. One-third of the remaining flow at the mouths of each of these six tributaries then is diverted and subsequently discharged as return flows to the United States segment of the river. Demands for water along the Rio Grande by both the United States and Mexican water users downstream of these Mexican tributaries then are simulated in the model based on each country's ownership of water flowing in the river. It is important to note that the 1944 Treaty provision requiring a minimum five-year average of 350,000 acre-feet/year to be delivered to the United States from the above six Mexican tributaries is not stipulated in the WAM because of uncertainties regarding how this provision is actually implemented and enforced in current practice. Consequently, in the WAM the only Mexican tributary water transferred to the United States is one-third of the flow of the six named tributaries after all upstream Mexican demands have been exercised, which can be less than a combined average of 350,000 acre-feet/year.

Another aspect of the international distribution of Rio Grande flows between the United States and Mexico relates to the equal split of the flows in the Rio Grande at Fort Quitman. It should be pointed out that the equal split of the Fort Quitman flows is the procedure currently employed by the International Boundary and Water Commission (IBWC) in its accounting of United States and Mexican ownership of water flowing in the Rio Grande. This procedure does not appear to be consistent, however, with language adopted by the 1906 Convention, which states that except for the delivery of Rio Grande Project water to Mexico at the Acequia Madre (Mexico's intake canal at Juarez), all water flowing in the Rio Grande above Fort Quitman is owned by the United States. This would suggest that the United States owns all of the river water passing Fort Quitman, but this is not how the current accounting is performed by IBWC. The implications of this interpretation have been evaluated as part of this study.

2.2 General Approach

The analyses undertaken pursuant to this study generally were accomplished through a systematic sequence of activities as listed below:

1) Acquisition and review of latest version of TCEQ Rio Grande WAM.
2) Identification of potential changes to Rio Grande Operating Rules or other aspects of the Rio Grande system as part of possible water management strategies.

3) Modification of the Rio Grande WAM to incorporate simplified representations of all Texas water rights on the Lower and Middle Rio Grande by sub-basin and by class of water use.

4) Modification of the Rio Grande WAM to represent potential changes to Rio Grande Operating Rules or other aspects of the Rio Grande system as possible water management strategies.

5) Evaluation of potential changes to Rio Grande Operating Rules or other aspects of the Rio Grande system as possible water management strategies using modified versions of the WAM.

6) Review and discussion of results from the WAM analyses with Region M representatives, Rio Grande water users, and other water interests, and identification of other analyses to be undertaken.

7) Evaluation of additional changes to Rio Grande Operating Rules or other aspects of the Rio Grande system as possible water management strategies using modified versions of the WAM.

8) Review and discussion of results with Region M representatives, Rio Grande water users, and other water interests, identification of other analyses to be undertaken, and description of possible changes to Rio Grande Operating Rules or other aspects of the Rio Grande system for consideration by the Rio Grande RPG as water management strategies.

During the course of the work, preliminary results from one or more of these activities formed the basis for proceeding with other analyses. Final results reflect a summary of the relevant findings from these analyses. All analyses were performed using variations of the TCEQ Rio Grande WAM, appropriately modified to incorporate simplified water rights representations in the model and to represent desired changes in allocation and management procedures used for water rights and reservoir and basin operations.

3.0 Study Results

Results from the analyses performed in this study are summarized and discussed by major activity in the following sections.

3.1 Rio Grande WAM Simplified Water Rights Representation

To simplify the modifications to the WAM that may be required to facilitate analyzing some of the potential changes in allocation and management procedures used for water rights and reservoir and basin operations, all of the individual Texas water rights included in the basic TCEQ Rio Grande WAM for the Lower and Middle Rio Grande were combined according to their various classes of use. This resulted in having only three individual water rights representing all of the domestic-municipal-industrial class, the Class A irrigation/mining class, and the Class B irrigation/mining class for the Lower Rio Grande and for the Middle Rio Grande, with the specified diversion amounts for each of these individual water rights equal to the sum of the annual diversion amounts for all of the water rights comprising each of the three different classes of rights. This simplification could be implemented because all water rights in a particular class are simulated in the WAM using the exact same procedure, with each individual water right being allocated its share of available water based on its annual authorized diversion amount as a proportional share of the total annual authorized diversion amount for all water rights in the use class. This modification to the WAM substantially reduced the time required to change the specified annual diversion amounts for all water rights on the Lower and Middle Rio Grande as required for some of the analyses.

Listed in the following table are the total annual diversion amounts, expressed in acre-feet/year, assigned to each of the combined water rights for the different use classes for water rights on the Lower and on the Middle Rio Grande as represented in the modified version of the TCEQ Rio Grande WAM used in this study. These combined total annual diversion amounts as used in the WAM are slightly different from those previously presented because they reflect authorized water rights conditions as of June 5, 2005, instead of May 28, 2008.

TABLE 3-1 AUTHORIZED ANNUAL DIVERSIONS FOR TEXAS WATER RIGHTS ON THE LOWER AND MIDDLE RIO GRANDE AS INCLUDED IN THE RIO GRANDE WAM

Lower Rio Grande	
Combined Domestic-Municipal-Industrial Right	247,046
Combined Class A Irrigation/Mining Right	1,463,044
Combined Class B Irrigation/Mining Right	166,147
Middle Rio Grande	
Combined Domestic-Municipal-Industrial Rights	62,430
Combined Class A Irrigation/Mining Rights	152,045
Combined Class B Irrigation/Mining Rights	17,693

3.2 Preliminary WAM Analyses

Preliminary analyses were made with the modified WAM to provide initial results for discussion with the Rio Grande RPG and other water interests. For these analyses, different assumptions were made with regard to water rights on the Lower and Middle Rio Grande, and varying types of results were produced. These WAM simulations are described and discussed in the following sections.

1) Using the simplified version of the TCEQ Rio Grande WAM as described above, the annual diversion amounts for all Texas water rights were assumed to be used only for municipal purposes (no irrigation or mining use), and the resulting firm yield of the Amistad-Falcon reservoir system for the United States was determined to be 1,131,500 acre-feet/year. With the annual diversion amounts for all current municipal water rights (as represented in the TCEQ Rio Grande WAM) set equal to their authorized amounts and the diversion amounts for the current irrigation/mining rights reduced as necessary to achieve a firm yield condition, the resulting firm yield of the Amistad-Falcon system was determined to be 1,012,081 acre-feet/year. Both of these WAM simulations produced a minimum storage of approximately 390,000 acre-feet in the reservoirs during the critical drought period, reflecting somewhat the maintenance of the DMI reserve and the operating reserve as required under the current Rio Grande Operating Rules. It should be noted that the critical drought period for the reservoir system begins in August 1992 and extends through the end of the simulation period, i.e., December 2000. The firm yield results from these two simulations indicate that the Amistad-Falcon reservoir system is more efficient at producing a firm supply of water solely for municipal use (by about 119,500 acre-feet/year) than for multiple types of uses with monthly water allocations made to the irrigation/mining accounts. This is significant considering that the current trend in the Lower and Middle Rio Grande basins is to convert irrigation/mining water rights to municipal water rights as population growth and urbanization continue to require additional municipal water and as agricultural operations continue to decline. It is also significant to note, as expected and as previously demonstrated in the 2006 Region M Plan, that the total authorized diversions from Amistad and Falcon Reservoirs as currently stipulated in Texas water rights (2,118,729 acre-feet/year in Table 1-1) substantially exceeds the firm supply of water from the reservoirs under either present water rights conditions or with all water rights converted to municipal use. This, of course, is precisely why the irrigation and mining rights are subject to the storage allocation and supply curtailment procedures contained in the TCEQ Rio Grande Operating Rules.

2) Again, using the simplified version of the TCEQ Rio Grande WAM, all current irrigation and mining water rights were assumed to be converted to municipal rights, producing a total municipal demand of 1,200,341 acre-feet/year (with zero irrigation/mining demand). As expected, because this total municipal demand is greater than the municipal firm yield of the Amistad-Falcon reservoir system determined in Item 1 above (1,131,500 acre-feet/year), shortages in the available water supply were simulated. These occurred during the years 1971 and 2000 of the WAM 1940-2000 simulation period. This result, coupled

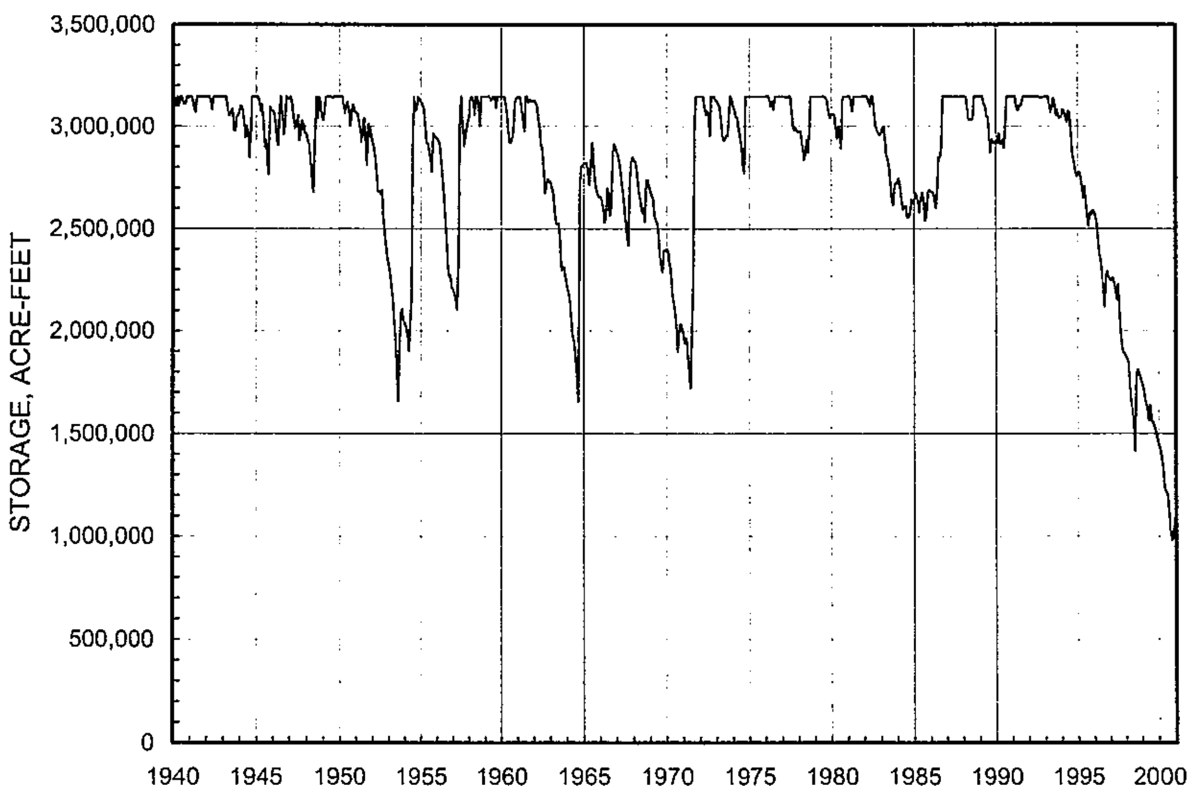
with that from Item 1 above, suggests that all of the annual diversions currently authorized in the existing irrigation and mining water rights on the Lower and Middle Rio Grande cannot be converted to municipal use in the future with the assurance that a firm supply of water will be available from Amistad and Falcon Reservoirs.

3) A final WAM simulation was made to demonstrate the behavior of the Amistad-Falcon reservoir system under current water rights authorizations (as represented in the TCEQ Rio Grande WAM) but with all Texas demands on the Lower and Middle Rio Grande specified in accordance with what might be considered to be typical demand conditions consistent with recent history. For this purpose, the actual 1992 demands were suggested by RPG members (see Figure 1-1), and the WAM was modified to reflect these demands as follows:

Municipal	201,434	acre-feet/year
Irrigation/Mining	728,365	acre-feet/year
Total Demand	929,799	acre-feet/year

As expected, with this level of total demand, no shortages in the available supply from the reservoirs were simulated because this total demand is less than the firm yield of the reservoir system determined in Item 1 above (1,012,081 acre-feet/year). The monthly variation of the combined storage in Amistad and Falcon Reservoir from this simulation is illustrated by the graph in Figure 3-1, and as shown, never approaches zero.

FIGURE 3-1 VARIATION OF AMISTAD-FALCON STORAGE FROM WAM OPERATED WITH 1992 ACTUAL DEMANDS FOR LOWER AND MIDDLE RIO GRANDE WATER RIGHTS



It is significant to note that the most severe drought indicated for Amistad and Falcon Reservoir based on the combined reservoir storage plotted on the graph in Figure 3-1 is that of the 1990s and early 2000s, rather than that of the 1950s as is often assumed. In fact, it is apparent from the graph that the end of the WAM simulation period (December 31, 2000) occurs in the middle of the most severe drought period since the storage in the two reservoirs is still falling at the end of the year 2000. This is important because with its current 1940-2000 flow data set, the Rio Grande WAM is not capable of representing water availability conditions throughout the duration of the most severe drought of record for the Rio Grande Basin, an obvious limitation when evaluating reservoir yield and other drought-driven water supply conditions. This situation should be corrected by extending the period of record for the WAM simulations through at least 2005 when both Amistad and Falcon Reservoirs were completely full, thus ending the 1990s-2000s drought period.

3.3 Additional WAM Analyses

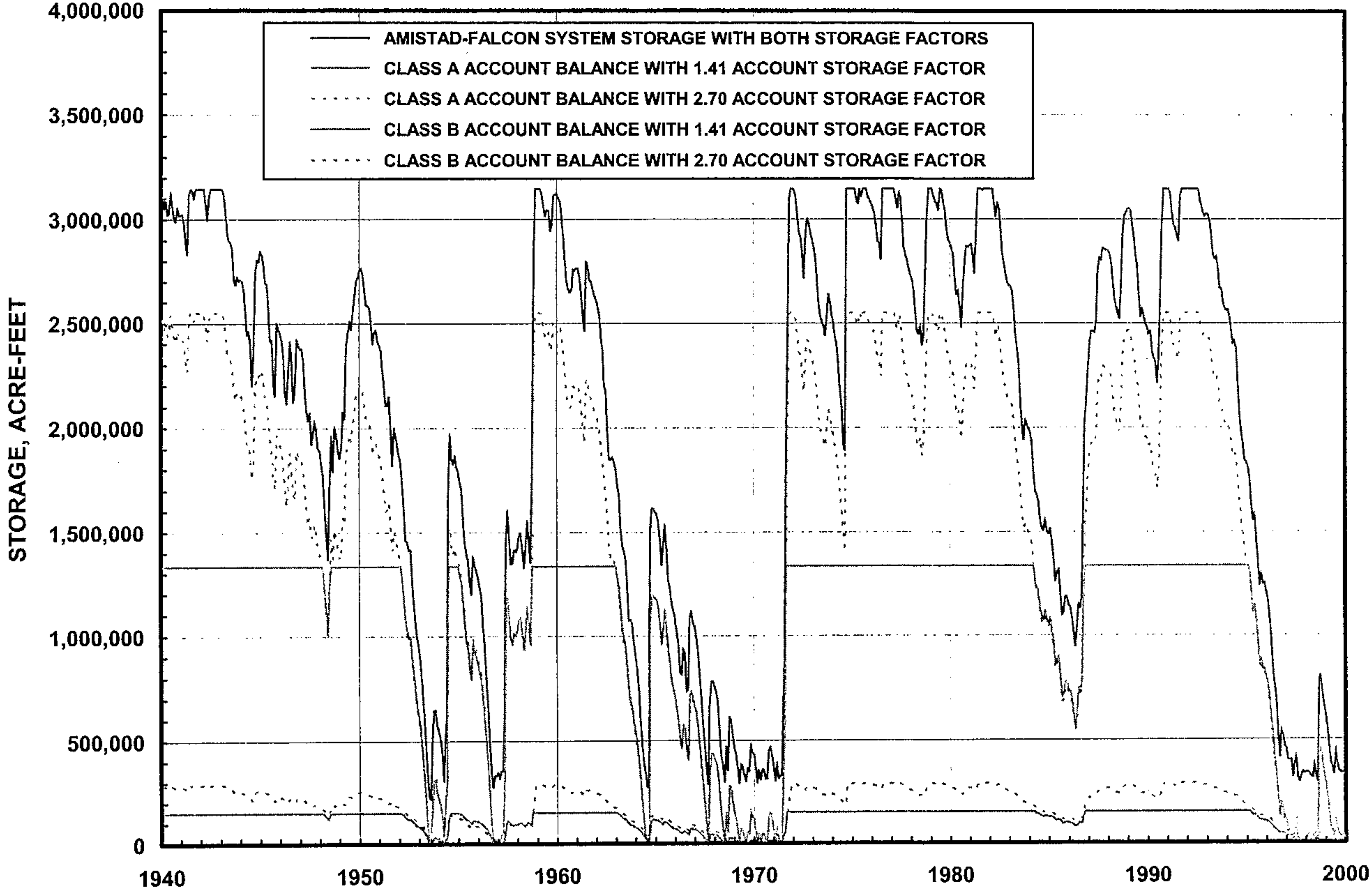
Results from the preliminary WAM simulations described above were presented to the Rio Grande RPG at its November 2007 meeting and then discussed in a special meeting of RPG members and water interests in Harlingen in February 2008. The outcome of this latter meeting was a list of additional analyses and WAM simulations that were identified as potentially being the most useful to further investigating the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system with regard to Amistad and Falcon Reservoirs and to evaluating certain aspects of the international agreements between the United States and Mexico for allocating waters of the Rio Grande. These additional analyses and simulations and their results are described in the following sections.

1) As noted earlier, the Rio Grande Operating Rules stipulate that the amount of water that each irrigation (and mining) water right can store in its account in Amistad and Falcon Reservoir is limited to 1.41 times its annual diversion authorization. Applying this Storage Factor to the total amount of annual diversions currently authorized for Lower and Middle Rio Grande irrigation/mining water rights, the total amount of water that can be stored in the reservoir by all irrigation and mining water rights at any given time is 2,532,079 acre-feet. By the year 2010, the combined conservation storage capacity for the United States in Amistad and Falcon Reservoirs is projected to be 3,146,545 acre-feet (Rio Grande RPG, 2005). According to the current Rio Grande Operating Rules for determining monthly allocations to irrigation and mining storage accounts, the dead storage (4,600 acre-feet), the DMI reserve (225,000 acre-feet), and the operating reserve (75,000 acre-feet) must first be subtracted from the total storage in Amistad and Falcon Reservoirs before establishing the total allocation amount. When the reservoirs are full (2010 conditions), this leaves a total of 2,841,945 acre-feet as the maximum amount of storage physically available in the reservoirs for irrigation and mining accounts. This amount exceeds the maximum allowable amount (2,532,079 acre-feet) that can be stored in the existing irrigation and mining accounts based on the 1.41 Storage Factor by 309,866 acre-feet. This suggests that the Storage Factor could be increased to fully utilize the entire storage capacity of the reservoirs for the irrigation and mining accounts. Based on the total amount of annual diversions currently authorized for Lower and

Middle Rio Grande irrigation/mining water rights (1,795,801 acre-feet) and the maximum available storage in the reservoirs for irrigation and mining accounts under 2010 storage conditions (2,841,945 acre-feet), the maximum value of the Storage Factor is calculated to be 1.58. Considering the maximum annual diversion by all active irrigation and mining water rights during the last 10 years (1,054,397 acre-feet in 2000, Figure 1-1), the Storage Factor is calculated to be 2.70. Thus, there appears to be potential for increasing the available storage capacity in Amistad and Falcon Reservoirs for irrigation and mining accounts under the Rio Grande Operating Rules.

2) To evaluate the extent to which the available supplies of water from Amistad and Falcon Reservoirs for the irrigation and mining water rights might be extended with increased values of the Storage Factors, WAM simulations were made with the Storage Factors equal to 1.41 (existing rules), 1.58 (considering all irrigation and mining water rights and the 2010 maximum available storage in the reservoirs), and 2.70 (considering the maximum irrigation and mining maximum usage in the last 10 years and the 2010 maximum available storage in the reservoirs). The demands specified in the WAM for the Texas water rights on the Lower and Middle Rio Grande for these simulations were assumed to be equal to the actual historical demands for municipal use in 2005 (260,881 acre-feet reflecting current conditions) and for irrigation and mining use in 2000 (1,054,397 acre-feet representing the maximum use in the last 10 years). Surprisingly, the results from these WAM simulations produced essentially the same reliability for the irrigation and mining demands for all three values of the Storage Factor, an average value of 93.4%. Upon reflection, these results appear to be correct because regardless of the maximum amount of designated storage available for the irrigation and mining accounts in the reservoirs, they still have access to any storage in excess of this amount through the monthly allocation process stipulated in the Rio Grande Operating Rules. Essentially, any water in storage in the reservoirs that exceeds the maximum allowable total storage for the irrigation and mining accounts based on the Storage Factor is automatically transferred to the irrigation and mining accounts as storage in the reservoir falls. Since these calculations are performed monthly, as storage in the reservoirs falls during dry periods, the storage in the reservoir and the total storage for the irrigation and mining accounts eventually converge and thereafter follow the same exact trend. Hence, the available supply of water for the irrigation and mining users is exactly the same before and after this point in the storage trace of the reservoirs, and, consequently, the reliability of the water supply is the same regardless of the value of the Storage Factor that is used. This concept is illustrated by the simulated monthly storage in Amistad and Falcon Reservoirs and the Class A and B account balances over the 1940-2000 simulation period shown on the graph in Figure 3-2. As indicated, the Class A and B account balances are depicted for two Storage Factors – 1.41 and 2.70 – with the higher account balance corresponding to the higher 2.70 Storage Factor. As the storage in Amistad and Falcon Reservoirs falls during dry conditions (solid blue line), the account balances for the Class A and B irrigation/mining water rights also fall, with the higher curves corresponding to the 2.70 Storage Factor (dotted red and green lines) eventually converging with the lower curves corresponding to the 1.41 Storage Factor (solid red and green lines). As illustrated, the Class A account balance for the 1.41 Storage Factor (solid red line) peaks at a value of 1,334,768 acre-feet, which is 1.41 times the Class A annual irrigation and

FIGURE 3-2 RESERVOIR STORAGE AND CLASS A & B ACCOUNT BALANCES ASSUMING 2005 DMI DEMANDS AND 2000 IRRIGATION/MINING DEMANDS WITH 1.41 AND 2.70 ACCOUNT STORAGE FACTORS



mining demand. The Class A account balance for the 2.70 Storage Factor (dotted red line) peaks at a value of 2,551,515 acre-feet, which is 2.70 times the Class A annual irrigation and mining demand. Even though the Class A account balance for the 2.70 Storage Factor often is higher than the corresponding Class A account balance for the 1.41 Storage Factor, it always converges to the 1.41 Storage Factor curve during dry periods such as those in 1952, 1963, 1984 and 1995. A similar trend is exhibited for the Class B storage balances for the two different Storage Factors. The fact that these curves with different Storage Factors converge during dry periods verifies that the total diversions by the Class A or Class B rights are essentially the same regardless of the value of the Storage Factor; thus, the average reliabilities for these diversions are essentially the same.

3) Another WAM simulation was made to evaluate the impact of reducing the domestic-municipal-industrial (DMI) reserve from the 225,000 acre-feet stipulated in the current Rio Grande Operating Rules down to 60,000 acre-feet, which was the amount specified in the original Valley Water Case judgment. For both of these simulations, the Storage Factor was set equal to 1.41, and the demands specified in the WAM for the Texas water rights on the Lower and Middle Rio Grande again were assumed to be equal to the actual historical demands for municipal use in 2005 (260,881 acre-feet reflecting current conditions) and for irrigation and mining use in 2000 (1,054,397 acre-feet representing the maximum use in the last 10 years). Results from this simulation indicate that the average reliability of the irrigation and mining rights is slightly increased with the lower DMI reserve, as less stored water in Amistad and Falcon Reservoirs is allocated to this reserve account. The overall reliability of the irrigation and mining rights increased from 93.4% with the DMI reserve at 225,000 acre-feet to 94.3% with the DMI reserve at 60,000 acre-feet. The graph in Figure 3-3 shows the simulated monthly storage in Amistad and Falcon Reservoirs and the Class A and B account balances for the 1990-2000 period for the two DMI reserve cases. The effect of the lower DMI reserve is illustrated beginning in 1995 as the storage in the reservoirs falls during the initiation of dry conditions, and as noted, the Class A total account balance with the 60,000 acre-foot reserve begins to diverge from and remain higher than the Class A total account balance with the 225,000 acre-foot reserve. This results in only slightly more water being available initially, as the two curves eventually converge during the extreme part of the drought in 1997.

4) A request was made by the Rio Grande RPG to evaluate the reliability of the Amistad-Falcon water supply for satisfying the Lower and Middle Rio Grande DMI demands if all of these water rights were converted to Class A rights subject to the same allocation procedures as Class A irrigation and mining rights. The Rio Grande WAM was modified to accommodate this change, and the resulting simulation indicated that, as expected, the reliability for satisfying these DMI demands was reduced from 100%, as is currently the case under the existing Rio Grande Operating Rules, down to 94.6%. This level of reliability is slightly higher than the previous average for the irrigation and mining water rights under current water rights conditions because in this case there is no firm demand associated with the DMI water rights.

5) The issue of how flows in the Rio Grande at Fort Quitman are divided between the United States and Mexico has been of concern to Texas Rio Grande water users and other interests because of the apparent inconsistencies in language regarding this distribution in two historical agreements between the United States and Mexico; the 1906 Convention and the 1944 Treaty. Article I of the 1906 Convention states that "....the United States shall deliver to Mexico a total of 60,000 acre-feet of water annually in the bed of the Rio Grande at the point where the head works of the Acequia Madre, known as the Old Mexican Canal, now exist above the city of Juarez, Mexico." Article IV states that "The delivery of water as herein provided is not to be construed as a recognition by the United States of any claim on the part of Mexico to the said waters; and it is agreed that in consideration of such delivery of water, Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican Canal and Fort Quitman, Texas .....". The 1944 Treaty between the United States and Mexico, which, among other things, establishes ownership of waters flowing in the Rio Grande between the two countries from Fort Quitman downstream to the Gulf of Mexico, states in Article 4 of Section II that inflows to the Rio Grande below Fort Quitman from certain named tributaries are allotted to each of the two countries in specified proportions and that each country is allotted "One-half of all flows not otherwise allotted by this Article occurring in the main channel of the Rio Grande (Rio Bravo), including the contributions from all the unmeasured tributaries, which are those not named in this Article, between Fort Quitman and the lowest major international storage dam." Historically, in its accounting for ownership of waters of the Rio Grande, the IBWC has imposed the 50/50 language in the 1944 Treaty on the division of the flows in the Rio Grande at Fort Quitman so as to equally apportion them between the United States and Mexico. In direct contradiction, the 1906 Convention specifically states that "....Mexico waives any and all claims to the waters of the Rio Grande for any purpose whatever between the head of the present Mexican Canal and Fort Quitman, Texas .....". In this study, members of the Rio Grande RPG requested that the effect of distributing flows in the Rio Grande at Fort Quitman equally between the two countries as is the current practice be evaluated relative to allotting all of the flow to the United States in accordance with the 1906 Convention. First of all, it is important to understand that while the quantity of flow in the Rio Grande at Fort Quitman historically has varied considerably, it is not insignificant. Figure 3-4 is a bar chart showing the annual flows measured at Fort Quitman from 1925 through 2007. As shown, the minimum has been near zero and the maximum has exceeded a million acre-feet, with the average being approximately 117,000 acre-feet/year. Half of the time the flow is greater than about 88,000 acre-feet/year. For purposes of evaluating the effect of the different flow allocations at Fort Quitman, the Rio Grande WAM first was operated as it is currently structured in accordance with IBWC's current accounting practice, i.e., the 50/50 split of the Fort Quitman flows, and the United States' share of the firm yield of the Amistad-Falcon reservoir system was determined to be 1,012,081 acre-feet/year. The structure of the WAM then was modified to allot all of the flow in the Rio Grande at Fort Quitman to the United States, and this simulation produced a firm yield from the Amistad-Falcon reservoir system for the United States of 1,028,631 acre-feet/year, an increase of 16,550 acre-feet/year over the 50/50 allocation. Clearly, these results demonstrate that changing IBWC's accounting practices with regard to the allotment of flows in the Rio Grande at

Fort Quitman to be consistent with what appears to be the proper interpretation of language in the 1906 Convention would be a benefit to the Texas water rights that are dependent on the Amistad-Falcon reservoir system for their supplies.

Results from these additional WAM simulations and analyses as described above were presented to the Rio Grande RPG at its May 2008 meeting. Members discussed the general findings and generally determined that further evaluations to investigate the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system with regard to Amistad and Falcon Reservoirs or the effects of alternative international accounting practices as potential water supply strategies in the context of regional water planning were not warranted at that time and should not be undertaken. Based on this general assessment, no further analyses were performed as part of this study.

FIGURE 3-3 RESERVOIR STORAGE AND CLASS A & B ACCOUNT BALANCES
ASSUMING 2005 DMI DEMANDS AND 2000 IRRIGATION/MINING DEMANDS
WITH 225,000 AC-FT AND 60,000 AC-FT DOMESTIC-MUNICIPAL-INDUSTRIAL RESERVES

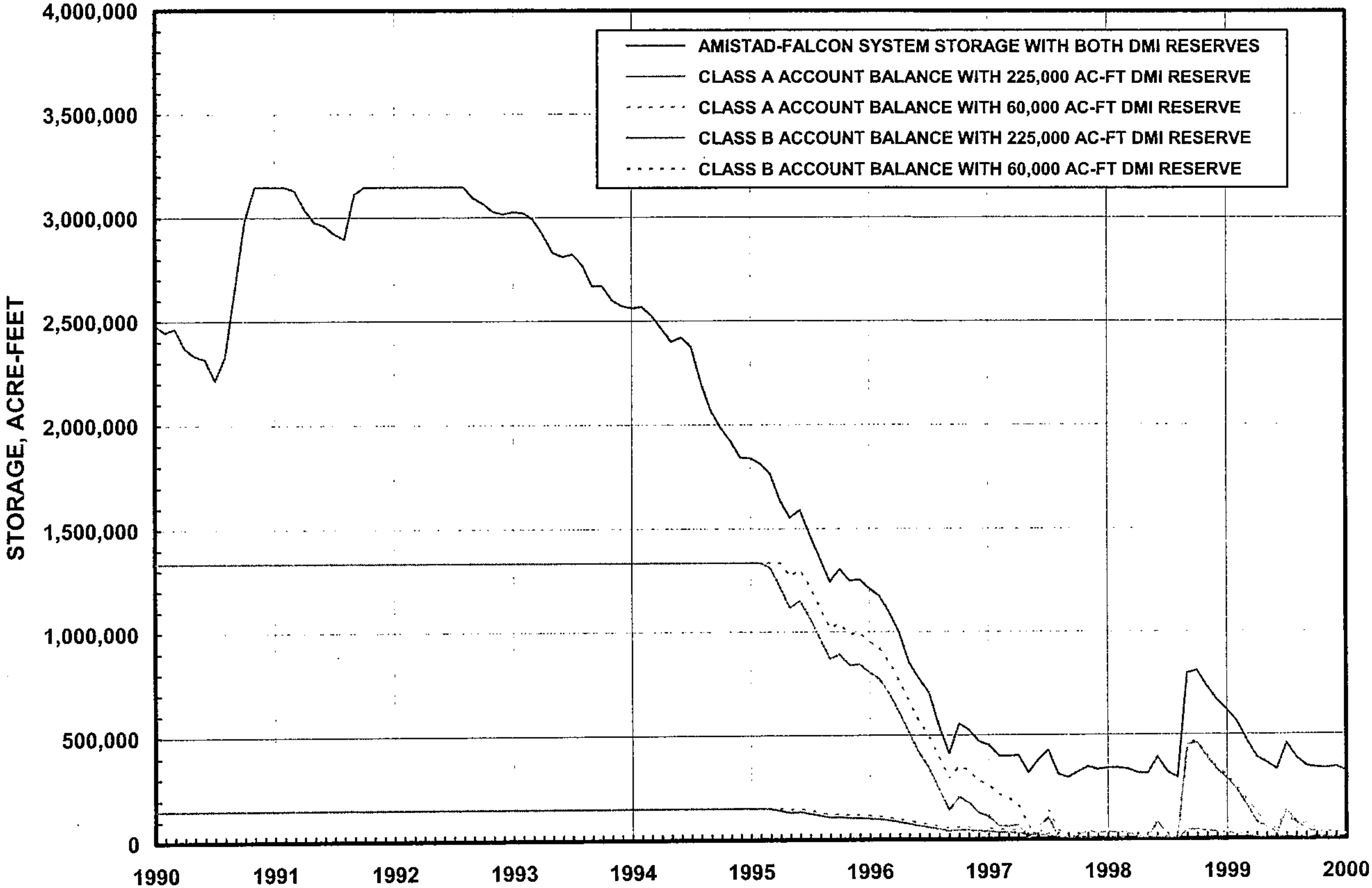
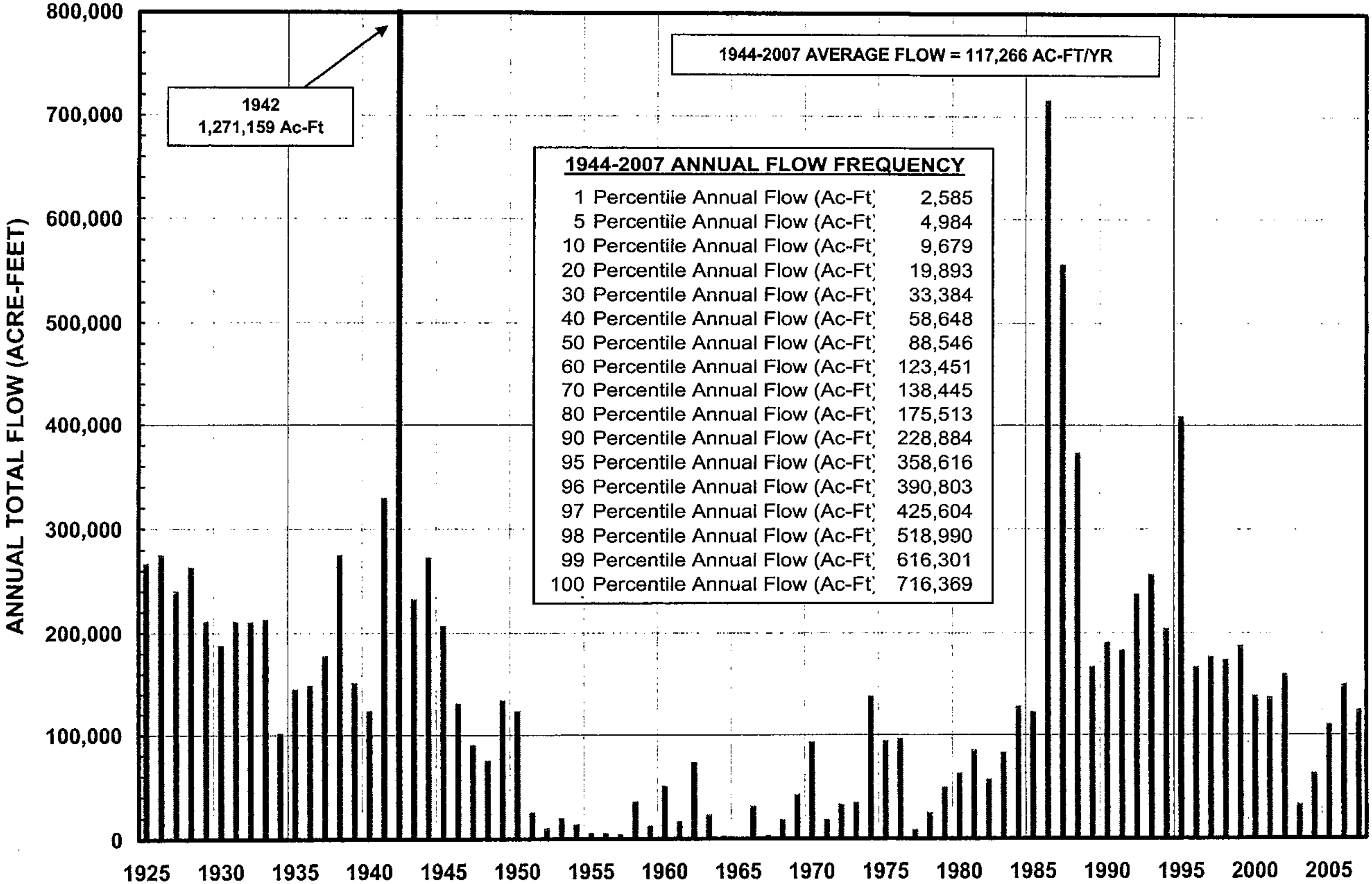


FIGURE 3-4 HISTORCIAL ANNUAL FLOWS IN THE RIO GRANDE AT FORT QUITMAN



1944-2007 ANNUAL FLOW FREQUENCY

1 Percentile Annual Flow (Ac-Ft)	2,585
5 Percentile Annual Flow (Ac-Ft)	4,984
10 Percentile Annual Flow (Ac-Ft)	9,679
20 Percentile Annual Flow (Ac-Ft)	19,893
30 Percentile Annual Flow (Ac-Ft)	33,384
40 Percentile Annual Flow (Ac-Ft)	58,648
50 Percentile Annual Flow (Ac-Ft)	88,546
60 Percentile Annual Flow (Ac-Ft)	123,451
70 Percentile Annual Flow (Ac-Ft)	138,445
80 Percentile Annual Flow (Ac-Ft)	175,513
90 Percentile Annual Flow (Ac-Ft)	228,884
95 Percentile Annual Flow (Ac-Ft)	358,616
96 Percentile Annual Flow (Ac-Ft)	390,803
97 Percentile Annual Flow (Ac-Ft)	425,604
98 Percentile Annual Flow (Ac-Ft)	518,990
99 Percentile Annual Flow (Ac-Ft)	616,301
100 Percentile Annual Flow (Ac-Ft)	716,369

4.0 Findings and Recommendations

Based on the analyses performed in this study and the results obtained, the following summarizes the principal findings and recommendations:

- The United States' share of the firm annual yield of the Amistad-Falcon reservoir system, assuming 2010 reservoir storage conditions, current domestic-municipal-industrial (DMI) authorized diversions (approximately 320,000 acre-feet/year) with the remainder of the yield used for irrigation and mining purposes, is 1,012,081 acre-feet/year based on simulations with the current TCEQ Rio Grande WAM.
- The United States' share of the 2010 firm annual yield of the Amistad-Falcon reservoir system assuming that all water is used for municipal purposes is 1,131,500 acre-feet/year based on simulations with the Rio Grande WAM, an increase of almost 120,000 acre-feet/year over current system operations.
- Based on the United States' share of the estimated firm yield of the Amistad-Falcon reservoir system, the projected municipal demands over the next 50 years along the Lower and Middle Rio Grande as presented in the 2006 Rio Grande Regional Plan (about 626,000 acre-feet/year in 2060) can be fully satisfied by converting irrigation/mining water rights to municipal use.
- The historical hydrologic data set incorporated in the current version of the Rio Grande WAM extends from 1940 through 2000, which ends in the middle of what appears to be the critical drought of record for the Lower and Middle Rio Grande; the hydrologic inputs to the WAM should be extended at least through 2005 in order to be able to simulate and analyze the entire 1990s-2000s critical drought period conditions when evaluating water availability.
- TCEQ's current Rio Grande Operating Rules limit the amount of storage in the Amistad-Falcon reservoir system for irrigation and mining accounts to a factor of 1.41 times the annual authorized diversions of these water rights. This factor is referred to in this report as the Storage Factor.
- Based on current irrigation/mining water rights on the Lower and Middle Rio Grande and the projected maximum storage capacity of Amistad and Falcon Reservoirs in 2010, the Storage Factor for irrigation and mining water rights could be increased to 1.58.
- The long-term overall reliability of the Amistad-Falcon water supply for the United States under existing Rio Grande Operating Rules for satisfying current irrigation/mining demands along the Lower and Middle Rio Grande is approximately 93.4% based on Rio Grande WAM simulations.
- Based on analyses performed with modified versions of the Rio Grande WAM, increasing the Storage Factor above the current value of 1.41 does not improve the reliability of the Amistad-Falcon water supply for satisfying irrigation/mining demands along the Lower and Middle Rio Grande.

- Based on analyses performed with modified versions of the Rio Grande WAM, reducing the DMI reserve from the current amount of 225,000 acre-feet as stipulated I the Rio Grande Operating Rules to 60,000 acre-feet only slightly increases the long-term reliability of the Amistad-Falcon water supply for satisfying irrigation/mining demands along the Lower and Middle Rio Grande – from 93.4% to 94.3%.
- Converting all DMI water rights to Class A water rights subject to the same allocation procedures as Class A irrigation and mining rights results in the reliability of the Amistad-Falcon water supply for these rights being reduced from 100%, as is currently the case under the existing Rio Grande Operating Rules, down to 94.6%, which is slightly higher than the previous 93.4% average for the irrigation and mining water rights under current water rights conditions because in this case there is no firm demand associated with the DMI water rights.
- Revising current IBWC water ownership accounting procedures to allot 100% of the flow in the Rio Grande at Fort Quitman to the United States (as stipulated in the 1906 Convention) instead of the 50/50 split with Mexico (as is the current IBWC practice purportedly in accordance with the 1944 Treaty) would increase the United States' share of the firm yield of the Amistad-Falcon reservoir system from approximately 1,012,081 acre-feet/year to 1,028,631 acre-feet/year, or about 16,550 acre-feet/year (~1.6%), and this change in current procedures should be pursued.
- Results from the various WAM simulations and analyses performed in this study were discussed and examined by the Rio Grande RPG, and it was generally determined that further evaluations to investigate the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system and Amistad and Falcon Reservoirs as potential water supply strategies in the context of regional water planning were not warranted at this time and should not be pursued.
- Based on the findings herein, it is recommended that further analyses not be undertaken as part of this study with regard to investigating the implications of using different methods or procedures in the future for operating the Lower and Middle Rio Grande water supply system and Amistad and Falcon Reservoirs as potential water supply strategies in the context of regional water planning.

5.0 References

Rio Grande Watermaster (May 2008a); Email and summary table of authorized annual diversions for Lower and Middle Rio Grande water rights; provided to R. J. Brandes Company; Harlingen, Texas.

Rio Grande Watermaster (May 2008b); Summary table of historical water use by Lower and Middle Rio Grande water rights; provided to R. J. Brandes Company; Harlingen, Texas.

Rio Grande Regional Planning Group (January 2005); "2006 Rio Grande Regional Water Plan – Final Plan"; Austin, Texas.

R. J. Brandes Company, *et al* (March 2004); "Water Availability Report for the Rio Grande Basin – Water Availability Assessment"; report to the Texas Commission on Environmental Quality; Austin, Texas.

These historical use quantities indicate that considerably less water has been used for irrigation and mining purposes than is authorized for use under existing water rights (1,795,801 acre-feet/year as per Table 1-1), and they could be interpreted to suggest that there are more authorized diversions for irrigation and mining use than are actually needed. This is not necessarily the case because of the procedures that are used to allocate excess stored water in Amistad and Falcon Reservoirs to the irrigation and mining accounts at the end of each month and the limit on the amount of water each account can store in Amistad and Falcon Reservoirs. Since the allocations are made on a pro rata basis in proportion to the annual authorized diversion amounts for all of the irrigation water rights, having more annual diversion authorized under a particular water right than what actually may be used for irrigation in a given year provides for a more reliable water supply year in and year out. This is not to say, however, that occasionally there are irrigation water rights, or portions of irrigation water rights, that are deemed by the owners to not be needed or usable in the future. These are the water rights, of course, that are potentially available for acquisition and use by municipal users as their demands for water grow in response to increasing population and urban development. Such acquired irrigation rights must first be amended by the State (TCEQ) to convert their authorized type of use from irrigation to municipal use.

Based on the 2006 Region M Water Plan (Rio Grande Regional Water Planning Group, 2005), total municipal water demands for the entire eight-county region are projected to increase from about 280,000 acre-feet/year in 2010 to about 626,000 acre-feet/year in 2060, an overall increase of about 346,000 acre-feet/year. Taking into account existing surplus supplies among some municipal water rights holders, the projected shortage in available municipal water supplies by 2060 has been estimated to be approximately 320,000 acre-feet/year. Over this same 2010-2060 period, demands for irrigation water are projected to decrease from about 1,164,000 acre-feet/year down to about 982,000 acre-feet/year, an overall decrease of about 182,000 acre-feet/year. Certainly, much of the decrease in irrigation demand will be the result of the loss of irrigation land to development and urbanization, which, in turn, will make water which is no longer needed for irrigation potentially available for municipal use. It is not surprising that the fundamental water supply strategy included in the Region M Water Plan for meeting future municipal water demands is, indeed, the conversion of available irrigation water rights to municipal use.

The intent of the studies reported herein has been to investigate how such conversions from irrigation to municipal uses might be undertaken and what overall water supply management strategies might be considered for implementation in order to more effectively use and enhance the available future supply of water from Amistad and Falcon Reservoirs. An integral part of these investigations also has addressed the overall allocation process itself, particularly with regard to how modifications of current allocation prescriptions and storage reserve requirements might impact overall available water supplies in Amistad and Falcon Reservoirs. To a large extent, the results from the analyses performed in this investigation themselves have dictated how the studies have been undertaken and what the specific outcome of the work has been with respect to potential water supply management strategies. Changes in the scope of the analyses have been made during the course of the work to respond to interim findings, and results presented in this report reflect these scope modifications.

2.0 Methodology

The approach taken for performing the analyses of the potential implications of using different methods or procedures in the future for managing and using water rights on the Lower and Middle Rio Grande has focused on application of the existing WAM for the Rio Grande Basin, appropriately modified to represent desired changes in the allocation and management procedures used for water rights and reservoir and basin operations.

2.1 Rio Grande WAM

For a specified sequence of monthly hydrologic and climatic conditions, the Rio Grande WAM simulates the allocation of prescribed amounts of water within the basin to water users and water rights holders in Texas and Mexico. Allocations to individual Texas water rights, i.e. for diversion and/or storage, are subject to either the class-based system for Amistad-Falcon rights or the prior appropriation doctrine as it is applied for water rights upstream of Amistad Reservoir and on downstream tributaries. A modified system of priority dates is used in the model to implement international treaty obligations for assigning ownership of Rio Grande water between the United States and Mexico, to represent the natural-priority system (whereby water is appropriated by upstream users first) used for allocating Mexican flows to water rights in Mexico, known as "concessions", and to reflect the class-based priority system and the prior appropriation doctrine used for apportioning water among Texas water rights

The Rio Grande WAM utilizes a network of control points with interconnected links to describe flow paths and the locations of inflows, diversion points, reservoirs, and return flows. Computations within the model are performed on a monthly basis using monthly time series values of specified flows, reservoir net evaporation rates, and water demands subject to prescribed water rights conditions and reservoir system operating rules. Results from the model include monthly diversion and storage amounts for each water right (Texas and Mexico) and remaining unappropriated water at selected locations throughout the basin. [4]

Monthly historical naturalized flows are used in the Rio Grande WAM as the hydrologic input for evaluating water availability. Naturalized flows represent historical streamflow conditions, including typical wet, dry, and normal flow periods, without the influence of man's historical activities as they relate to water rights and water use. In essence, naturalized flows exclude the effects of historical diversions, return flows, and reservoir storage and evaporation. For the Rio Grande WAM, the naturalized flow database covers the 61-year period from January 1940 through December 2000. This period includes the droughts of the 1950s and 1990s, both of which represent extreme drought conditions for most of the Rio Grande Basin.

Because all of the Rio Grande Basin below the New Mexico state line, including the Mexican portion of the basin, is included in the Rio Grande WAM, essential provisions of existing

[4] It should be noted that demands for Mexico that are included in the current version of the Rio Grande WAM have not been modified for purposes of this study. These demands for Mexico are described and quantified in the Rio Grande WAM report, which is referenced in Section 5.0 of this report.

RIO GRANDE
REGIONAL WATER PLANNING GROUP

Rio Grande Regional Water Planning Group
3rd Round of Regional Planning: 1st Phase

Task #2: Classify Irrigation Districts as Water User Groups

Amendment #1 to Final Report

November 3, 2009

Submitted by:

NRS
engineering better communities

NRS Consulting Engineers, Inc.
Texas Registered Engineering Firm F-2705
1222 E. Tyler Avenue
Harlingen, TX 78550
Phone: 956-423-7409
Fax: 956-423-7482
www.nrsengineers.com

STATE OF TEXAS
JACOB M. WHITE
103827
LICENSED
PROFESSIONAL ENGINEER

11/3/09

Study #2: Classify Individual Irrigation Districts as Water User Groups or Wholesale Water Providers

Amendment #1

The final report titled "Study #2: Classify Individual Irrigation Districts as Water User Groups or Wholesale Water Providers", submitted on July 31, 2009 to the Texas Water Development Board, shall be amended as follows:

Executive Summary – Page 4

> Remove text that reads:
> Based on this information, it is recommended to include individual Irrigation Districts into the Regional Water Plan as Water User Groups. Supply and demand projections should be as previously listed, and conveyance efficiencies for each District should be included. This will allow for an accurate determination to be made as to specific water management strategies recommended for each District.
>
> Replace with text that reads:
> Through multiple discussions with the Rio Grande Regional Water Planning Group Board and Committees, it has been decided that the most prudent and accurate method for describing individual Irrigation Districts in future phases of regional planning is to continue referencing irrigation water supply and demand on a county-wide basis. However, future regional plans shall include water supply and demand numbers for each individual Irrigation District as a subdivision of the county-wide reporting unit. For those Irrigation Districts that are located in two or more counties, the fraction of acreage served in each county shall be used to allocate supply and demand figures accordingly. This method will allow for water management strategies to be identified with more accuracy.

Recommendations – Page 36

> Remove text that reads:
> Therefore, Irrigation Districts serve as water user groups in much the same way that municipalities deliver water to their end users. A blanket characterization that Irrigation Districts are wholesale providers does not fit the role that Irrigation Districts play in the Region. It is hereby recommended that individual Irrigation Districts be classified as Water User Groups.
>
> Replace with text that reads:
> Through multiple discussions with the Regional Water Planning Group Board and Committees, it has been decided that the most prudent and accurate method for describing individual Irrigation Districts in future phases of regional planning is to continue referencing irrigation water supply and demand on a county-wide basis. However, future regional plans shall include water supply and demand

numbers for each individual Irrigation District as a subdivision of the county-wide reporting unit. For those Irrigation Districts that are located in two or more counties, the fraction of acreage served in each county shall be used to allocate supply and demand figures. This method will allow for water management strategies to be identified with more accuracy.

RIO GRANDE
REGIONAL WATER PLANNING GROUP

Rio Grande Regional Water Planning Group
3rd Round of Regional Planning: 1st Phase

Task #2: Classify Irrigation Districts as Water User Groups

Final Report

August 14, 2009

Submitted by:

NRS
engineering better communities

NRS Consulting Engineers, Inc.
Texas Registered Engineering Firm F-2705
1222 E. Tyler Avenue
Harlingen, TX 78550
Phone: 956-423-7409
Fax: 956-423-7482
www.nrsengineers.com

STATE OF TEXAS
JACOB M. WHITE
103827
LICENSED
PROFESSIONAL ENGINEER

8/14/09

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Executive Summary

The purpose of this study is to better clarify actual need for water conservation efforts specific to Region M. Irrigation Districts make up nearly 85% of the total regional demand for water. In the previous rounds of regional planning, water supply and demand analysis were performed for a multitude of Water User Groups (WUGs) in the region including the classification of irrigation water users as a county-wide group (i.e. Irrigation – Cameron County). Utilizing this classification system creates a difficult set of circumstances in which to accurately evaluate irrigation water users including the development of accurate water supply and demand figures and developing water management strategies for implementation.

In terms of Regional water planning, the analysis of individual Irrigation Districts will allow for a better understanding of the Region's water supply and demand. With this information, the Region will be better able to evaluate specific water management strategies needed to meet future water deficits.

A thorough analysis of irrigation water supply and demand data is critical. In Region M, irrigation demand is primarily based on the available supply from the Amistad-Falcon reservoir system. During droughts, supply is limited and allowable irrigation water is allocated accordingly, resulting in a perceived reduction in demand. Ultimately, the demand on any given Irrigation District would be such that all land in the District that is included as flat-rate acreage would have the option to receive irrigation water. In turn, Irrigation Districts typically own enough irrigation water rates (class A, class B, or a combination of both) to serve irrigation water users within their boundaries should the water be available in the reservoir.

Regarding specific water supply and demand figures, the following table summarizes the findings:

Table ES.1: Irrigation District Demand and Supply Projections Summary

	Year	2000	2010	2020	2030	2040	2050	2060
BID	Demand (acre-feet)	50,875	40,186	29,798	22,164	22,164	22,164	22,164
	Supply (acre-feet)	10,008	10,203	10,105	10,015	9,924	9,834	9,750
CCID2	Demand	152,017	137,738	121,821	107,867	107,867	107,867	107,867
	Supply	64,121	65,372	64,747	64,167	63,587	63,007	62,472
HIDCC1	Demand	88,128	84,479	80,175	76,127	76,127	76,127	76,127
	Supply	29,031	29,598	29,315	29,052	28,790	28,527	28,284
CCID6	Demand	52,142	47,244	41,785	36,998	36,998	36,998	36,998
	Supply	27,950	28,495	28,223	27,970	27,718	27,465	27,231
Mercedes	Demand	144,343	125,925	105,301	86,365	86,365	86,365	86,365
	Supply	82,449	86,299	85,495	84,748	84,001	83,253	82,564
Delta Lake	Demand	176,099	174,911	173,395	171,746	171,746	171,746	171,746
	Supply	56,798	59,451	58,897	58,382	57,867	57,352	56,877
Sharyland	Demand	4,053	2,138	841	281	281	281	281
	Supply	6,858	7,179	7,112	7,050	6,987	6,925	6,868
Adams Garden	Demand	18,105	18,624	19,281	19,955	19,955	19,955	19,955
	Supply	7,338	7,481	7,409	7,343	7,277	7,210	7,149
HCID2	Demand	103,008	82,550	61,506	44,290	44,290	44,290	44,290
	Supply	55,948	58,561	58,015	57,508	57,001	56,494	56,026
HCID6	Demand	42,068	36,154	29,901	24,775	24,775	24,775	24,775
	Supply	16,098	16,850	16,693	16,547	16,401	16,255	16,120
Donna	Demand	80,953	77,425	73,274	69,379	69,379	69,379	69,379
	Supply	40,824	42,731	42,332	41,962	41,592	41,223	40,881
Santa Cruz	Demand	82,934	79,967	76,296	72,449	72,449	72,449	72,449
	Supply	27,674	28,966	28,696	28,445	28,195	27,944	27,712
Baptist Seminary	Demand	4,857	2,498	1,005	410	410	410	410
	Supply	460	481	477	473	469	464	461
HCID5	Demand	14,135	13,464	12,643	11,796	11,796	11,796	11,796
	Supply	6,863	7,184	7,117	7,055	6,992	6,930	6,873
Engleman	Demand	19,325	17,874	16,151	14,442	14,442	14,442	14,442
	Supply	3,548	3,714	3,679	3,647	3,615	3,583	3,553
HCID16	Demand	30,749	26,426	21,856	18,109	18,109	18,109	18,109
	Supply	15,255	15,968	15,819	15,681	15,542	15,404	15,277
HCMUD1	Demand	6,011	5,166	4,273	3,540	3,540	3,540	3,540
	Supply	2,080	2,178	2,157	2,138	2,120	2,101	2,083
HCWCID18	Demand	5,505	4,731	3,913	3,242	3,242	3,242	3,242
	Supply	1,864	1,951	1,932	1,916	1,899	1,882	1,866
United	Demand	64,464	55,402	45,821	37,966	37,966	37,966	37,966
	Supply	15,378	16,096	15,946	15,807	15,668	15,528	15,400
HCID1	Demand	85,615	68,611	51,121	36,812	36,812	36,812	36,812
	Supply	28,909	30,259	29,977	29,715	29,453	29,191	28,949
CCID16	Demand	3,773	3,419	3,024	2,677	2,677	2,677	2,677
	Supply	1,285	1,310	1,297	1,286	1,274	1,262	1,252
La Feria	Demand	74,898	69,722	63,795	58,419	58,419	58,419	58,419
	Supply	39,959	40,738	40,349	39,987	39,626	39,265	38,931
Santa Maria	Demand	9,098	8,763	8,367	7,992	7,992	7,992	7,992
	Supply	5,516	5,624	5,570	5,520	5,471	5,421	5,375
Valley Acres	Demand	15,150	15,187	15,233	15,278	15,278	15,278	15,278
	Supply	10,373	10,576	10,475	10,381	10,287	10,193	10,106
Bayview	Demand	17,478	15,836	14,006	12,402	12,402	12,402	12,402
	Supply	6,526	6,653	6,590	6,531	6,472	6,413	6,358
McAllen 3	Demand	9,752	7,815	5,823	4,193	4,193	4,193	4,193
	Supply	3,760	3,935	3,899	3,864	3,830	3,796	3,765

As previously mentioned, each Irrigation District was asked to complete a survey that inquired about a number of District specific items. Of these items, each District was asked to furnish information pertaining to miles of canal (earthen and unlined) and miles of pipeline. Information from these surveys was combined with existing data on major distribution systems for each District. The result is an understanding of the method in which water is conveyed through each District.

Table ES.2: Main Irrigation Distribution Network

Main Irrigation Distribution Network	Canals miles	Pipeline Miles	Total miles	Canal:Pipeline
Adams Garden	21.49	2.01	23.5	10.7 :1
Bayview	14.06	0.43	14.49	32.7 :1
Brownsville	2.36	31.08	33.44	0.1 :1
San Benito	108.52	0.74	109.26	146.6 :1
Los Fresnos	41.82	0	41.82	0.0 :1
Rutherford-Harding	4.67	1.84	6.51	2.5 :1
Cameron 16	3.51	0	3.51	1.0 :0
Delta Lake	69.43	7.71	77.14	9.0 :1
Donna	32.49	0.8	33.29	40.6 :1
Engleman Gardens	12.43	5.7	18.13	2.2 :1
Mercedes	71.8	2.74	74.54	26.2 :1
Harlingen	52.78	7.65	60.43	6.9 :1
Edinburg	35.54	24.37	59.91	1.5 :1
McAllen 3	9.7	3.67	13.37	2.6 :1
Baptist Seminary	0	4.61	4.61	0.0 :1
HCID14	0	0	0	0.0 :0
Mission 16	15.17	2.25	17.42	6.7 :1
Monte Grande	0	0	0	0.0 :0
San Juan	37.5	50.48	87.98	0.7 :1
Progreso	0.8	20.54	21.34	0.0 :1
Mission 6	19.42	0	19.42	1.0 :0
Sharyland Plantation	4.58	0	4.58	1.0 :0
LaFeria	43.74	4.02	47.76	10.9 :1
Meaverick	120.86	0	120.86	1.0 :0
Santa Cruz	34.06	4.58	38.64	7.4 :1
Santa Maria	2.92	0	2.92	1.0 :0
United	29.11	5.9	35.01	4.9 :1
Valley Acres	5.66	10.29	15.95	0.6 :1
Average				11.4 :.75

Conveyance efficiencies were also analyzed to determine the effectiveness of delivering water to the end users. Due to inaccuracies and inconsistencies in District conveyance efficiency reporting, it is recommended to utilize the following conveyance efficiencies.

This analysis will allow for an accurate determination to be made as to potential water management strategies for the Region.

Table ES.3: Irrigation District Conveyance Efficiency

District Name	Conveyance Efficiency
Adams Garden	68.0%
Bayview	68.0%
Brownsville	68.0%
San Benito	68.0%
Los Fresnos	68.0%
Rutherford-Harding	68.0%
Cameron 16	68.0%
Delta Lake	70.6%
Donna	71.0%
Engleman Gardens	71.0%
Mercedes	69.9%
Harlingen	68.0%
Edinburg	71.0%
McAllen 3	71.0%
Baptist Seminary	71.0%
HCID14	71.0%
Mission 16	71.0%
Monte Grande	71.0%
San Juan	71.0%
Progreso	71.0%
Mission 6	71.0%
Sharyland Plantation	71.0%
LaFeria	68.0%
Santa Cruz	71.0%
Santa Maria	68.0%
United	71.0%
Valley Acres	70.6%

Important Note: Using county-wide estimates to qualify individual Irrigation District conveyance system efficiencies does not represent an accurate scenario. Each District has a wide range of conveyance methods including open canals, pipelines, lined canals, and storage. In addition, the age of infrastructure plays a significant role in the efficiency of conveyance. Therefore, this analysis does not represent actual conveyance efficiencies. However, it does represent the best available quantifiable analysis of efficiency.

Based on this information, it is recommended to include individual Irrigation Districts into the Regional Water Plan as Water User Groups. Supply and demand projections should be as previously listed, and conveyance efficiencies for each District should be included. This will allow for an accurate determination to be made as to specific water management strategies recommended for each District.

Purpose of Study

The purpose of this study is to better clarify actual need for water conservation efforts specific to Region M. Irrigation Districts make up nearly 85% of the total regional demand for water.

In the previous rounds of regional planning, water supply and demand analysis were performed for a multitude of Water User Groups (WUGs) in the region including the classification of irrigation water users as a county-wide group (i.e. Irrigation – Cameron County). Utilizing this classification system creates a difficult set of circumstances in which to accurately evaluate irrigation water users. For one, developing accurate and applicable water management strategies for irrigation water users on a county-wide basis does not take into consideration individual irrigation districts that deliver irrigation water. Also, irrigation districts deliver the majority of raw water for municipal users. The conveyance system utilized for irrigation water is also utilized for raw water deliveries. Analyzing the conveyance system for each irrigation district will give valuable insight into conveyance efficiencies. The evaluation of irrigation water users on a county-wide level does not provide this level of insight. The current conveyance efficiencies associated with each irrigation district, and their method of water deliveries, varies significantly from district to district, as does the amount of irrigation water allocated to each district. In addition, individual irrigation districts are in various states of urbanization and the irrigation water demands they serve vary significantly. Again, a county-wide evaluation of irrigation water users cannot take into consideration the wide range of supplies and demands.

In terms of Regional water planning, the analysis of individual Irrigation Districts will allow for a better understanding of the Region's water supply and demand. With this information, the Region will be better able to evaluate specific water management strategies needed to meet future water deficits. Furthermore, funding recommendations for the implementation of specific projects by specific entities can be better made. By incorporating the results of this report into the Region M Regional Water Plan, the 2nd phase of the 3rd round of regional planning will be more detailed and offer a more comprehensive understanding of the Region's water supply and demand.

Water Supply and Demand

Methodology

The following Irrigation District analyses were based on the results of a survey sent to all Irrigation Districts in Region M. A thorough analysis of irrigation water supply and demand data is critical. In Region M, irrigation demand is primarily based on the available supply from the Amistad-Falcon reservoir system. During droughts, supply is limited and allowable irrigation water is allocated accordingly, resulting in a perceived reduction in demand. With the structure of irrigation water allocations, a paper analysis will show that supply equals demand in times of drought. Therefore, one should not evaluate irrigation water demand solely on allocations or water usage, even during times of non-drought. Rainfall can have a pronounced impact on perceived irrigation water usage. For instance, in the year 2002, there was above average rainfall (24.75") and the reservoir levels were also low (32.49% of conservation). These factors contributed to low irrigation usage. In order to gain an accurate understanding of actual irrigation demand, once must take into consideration all of these factors.

Ultimately, the demand on any given Irrigation District would be such that all land in the District that is included as flat-rate acreage would have the option to receive irrigation water. In turn, Irrigation Districts typically own enough irrigation water rates (class A, class B, or a combination of both) to serve irrigation water users within their boundaries should the water be available in the reservoir. In the original adjudication of water rights in the Lower Rio Grande, a factor of 2.5 acre-feet of water per acre of land was applied for irrigation purposes. This factor still serves as the standard for determining the amount of irrigation water rights that are held by each District. When evaluating irrigation water demand on a specific Irrigation District, the scenario in which supplies the most pertinent information in terms of future water planning is to apply a factor of 2.5 acre-feet of water for each flat-rate acre within a District. Projections for future demands are based on either changes to flat-rate acres or changes in irrigated acres for each District. In terms of regional planning, a scenario was chosen for each Irrigation District that represented the most challenging scenario in terms of projected water demand. For select Irrigation Districts, analyses were performed based on analyzing the rate of urbanization based on aerial imagery. The results of these analyses were compared to the calculated rates based on a reduction in flat rate acres and irrigated acres. These maps, along with an overall aerial map showing the boundaries of irrigation districts in the region can be found in the digital appendix.

Flat-rate acreage is typically defined as the acreage within an irrigation district's boundary that pays a yearly flat-rate for the opportunity to utilize irrigation water. This value differs from the overall surface area of a district due to the fact that there are certain areas that do not have the opportunity to receive irrigation water. The method in which acreage is removed from the flat-rate is through a process called exclusion. Furthermore, flat-rate acreage differs from irrigated acres due to the fact that not all flat-rate land is irrigated on a consistent basis.

Additional information was collected associated with population growth in cities that have intersecting boundaries with irrigation districts. Aerial imagery was overlaid with GIS shapefiles. Irrigation District and City boundaries were overlayed on these maps. Census data was then obtained for all cities that have a portion of their boundaries inside of an irrigation district's boundary. A map showing irrigation district boundaries and city boundaries can be found in the digital appendix.

In terms of projected water supply, results from the Water Availability Model performed in the 2nd round of Regional Planning were used as a base for Irrigation District supplies. As previously described, Irrigation supplies and demands were based on a county-wide analysis. For this analysis, the base year Irrigation District supply was calculated using the county-wide supply and demand analyses utilized in the 2nd round. The percentage difference between supply and demand was applied to the base year demand (using the method previously described). Irrigation District supply projections then followed the percentage change (increase or decrease) of water availability using results of the WAM.

Results

Cameron County Irrigation District #2 (San Benito)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.12% and a yearly average reduction in irrigated acres of 0.94% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 11.18% and an irrigated acres reduction of 9.39%. A historical aerial mapping study was performed and, during a similar time frame, the rate of urbanization was proven to be approximately 3.3% throughout the District's boundaries.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 106,461 acre-feet.

Table 2.1: CCID2 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	106,461	96,461	85,314	75,542	75,542	75,542	75,542
Supply (acre-feet)	64,121	65,372	64,747	64,167	63,587	63,007	62,472

Brownsville Irrigation District (Brownsville)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 2.1% and a yearly average reduction in irrigated acres of 2.94% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 21.01% and an irrigated acres reduction of 29.41%. A historical aerial mapping study was performed and, during a similar time frame, the rate of urbanization was proven to be approximately 7.7% throughout the District's boundaries.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 16,616 acre-feet.

Table 2.2: BID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	16,616	13,125	9,732	7,239	7,239	7,239	7,239
Supply (acre-feet)	10,008	10,203	10,105	10,015	9,924	9,834	9,750

Harlingen Irrigation District No. 1 (Harlingen)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.46% and a yearly average reduction in irrigated acres of 0.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 4.64% and an irrigated acres reduction of 4.14%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 48,201 acre-feet.

Table 2.3: HID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	48,201	46,205	43,851	41,637	41,637	41,637	41,637
Supply (acre-feet)	29,031	29,598	29,315	29,052	28,790	28,527	28,284

Cameron County Irrigation District #6 (Los Fresnos)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.12% and a yearly average increase in irrigated acres of 0.94% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 11.18% and an irrigated acres increase of 9.39%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with an increase in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 46,406acre-feet.

Table 2.4: CCID6 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	52,142	47,244	41,785	36,998	36,998	36,998	36,998
Supply (acre-feet)	27,950	28,495	28,223	27,970	27,718	27,465	27,231

Hidalgo and Cameron Counties Irrigation District No. 9 (Mercedes)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.28% and a yearly average reduction in irrigated acres of 1.43% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 12.76% and an irrigated acres reduction of 14.29%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 48,201 acre-feet.

Table 2.5: HCCID9 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	136,974	119,496	99,925	81,956	81,956	81,956	81,956
Supply (acre-feet)	82,449	86,299	85,495	84,748	84,001	83,253	82,564

Delta Lake Irrigation District (Delta Lake)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.07% and a yearly average reduction in irrigated acres of 0.07% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 0.68% and an irrigated acres reduction of 0.68%. A historical aerial mapping study was performed and, during a similar time frame, the rate of urbanization was proven to be approximately 2.2% throughout the District's boundaries.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with both a reduction in flat rate acres and irrigation acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 94,360 acre-feet.

Table 2.6: DLID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	94,360	93,723	92,911	92,027	92,027	92,027	92,027
Supply (acre-feet)	56,798	59,451	58,897	58,382	57,867	57,352	56,877

Hidalgo County Improvement District No. 19 (Sharyland Plantation)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 6.69% and a yearly average reduction in irrigated acres of 4.73% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 66.87% and an irrigated acres reduction of 47.26%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigation acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 11,394 acre-feet.

Table 2.7: HCID19 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	11,394	6,009	2,364	790	790	790	790
Supply (acre-feet)	6,858	7,179	7,112	7,050	6,987	6,925	6,868

Adams Gardens Irrigation District No. 19 (Adams Garden)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.32% and a yearly average increase in irrigated acres of 0.29% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 3.18% and an irrigated acres increase of 2.87%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with an increase in irrigation acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 12,183 acre-feet.

Table 2.8: AGID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	12,183	12,532	12,974	13,428	13,428	13,428	13,428
Supply (acre-feet)	7,338	7,481	7,409	7,343	7,277	7,210	7,149

Donna Irrigation District No. 2 (Donna)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 4.95% and a yearly average reduction in irrigated acres of 3.05% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 7.07% and an irrigated acres reduction of 4.36%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 67,822 acre-feet.

Table 2.9: DID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	67,822	64,866	61,388	58,125	58,125	58,125	58,125
Supply (acre-feet)	40,824	42,731	42,332	41,962	41,592	41,223	40,881

Hidalgo County Irrigation District No. 2 (San Juan)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.99% and a yearly average reduction in irrigated acres of 4.40% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.86% and an irrigated acres reduction of 43.98%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 92,948 acre-feet.

Table 2.10: HCID2 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	92,948	74,488	55,499	39,965	39,965	39,965	39,965
Supply (acre-feet)	55,948	58,561	58,015	57,508	57,001	56,494	56,026

Hidalgo County Irrigation District No. 6 (Mission #6)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.94% and a yearly average reduction in irrigated acres of 1.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.42% and an irrigated acres reduction of 14.06%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 26,744 acre-feet.

Table 2.11: HCID6 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	92,948	74,488	55,499	39,965	39,965	39,965	39,965
Supply (acre-feet)	55,948	58,561	58,015	57,508	57,001	56,494	56,026

Santa Cruz Irrigation District No. 15 (Santa Cruz)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.36% and a yearly average reduction in irrigated acres of 2.75% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 3.58% and an irrigated acres reduction of 27.46%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 45,975 acre-feet.

Table 2.12: SCID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	45,975	44,330	42,295	40,163	40,163	40,163	40,163
Supply (acre-feet)	27,674	28,966	28,696	28,445	28,195	27,944	27,712

Engleman Irrigation District (Engleman)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.75% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 7.51%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 5,895 acre-feet.

Table 2.13: EID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	5,895	5,452	4,927	4,405	4,405	4,405	4,405
Supply (acre-feet)	3,548	3,714	3,679	3,647	3,615	3,583	3,553

Hidalgo County Irrigation District No. 5 (Progreso)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.48% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 4.75%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 11,402 acre-feet.

Table 2.14: HCID5 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	11,402	10,860	10,198	9,516	9,516	9,516	9,516
Supply (acre-feet)	6,863	7,184	7,117	7,055	6,992	6,930	6,873

Hidalgo County Irrigation District No. 13 (Baptist Seminary)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 4.86% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 48.57%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 764 acre-feet.

Table 2.15: HCID13 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	764	393	158	64	64	64	64
Supply (acre-feet)	460	481	477	473	469	464	461

Hidalgo County Irrigation District No. 16 (Mission #16)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.94% and a yearly average reduction in irrigated acres of 1.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.42% and an irrigated acres reduction of 14.06%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 25,344 acre-feet.

Table 2.16: HCID16 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	30,749	26,426	21,856	18,109	18,109	18,109	18,109
Supply (acre-feet)	15,255	15,968	15,819	15,681	15,542	15,404	15,277

Hidalgo County Municipal Utility District No. 1 (MUD)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.94% and a yearly average reduction in irrigated acres of 1.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.42% and an irrigated acres reduction of 14.06%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on extrapolations of 1994 allocations, which totaled 3,456 acre-feet.

Table 2.17: HCMUD Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	6,011	5,166	4,273	3,540	3,540	3,540	3,540
Supply (acre-feet)	2,080	2,178	2,157	2,138	2,120	2,101	2,083

Hidalgo County Water Control and Improvement District No. 18 (Monte Grande)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.94% and a yearly average reduction in irrigated acres of 1.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.42% and an irrigated acres reduction of 14.06%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 3,096 acre-feet.

Table 2.18: HCWCID18 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	5,505	4,731	3,913	3,242	3,242	3,242	3,242
Supply (acre-feet)	1,864	1,951	1,932	1,916	1,899	1,882	1,866

United Irrigation District of Hidalgo County (United)

The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.94% and a yearly average reduction in irrigated acres of 1.41% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.42% and an irrigated acres reduction of 14.06%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 25,548 acre-feet.

Table 2.19: UID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	64,464	55,402	45,821	37,966	37,966	37,966	37,966
Supply (acre-feet)	15,378	16,096	15,946	15,807	15,668	15,528	15,400

Hidalgo County Irrigation District No. 1 (Edinburg)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.99% and a yearly average reduction in irrigated acres of 4.40% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.86% and an irrigated acres reduction of 43.98%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 48,027 acre-feet.

Table 2.20: HCID1 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	85,615	68,611	51,121	36,812	36,812	36,812	36,812
Supply (acre-feet)	28,909	30,259	29,977	29,715	29,453	29,191	28,949

Cameron County Irrigation District No. 16 (Cameron #16)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.12% and a yearly average reduction in irrigated acres of 0.94% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 11.18% and an irrigated acres reduction of 9.39%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 2,133 acre-feet.

Table 2.21: CCID16 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	3,773	3,419	3,024	2,677	2,677	2,677	2,677
Supply (acre-feet)	1,285	1,310	1,297	1,286	1,274	1,262	1,252

Cameron County Irrigation District Cameron County No. 3 (LaFeria)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.69% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 6.91%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 66,344acre-feet.

Table 2.22: CCID3 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	74,898	69,722	63,795	58,419	58,419	58,419	58,419
Supply (acre-feet)	39,959	40,738	40,349	39,987	39,626	39,265	38,931

Cameron County Irrigation District Cameron County No. 4 (Santa Maria)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 0.37% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 3.68%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 9,159 acre-feet.

Table 2.23: CCID4 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	9,098	8,763	8,367	7,992	7,992	7,992	7,992
Supply (acre-feet)	5,516	5,624	5,570	5,520	5,471	5,421	5,375

Valley Acres Irrigation District (Valley Acres)
The results of the Irrigation District survey show a yearly average increase in flat rate acreage of 0.02% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate increase of 0.24%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on extrapolations of 1994 allocations, which totaled 17,223 acre-feet.

Table 2.24: VAID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	15,150	15,187	15,233	15,278	15,278	15,278	15,278
Supply (acre-feet)	10,373	10,576	10,475	10,381	10,287	10,193	10,106

Bayview Irrigation District No. 11(Bayview)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.12% and a yearly average reduction in irrigated acres of 0.94% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 11.18% and an irrigated acres reduction of 9.39%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in irrigated acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 10,835 acre-feet.

Table 2.25: Bayview ID Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	17,478	15,836	14,006	12,402	12,402	12,402	12,402
Supply (acre-feet)	6,526	6,653	6,590	6,531	6,472	6,413	6,358

Hidalgo County Water Irrigation District No. 3 (McAllen #3)
The results of the Irrigation District survey show a yearly average reduction in flat rate acreage of 1.99% and a yearly average reduction in irrigated acres of 4.40% during the span from 2000 to 2007. Extrapolating this data for a 10 year span yields a flat rate reduction of 19.86% and an irrigated acres reduction of 43.98%.

The situation that represents the most challenging scenario in terms of future water demand uses data associated with a reduction in flat rate acres. As previously described, the base year irrigation water demand for the District is based on allocations in 1994, which totaled 6,246 acre-feet.

Table 2.26: HCID3 Demand and Supply Projections

Year	2000	2010	2020	2030	2040	2050	2060
Demand (acre-feet)	9,752	7,815	5,823	4,193	4,193	4,193	4,193
Supply (acre-feet)	3,760	3,935	3,899	3,864	3,830	3,796	3,765

External Factors Influencing Future Irrigation Water Demands
The major crops grown in the Region include corn, grain sorghum, cotton, sugarcane, and citrus. External factors are at play when attempting to predict future planting scenarios and subsequent water demands. Urbanization plays a major role in determining future demand. This impact can be quantified based on previous rates of urbanization (loss of flat-rate acres and loss of irrigated acres). However, there are a number of factors that cannot be accurately quantified and are therefore not included in the demand projections. Even though these factors were not specifically analyzed, the potential impacts deserve discussion.

For one, climate change could lead to changes in the amount of rainfall in the Region. This, in turn, would lead to a change in the amount of irrigation water needed to produce an equivalent crop yield. In addition, the types of crops planted could be modified based on changes to the overall climate to better utilize rainfall and optimize the use of delivered irrigation water[1].

Second, crop schedules could be modified based on improvements to the irrigation conveyance system. As improvements are made, the delivery efficiency of the system

[1] Doria, R.; Madramootoo, C.A.; Mehdi, B.B. - 2007

will increase. The potential impact of this is two-fold. First, increasing delivery efficiencies could allow the District to pump less water at the Rio Grande while maintaining status quo water deliveries. Second, increasing efficiencies could allow the District to pump the same amount of water at the River and deliver higher quantities of water to the end user. Under the first scenario, it is not anticipated that changes to the types of crops grown throughout the District would change.
However, the second scenario provides a different impact. Increasing the amount of water delivered to the grower will allow them to modify their crop type to maximize yield with the water available. The result could be the planting of higher water using crops such as sugarcane or citrus.

The third factor impacting future planting scenarios is the potential increase in energy costs. Rising fossil fuel prices increase chemical costs, fertilizer costs, and tractor operation costs. In addition, higher gasoline/diesel costs could raise the prices that people will pay for ethanol from corn. These potential impacts could be offset by the implementation of reusable and clean energy (wind, solar, tide, wave, etc.). Regardless, rising fuel costs cut into farmers' profits.[2] This in turn can lead to changes in farming technologies which could significantly impact the types of crops being grown and the amount of water used.

Fourth, changes to crop subsidies, crop prices, and overall changes to the type of crop being planted which would have a direct impact on water requirements. Historical crop planting schedules were analyzed in order to determine county wide trends. Figures 1, 2, 3, and 4 show crop planting trends for corn, cotton, grain sorghum, and sugarcane. Data was obtained from United States Department of Agriculture – National Agriculture Statistics Service, and the data spans a timeframe from 1970 to 2007.

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[2] Parker, Randall - 2008

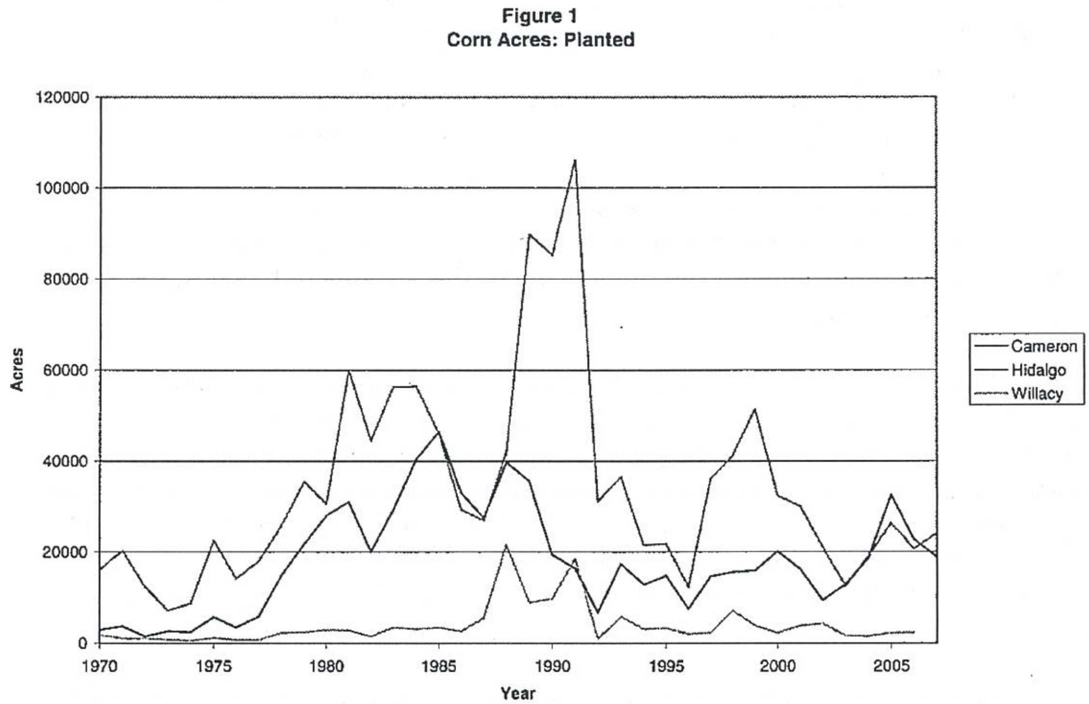

Figure 1: Corn Acres: Planted

As can be seen in Figure 1, the rate of planting corn in the three county area peaked from the mid-1980's until the early 1990's. Beginning in the early 1990's, a general downward trend in planted acreage can be seen. However, in the past few years, an increased interest in ethanol production has caused an upward trend in corn planting[3].

[3] Conversation with Ray Pruett, January 27, 2009

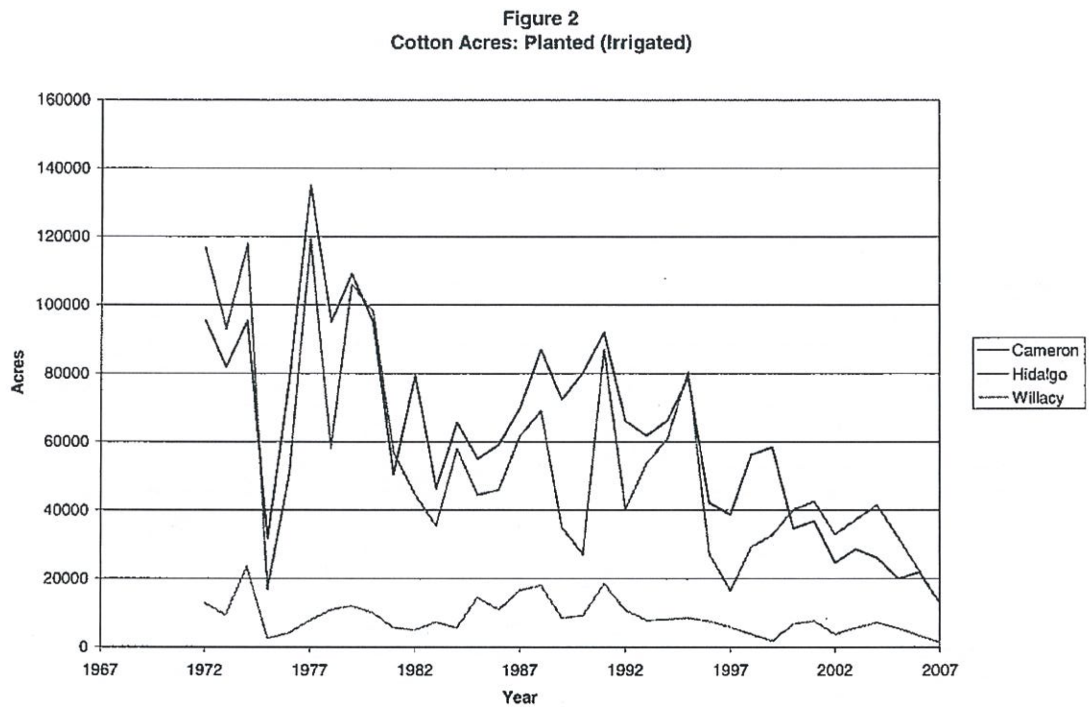

Figure 2: Cotton Acres: Planted (Irrigated)

Figure 2 shows the historical planting schedule of cotton for acreage that is irrigated. The graph shows a fairly consistent downward trend in cotton acreage beginning in the early 1970's and continuing to present.

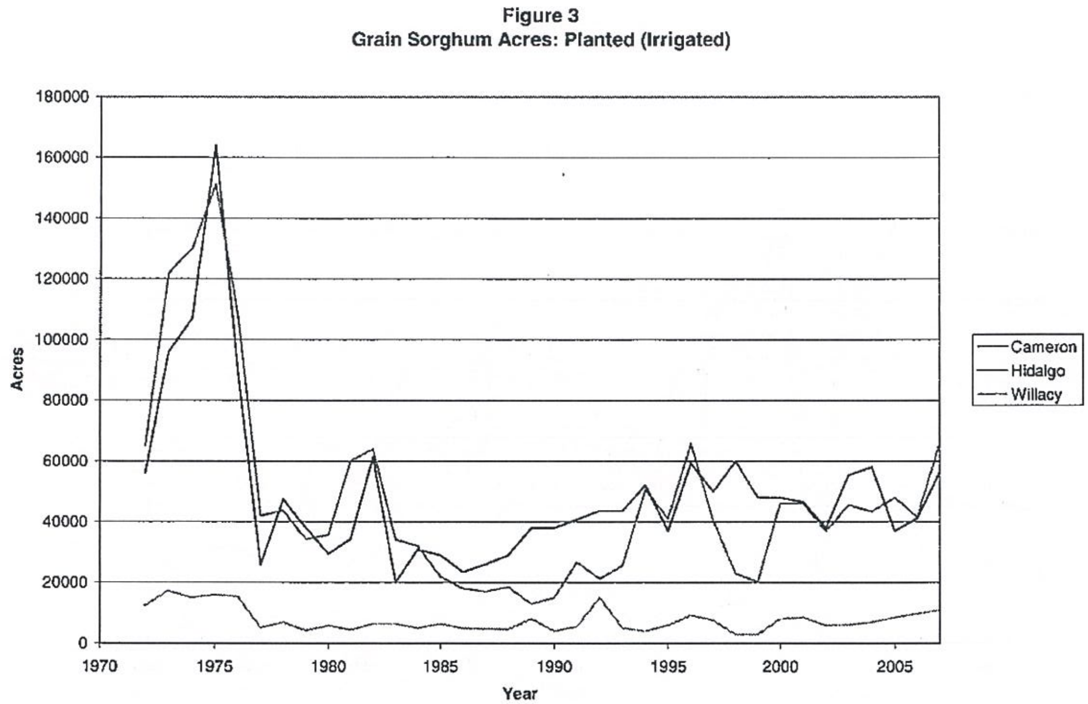

Figure 3: Grain Sorghum Acres: Planted (Irrigated)

Figure 3 shows the historical planting schedule of grain sorghum that is irrigated. After a sharp decline in acreage in the mid-1970's, the rate of sorghum planting has steadily increased.

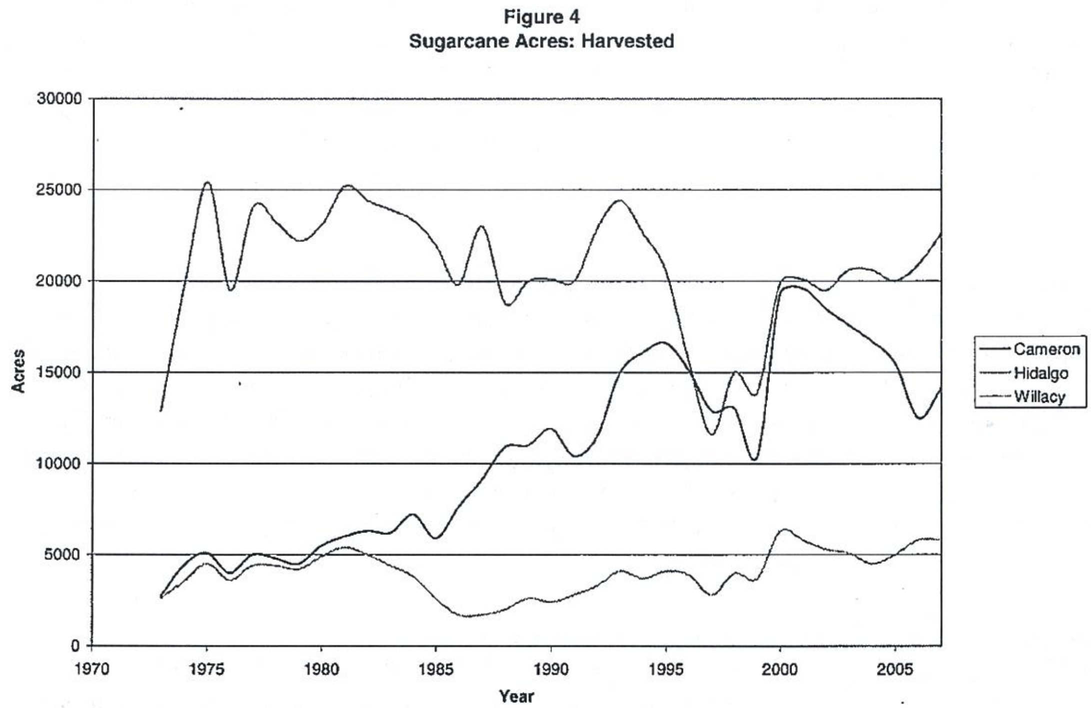

Figure 4: Sugarcane Acres: Harvested

The data represented in Figure 4 represents historical trends in sugarcane harvest in the three county area. The only recognizable trend in sugarcane acreage is for Cameron County which has seen a steady increase in sugarcane production. Hidalgo and Willacy counties have seen fairly steady sugarcane harvests.

The strongest trend in crop planting is a shift from cotton to grain sorghum. This historical trend is expected to continue in the near future due to a number of external factors including rainfall and urbanization. The impact of such a paradigm shift impacts irrigation water deliverers due to a change in water requirements for the crops[4]. It has been reported that the recommended evapotranspiration rate for cotton is 30.0 inches while the recommended evapotranspiration rate for grain sorghum is 20.2 inches[5]. Therefore, as the shift from cotton to sorghum continues, so does the water demand exerted on the irrigation conveyance systems.

The final factor that could impact future irrigation water demands is directly tied into the rate of urbanization. As is the case in many Irrigation Districts, small parcels of land are excluded from the District due to development. Many times this parcel of land is surrounded by acreage that continues to be irrigated. In other instances, land that is irrigable may be completely surrounded by urbanized acreage.

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[4] Conversation with Ray Pruett and Luis Rededa – January 27, 2009
[5] Enciso, Juan, Ph.D., P.E. – Irrigation in the Lower Rio Grande Valley of Texas

On the more conservative side, these changes may result in changes to crop due to the inability to apply proper pesticide to the land (i.e. Since cotton requires more pesticide which is traditionally applied aerially, the presence of subdivisions or other cases or urbanization results in the inability to aerially apply pesticide. Therefore, a change in crop may be necessary. This will have a direct impact in the water demand on that parcel of land.[6]). On the more aggressive side, these changes may result in the inability to apply irrigation water to land that is undeveloped due to the surrounding presence of urbanized land.

Ultimately, modifying the types of crops planted throughout each Irrigation District depend on a cost/benefit correlation. In other words, if the grower could increase the amount of money they make off of a parcel of land, or reduce the amount of money being spent to plant and harvest a crop, without making vast changes to the water delivery mechanism, different crops could be planted. It cannot be argued that future conditions will change based on climate change, conveyance system improvements, changes to fuel prices, and changes in crop schedules, but the extent of these impacts cannot be accurately quantified due to the relative difficulty of predicting when changes will take place and the impact of such changes.

Irrigation District Boundaries and City Boundaries
Additional information was collected associated with population growth in cities that have intersecting boundaries with irrigation districts. Aerial imagery was overlaid with GIS shapefiles. Irrigation District and City boundaries were overlayed on these maps. These maps can be found in the digital appendix. Census data was then obtained for all cities that have a portion of their boundaries inside of an irrigation district's boundary.

It was quickly realized that information obtained from this analysis could not be used to extrapolate the rate of urbanization of irrigation districts. After discussions with multiple utility general managers, it was learned that population growth does not correlate directly to the loss of irrigable acres. In many instances, population growth occurs in areas that are not irrigable. Therefore, there is no net impact to a District's irrigable acreage. Without being able to tie together population growth of cities to loss of irrigable acreage, there isn't a proper way to tie together population growth of cities to a loss of irrigation water demand for individual irrigation districts.

Even though this is the case, the data obtained does provide pertinent information as to the potential future case of increased municipal water demands that may require additional conveyance of raw water through the irrigation district's conveyance system.

[6] Conversation with Ray Pruett – January 27, 2009

Table 2.27: City populations that intersect with Irrigation District boundaries

Irrigation District Name and Associated Cities	Census Population Data			Projected Yearly Growth Rate 2000-2010 (State Water Plan)
	1990	2000	2008	
HCID 6				
Palmview	1,818	4,107	5,502	24%
Alton	3,069	4,384	11,523	18.15%
Mission	28,653	45,408	67,119	3.47%
Penitas	n/a	1,167	1,181	0.29%
United				
Alton	3,069	4,384	11,523	18.15%
Palmhurst	326	4,872	4,988	8.77%
Mission	28,653	45,408	67,119	3.47%
McAllen	84,021	106,414	129,776	1.98%
HCID 1				
Edinburg	29,885	48,465	71,520	3.37%
McAllen	84,021	106,414	129,776	1.98%
Santa Cruz				
Edinburg	29,885	48,465	71,520	3.37%
HCWID3				
Hidalgo	3,292	7,322	11,984	5.17%
McAllen	84,021	106,414	129,776	1.98%
HCID2				
Hidalgo	3,292	7,322	11,984	5.17%
Pharr	32,921	46,660	65,258	2.77%
San Juan	10,815	26,229	33,970	4.90%
Alamo	8,210	14,760	16,608	4.17%
Edinburg	29,885	48,465	71,520	3.37%
Donna				
Donna	12,652	14,768	17,094	2.10%
Alamo	8,210	14,760	16,608	4.17%
HCCID9				
Elsa	5,242	5,549	6,624	0.52%
Edcouch	2,878	3,342	4,613	1.30%
La Villa	1,388	1,305	1,434	0%
Weslaco	21,877	26,935	33,354	1.46%
Mercedes	12,694	13,649	15,131	0.66%
La Feria	4,360	6,115	7,023	3.01%
Delta Lake				
Raymondville	8,880	9,733	9,522	0.35%

La Feria				
Santa Rosa	2,223	2,833	3,152	2.26%
Combes	2,042	2,553	2,845	2.10%
La Feria	4,360	6,115	7,023	3.01%
Primera	2,030	2,723	4,230	2.67%
Adams Garden				
Harlingen	48,735	57,564	64,843	1.61%
Primera	2,030	2,723	4,230	2.67%
Harlingen				
Harlingen	48,735	57,564	64,843	1.61%
Combes	2,042	2,553	2,845	2.10%
Rangerville	280	203	n/a	n/a
Los Indios	n/a	1,149	1,227	2.34%
Rio Hondo	1,793	1,942	2,128	0.80%
Palm Valley	1,199	1,298	1,262	0.80%
Primera	2,030	2,723	4,230	2.67%
CCID2				
Rio Hondo	1,793	1,942	2,128	0.80%
San Benito	20,125	23,444	25,072	1.48%
Los Indios	n/a	1,149	1,227	2.34%
Harlingen	48,735	57,564	64,843	1.61%
Indian Lake	390	541	559	2.92%
Los Fresnos	2,473	4,512	5,538	4.74%
Rancho Viejo	885	1,754	1,847	5.19%
CCWID16				
Rancho Viejo	885	1,754	1,847	5.19%
BID				
Brownsville	98,962	139,722	175,494	2.45%
Bayview				
Bayview	231	323	535	n/a
Brownsville	98,962	139,722	175,494	2.45%
HCWID5				
Progreso	n/a	4,851	5,511	3.09%
Progreso Lakes	154	234	266	n/a

Existing Conveyance System

Methodology

As previously mentioned, each Irrigation District was asked to complete a survey that inquired about a number of District specific items. Of these items, each District was asked to furnish information pertaining to miles of canal (earthen and unlined) and miles of pipeline. This information was to be used to update information from previous Region M Regional Water Plans. In turn, the data was to be used to determine potential areas of conveyance losses. The following table represents the survey results:

Table 2.28: Survey results for Irrigation District Conveyance System

District Name	Earthen Canal	Lined Canal	Pipeline
	Miles	Miles	Miles
Hidalgo and Cameron Counties Irrigation #9	20	50	250
Adams Garden Irrigation District	8.5	15.8	45
Brownsville Irrigation District	0.5		284
Cameron County Irrigation District No. 6	100	25	25
Donna Irrigation District, Hidalgo County No. 1	4.3	87.7	88
Delta Lake Irrigation District	420	250	122
Hidalgo Co. Irrigation District No. 13	1.6	0	3.8
Hidalgo Co. Irrigation District No. 2	43.5	21.04	226.72
Hidalgo Co. Irrigation District No. 6	0.53	45.41	72.29
HCWC ID No. 19	4	2.5	18
Harlingen Irrigation District	40	15	200

As can be seen, overwhelming majority of Irrigation District's did not respond to this portion of the survey. Therefore, the response to the surveys was such that a detailed analysis of each Irrigation District's conveyance system cannot be determined with the information made available. However, information was obtained in which the main irrigation distribution system network for each District was given. Maps showing the main conveyance system for each irrigation district can be found in the digital appendix. Information pertaining to the miles of canals and pipeline was obtained from Fipps 2005.

Table 2.29: Main Irrigation Distribution Network

Main Irrigation Distribution Network	Canals miles	Pipeline Miles	Total miles	Canal:Pipeline
Adams Garden	21.49	2.01	23.5	10.7 :1
Bayview	14.06	0.43	14.49	32.7 :1
Brownsville	2.36	31.08	33.44	0.1 :1
San Benito	108.52	0.74	109.26	146.6 :1
Los Fresnos	41.82	0	41.82	1 :0
Rutherford-Harding	4.67	1.84	6.51	2.5 :1
Cameron 16	3.51	0	3.51	1.0 :0
Delta Lake	69.43	7.71	77.14	9.0 :1
Donna	32.49	0.8	33.29	40.6 :1
Engleman Gardens	12.43	5.7	18.13	2.2 :1
Mercedes	71.8	2.74	74.54	26.2 :1
Harlingen	52.78	7.65	60.43	6.9 :1
Edinburg	35.54	24.37	59.91	1.5 :1
McAllen 3	9.7	3.67	13.37	2.6 :1
Baptist Seminary	0	4.61	4.61	0.0 :1
HCID14	0	0	0	0.0 :0
Mission 16	15.17	2.25	17.42	6.7 :1
Monte Grande	0	0	0	0.0 :0
San Juan	37.5	50.48	87.98	0.7 :1
Progreso	0.8	20.54	21.34	0.0 :1
Mission 6	19.42	0	19.42	1.0 :0
Sharyland Plantation	4.58	0	4.58	1.0 :0
LaFeria	43.74	4.02	47.76	10.9 :1
Meaverick	120.86	0	120.86	1.0 :0
Santa Cruz	34.06	4.58	38.64	7.4 :1
Santa Maria	2.92	0	2.92	1.0 :0
United	29.11	5.9	35.01	4.9 :1
Valley Acres	5.66	10.29	15.95	0.6 :1
Average				11.4 :.75

It should be noted that the information contained in the above table is only for the main irrigation distribution network and does not include the lengths of canals and pipeline on the secondary and tertiary distribution systems for each District. Regardless, the majority of flow is transported through the main canal distribution system. Therefore, a good understanding of conveyance methods can be established. There are inherent disadvantages in using Fipps 2005 data to analyze individual irrigation district conveyance efficiencies. For instance, each individual irrigation district has a certain percentage of conveyance that is made up of open canals and pipelines. Therefore, using a county-wide or region-wide value to estimate conveyance efficiencies is erroneous.

In turn, it has been decided to use the Fipps 2005 estimate for region-wide conveyance efficiency to serve as a basis for the evaluation of individual irrigation district's efficiencies.

In terms of overall conveyance efficiency, it is estimated that county-wide conveyance efficiencies are as follows:

- Cameron County – 68%
- Willacy County – 70%
- Hidalgo County – 71%

(source: Fipps 2005)

Conveyance efficiency is a measure of the amount of water delivered to the end user when compared to the amount of water pumped from the Rio Grande to serve that user. Water loss can typically occur in one of four areas: seepage, evaporation, spill, or management. For the purpose of this investigation, seepage is defined as water lost through the wetted perimeter of a canal or pipeline. Evaporation is defined as water lost through the conversion from liquid to vapor. Spill is defined as water lost over canal banks or through canal overflow structures. Management is made up of multiple areas including water accounting, flow measurement, water routing, and any other area that operations could benefit conveyance.

Information on conveyance efficiency was polled from each Irrigation District. However, it was discovered that only a few kept suitable information necessary to accurately determine losses. The following table represents the best information available in terms of overall conveyance efficiency for each irrigation district:

Table 2.30: Reported, County, and Region Irrigation District Conveyance Efficiencies

District Name	Reported efficiency	County Efficiency	Regional Efficiency
Adams Garden		68.0%	69.7%
Bayview		68.0%	69.7%
Brownsville		68.0%	69.7%
San Benito		68.0%	69.7%
Los Fresnos	87%	68.0%	69.7%
Rutherford-Harding		68.0%	69.7%
Cameron 16		68.0%	69.7%
Delta Lake	66%	70.6%	69.7%
Donna	75%	71.0%	69.7%
Engleman Gardens		71.0%	69.7%
Mercedes		69.9%	69.7%
Harlingen		68.0%	69.7%
Edinburg	70%	71.0%	69.7%
McAllen 3		71.0%	69.7%
Baptist Seminary		71.0%	69.7%
HCID14		71.0%	69.7%
Mission 16		71.0%	69.7%
Monte Grande		71.0%	69.7%
San Juan	87.7%	71.0%	69.7%
Progreso		71.0%	69.7%
Mission 6	95%	71.0%	69.7%
Sharyland Plantation		71.0%	69.7%
LaFeria		68.0%	69.7%
Santa Cruz		71.0%	69.7%
Santa Maria		68.0%	69.7%
United		71.0%	69.7%
Valley Acres		70.6%	69.7%

There are uncertainties in these estimates. Where Irrigation District's have reported conveyance efficiencies, a thorough analysis was performed on how the figures were obtained. It was discovered that each District uses a different formula for determining efficiency. For instance, some District's evaluate efficiency by calculating the number of irrigated acreage and the amount of water pumped at the river. By dividing acres irrigated by acre feet of water diverted, they arrive at an efficiency. This method does not consideration the amount of water used for irrigation nor does it include the amount of water diverted vs. the amount of water delivered to all users. Other Irrigation Districts include a much more comprehensive evaluation by taking into consideration water diverted and water deliveries to all users including irrigation and municipal. This method does provide an accurate determination of conveyance efficiency. However, not all District's have the capability to accurately measure on-farm deliveries. Even further, many District's don't have the ability to measure smaller water users who divert water

from the conveyance system for purposes such as yard watering. In terms of county and regional efficiencies, using only the length of open canals and pipelines does not take into consideration the relative state of each canal or pipeline.
A new, well constructed earthen canal located in a high clay soil area will have much less water loss when compared to an old canal located in a loamy soil. In addition, the age of pipeline has a significant impact on conveyance efficiencies. Older pipelines are more prone to settling and joint leakage when compared to new installations. Other areas of uncertainty are the methods in which individual Irrigation Districts report their efficiency. The need for on-farm meters to be highly accurate is paramount to obtaining an accurate conveyance efficiency. Also, the maintenance schedule of meter calibration, repair, and replacement at the main pumping plant as well as the end user is unknown. Calculating conveyance efficiency without direct and specific input from each District can lead to significant errors due to unknown water management techniques, canal spillage, leaky gates/checks, and other unaccounted for water. In many irrigation districts, small yard watering taps are connected to the conveyance system. The amount of water used is not metered. Finally, many Irrigation District's reported efficiencies do not take into consideration no-charge pumping. This can significantly skew any reported efficiencies.

Therefore, county-wide estimated conveyance efficiencies as prepared by Fipps 2005 shall be used for each irrigation district.

Important Note: Using county-wide estimates to qualify individual Irrigation District conveyance system efficiencies does not represent an accurate scenario. Each District has a wide range of conveyance methods including open canals, pipelines, lined canals, and storage. In addition, the age of infrastructure plays a significant role in the efficiency of conveyance. Therefore, this analysis does not represent actual conveyance efficiencies. However, it does represent the best available quantifiable analysis of efficiency.

In addition to information pertaining to the conveyance system, information was gathered on the storage of each District. Information pertaining to storage surface area was adapted from Fipps 2005.

Table 2.31: Reservoir and Resaca Evaporation Losses

	Reservoir	Resaca	Evaporation	Losses
	acres	acres	ft	acre-feet/yr
Bayview	0	0	7	0
Brownsville	0	531	7	3717
San Benito	530	320	7	5950
Los Fresnos	0	1130	7	7910
Cameron 16	165	0	7	1155
Delta Lake	0	0	7	0
Donna	0	0	7	0
Engelman Gardens	60	0	7	420
Mercedes	750	0	7	5250
Harlingen	160	0	7	1120
Edinburg	0	0	7	0
Baptist Seminary	0	0	7	0
San Juan	350	0	7	2450
Mission 6	175	0	7	1225
Monte Grande	0	0	7	0
McAllen 3	0	0	7	0
Progresso	48	0	7	336
La Feria	0	0	7	0
Santa Cruz	0	0	7	0
United	0	0	7	0
Valley Acres	325	0	7	2275
Adams Garden	470	0	7	3290
Rutherford-Harding	0	0	7	0
Santa Maria	0	0	7	0
Mission 16	500	0	7	3500

An evaporation rate of 84 inches (7 feet) per year was utilized based on data from several local reservoirs (Reclamation 2003). Multiplying the surface area of each reservoir and resaca by 7 feet gives a yearly estimation of evaporation losses (acre-feet/year). The surface area data in the above table is only for those reservoirs/resacas in which the storage surface area and volume were known as indicated in Fipps 2005. Therefore, it is not an all-inclusive evaluation but does give an indication of expected losses due to evaporation.

Results

Cameron County Irrigation District No. 2 (San Benito)

The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron

County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 5,950 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of San Benito and Rio Hondo as well as East Rio Hondo Water Supply Corporation.

Brownsville Irrigation District (Brownsville)
The District's conveyance system is predominantly pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 3,717 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to El Jardin WSC, Aqua SUD, and the City of McAllen.

Harlingen Irrigation District No. 1 (Harlingen)
The District's conveyance system has a higher percentage of open canals than pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 1,120 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of Harlingen, Combes, and Palm Valley.

Cameron County Irrigation District #6 (Los Fresnos)
The District's conveyance system is predominantly open canal. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 7,910 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of Los Fresnos and Olmito as well as to the Brownsville PUB.

Hidalgo and Cameron Counties Irrigation District No. 9 (Mercedes)
The District's conveyance system is predominantly open canal. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. The District has acreage in both Cameron (4%) and Hidalgo Counties (96%). The weighted average using Fipps 2005 figures is 69.9%. Therefore, it is estimated that the conveyance efficiency of

the District is 69.9%. Furthermore, it is estimated that the District is losing 5,250 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of La Villa, Mercedes, Elsa, Weslaco, and Edcouch as well as to North Alamo WSC.

Delta Lake Irrigation District (Delta Lake)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. The District has acreage in both Willacy (43%) and Hidalgo Counties (57%). The weighted average using Fipps 2005 figures is 70.6%. Therefore, it is estimated that the conveyance efficiency of the District is 70.6%.

In addition to irrigation water users, the District provides raw water to the cities of Lyford, Raymondville, LaSara, Monte Alto, and Hargill as well as to North Alamo WSC.

Hidalgo County Improvement District No. 19 (Sharyland Plantation)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

The District only provides water to irrigators.

Adams Gardens Irrigation District No. 19 (Adams Garden)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%.

The District only provides water to irrigators.

Donna Irrigation District No. 2 (Donna)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

In addition to irrigation water users, the District provides raw water to the City of Donna as well as to North Alamo WSC.

Hidalgo County Irrigation District No. 2 (San Juan)
The District's conveyance system is predominantly pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

Furthermore, it is estimated that the District is losing 2,450 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of McAllen, Pharr, San Juan, Alamo, and Edinburg as well as to North Alamo WSC.

Hidalgo County Irrigation District No. 6 (Mission #6)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%. Furthermore, it is estimated that the District is losing 1,225 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to Aqua SUD.

Santa Cruz Irrigation District No. 15 (Santa Cruz)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

In addition to irrigation water users, the District provides raw water to North Alamo WSC.

Engleman Irrigation District (Engleman)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%. Furthermore, it is estimated that the District is losing 420 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to North Alamo WSC.

Hidalgo County Irrigation District No. 5 (Progreso)
The District's conveyance system is predominantly pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%. Furthermore, it is estimated that the District is losing 336 acre-feet/year due to evaporation from reservoirs and resacas.

The District only serves water to irrigation users.

Hidalgo County Irrigation District No. 13 (Baptist Seminary)
The District's conveyance system is predominantly pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

The District only serves water to irrigation users.

Hidalgo County Irrigation District No. 16 (Mission #16)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%. Furthermore, it is estimated that the District is losing 3,500 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to Aqua SUD and the City of LaJoya.

Hidalgo County Water Control and Improvement District No. 18 (Monte Grande)
No data was provided for the District's conveyance system. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

The District only delivers water to irrigation users.

United Irrigation District (United)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

In addition to irrigation water users, the District provides raw water to the cities of Mission and McAllen as well as to Sharyland WSC.

Hidalgo County Irrigation District No. 1 (Edinburg)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

In addition to irrigation water users, the District provides raw water to the City of Edinburg, North Alamo WSC, and Sharyland WSC.

Cameron County Irrigation District No. 16 (Cameron #16)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 3,717 acre-feet/year due to evaporation from reservoirs and resacas.

The District only provides service to irrigation water users.

Cameron County Irrigation District Cameron County No. 3 (La Feria)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%. Furthermore, it is estimated that the District is losing 1,155 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the cities of LaFeria, Santa Rosa, and Sebastian.

Cameron County Irrigation District Cameron County No. 4 (Santa Maria)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%.

The District only provides water to irrigation users.

Valley Acres Irrigation District (Valley Acres)
The District's conveyance system is predominantly pipelines. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. The District is located in both Cameron County (13%) and Hidalgo County (87%). Using Fipps 2005 figures, the weighted average conveyance efficiency is 70.6%. Therefore, it is estimated that the conveyance efficiency of the District is 70.6%. Furthermore, it is estimated that the District is losing 2,275 acre-feet/year due to evaporation from reservoirs and resacas.

In addition to irrigation water users, the District provides raw water to the Rio Grande Valley Sugarmill.

Bayview Irrigation District No. 11 (Bayview)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Cameron

County as a whole, the average conveyance efficiency is reported at 68% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 68%.

The District only provides water to irrigation users.

Hidalgo County Water Irrigation District No. 3 (McAllen #3)
The District's conveyance system is predominantly open canals. It was estimated that the average conveyance efficiency for all irrigation districts is 69.7%. For Hidalgo County as a whole, the average conveyance efficiency is reported at 71% (Fipps 2005). Therefore, it is estimated that the conveyance efficiency of the District is 71%.

In addition to irrigation water users, the District provides raw water to the City of McAllen.

Recommendations

In terms of the method in which individual Irrigation Districts could be included in the Regional Water Plan, there are three options available: wholesale water provider, water user group, and county-wide. The reason for evaluating individual Irrigation Districts is to increase the effectiveness of the plan by allowing for more accuracy in pinpointing specific water management strategies for specific users. In the previous rounds of regional planning, water supply and demand analysis were performed for a multitude of Water User Groups (WUGs) in the region including the classification of irrigation water users as a county-wide group (i.e. Irrigation – Cameron County). Utilizing this classification system creates a difficult set of circumstances in which to accurately evaluate irrigation water users including the development of accurate water supply and demand figures and developing water management strategies for implementation. In terms of Regional water planning, the analysis of individual Irrigation Districts will allow for a better understanding of the Region's water supply and demand. With this information, the Region will be better able to evaluate specific water management strategies needed to meet future water deficits.

Due to the number and type of water rights held, the primary purpose of an Irrigation District is to provide water for agricultural purposes. The District holds the irrigation water right that is being diverted from the river and delivers it to agricultural users of the District. The secondary function is to convey water for other water users. In some cases, the District owns the DMI water right that is being diverted. In other instances, the District simply conveys a water right that is owned by others. Therefore, Irrigation Districts serve as water user groups in much the same way that municipalities deliver water to their end users. A blanket characterization that Irrigation Districts are wholesale providers does not fit the role that Irrigation Districts play in the Region. It is hereby recommended that individual Irrigation Districts be classified as Water User Groups.

Regarding specific water supply and demand figures, the following table summarizes the findings:

Table 2.32: Irrigation District Demand and Supply Projections Summary

	Year	2000	2010	2020	2030	2040	2050	2060
BID	Demand (acre-feet)	50,875	40,186	29,798	22,164	22,164	22,164	22,164
	Supply (acre-feet)	10,008	10,203	10,105	10,015	9,924	9,834	9,750
CCID2	Demand	152,017	137,738	121,821	107,867	107,867	107,867	107,867
	Supply	64,121	65,372	64,747	64,167	63,587	63,007	62,472
HIDCC1	Demand	88,128	84,479	80,175	76,127	76,127	76,127	76,127
	Supply	29,031	29,598	29,315	29,052	28,790	28,527	28,284
CCID6	Demand	52,142	47,244	41,785	36,998	36,998	36,998	36,998
	Supply	27,950	28,495	28,223	27,970	27,718	27,465	27,231
Mercedes	Demand	144,343	125,925	105,301	86,365	86,365	86,365	86,365
	Supply	82,449	86,299	85,495	84,748	84,001	83,253	82,564
Delta Lake	Demand	176,099	174,911	173,395	171,746	171,746	171,746	171,746
	Supply	56,798	59,451	58,897	58,382	57,867	57,352	56,877
Sharyland	Demand	4,053	2,138	841	281	281	281	281
	Supply	6,858	7,179	7,112	7,050	6,987	6,925	6,868
Adams Garden	Demand	18,105	18,624	19,281	19,955	19,955	19,955	19,955
	Supply	7,338	7,481	7,409	7,343	7,277	7,210	7,149
HCID2	Demand	103,008	82,550	61,506	44,290	44,290	44,290	44,290
	Supply	55,948	58,561	58,015	57,508	57,001	56,494	56,026
HCID6	Demand	42,068	36,154	29,901	24,775	24,775	24,775	24,775
	Supply	16,098	16,850	16,693	16,547	16,401	16,255	16,120
Donna	Demand	80,953	77,425	73,274	69,379	69,379	69,379	69,379
	Supply	40,824	42,731	42,332	41,962	41,592	41,223	40,881
Santa Cruz	Demand	82,934	79,967	76,296	72,449	72,449	72,449	72,449
	Supply	27,674	28,966	28,696	28,445	28,195	27,944	27,712
Baptist Seminary	Demand	4,857	2,498	1,005	410	410	410	410
	Supply	460	481	477	473	469	464	461
HCID5	Demand	14,135	13,464	12,643	11,796	11,796	11,796	11,796
	Supply	6,863	7,184	7,117	7,055	6,992	6,930	6,873
Engleman	Demand	19,325	17,874	16,151	14,442	14,442	14,442	14,442
	Supply	3,548	3,714	3,679	3,647	3,615	3,583	3,553
HCID16	Demand	30,749	26,426	21,856	18,109	18,109	18,109	18,109
	Supply	15,255	15,968	15,819	15,681	15,542	15,404	15,277
HCMUD1	Demand	6,011	5,166	4,273	3,540	3,540	3,540	3,540
	Supply	2,080	2,178	2,157	2,138	2,120	2,101	2,083
HCWCID18	Demand	5,505	4,731	3,913	3,242	3,242	3,242	3,242
	Supply	1,864	1,951	1,932	1,916	1,899	1,882	1,866
United	Demand	64,464	55,402	45,821	37,966	37,966	37,966	37,966
	Supply	15,378	16,096	15,946	15,807	15,668	15,528	15,400
HCID1	Demand	85,615	68,611	51,121	36,812	36,812	36,812	36,812
	Supply	28,909	30,259	29,977	29,715	29,453	29,191	28,949
CCID16	Demand	3,773	3,419	3,024	2,677	2,677	2,677	2,677
	Supply	1,285	1,310	1,297	1,286	1,274	1,262	1,252
La Feria	Demand	74,898	69,722	63,795	58,419	58,419	58,419	58,419
	Supply	39,959	40,738	40,349	39,987	39,626	39,265	38,931
Santa Maria	Demand	9,098	8,763	8,367	7,992	7,992	7,992	7,992
	Supply	5,516	5,624	5,570	5,520	5,471	5,421	5,375
Valley Acres	Demand	15,150	15,187	15,233	15,278	15,278	15,278	15,278
	Supply	10,373	10,576	10,475	10,381	10,287	10,193	10,106
Bayview	Demand	17,478	15,836	14,006	12,402	12,402	12,402	12,402
	Supply	6,526	6,653	6,590	6,531	6,472	6,413	6,358
McAllen 3	Demand	9,752	7,815	5,823	4,193	4,193	4,193	4,193
	Supply	3,760	3,935	3,899	3,864	3,830	3,796	3,765

In terms of canal conveyance efficiencies for each District, it is recommended to utilize the following table. Data reported by each District will take precedence over the county-wide average.

Table 2.32: Irrigation District Conveyance Efficiency

District Name	Conveyance Efficiency
Adams Garden	68.0%
Bayview	68.0%
Brownsville	68.0%
San Benito	68.0%
Los Fresnos	68.0%
Rutherford-Harding	68.0%
Cameron 16	68.0%
Delta Lake	70.6%
Donna	71.0%
Engleman Gardens	71.0%
Mercedes	69.9%
Harlingen	68.0%
Edinburg	71.0%
McAllen 3	71.0%
Baptist Seminary	71.0%
HCID14	71.0%
Mission 16	71.0%
Monte Grande	71.0%
San Juan	71.0%
Progreso	71.0%
Mission 6	71.0%
Sharyland Plantation	71.0%
LaFeria	68.0%
Santa Cruz	71.0%
Santa Maria	68.0%
United	71.0%
Valley Acres	70.6%

Important Note: Using county-wide estimates to qualify individual Irrigation District conveyance system efficiencies does not represent an accurate scenario. Each District has a wide range of conveyance methods including open canals, pipelines, lined canals, and storage. In addition, the age of infrastructure plays a significant role in the efficiency of conveyance. Therefore, this analysis does not represent actual conveyance efficiencies. However, it does represent the best available quantifiable analysis of efficiency.

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RIO GRANDE
REGIONAL WATER PLANNING GROUP

Rio Grande Regional Water Planning Group
3rd Round of Regional Planning: 1st Phase

Task #3: Analyze Results of Demonstration Projects

Final Report
August 14, 2009

Submitted by:

NRS
engineering better communities

NRS Consulting Engineers, Inc.
Texas Registered Engineering Firm F-2705
1222 E. Tyler Avenue
Harlingen, TX 78550
Phone: 956-423-7409
Fax: 956-423-7482
www.nrsengineers.com

STATE OF TEXAS
JACOB M. WHITE
103827
LICENSED
PROFESSIONAL ENGINEER

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Study #3: Analyze Results of Demonstration Projects

Executive Summary

Since the last round of regional planning was complete, a number of demonstration projects have been undertaken. Included in these demonstration projects are two studies that will add substantial information to the regional water plan. First, the Harlingen Irrigation District undertook a comprehensive analyses aimed at evaluating on-farm water conservation. Second, a seawater reverse osmosis pilot study was performed by the Public Utility Board of the City of Brownsville. Each of these studies reflect previously recommended water management strategies for Region M.

Harlingen Irrigation District: Agricultural Water Conservation Demonstration Initiative
The Harlingen Irrigation District, through a grant from the Texas Water Development Board, has implemented a ten-year project in the lower Rio Grande Valley aimed at improving on-farm irrigation technologies and methods. The project began in 2005 and is scheduled for completion in 2014. Although this project is termed a demonstration project, there are actually five demonstration projects that make up the ADI: 1)drip and furrow flood irrigation in annual crops and multi-year crops, 2)surge, automated surface, and precision surface irrigation, 3) low elevation spray application, low pressure in canopy, and low energy precision application center pivot sprinkler demonstration sites, 4) automated and manual on-farm measurements systems, and 5) variable speed pump control and optimized delivery of on-farm demands.

The most gains in water conservation were observed for drip irrigated onions compared to furrow irrigation. In this case, the yield doubled, quality remained the same, and water use was reduced by 50%. When using poly-pipe verses open ditches, irrigators saw savings in terms of less labor and less water usage (5% to 40% less). Mini-pivots irrigation were shown to be effective in areas where the water table is shallow and in areas where the land is undulating.

The implementation of on-farm irrigation improvements has been a source of discussion. Implementation of on-farm water conservation measures will require individual agricultural producers to adopt new irrigation technologies and management practices. There has already been a degree of adoption of on-farm water conservation measures by producers in the Rio Grande Region. However, to achieve the recommended rates of implementation, it will be important to expand state and federal technical assistance programs, provide incentives, and/or financial assistance to irrigators. As it currently exists, the monetary incentive for implementing on-farm conservation is not in place for the irrigator. Even though water conservation is an important factor that many look at, the practice of farming is a business to most, and monetary incentives could drive the rate of implementation of on-farm conservation. Ultimately, the recommended on-farm incentive program will be directly hinged to the amount of funding made available for the implementation of any improvements.

The current agricultural climate in the region is such that the majority of irrigators are not willing to expend large amounts of money on such improvements. Therefore, State and Federal funding must continue to be allocated to such actions.

Preliminary results of the demonstration project indicate that on-farm conservation is a viable water management strategy for the Region. The demonstration project has proven that water consumption can be reduced by implementing on-farm conservation while maintaining crop yields similar to more water intensive irrigation methods (i.e. flood irrigation). The potential for sustained drought in the Region, combined with the uncertainty of Mexico's compliance with the 1944 treaty, should cause an enhanced evaluation of on-farm conservation implementation.

Brownsville Public Utilities Board: Texas Seawater Desalination Demonstration Project
In 2004, a Feasibility Study determined that the Lower Rio Grande Valley region would be confronted with a water supply deficit by 2050 and that seawater desalination was a viable alternative. In 2007, BPUB and TWDB partnered together to implement a seawater desalination Pilot Study. The pilot facility was located on the north shore of the Brownsville Ship Channel on land made available by the Port of Brownsville. The primary purpose of the pilot was to provide an opportunity to evaluate actual performance of proposed water treatment systems under site-specific conditions.

Because the objective of a seawater desalination project is to produce potable drinking water from the ocean, the Pilot Study established testing protocols approved by the Texas Commission on Environmental Quality (TCEQ). The performance of each pretreatment and primary treatment (reverse osmosis) process was then evaluated and documented. TCEQ requirements served as the base point for testing. However, the data required in order to meet these requirements does not provide all necessary information needed to accurately determine the most effective treatment technology for the full-scale facility.

The original study scope developed by BPUB and TWDB called for the comparison of two types of pretreatment technologies: 1) conventional (rapid mix/flocculation/clarification/filtration), and 2) ultrafiltration (a membrane-based technology). However, at the outset of the project, BPUB decided to increase the scope and value of the Pilot Study by including two additional membrane-based pretreatment units.

During the Pilot Study, source water quality was characterized at both potential full-scale site locations, including the inland site on the Brownsville Ship Channel and the ocean site off-shore of Boca Chica Beach in the Gulf of Mexico. In the ship channel, large fluctuations in turbidity and suspended solids were observed. These variations were attributed mainly to the passing of cargo ships in the Brownsville Ship Channel and predominant (southeasterly) wind direction and speed. Water quality in the Gulf of Mexico varied less, but samples were not taken during adverse weather conditions when variability would be expected to increase and overall quality decrease. Therefore, pilot data for the Gulf of Mexico do not reflect the worst-case water quality scenario for the open ocean that would occur during hurricane or other severe storm events.

During the Pilot Study, four pretreatment systems were subjected to protocol tests: 1) Eimco Conventional System, 2) GE Zenon Ultrafiltration, 3) Norit Ultrafiltration, and 4) Pall Microfiltration. With challenging raw water quality, each pretreatment system was tested at a number of operating conditions to document performance. The removal efficiency of potential membrane fouling agents (i.e., particulates, total organic carbon, etc.) was also measured and system reliability evaluated in terms of treatment consistency. Three of the four tested pretreatment units (conventional, GE Zenon, and Norit) failed to prove sustainable operation without exhibiting significant fouling tendencies and, in the extreme case, irreversible fouling on the membrane surface. The fourth pretreatment unit (Pall Microza system) did successfully operate for periods of 66 days and 72 days during two separate runs performing TCEQ Stage 2 and Stage 3 of the pilot protocols.

Three RO membranes were tested during the pilot study. The first set of membranes tested was Toray TM820C-400, a membrane designed to maximize boron rejection. The other two membranes tested were Toray TM820-400 and Filmtec SW30HR-LE-400i. With both the Filmtec SW30HR LE-400i and Toray TM820-400 elements, it was concluded that the RO system exhibited acceptable performance.

The Brownsville PUB pilot study proved that seawater desalination at the Brownsville Ship Channel is technologically feasible. Water quality in the Ship Channel was challenging with high levels of suspended solids and wide ranges of temperatures. However, a system of microfiltration and reverse osmosis proved effective at treating the challenging water to a finished water quality that meets or exceeds Texas Commission on Environmental Quality standards (both primary and secondary). On a region-wide basis, seawater desalination has the ability to provide a drought proof source of water to all users in the Region. The results of the Brownsville PUB pilot study indicate that seawater desalination is a feasible and recommended water management strategy for the region.

Purpose of Study

Since the last round of regional planning was complete, a number of demonstration projects have been undertaken. Included in these demonstration projects are two studies that will add substantial information to the regional water plan. First, the Harlingen Irrigation District undertook a comprehensive analyses aimed at evaluating on-farm water conservation. In the past regional plan, on-farm conservation was included as a water management strategy aimed at irrigation water users. Even though substantial amounts of water can be conserved by this method, implementation of on-farm conservation proved to be difficult given a lack of information available regarding implementation costs and potential water conservation amounts. In order to promote implementation, an analysis of the Harlingen Irrigation District project will be performed with the ultimate goal being to develop an on-farm incentive for implementation.

In addition to the on-farm study, a seawater reverse osmosis pilot study was performed by the Public Utility Board of the City of Brownsville. Seawater desalination was also recommended as a water management strategy in the previous round of regional planning.

Results of the seawater desalination pilot study will be analyzed and incorporated into the regional water plan to gain a better understanding as to the applicability of seawater desalination as a regional water management strategy.

Harlingen Irrigation District: Agricultural Water Conservation Demonstration Initiative

Methodology

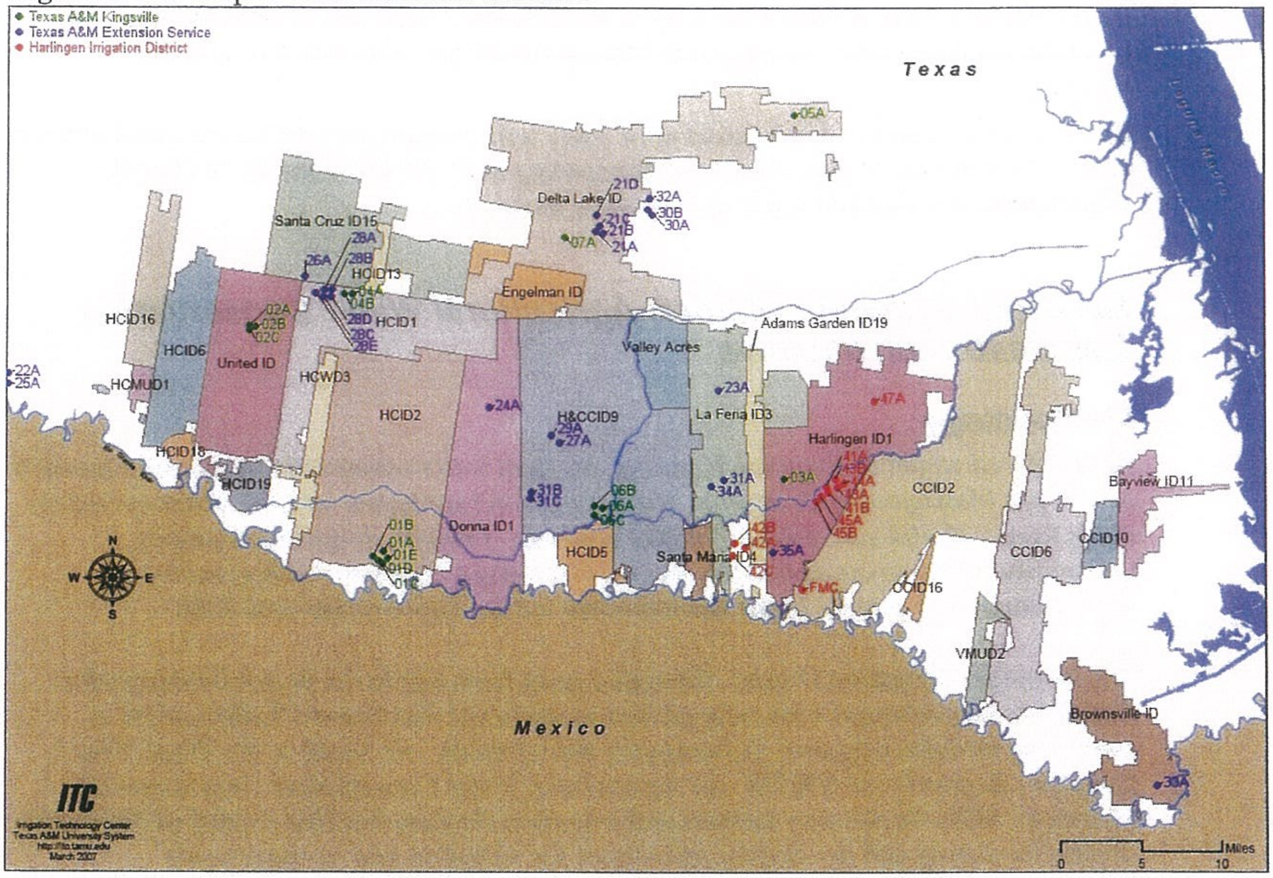
In the second round of Regional Planning, on-farm water conservation was recommended as a Water Management Strategy in which one could anticipate on-farm water savings to range from 125,194 acre-feet to 274,033 acre-feet. Overall, irrigation strategies (conveyance system improvements and on-farm improvements) could generate approximately 15 percent of the needed water for the region in the year 2060.

The Harlingen Irrigation District, through a grant from the Texas Water Development Board, has implemented a ten-year project in the lower Rio Grande Valley aimed at improving on-farm irrigation technologies and methods. As stated in the Three Year Summary Report to the TWDB, the Agricultural Water Conservation Demonstration Initiative (ADI) "is one way farmers and irrigation districts can take control of their water destiny by testing and developing techniques for irrigation and on-farm water efficiencies." The project began in 2005 and is scheduled for completion in 2014.

The ADI project is a culmination of a number of partners including Delta Lake Irrigation District, Texas A&M-Kingsville, U.S. Department of Agriculture – Natural Resources Conservation Service, Texas AgriLife Extension Service, Rio Farms, Inc., and agricultural producers in Cameron, Hidalgo, and Willacy counties.

Although this project is termed a demonstration project, there are actually five demonstration projects that make up the ADI: 1)drip and furrow flood irrigation in annual crops and multi-year crops, 2)surge, automated surface, and precision surface irrigation, 3) low elevation spray application, low pressure in canopy, and low energy precision application center pivot sprinkler demonstration sites, 4) automated and manual on-farm measurements systems, and 5) variable speed pump control and optimized delivery of on-farm demands.

Figure 1: Site Map of Demonstration Initiative

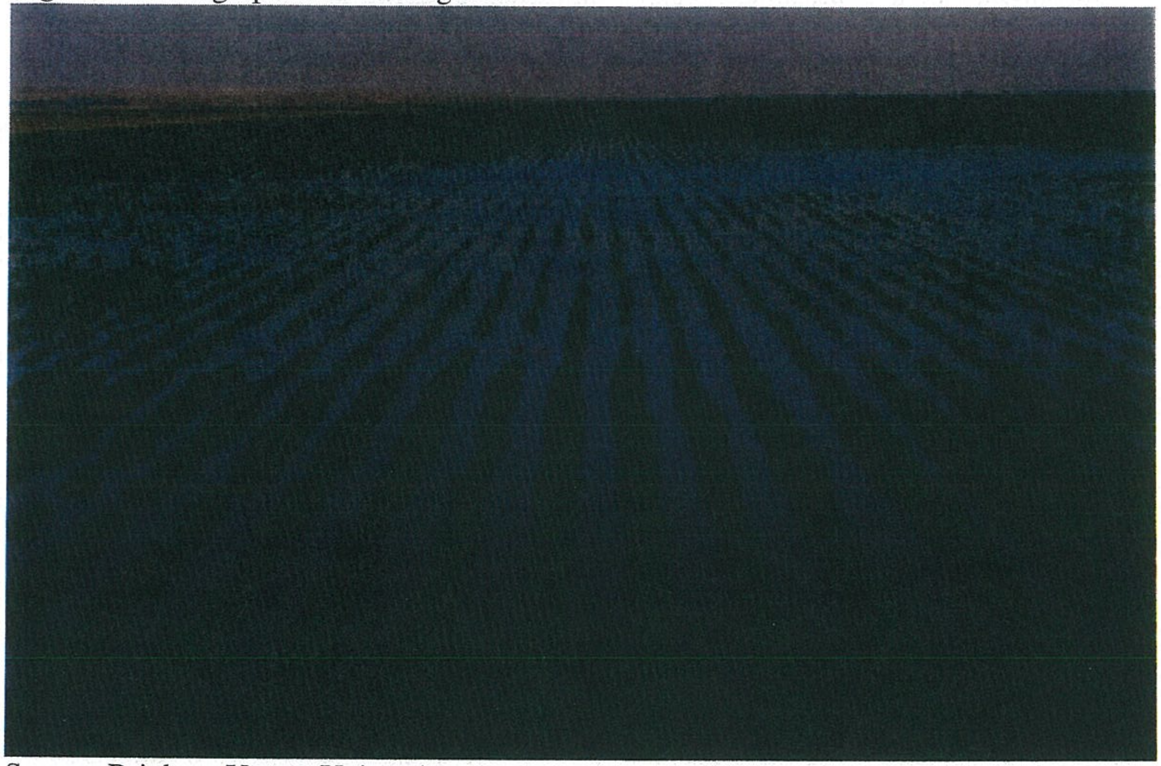


Results

Drip and Furrow Flood Irrigation in Annual Crops and Multi-Year Crops

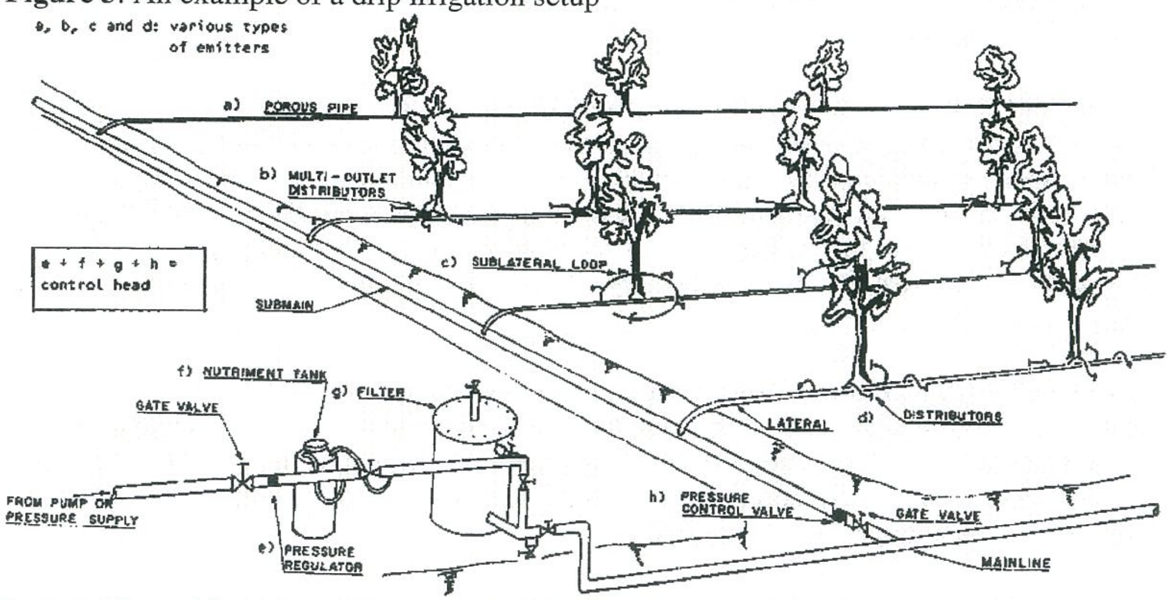
Over 3 years of data has been obtained ranging from rainfall, soil moisture levels, and crop yields. The Rio Red grapefruit crop was used as a control for the analysis. Seventeen (17) collaborating participants were used in this study. In the area, citrus is typically irrigated using the flood technique in which 0.6 acre-feet of water are applied to the ground per watering event. For the purpose of the study, three alternative methods of irrigation were tested: bordered flood, microject spray, and drip irrigation. Each irrigation method was tested at a prospective site. The results of the alternative irrigation technique were measured against the traditional flood irrigation average during the 2007-2008 growing season.

Figure 2: Photograph of flood irrigation



Source: Brigham Young University

Figure 3: An example of a drip irrigation setup



Source: Natural Resources Management and Environment Department

The following table gives a representative summary of water use:

Table 1: Water use summary for various on-farm delivery methods

Site	Acres	Irrigation Type	Trees per Acre	Total Irrigation	Total Irrigation	Water Savings
				gallons/acre	acre-feet per acre	acre-feet per acre
1a	50	Border field	115	832334	2.55	0.62
31a	9.4	Drip	116	610971	1.88	1.3
4b	38	Microjet	115	438270	1.35	1.83

The reported data indicates a significant drop in water volume using alternative technologies. When the data from alternative watering technologies is compared to standard flood irrigation, substantial water savings can be realized.

As important as evaluating various types of irrigation techniques may be, it is just as important to create an awareness of the technologies available to the irrigators. The ADI has been successful in collaborating with end users on the implementation techniques of various technologies. The results showed that an overwhelming majority felt that drip irrigation is the "most effective method of irrigation".

Surge, Automated Surface, and Precision Surface Irrigation

Surge irrigation technologies under this study have been applied to a number of different crops including sugarcane, cotton, corn, soybeans, and sorghum. Many farmers found the reduced flow as a result of using the surge valve, in addition to the necessity for increased management, to be cumbersome. However, surge irrigation was proven to reduce water use.

The surge technology allowed for user specified intervals to complete a single irrigation. By reducing the watering interval, a reduction in consumption was reported. However, there are certain drawbacks to this method. One, the technology is cumbersome and requires increased management. Two, the conveyance pipe (typically poly pipe) can rupture due to a rapid increase in flow. It was reported that a 27% reduction in water consumption was realized by utilizing surge irrigation. No other comparative data was made available.

LESA/LPIC/LEPA Center Pivot Sprinkler Demonstration Sites

It has been proven that "crop yields could be increased by 15% using the same amount or less water in most of" the demonstrations by scheduling irrigation. This could correlate to a savings of one, 8" irrigation per year when using water mark sensors and monitoring soil water content in grain and cotton crops.

Specific conclusions regarding the effectiveness of center pivot irrigation techniques were not available. However, it was reported that the distribution uniformity (DU), based on volumes collected ranged from 75.6% to 76.3% with a uniformity coefficient (UC) ranging from 82% to 85.8%.

The center pivot technology was only tested on pasture Bermuda grass, and data was not available as to the water savings associated with such a technique. However, it was reported that the cost of irrigating using center pivot was between $2.23 per acre-inch and $2.39 per acre-inch.

Figure 4: Photograph of center pivot technology

Source: Texas Water Development Board

Demonstration Summary

The most gains in water conservation were observed for drip irrigated onions compared to furrow irrigation. In this case, the yield doubled, quality remained the same, and water use was reduced by 50%. When using poly-pipe verses open ditches, irrigators saw savings in terms of less labor and less water usage (5% to 40% less). Mini-pivots irrigation were shown to be effective in areas where the water table is shallow and in areas where the land is undulating.

In addition to actual studies performed in the field, a major portion of the ADI program is associated with public perception, outreach, and training. The Harlingen Irrigation District operates a state-of-the-art meter calibration and training facility. New technologies can be tested at the site in simulated irrigation scenarios, and Irrigation District canal riders can be trained in the principals of water management. These two items combined, if utilized to the fullest extent, could prove highly effective at reducing water losses due to improper or absent water flow metering as well as reduce water spillage due to poor canal management.

In addition, a major component of the demonstration project is the installation of automated and manual on-farm measurements systems. Installed in 2006, the automated meter and telemetry system allows for real-time monitoring of data on the District's website. This allows irrigators and other water users to monitor water deliveries throughout the District. Information obtained here is being compared to manual collection.

Future Plans
It is anticipated that the ADI will be completed in 2014 with the demonstration phase being completed within 2 years. The final results of the demonstration phase will show farmers multiple water conservation options including on-farm delivery techniques. Supporting data in terms of water consumption and cost of conveyance will be evaluated. As of current, "the project has failed to provide a financial incentive to encourage the investment in these demonstrated technologies. Even though the demonstration sites are accepted as successfully providing alternatives to traditional irrigation practices, the risk is often too great for the farmer to commit to large scale changes."[1] It has been discussed that additional funding toward implementation would allow for the ADI group to discuss alternative water delivery mechanisms with the farmer with the ultimate goal being to educate irrigators as to the benefits.

Additional training events, using the recently constructed training facility, are being proposed. With equipment installed on site, the object of training would be to increase awareness of gate operation, automation, SCADA, flow measurement, flow management, and other methods for delivering water through a conveyance system. These training events would be perfectly suited to all levels of Irrigation District employees from canal riders to General Managers. In addition, the individual farmers would benefit from the plethora of training options available.

Figure 5: Automated flume gate and metering flume at the Harlingen Irrigation District training facility

Source: Harlingen Irrigation District

As the demonstration study progresses, additional information will be made available. Even though the study is not quite complete, it can be seen that alternative on-farm delivery techniques can be effective at reducing consumption.

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[1] Harlingen Irrigation District, 2008

In addition, an increase in water delivery management using SCADA, automation, flow meters, and other technologies can increase delivery efficiencies. Ultimately, the preliminary results of the study support previous Regional Water Plan recommendations that on-farm conservation, as a water management strategy, could potentially generate approximately 15% of the needed water in the Region in 2060. As the study progresses, this inference could be tested with appropriate results.

Recommendations

On-farm Implementation

The implementation of on-farm irrigation improvements has been a source of discussion. Implementation of on-farm water conservation measures will require individual agricultural producers to adopt new irrigation technologies and management practices. There has already been a degree of adoption of on-farm water conservation measures by producers in the Rio Grande Region. However, to achieve the recommended rates of implementation, it will be important to expand state and federal technical assistance programs, provide incentives, and/or financial assistance to irrigators. As it currently exists, the monetary incentive for implementing on-farm conservation is lacking for the irrigator. Even though water conservation is an important factor that many look at, the practice of farming is a business to most, and monetary incentives could drive the rate of implementation of on-farm conservation.

In a White Paper produced by the Valley Water Summit titled "On-Farm Water Applications", nine potential solutions to increasing on-farm conservation were presented:

- Increase funding and cost-share programs via the TWDB or the EQIP to help fund on-farm irrigation conservation projects
    - Sponsor field-size demonstrations of new technologies
    - Help purchase on-farm technology
- Replace open canals with pipelines in the delivery system so water will be available at all times and at constant head pressures. This will allow for alternative on-farm technologies to be used including drip, micro-jet, sprinklers, etc.
- Increase the use of on-farm water measurement and price incentive programs
- Develop water marketing to facilitate water sales and transfers between Irrigation Districts
- Develop other sources of water
- Adopt water-saving application technologies and invest in related education for farmers
- Invest in agronomic and irrigation research, and modify production practices
- Require Mexico to comply with the 1944 Water Treaty
- Increase water rates for users to provide investment funding for infrastructure improvements

The report went on to describe ten potential pitfalls to on-farm solutions:

- Lack of concerted effort to obtain State and Federal funding to assist on-farm conservation
- Improvements in the infrastructure of Irrigation Districts may have to be made before on-farm conservation efforts will succeed.
- Reluctance to raise rates, due to political and economic concerns, will limit capital investment.
- Lack of conservation incentives: under non-volumetric rates, farmers do not receive the benefit of saving water
- ID rules and institutional constraints on moving water between districts
- High costs for on-farm water distribution systems
- Lack of knowledge and experience with improved on-farm water distribution systems
- Lack of research on optimal irrigation strategies for alternative crops in the region
- High-value crops tend to use large volumes of water
- Soil salinity is not necessarily reduced if the amount of water irrigation the fiels is reduced.

A key factor in analyzing on-farm efficiencies lies in the irrigation conveyance system. The degree to which on-farm water savings can be achieved is partially dependent upon improved efficiencies of irrigation conveyance and distribution facilities. The end-user can only conserve water that is made available to them, and the rate of conservation is linearly attached to the rate at which water is applied to the field. On-farm technologies that typically apply low volumetric flow rates to the field require a different conveyance system operation when compared to typical flood irrigation techniques which provide rapid, high flow rate watering.

The critique on a hesitation to proceed with wide-spread on-farm efficiency improvements provided in the Valley Water Summit White Paper is well founded, and progress is being made to address many of the issues laid forth. Many Irrigation Districts have implemented, or are in the process of implementing, volumetric pricing. In addition, funding has been put forward to increase understanding and testing of on-farm delivery methods (i.e. Agriculture Water Conservation Demonstration Initiative).

Modifying the cost of irrigation water could prove to be effective at curbing usage and spurring increased efficiency on the farm level. While this theory may be accurate, it may not be an available tool for many Irrigation Districts. A secondary approach of offering monetary subsidies to aid in the transfer of technology could be an effective approach. In many cases, a higher subsidy amount results in a greater probability of adopting improved on-farm irrigation technologies[2].

As the demand on surface water resources in the Region increases, the need to increase water efficiency (both conveyance and application) will increase as well.

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[2] Scheierling, Young, and Cardon – Can Farm Irrigation Technology Subsidies Effect Real Water Conservation?

A number of governmental agencies and entities can assist in the inevitable need to conserve irrigation water. These entities include the Texas State Soil and Water Conservation Board, the U.S. Department of Agriculture – Natural Resources Conservation Service, and Universities. The Texas State Soil and Water Conservation Board administers three key programs: Soil Water Conservation District Assistance, Water Quality Management Plan, and Brush Control programs. The USDA – NRCS offers support for water conservation programs including Conservation Innovation Grants, Conservation Security Program, Environmental Quality Incentives Program, Grassland Reserve Program, Farm and Ranch Lands Protection Program, Wetlands Reserve Program, and Wildlife Habitat Incentives Program. Local university programs include the Texas AgriLife Extension Service, Texas Water Resources Institute, and AgriLife Research[3].

Ultimately, the recommended on-farm incentive program will be directly hinged to the amount of funding made available for the implementation of any improvements. The current agricultural climate in the region is such that the majority of irrigators are not willing to expend large amounts of money on such improvements. Therefore, State and Federal funding must continue to be allocated to such actions.

When looking at the on-farm conservation as a recommended water management strategy, the previous Regional Water Plan included three methods for increasing water supply yield: farm level water measurement and metering, replacement of field ditches with poly/gates pipe, and adoption of improved water management practices and irrigation technologies. As detailed in the Fipps 2005 report, 60% of the Region needs improved management and irrigation technologies.

Quantifiable water conservation figures for the Region, based on the findings of the demonstration study, cannot be ascertained at this time. However, preliminary results of the demonstration project indicate that on-farm conservation is a viable water management strategy for the Region. The demonstration project has proven that water consumption can be reduced by implementing on-farm conservation while maintaining crop yields similar to more water intensive irrigation methods (i.e. flood irrigation). The potential for sustained drought in the Region, combined with the uncertainty of Mexico's compliance with the 1944 treaty, should cause an enhanced evaluation of on-farm conservation implementation. As is often the case, large-scale implementation of an unfamiliar technology takes incredible foresight.

[3] Texas Water Development Board – Agriculture Water Conservation: Best management Practices

Brownsville Public Utility Board: Texas Seawater Desalination Demonstration Project

Methodology

In 2004, a Feasibility Study determined that the Lower Rio Grande Valley region would be confronted with a water supply deficit by 2050 and that seawater desalination was a viable alternative (Dannenbaum and URS 2004). Based on data and information available at the time, the Feasibility Study estimated the total probable costs for a full-scale 25 mgd facility to be approximately $152 million. The study recognized that some form of supplemental (grant) funding would have to be provided to bridge the gap between what such a facility would cost and what local utilities could afford to pay. Since that time, substantial increases in the costs for fuel, electricity, steel, and petroleum-based products have been observed.

In 2007, BPUB and TWDB partnered together to implement a seawater desalination Pilot Study. The pilot facility was located on the north shore of the Brownsville Ship Channel on land made available by the Port of Brownsville. The primary purpose of the pilot was to provide an opportunity to evaluate actual performance of proposed water treatment systems under site-specific conditions. Piloting results would then be used to refine the designs and cost estimates for a full-scale (25 mgd) seawater desalination facility. The *Brownsville Seawater Desalination Pilot Project* operated from February 2007 to July 2008, and this Final Pilot Study Report presents its results and recommendations.

Two alternative site locations were considered for the pilot facility: Boca Chica Beach (coastal) and the Brownsville Ship Channel (inland approximately 11 miles) (Figure 6). Although the raw water quality was expected to be generally poorer at the ship channel site, the pilot facility was located there because of power supply, cost, security, and access considerations. As such, the site represents a worst-case source water quality testing scenario.

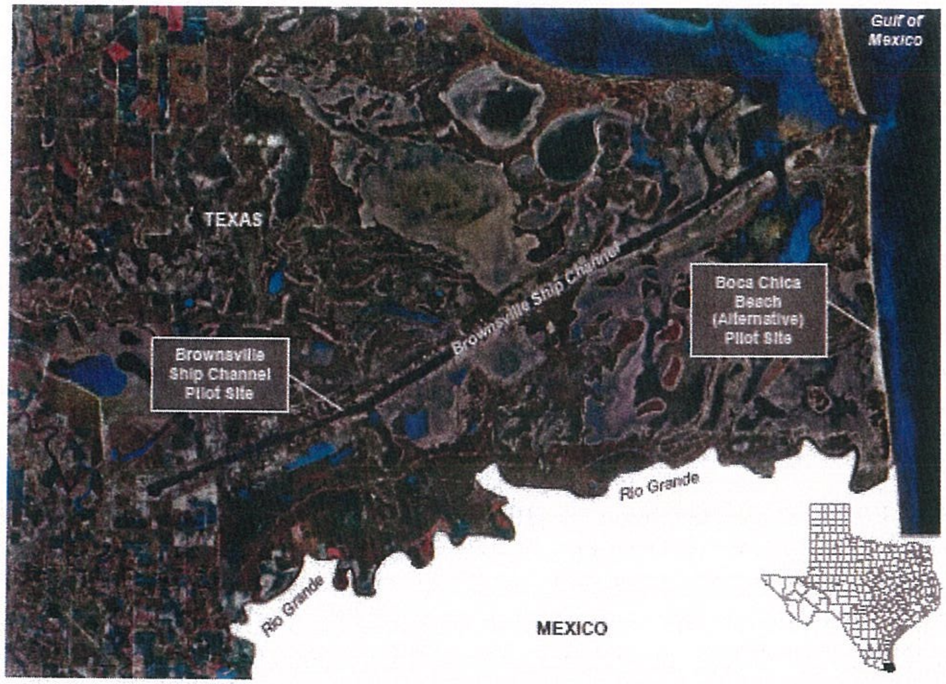

Figure 6: Location of the Brownsville Seawater Desalination Pilot Project

Because the objective of a seawater desalination project is to produce potable drinking water from the ocean, the Pilot Study established testing protocols approved by the Texas Commission on Environmental Quality (TCEQ). The performance of each pretreatment and primary treatment (reverse osmosis) process was then evaluated and documented. TCEQ requirements served as the base point for testing. However, the data required in order to meet these requirements does not provide all necessary information needed to accurately determine the most effective treatment technology for the full-scale facility. Prior to beginning the pilot, the goals listed in Table 2 were developed. Due to the unavailability of raw water quality data on a real-time basis, it was difficult to accurately determine piloting setpoints such as flux, backwash frequency, recovery, etc. The pilot team developed a testing plan that consisted of testing each treatment component on a stand-alone basis.

Table 2: Testing goals for pretreatment and RO systems

Performance Item	Pretreatment Goals	RO Goals
Silt Density Index	Filtrate <3.0 (100%) and <2.0 (95%)	-
Turbidity	Filtrate <0.2 NTU	-
Sustainable flux	Highest	Highest
Particle counts	Lowest	-
Influence on SWRO specific flux	Least	-
Chemical use	Lowest consumption	Least consumption
On-line time	Most utilization	-
Residuals	Least quantity and hazardous	-
Power consumption	Lowest	Lowest
Salt passage	-	Lowest
Cartridge filter change	-	Least frequent
Recovery	-	Greatest

The original study scope developed by BPUB and TWDB called for the comparison of two types of pretreatment technologies: 1) conventional (rapid mix/flocculation/clarification/filtration), and 2) ultrafiltration (a membrane-based technology). However, at the outset of the project, BPUB decided to increase the scope and value of the Pilot Study by including two additional membrane-based pretreatment units. The project budget was thereby increased by almost $1.0 million and funded by BPUB. This side-by-side comparison of four different pretreatment technologies resulted in an unprecedented level of study complexity (Figure 7 and Table 3).

LEGEND
1 Intake
2 Intake pumps
3 Norit ultrafiltration pretreatment unit
4 GE Zenon ultrafiltration pretreatment unit
5 Pall microfiltration pretreatment unit
6 Eimco conventional pretreatment unit
7 Pretreatment filtrate storage tanks
8 Reverse Osmosis treatment
9 Water storage tanks
10 Mixing tanks
11 Lagoon
12 Neutralization tank and discharge point
13 Discharge ditch
A Chemical storage building
B Operations building

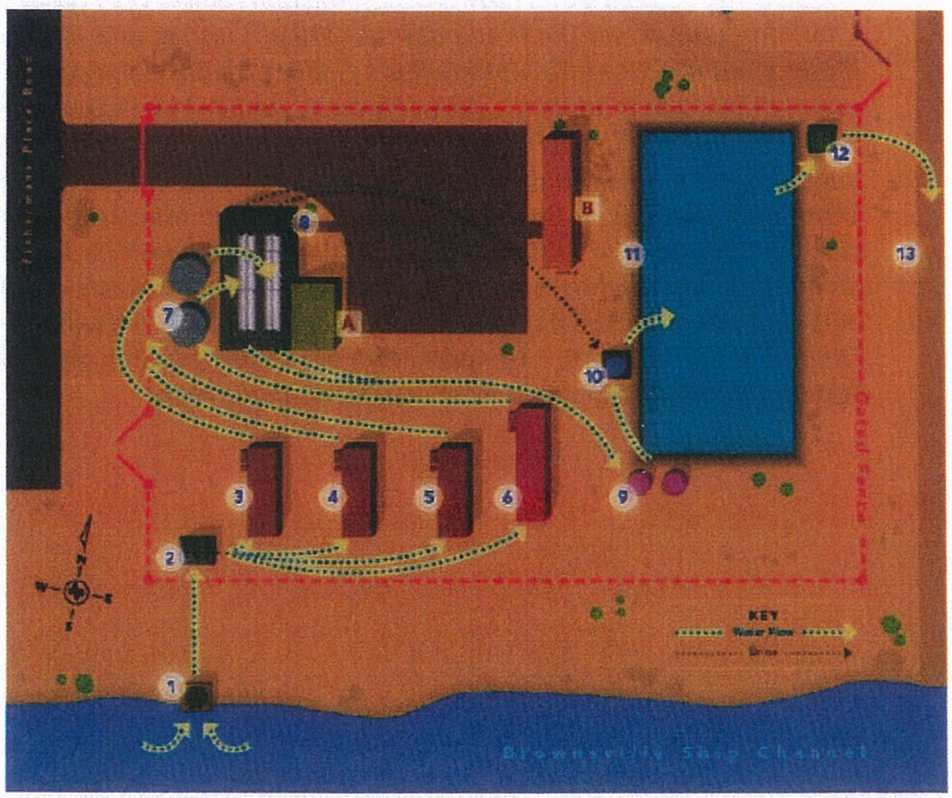

Figure 7: Layout of the Brownsville Seawater Desalination Pilot Project

Table 3: General specifications for pretreatment modules

Membrane Element Characteristic	GE Zenon UF	Norit UF	Pall MF
Active Membrane Area per Module (ft^2)	600	431	538
Flow Path (In-Out, Out-In)	Outside-In	Inside-Out	Outside–In
Number of Membranes	6	2/4	3
Molecular Weight Cutoff (Daltons)	100,000	350,000	-
Nominal Membrane Pore Size (microns)	0.02	0.05	0.10
Absolute Membrane Pore Size (microns)	0.1	0.075	NA
Membrane Material/Construction	PVDF	PES	PVDF
Membrane Hydrophobicity	Hydrophilic	Hydrophilic	Hydrophobic
Membrane Charge	Slightly Negative	Neutral	Slightly Negative
Design Operating/Vacuum Pressure (psi)	1 to 13	3.5 to 10.0	NA
Acceptable Range of Operating Pressures (psi)	1 to 13	0 to 14.5	Up to 43.5 psi
Acceptable Range of Operating pH Values	5 to 10	2 to 12	1 to 10
Maximum TMP for System (psi)	13	36	43.5
Maximum Permissible Feed Turbidity (NTU)	250	30	1,500
Chlorine/Oxidant Tolerance	Resistant to Hypochlorite, Chlorine dioxide, and $KMnO_4$	200 ppm continuous, 250,000 ppm hrs life time	Chlorine 10,000 mg/L, Oxidant Resistance
Suggested Cleaning Procedures	Sodium hypochlorite 500 ppm, 2 g/L of citric acid	Chlorine, Acid, Caustic	Air scrub, enhanced flux maintenance, CIP

Results

Raw Water Characterization

During the Pilot Study, source water quality was characterized at both potential full-scale site locations, including the inland site on the Brownsville Ship Channel and the ocean site off-shore of Boca Chica Beach in the Gulf of Mexico. In the ship channel, large fluctuations in turbidity and suspended solids were observed. These variations were attributed mainly to the passing of cargo ships in the Brownsville Ship Channel and predominant (southeasterly) wind direction and speed. Water quality in the Gulf of Mexico varied less, but samples were not taken during adverse weather conditions when variability would be expected to increase and overall quality decrease. Therefore, pilot data for the Gulf of Mexico do not reflect the worst-case water quality scenario for the open ocean that would occur during hurricane or other severe storm events. Tables 3 and 4 breakdown the raw water quality data obtained from the Ship Channel.

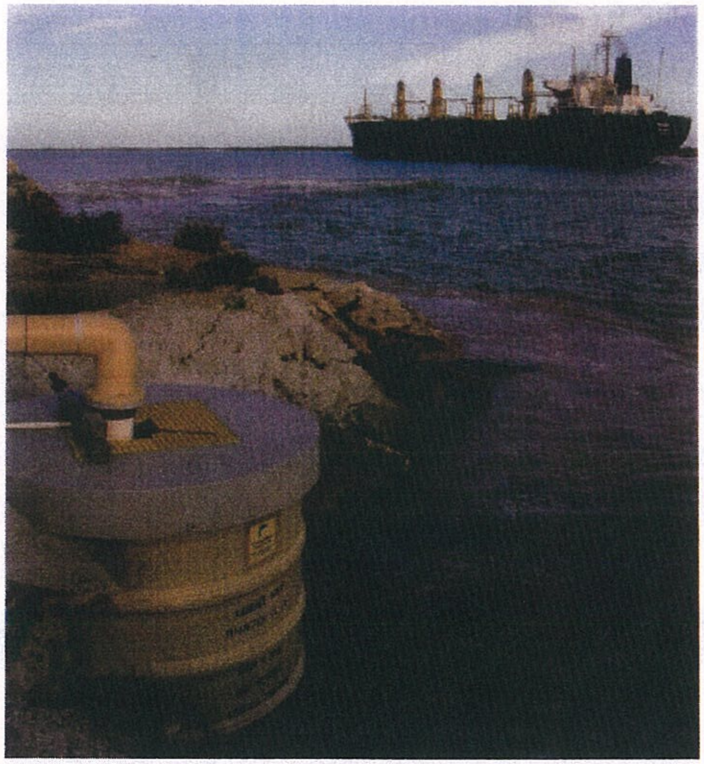

Figure 8: Photograph of the effect of a cargo ship passing on raw water turbidity in the Brownsville Ship Channel

Table 4: Summary raw water quality in the Brownsville Ship Channel, BPUB laboratory results for daily grab samples

Parameter	Number of Points	Maximum	Minimum	Average	95^{th} Percentile
Turbidity (NTU)	54,651	2,745	0.305	44.7	121.8
TOC (mg/L)	403	7.768	2.029	3.525	4.517
DOC (mg/L)	403	6.351	1.664	3.252	4.117
UV_{254} (cm^{-1})	404	0.13	0.019	0.047	0.07
Alkalinity (mg/L as $CaCO_3$)	404	318.5	109.4	140.96	155.2
Temperature (C)	449	31.8	14.5	25.0	30.0
Conductivity (mS)	445	55,500	28,400	48,100	53,800
TDS (mg/L)[a]	445	34,400	17,600	29,800	33,300
pH (SU)	448	8.66	7.12	8.01	8.27

[a] TDS was not tested on site. The information contained here was calculated using a conversion factor of 0.62 to convert conductivity to TDS. This conversion factor was calculated using laboratory testing data from an independent lab.

Table 5: Summary raw water quality in the Brownsville Ship Channel, independent laboratory results for periodic grab samples

Parameter	Units	No. of Points	Maximum	Minimum	Average	95th Percentile
Oil and Grease	mg/L	3	ND	ND	ND	N/A
Boron	mg/L	13	19.3	3.02	7.75	17.8
Strontium	mg/L	14	7.98	2.23	5.69	7.73
Calcium	mg/L	14	434	357	386	418
Iron	mg/L	14	22.1	ND	4.67	17.36
Magnesium	mg/L	14	1,330	911	1,135	1,310
Potassium	mg/L	13	684	417	487	661
Silica	mg/L	9	116	ND	24	29.5
Sodium	mg/L	14	10,500	6,390	8,468	10,175
Barium	mg/L	14	0.318	ND	0.086	0.242
Sulfate	mg/L	14	6,380	1,850	2,642	4,365
Fluoride	mg/L	13	ND	ND	ND	ND
Nitrate-Nitrogen, Total	mg/L	13	2.62	ND	2.62	1.048
Chloride	mg/L	13	25,500	13,900	17,083	24,360
SOCs	Mg/L	6	ND	ND	ND	ND
VOCs	mg/L	6	ND	ND	ND	ND
HAA5	mg/L	1	ND	ND	ND	ND
Bicarbonate (as $CaCO_3$)	mg/L	10	433	144	171	313
Carbonate (as $CaCO_3$)	mg/L	10	6.46	2.49	3	5.99
Color, True	PCU	9	10	ND	8	10
Color, Apparent	PCU	9	25	ND	12	25
Total Dissolved Solids	mg/L	14	46,800	28,100	30,515	39,585

Intake System

The Pilot Study utilized a wetwell, pumps, and intake screen to provide raw water form the ship channel to the pretreatment systems. Although this configuration was effective at the pilot-scale, a permanent intake system for a seawater desalination production facility will incorporate features that provide sufficient feed volume while minimizing the collection of suspended solids and protecting marine life. The recommended design includes a lengthy and wide constructed intake channel that connects the Brownsville Ship Channel to the intake screen assemblies and raw water pump station. This design would increase raw water settling time, thereby minimizing total suspended solids and turbidity introduced into the pretreatment systems. In addition, locating the facility on the south side of the ship channel may also reduce adverse water quality conditions imposed by prevailing southeasterly winds at the site.

Pretreatment System

A well designed pretreatment system is the most critical component of a successful seawater desalination facility. During the Pilot Study, four pretreatment systems were subjected to protocol tests: 1) Eimco Conventional System, 2) GE Zenon Ultrafiltration, 3) Norit Ultrafiltration, and 4) Pall Microfiltration. With challenging raw water quality, each pretreatment system was tested at a number of operating conditions to document loading rates, pressure losses, water production efficiency, filter backwash rates and frequencies, and chemical types and dosing rates.

The optimum operation of each pretreatment system was evaluated in terms of operational flux, temperature corrected flux, backwash frequency, and the frequency of chemical cleans. The removal efficiency of potential membrane fouling agents (i.e., particulates, total organic carbon, etc.) was also measured and system reliability evaluated in terms of treatment consistency.

Three of the four tested pretreatment units (conventional, GE Zenon, and Norit) failed to prove sustainable operation without exhibiting significant fouling tendencies and, in the extreme case, irreversible fouling on the membrane surface. It should be noted that the GE Zenon (ZW-1000) system was able to operate without performing a CIP for the minimum required 30 days. Fouling was present on the membranes due to the inability of the system to operate at greater than 15 gfd in a sustainable fashion. What is knows is that organic fouling occurs in seawater applications similarly to other surface water sources though the exact mechanism at Brownsville cannot be determined with the Zenon fiber.

The fourth pretreatment unit (Pall Microza system) did successfully operate for periods of 66 days and 72 days during two separate runs performing TCEQ Stage 2 and Stage 3 of the pilot protocols. Figures 9 and 10 show performance data of the Pall system at a flux of 25 gfd.

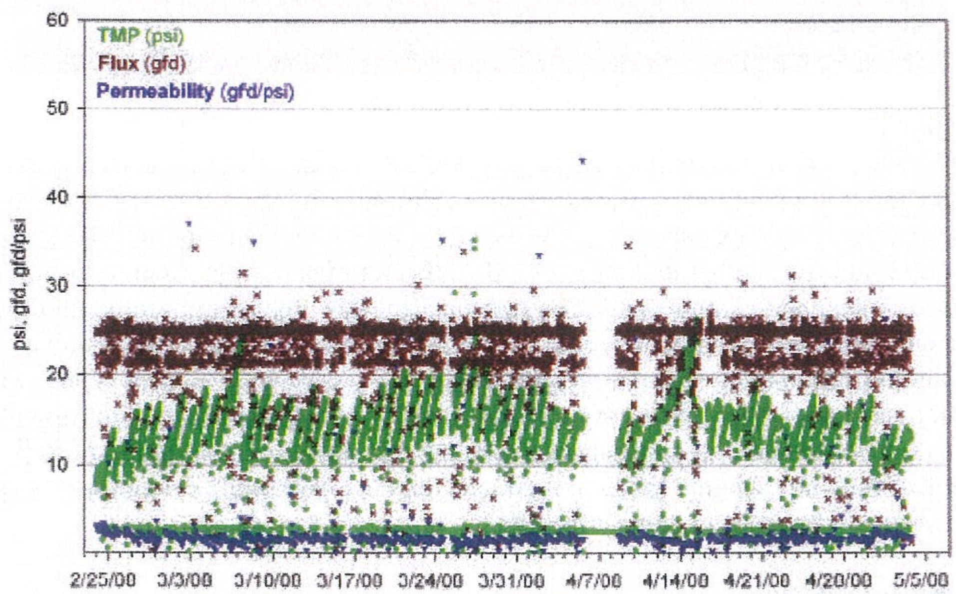

Figure 9: Operation at 25 gfd (TCEQ Stage 2), Pall MF membrane performance

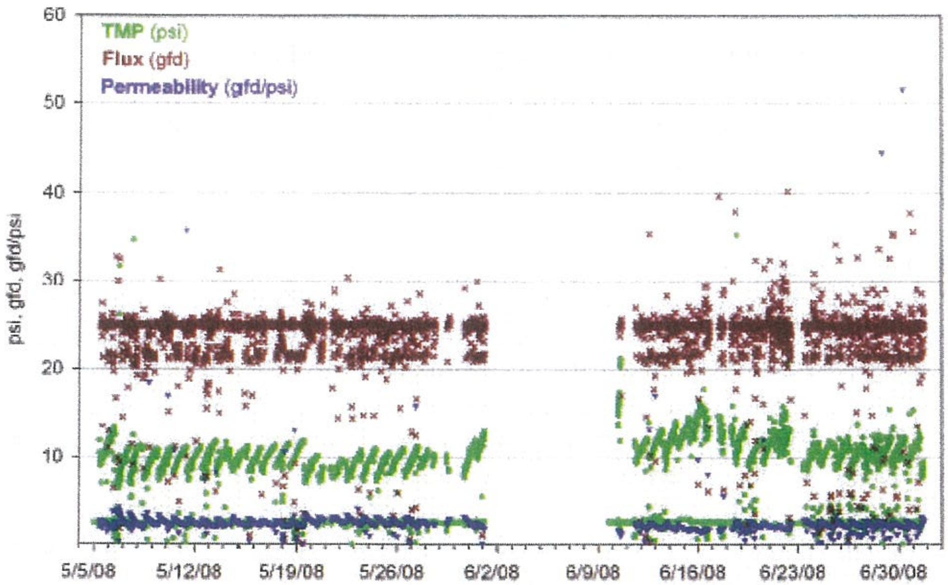

Figure 10: Operation at 25 gfd (TCEQ Stage 3), Pall MF membrane performance

The Pall pilot system utilized single, 200 micron Arkal 2" Spin Klin Automatic Disc Filter Battery. The prescreening surface area was 0.94 ft2. Backwashes were initiated once differential pressure reached or exceeded 3 psi. Over the course of the study, an average of 16 backwashes per day were performed with 3.6 gallons of water being user per backwash. This prescreening system provided consistent run time, and the only maintenance performed on the filter were manual cleans when the Pall unit was performing a CIP. Consistent prescreened flow was afforded to the Pall unit, and at no time during the pilot was the Pall unit shut down due to low prescreened flow.

The Pilot Study met the objective of developing a sufficient amount of real time information and data to demonstrate the technical feasibility of a successful pretreatment system. The following known conclusions apply to the successful pretreatment system for this Pilot Study:

1. The Pall Microza MF system proved to have the capability to operate under the worst case scenarios of high turbidity, TSS spikes, and variable raw water temperatures.
2. A flux of 25 gfd with a filtration duration per cycle of 15 minutes, daily EFMs utilizing 400 ppm of NaOCl, and a system recovery of 88.6% were determined to be the optimum operational settings for the design of a Pall MF system at this site specific location
3. The system is capable of sustainable operations for greater than 60 days at the optimum flux of 25 gfd without having to perform a CIP.
4. The Pall pretreatment system consistently removed greater than 97% of the raw water TSS.

5. The Pall MF system at 25 gfd achieved established testing goals and water quality guidelines of the pilot protocols which included:
    a. SDI<3.0 (100%) and <2.0 (95%)
    b. Filtrate turbidity of <0.2 NTU at the optimum flux
    c. >3-log removal for Giardia
    d. >2-log removal for Cryptosporidium

Reverse Osmosis System

Three RO membranes were tested during the pilot study. The first set of membranes tested was Toray TM820C-400, a membrane designed to maximize boron rejection. The other two membranes tested were Toray TM820-400 and Filmtec SW30HR-LE-400i. The testing setup consisted of a single-pass, single-stage design with 7 elements per pressure vessel. Each set of membranes was tested in a single pressure vessel. It was the objective to test the RO elements using pretreated seawater. The salt rejection, differential pressure, and permeate flow was measured routinely to determine the rate of fouling. It was the goal to maximize runtime between chemical cleans. In addition, the effectiveness of cartridge filters was analyzed.

With both the Filmtec SW30HR LE-400i and Toray TM820-400 elements, it was concluded that the RO system was able to perform without the need to clean for an equivalent of at least 69 days (118 calendar days) based on normalized permeate flow. Due to mechanical issues of the pretreatment system, steady pretreated flow was not available to the RO units. If the pretreatment units were able to provide ample flow to the RO train, it is possible that extended runtime, above the 90 days that was tested, would be possible.

The presence of biological growth in the RO piping was noticed throughout the testing. It was inferred that this growth caused premature fouling of the membranes. The presence of biological growth can lead to increases in differential pressure and salt passage as well as a decrease in normalized permeate flow.

The pilot met the objective of developing a sufficient amount of real time information and data to demonstrate the applicability of seawater desalination as a potential water management strategy. The following conclusions apply to the SWRO elements as tested at the pilot facility:

1. The Filmtec SW30HR LE-400i and Toray TM820-400 elements proved the ability to operate under severe conditions of high temperature variations and fluctuations in TDS
2. Operational conditions consisting of a flux of 8.2 gfd and a recovery of 48.8% allowed for operation of the RO elements for an extended period
3. The RO system for both membrane suppliers are capable of sustainable operations for up to 70 days at the optimum flux of 8.2 gfd and 48.8% recovery.
4. The RO membranes achieved finished water quality goals of turbidity (<0.1 NTU), THM formation potential (<40 ug/L), and compliance with current and anticipated future water standards.

Even though the testing results indicated proper performance, the following conclusions may apply to a full-scale facility. These conclusions were unfounded during pilot testing, but thorough research and testing indicates that they could be a part of a successful RO treatment scheme:

1. Cartridge filter changeout frequency of 90 days
2. The potential elimination of cartridge filters from the treatment scheme. Due to the inherent characteristics of MF/UF pretreatment, the possibility of substantial breakthrough is minimal. However, the impact of removing cartridge filters shall be researched with RO membrane manufacturers.
3. The use of a biocide could curb the impacts of biological fouling.
4. Chlorine dioxide could serve as a biogrowth control mechanism.

Ultimately, it was recommended that the full-scale design consist of an RO recovery of 45%, a flux of 8.1 gfd.

Concentrate Disposal

Two options for concentrate disposal were evaluated: deep well injection and diffusion into the Gulf of Mexico. Deep well injection is technologically feasible. However, it is costly. Diffusion into the Gulf of Mexico was analyzed on a desk top level. At a location approximately 2 miles offshore from Boca Chica Beach, modeling showed that the presence of a "dead zone" is extremely unlikely with a properly designed diffuser array.

Environmental Review and Permitting

The disposal of concentrate is a critical permitting issue. This is an issue that was addressed in previous Regional Water Plans. Permitting for diffusion into the Gulf of Mexico or deep injection wells appears to be viable both from a technical and permitting standpoint. Additional work may be necessary to address specific concerns of State and Federal agencies.

In addition to discharge permitting, other full-scale design and implementation components may require special permitting. The following agencies have been identified as having potential input into a full-scale design:

- Texas Parks and Wildlife Department
- Texas State Historic Preservation Office
- Texas General Land Office
- Texas Commission on Environmental Quality
- Texas Department of Transportation

In addition, county and local permits may be required for the implementation of a full scale facility.

Pilot Study Recommendations

Based on Pilot Study results, a full-scale (25 mgd) seawater desalination plant at the Brownsville Ship Channel would cost approximately $182 million (2008 dollars) (Table 1). To ensure long-term operational success of the plant, about 26 percent of this total accounts for a conservative pretreatment design consisting of conventional treatment elements ahead of the microfiltration pretreatment system.

Table 6: ***Comparison of Feasibility Study and Pilot Study total project cost estimates for a full-scale (25 mgd) seawater desalination plant.***

Project Component	*Feasibility Estimate [a] (2004)*	*Pilot Study Estimate (2008)*
Desalination Plant	*$90,167,000*	*$126,612,000*
Concentrate Disposal System	*$30,583,000*	*$21,217,000*
Finished Water Transmission System	*$9,232,000*	*$12,180,000*
Project Implementation Costs	*$21,406,000*	*$22,400,000*
Total Capital Costs	***$151,388,000***	***$182,409,000***

[a] Source: *Dannenbaum and URS (2004).*

After considering the costs of other water supply alternatives available for the future needs of Brownsville, BPUB determined that it could afford up to $70 million for a 25 mgd seawater desalination project. This would leave an infeasible funding gap well over $100 million. In addition, the full anticipated regional water demand envisioned for the full-scale facility is not expected to materialize for several years. Therefore, it is recommended that a full-scale (25 mgd) seawater desalination facility not be implemented at this time due to the magnitude of the required funding gap and the current lack of full demand by BPUB and regional partners.

A phased project development approach will best mitigate the risks and uncertainties associated with seawater desalination. Such an approach will allow an evaluation of system performance over several years of operation prior to an investment in full-scale capacity. This data is expected to yield a more efficient overall treatment system design and lower the cost of future expansions as they occur. The demonstration facility will also include the capability for continuous testing of the latest desalination technologies for this and other future seawater desalination facilities along the Texas coast. Such technologies include applications for pretreatment, energy recovery, sustainable energy supply, and larger (potentially more efficient) RO membranes.

Recommendations

The Brownsville PUB pilot study proved that seawater desalination at the Brownsville Ship Channel is technologically feasible. Water quality in the Ship Channel was challenging with high levels of suspended solids and wide ranges of temperatures.

However, a system of microfiltration and reverse osmosis proved effective at treating the challenging water to a finished water quality that meets or exceeds Texas Commission on Environmental Quality standards (both primary and secondary).

In the second round of Regional Planning, seawater desalination was a recommended water management strategy for Brownsville PUB as well as the Laguna Madre Water District. The results of the pilot study concluded that seawater desalination is a technologically feasible method to provide sustained water sources for the Region. However, the extent of seawater desalination cannot be relegated to the coastal area. Previous regional water plans have shown a substantial deficit in water supplies, and Region M is particularly dependent on the Rio Grande to supply the majority of those supplies. Surface and groundwater supplies continue to be limited. Surface water in the Rio Grande is vulnerable to drought. In addition, the ongoing dilemma of Mexico abiding by their treaty obligations proves another harrowing water supply scenario for the Region. Groundwater is limited by individual well production and aquifer recharge rates.

On a region-wide basis, seawater desalination has the ability to provide a drought proof source of water to all users in the Region. The results of the Brownsville PUB pilot study indicate that seawater desalination is a feasible and recommended water management strategy for the region. However, economies of scale play a large part in the development of a desalination facility. Any entity that wishes to pursue seawater desalination as a water management strategy to meet future water supply needs shall perform an extensive evaluation. This evaluation should consist of the following items, at a minimum:

- Source water quality should be carefully analyzed. The desalination of seawater isn't a one size fits all treatment scheme. At different locations along the Gulf of Mexico, the water quality can contain various fouling characteristics. These fouling characteristics shall be evaluated thoroughly.
- Pretreatment is often considered the most critical component of any seawater desalination facility. Being the initial filtering component of the system, the pretreatment must be able to handle foulant loading rates at acceptable operational conditions. The main operational conditions include flux (flow per surface area of membrane) and recovery (net filtrate production as a function of gross filtrate production). In order to ensure sustained operation of the facility, special care shall be taken in designing the pretreatment system.
- Finished water quality shall meet all requirements of the TCEQ.
- Environmental compliance shall be carefully analyzed. It is recommended to begin dialogue with any and all applicable environmental agencies during the preliminary/pilot phase of the project.

References

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Cost Estimation Methodology for the 2010 Region M Water Plan

Introduction

In accordance with the instructions provided by the Texas Water Development Board in "Exhibit C - Guidelines for Regional Water Plan Development"(Appendix 10) individual, per-unit cost estimates were generated for the following water management strategies (WMSs) available in Region M:

A. Acquisition of Rio Grande Water Rights Through Purchase
B. Acquisition of Rio Grande Water Rights Through Urbanization
C. Acquisition of Rio Grande Water Rights Through Contract
D. Non-Potable Water Re-Use
E. Potable Water Re-Use
F. Advanced Water Conservation
G. Seawater Desalination
H. Brackish Groundwater Desalination
I. Additional Groundwater
J. Brownsville Weir and Reservoir
K. Resaca Restoration
L. Laredo Low Water Weir
M. Banco Morales Reservoir
N. Proposed Elevated Storage Tank and Infrastructure Improvements for City of Elsa
O. On-Farm Conservation
P. Conveyance System Conservation

This document explains the origin and development of the per-unit cost estimates for Water Management Strategies (WMS)

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	619,094,351
Monthly Payment	$4,435,384.21
Annual Payment	$53,224,610.51
Lifetime payments	$1,064,492,210.21

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$1,339,912.46	$3,095,471.75	$4,435,384.21	617,754,438.18	$2,059,181.46
Feb	2	$1,346,612.02	$3,088,772.19	$4,435,384.21	617,747,738.62	$2,059,159.13
Mar	3	$1,353,345.08	$3,082,039.13	$4,435,384.21	617,741,005.56	$2,059,136.69
Apr	4	$1,360,111.80	$3,075,272.41	$4,435,384.21	617,734,238.83	$2,059,114.13
May	5	$1,366,912.36	$3,068,471.85	$4,435,384.21	617,727,438.27	$2,059,091.46
Jun	6	$1,373,746.92	$3,061,637.28	$4,435,384.21	617,720,603.71	$2,059,068.68
Jul	7	$1,380,615.66	$3,054,768.55	$4,435,384.21	617,713,734.98	$2,059,045.78
Aug	8	$1,387,518.74	$3,047,865.47	$4,435,384.21	617,706,831.90	$2,059,022.77
Sep	9	$1,394,456.33	$3,040,927.88	$4,435,384.21	617,699,894.30	$2,058,999.65
Oct	10	$1,401,428.61	$3,033,955.60	$4,435,384.21	617,692,922.02	$2,058,976.41
Nov	11	$1,408,435.76	$3,026,948.45	$4,435,384.21	617,685,914.88	$2,058,953.05
Dec	12	$1,415,477.93	$3,019,906.27	$4,435,384.21	617,678,872.70	$2,058,929.58
Total		$16,528,573.68	$36,696,036.83	$53,224,610.51		$24,708,678.78

Capital Cost $631,081,709

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$55,100,168
Monthly Payment	$394,754.72
Annual Payment	$4,737,056.63
Lifetime payments	$94,741,132.67

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment	Interest Payment	Total Payment	Unspent Funds	Return on Investment
		PP_t	IP_t	$TP_t = IP_t + PP_t$	UF_t	
Jan	1	$119,253.88	$275,500.84	$394,754.72	$54,980,914.49	$183,269.71
Feb	2	$119,850.15	$274,904.57	$394,754.72	$54,980,914.49	$183,267.73
Mar	3	$120,449.40	$274,305.32	$394,754.72	$54,980,914.49	$183,265.73
Apr	4	$121,051.64	$273,703.07	$394,754.72	$54,980,914.49	$183,263.72
May	5	$121,656.90	$273,097.82	$394,754.72	$54,980,914.49	$183,261.70
Jun	6	$122,265.19	$272,489.53	$394,754.72	$54,980,914.49	$183,259.68
Jul	7	$122,876.51	$271,878.21	$394,754.72	$54,980,914.49	$183,257.64
Aug	8	$123,490.90	$271,263.82	$394,754.72	$54,980,914.49	$183,255.59
Sep	9	$124,108.35	$270,646.37	$394,754.72	$54,980,914.49	$183,253.53
Oct	10	$124,728.89	$270,025.83	$394,754.72	$54,980,914.49	$183,251.46
Nov	11	$125,352.54	$269,402.18	$394,754.72	$54,980,914.49	$183,249.39
Dec	12	$125,979.30	$268,775.42	$394,754.72	$54,980,914.49	$183,247.30
Total			$3,265,992.99	$4,737,056.63		$2,199,103.19

Capital Cost $56,167,058

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	15,954,945
Monthly Payment	$114,306.18
Annual Payment	$1,371,674.20
Lifetime payments	$27,433,483.93

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$34,531.46	$79,774.73	$114,306.18	15,920,413.78	$53,068.05
Feb	2	$34,704.11	$79,602.07	$114,306.18	15,920,241.13	$53,067.47
Mar	3	$34,877.63	$79,428.55	$114,306.18	15,920,067.60	$53,066.89
Apr	4	$35,052.02	$79,254.16	$114,306.18	15,919,893.22	$53,066.31
May	5	$35,227.28	$79,078.90	$114,306.18	15,919,717.96	$53,065.73
Jun	6	$35,403.42	$78,902.76	$114,306.18	15,919,541.82	$53,065.14
Jul	7	$35,580.44	$78,725.75	$114,306.18	15,919,364.80	$53,064.55
Aug	8	$35,758.34	$78,547.84	$114,306.18	15,919,186.90	$53,063.96
Sep	9	$35,937.13	$78,369.05	$114,306.18	15,919,008.11	$53,063.36
Oct	10	$36,116.82	$78,189.37	$114,306.18	15,918,828.42	$53,062.76
Nov	11	$36,297.40	$78,008.78	$114,306.18	15,918,647.84	$53,062.16
Dec	12	$36,478.89	$77,827.30	$114,306.18	15,918,466.35	$53,061.55
Total			$945,709.26	$1,371,674.20		$636,777.93

Capital Cost 16,263,876.57

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	170,501,712
Monthly Payment	$1,221,527.22
Annual Payment	$14,658,326.67
Lifetime payments	$293,166,533.45

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$369,018.66	$852,508.56	$1,221,527.22	170,132,693.72	$567,108.98
Feb	2	$370,863.75	$850,663.47	$1,221,527.22	170,130,848.62	$567,102.83
Mar	3	$372,718.07	$848,809.15	$1,221,527.22	170,128,994.30	$567,096.65
Apr	4	$374,581.66	$846,945.56	$1,221,527.22	170,127,130.71	$567,090.44
May	5	$376,454.57	$845,072.65	$1,221,527.22	170,125,257.80	$567,084.19
Jun	6	$378,336.84	$843,190.38	$1,221,527.22	170,123,375.53	$567,077.92
Jul	7	$380,228.53	$841,298.69	$1,221,527.22	170,121,483.85	$567,071.61
Aug	8	$382,129.67	$839,397.55	$1,221,527.22	170,119,582.70	$567,065.28
Sep	9	$384,040.32	$837,486.90	$1,221,527.22	170,117,672.06	$567,058.91
Oct	10	$385,960.52	$835,566.70	$1,221,527.22	170,115,751.85	$567,052.51
Nov	11	$387,890.32	$833,636.90	$1,221,527.22	170,113,822.05	$567,046.07
Dec	12	$389,829.78	$831,697.45	$1,221,527.22	170,111,882.60	$567,039.61
Total		$4,552,052.71	$10,106,273.97	$14,658,326.67		$6,804,894.99

Capital Cost 173,803,091.35

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	7,377,011
Monthly Payment	$52,851.20
Annual Payment	$634,214.37
Lifetime payments	$12,684,287.33

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$15,966.14	$36,885.05	$52,851.20	7,361,044.75	$24,536.82
Feb	2	$16,045.97	$36,805.22	$52,851.20	7,360,964.92	$24,536.55
Mar	3	$16,126.20	$36,724.99	$52,851.20	7,360,884.69	$24,536.28
Apr	4	$16,206.83	$36,644.36	$52,851.20	7,360,804.06	$24,536.01
May	5	$16,287.87	$36,563.33	$52,851.20	7,360,723.02	$24,535.74
Jun	6	$16,369.31	$36,481.89	$52,851.20	7,360,641.58	$24,535.47
Jul	7	$16,451.15	$36,400.04	$52,851.20	7,360,559.74	$24,535.20
Aug	8	$16,533.41	$36,317.79	$52,851.20	7,360,477.48	$24,534.92
Sep	9	$16,616.08	$36,235.12	$52,851.20	7,360,394.81	$24,534.65
Oct	10	$16,699.16	$36,152.04	$52,851.20	7,360,311.73	$24,534.37
Nov	11	$16,782.65	$36,068.54	$52,851.20	7,360,228.24	$24,534.09
Dec	12	$16,866.57	$35,984.63	$52,851.20	7,360,144.32	$24,533.81
Total		$196,951.35	$437,263.02	$634,214.37		$294,423.93

Capital Cost 7,519,849.98

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	21,858,535
Monthly Payment	$156,601.34
Annual Payment	$1,879,216.03
Lifetime payments	$37,584,320.67

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$47,308.66	$109,292.68	$156,601.34	21,811,226.68	$72,704.09
Feb	2	$47,545.20	$109,056.13	$156,601.34	21,810,990.14	$72,703.30
Mar	3	$47,782.93	$108,818.41	$156,601.34	21,810,752.41	$72,702.51
Apr	4	$48,021.84	$108,579.49	$156,601.34	21,810,513.50	$72,701.71
May	5	$48,261.95	$108,339.38	$156,601.34	21,810,273.39	$72,700.91
Jun	6	$48,503.26	$108,098.07	$156,601.34	21,810,032.08	$72,700.11
Jul	7	$48,745.78	$107,855.56	$156,601.34	21,809,789.56	$72,699.30
Aug	8	$48,989.51	$107,611.83	$156,601.34	21,809,545.83	$72,698.49
Sep	9	$49,234.46	$107,366.88	$156,601.34	21,809,300.89	$72,697.67
Oct	10	$49,480.63	$107,120.71	$156,601.34	21,809,054.71	$72,696.85
Nov	11	$49,728.03	$106,873.31	$156,601.34	21,808,807.31	$72,696.02
Dec	12	$49,976.67	$106,624.67	$156,601.34	21,808,558.67	$72,695.20
Total		$583,578.92	$1,597,571.26	$1,879,216.03		$872,396.15

Capital Cost 22,583,710.45

Seawater Desalination

Item	Construction Costs Description	
Desalination		
1	Site Development	$6,828,393
2	Seawater Intake System	$10,960,282
3	Pretreatment System	$20,672,097
4	Primary Treatment System	$12,513,570
5	Post Treatment System	$425,752
6	Solids Handling System	$1,795,255
7	Yard Piping	$1,277,257
8	Support Facilities	$9,307,417
9	Electrical and Instrumentation	$7,095,871
10	**Subtotal**	$70,875,895
11	Effective Contingency	$7,087,588
12	**Total Desalination Plant**	$77,963,483
Brine Disposal System		
13	Brine Transfer Pump Station	$2,703,189
14	Brine Disposal Main (Open-cut Land Installation)	$37,755,440
15	Brine Disposal Main (Ocean Installation	$1,365,110
16	Brine Disposal Main (Bench head)	$4,054,783
17	Diffuser Array	$1,351,594
18	Easement Acquisition	$1,567,850
19	**Subtotal**	$48,797,967
20	Contingency	$4,879,797
21	**Total Brine Disposal**	$53,677,763
Finished Water Transmission System		
22	Finished Water Transfer & HS Pumps	$2,459,902
23	Finished Water Transmission System	$6,163,271
24	2.0 MG Ground Storage Tank	$3,481,437
25	Land and Right of Way	$810,957
26	**Subtotal**	$12,915,566
27	Effective Contingency	$1,291,557
28	**Total Finished Water**	$14,207,123
29	**TOTAL Construction Cost**	$145,848,370

Other Capital Outlays

1	Design Determination Studies	$8,020,362
2	Design and Specifications	$16,043,426
3	Environmental Review and Permitting	$2,916,741
4	Construction Support Services	$7,293,204
5	Startup Support Services	$2,286,898
6	**Total Project Implementation**	$36,560,630

Item	Description	Unit
1	Construction costs	$145,848,370
2	Other Capital Outlay Costs	$36,560,630
3	Total initial costs (i.e., loan principle)	$182,409,000
4	Annual Interest Rate	0.06
5	Monthly Interest Rate	0.005
6	Years of Loan/Lifetime	20
7	Number Monthly Payments	240
8	Monthly Payments on Loan	$1,306,835
9	Annual Payments on Loan	$15,682,017
10	Interest During Construction	$7,280,127

Item	Description	Value
	Annual Costs	
1	Operations and maintenance	$19,814,910
2	Power cost	$9,605,980
	Total Annual Costs	$29,420,890
	Water Production	
3	Million-Gallons-Per-Day	25
4	1,000 gallons/year	9,125,000
5	acre-feet/year	28,004
	Costs per-unit	
6	$/1,000 gallons	$3.22
7	$/acre-foot	$1,051

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$182,409,000
Monthly Payment	$1,306,834.73
Annual Payment	$15,682,016.75
Lifetime payments	$313,640,335.07

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$394,789.73	$912,045.00	1,306,835	182,014,210.27	$606,714.03
Feb	2	$396,763.68	$910,071.05	1,306,835	182,012,236.32	$606,707.45
Mar	3	$398,747.50	$908,087.23	1,306,835	182,010,252.50	$606,700.84
Apr	4	$400,741.23	$906,093.50	1,306,835	182,008,258.77	$606,694.20
May	5	$402,744.94	$904,089.79	1,306,835	182,006,255.06	$606,687.52
Jun	6	$404,758.66	$902,076.06	1,306,835	182,004,241.34	$606,680.80
Jul	7	$406,782.46	$900,052.27	1,306,835	182,002,217.54	$606,674.06
Aug	8	$408,816.37	$898,018.36	1,306,835	182,000,183.63	$606,667.28
Sep	9	$410,860.45	$895,974.28	1,306,835	181,998,139.55	$606,660.47
Oct	10	$412,914.75	$893,919.97	1,306,835	181,996,085.25	$606,653.62
Nov	11	$414,979.33	$891,855.40	1,306,835	181,994,020.67	$606,646.74
Dec	12	$417,054.22	$889,780.50	1,306,835	181,991,945.78	$606,639.82
Total		$4,869,953.33	$10,812,063.42	15,682,017		$7,280,126.82

Capital Cost	$185,940,937

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$258,592,338
Monthly Payment	$1,852,635.82
Annual Payment	$22,231,629.89
Lifetime payments	$444,632,597.79

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$559,674.13	$1,292,961.69	$1,852,635.82	$258,032,663.84	$860,108.88
Feb	2	$562,472.50	$1,290,163.32	$1,852,635.82	$258,029,865.47	$860,099.55
Mar	3	$565,284.87	$1,287,350.96	$1,852,635.82	$258,027,053.11	$860,090.18
Apr	4	$568,111.29	$1,284,524.53	$1,852,635.82	$258,024,226.68	$860,080.76
May	5	$570,951.85	$1,281,683.98	$1,852,635.82	$258,021,386.13	$860,071.29
Jun	6	$573,806.61	$1,278,829.22	$1,852,635.82	$258,018,531.37	$860,061.77
Jul	7	$576,675.64	$1,275,960.18	$1,852,635.82	$258,015,662.34	$860,052.21
Aug	8	$579,559.02	$1,273,076.81	$1,852,635.82	$258,012,778.96	$860,042.60
Sep	9	$582,456.81	$1,270,179.01	$1,852,635.82	$258,009,881.16	$860,032.94
Oct	10	$585,369.10	$1,267,266.73	$1,852,635.82	$258,006,968.88	$860,023.23
Nov	11	$588,295.94	$1,264,339.88	$1,852,635.82	$258,004,042.03	$860,013.47
Dec	12	$591,237.42	$1,261,398.40	$1,852,635.82	$258,001,100.55	$860,003.67
Total		$6,903,895.19	$15,327,734.70	$22,231,629.89		$10,320,680.54

Capital Cost $263,599,392

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	62,106,340
Monthly Payment	$444,949.11
Annual Payment	$5,339,389.35
Lifetime payments	$106,787,786.92

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$134,417.41	$310,531.70	$444,949.11	$61,971,923.03	$206,573.08
Feb	2	$135,089.50	$309,859.62	$444,949.11	$61,971,250.94	$206,570.84
Mar	3	$135,764.94	$309,184.17	$444,949.11	$61,970,575.49	$206,568.58
Apr	4	$136,443.77	$308,505.34	$444,949.11	$61,969,896.67	$206,566.32
May	5	$137,125.99	$307,823.12	$444,949.11	$61,969,214.45	$206,564.05
Jun	6	$137,811.62	$307,137.49	$444,949.11	$61,968,528.82	$206,561.76
Jul	7	$138,500.68	$306,448.44	$444,949.11	$61,967,839.76	$206,559.47
Aug	8	$139,193.18	$305,755.93	$444,949.11	$61,967,147.26	$206,557.16
Sep	9	$139,889.15	$305,059.97	$444,949.11	$61,966,451.29	$206,554.84
Oct	10	$140,588.59	$304,360.52	$444,949.11	$61,965,751.85	$206,552.51
Nov	11	$141,291.53	$303,657.58	$444,949.11	$61,965,048.90	$206,550.16
Dec	12	$141,997.99	$302,951.12	$444,949.11	$61,964,342.44	$206,547.81
Total		$1,658,114.34	$3,681,275.00	$5,339,389.35		$2,478,726.57

Capital Cost 63,308,888.87

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$96,541,765
Monthly Payment	$691,655.19
Annual Payment	$8,299,862.27
Lifetime payments	$165,997,245.33

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$208,946.36	$482,708.83	$691,655.19	96,332,818.64	$321,109.40
Feb	2	$209,991.10	$481,664.09	$691,655.19	96,331,773.90	$321,105.91
Mar	3	$211,041.05	$480,614.14	$691,655.19	96,330,723.95	$321,102.41
Apr	4	$212,096.26	$479,558.93	$691,655.19	96,329,668.74	$321,098.90
May	5	$213,156.74	$478,498.45	$691,655.19	96,328,608.26	$321,095.36
Jun	6	$214,222.52	$477,432.67	$691,655.19	96,327,542.48	$321,091.81
Jul	7	$215,293.63	$476,361.55	$691,655.19	96,326,471.37	$321,088.24
Aug	8	$216,370.10	$475,285.09	$691,655.19	96,325,394.90	$321,084.65
Sep	9	$217,451.95	$474,203.24	$691,655.19	96,324,313.05	$321,081.04
Oct	10	$218,539.21	$473,115.98	$691,655.19	96,323,225.79	$321,077.42
Nov	11	$219,631.91	$472,023.28	$691,655.19	96,322,133.09	$321,073.78
Dec	12	$220,730.07	$470,925.12	$691,655.19	96,321,034.93	$321,070.12
Total		$2,577,470.90	$5,722,391.36	$8,299,862.27		$3,853,079.03

Capital Cost	$98,411,077

Table RR-1. Resaca Restoration

Item	Description	US$2007
	Construction	
1	Resaca construction	$28,056,745
	Construction Cost Subtotal	**$28,056,745**
	Other Capital Outlays	
4	Delivery infrastructure @ 1 mile	$229,555
5	Engineering/Other (35%)	$19,512,191
6	Land and easements (5%)	$2,754,662
7	Environmental (1%)	$459,110
	Other Capital Outlay Costs Subtotal	**$22,955,519**

Table RR-2. Resaca Restoration debt service costs, 2007.

Item	Description	Value	Unit
1	Construction costs	$28,056,745	US$2007
2	Other Capital Outlay Costs	$22,955,519	US$2007
3	Total initial costs (i.e., loan principle)	$51,012,264	US$2007
4	Annual Interest Rate	0.06	Number
5	Monthly Interest Rate	0.005	Number
6	Years of Loan/Lifetime	20	Years
7	Number Monthly Payments	240	Number
8	Monthly Payments on Loan	$365,468	US$2007
9	Annual Payments on Loan	$4,385,612	US$2007
10	Interest During Construction	$2,035,951	US$2007

Table RR-3. Resaca Restoration total annual project costs, water production, and per unit production costs,

Item	Description	Value
	Annual Costs	
3	O&M Resacas	$510,397
	Total Annual Costs	**$510,397**
	Water Production	
4	Million-Gallons-Per-Day	0.75
5	1,000 gallons/year	273,750
6	acre-feet/year	877
	Costs per-unit	
6	$/1,000 gallons	$24.75
7	$/acre-foot	$2,542.00

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$288,415,489
Monthly Payment	$2,066,298.14
Annual Payment	$24,795,577.69
Lifetime payments	$495,911,553.76

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$624,220.70	$1,442,077.45	$2,066,298.14	287,791,268.30	$959,304.23
Feb	2	$627,341.80	$1,438,956.34	$2,066,298.14	287,788,147.20	$959,293.82
Mar	3	$630,478.51	$1,435,819.63	$2,066,298.14	287,785,010.49	$959,283.37
Apr	4	$633,630.90	$1,432,667.24	$2,066,298.14	287,781,858.10	$959,272.86
May	5	$636,799.06	$1,429,499.09	$2,066,298.14	287,778,689.94	$959,262.30
Jun	6	$639,983.05	$1,426,315.09	$2,066,298.14	287,775,505.95	$959,251.69
Jul	7	$643,182.97	$1,423,115.17	$2,066,298.14	287,772,306.03	$959,241.02
Aug	8	$646,398.88	$1,419,899.26	$2,066,298.14	287,769,090.12	$959,230.30
Sep	9	$649,630.87	$1,416,667.27	$2,066,298.14	287,765,858.13	$959,219.53
Oct	10	$652,879.03	$1,413,419.11	$2,066,298.14	287,762,609.97	$959,208.70
Nov	11	$656,143.42	$1,410,154.72	$2,066,298.14	287,759,345.58	$959,197.82
Dec	12	$659,424.14	$1,406,874.00	$2,066,298.14	287,756,064.86	$959,186.88
Total		$7,700,113.33	$17,095,464.36	$24,795,577.69		$11,510,952.52

Capital Cost $294,000,001

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$25,300,111
Monthly Payment	$181,257.85
Annual Payment	$2,175,094.24
Lifetime payments	$43,501,884.73

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$54,757.30	$126,500.56	$181,257.85	25,245,353.70	$84,151.18
Feb	2	$55,031.08	$126,226.77	$181,257.85	25,245,079.92	$84,150.27
Mar	3	$55,306.24	$125,951.61	$181,257.85	25,244,804.76	$84,149.35
Apr	4	$55,582.77	$125,675.08	$181,257.85	25,244,528.23	$84,148.43
May	5	$55,860.69	$125,397.17	$181,257.85	25,244,250.31	$84,147.50
Jun	6	$56,139.99	$125,117.86	$181,257.85	25,243,971.01	$84,146.57
Jul	7	$56,420.69	$124,837.16	$181,257.85	25,243,690.31	$84,145.63
Aug	8	$56,702.79	$124,555.06	$181,257.85	25,243,408.21	$84,144.69
Sep	9	$56,986.31	$124,271.55	$181,257.85	25,243,124.69	$84,143.75
Oct	10	$57,271.24	$123,986.62	$181,257.85	25,242,839.76	$84,142.80
Nov	11	$57,557.59	$123,700.26	$181,257.85	25,242,553.41	$84,141.84
Dec	12	$57,845.38	$123,412.47	$181,257.85	25,242,265.62	$84,140.89
Total		$675,462.07	$1,499,632.17	$2,175,094.24		$1,009,752.90

Capital Cost $25,789,990

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	8,718,886
Monthly Payment	$62,464.81
Annual Payment	$749,577.69
Lifetime payments	$14,991,553.74

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PPt	Interest Payment IPt	Total Payment TPt = IPt + PPt	Unspent Funds UFt	Return on Investment
Jan	1	$18,870.38	$43,594.43	$62,464.81	8,700,015.62	$29,000.05
Feb	2	$18,964.73	$43,500.08	$62,464.81	8,699,921.27	$28,999.74
Mar	3	$19,059.55	$43,405.25	$62,464.81	8,699,826.45	$28,999.42
Apr	4	$19,154.85	$43,309.96	$62,464.81	8,699,731.15	$28,999.10
May	5	$19,250.62	$43,214.18	$62,464.81	8,699,635.38	$28,998.78
Jun	6	$19,346.88	$43,117.93	$62,464.81	8,699,539.12	$28,998.46
Jul	7	$19,443.61	$43,021.19	$62,464.81	8,699,442.39	$28,998.14
Aug	8	$19,540.83	$42,923.98	$62,464.81	8,699,345.17	$28,997.82
Sep	9	$19,638.53	$42,826.27	$62,464.81	8,699,247.47	$28,997.49
Oct	10	$19,736.73	$42,728.08	$62,464.81	8,699,149.27	$28,997.16
Nov	11	$19,835.41	$42,629.40	$62,464.81	8,699,050.59	$28,996.84
Dec	12	$19,934.59	$42,530.22	$62,464.81	8,698,951.41	$28,996.50
Total			$516,800.97	$749,577.69		$347,979.52

Capital Cost	8,887,707.45

Irrigation On Farm Conservation

CONSTRUCTION CAPITAL COSTS

Construction Costs		$241,221,309
	Construction Capital Costs Subtotal	$241,221,309

OTHER CAPITAL OUTLAYS

1	Engineering, Legal Costs, Financing, & Contingencies (35%)	$84,427,458
2	Land Acquisition & Easements (5%)	$12,061,065
3	Environmental & Arch. Studies & Mitigation & Permitting (1%)	$2,412,213
	Other Capital Outlays Subtotal	$98,900,736

Item	Description	
1	Construction costs	$241,221,309
2	Other capital outlays	$98,900,736
3	Total initial costs (i.e., loan principle)	$340,122,045
4	Annual Interest Rate	$0
5	Monthly Interest Rate	$0
6	Years of Loan/Lifetime	$20
7	Number Monthly Payments	$240
8	Monthly Payments on Loan	$2,436,740
9	Annual Payments on Loan	$29,240,880
10	Interest During Construction	$67,201

Item	Description	Value
	Annual Costs	
	Operation and Maintenance	$39,776,678
	Total Annual Costs	$39,776,678
	Water Production	
4	Million-Gallons-Per-Day	195
5	1,000 gallons/year	71290659
6	acre-feet/year	219228
	Costs per-unit	
6	$/1,000 gallons	$0.56
7	$/acre-foot	$181.44

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	$340,122,045
Monthly Payment	$2,436,739.97
Annual Payment	$29,240,879.61
Lifetime payments	$584,817,592.11

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$736,129.74	$1,700,610.23	2,436,740	$1,700,610.23	$5,668.70
Feb	2	$739,810.39	$1,696,929.58	2,436,740	$1,696,929.58	$5,656.43
Mar	3	$743,509.44	$1,693,230.52	2,436,740	$1,693,230.52	$5,644.10
Apr	4	$747,226.99	$1,689,512.98	2,436,740	$1,689,512.98	$5,631.71
May	5	$750,963.12	$1,685,776.84	2,436,740	$1,685,776.84	$5,619.26
Jun	6	$754,717.94	$1,682,022.03	2,436,740	$1,682,022.03	$5,606.74
Jul	7	$758,491.53	$1,678,248.44	2,436,740	$1,678,248.44	$5,594.16
Aug	8	$762,283.99	$1,674,455.98	2,436,740	$1,674,455.98	$5,581.52
Sep	9	$766,095.41	$1,670,644.56	2,436,740	$1,670,644.56	$5,568.82
Oct	10	$769,925.88	$1,666,814.08	2,436,740	$1,666,814.08	$5,556.05
Nov	11	$773,775.51	$1,662,964.45	2,436,740	$1,662,964.45	$5,543.21
Dec	12	$777,644.39	$1,659,095.58	2,436,740	$1,659,095.58	$5,530.32
Total		$9,080,574.35	$20,160,305.26	29,240,880		$67,201.02

Capital Cost $360,215,149

Conveyance Improvements

CONSTRUCTION CAPITAL COSTS

Construction Costs	$20,020,648
Construction Capital Costs Subtotal	$20,020,648

OTHER CAPITAL OUTLAYS

1	Engineering, Legal Costs, Financing, & Contingencies (35%)	$7,007,227
2	Land Acquisition & Easements (5%)	$1,991,932
3	Environmental & Arch. Studies & Mitigation & Permitting (1%)	$200,206
	Other Capital Outlays Subtotal	$9,199,365

Item	Description	
1	Construction costs	$20,020,648
2	Other capital outlays	$9,199,365
3	Total initial costs (i.e., loan principle)	$29,220,013
4	Annual Interest Rate	0.06
5	Monthly Interest Rate	0.005
6	Years of Loan/Lifetime	20
7	Number Monthly Payments	240
8	Monthly Payments on Loan	$209,341
9	Annual Payments on Loan	$2,512,095
10	Interest During Construction	$5,773

Item	Description	Value
	Annual Costs	
	Operation and Maintenance	$211,441
	Total Annual Costs	$211,441
	Water Production	
4	Million-Gallons-Per-Day	195
5	1,000 gallons/year	71,290,659
6	acre-feet/year	218783
	Costs per-unit	
6	$/1,000 gallons	$0.00
7	$/acre-foot	$0.97

Interest During Construction (IDC) Calculator

Loan Information

Annual Interest Rate	0.06
Monthly Interest Rate	0.01
Years of Loan/Lifetime	20
Number Monthly Payments	240
Principal	29,220,013
Monthly Payment	$209,341.25
Annual Payment	$2,512,094.98
Lifetime payments	$50,241,899.62

Assuming: Construction period equals 1 year

Month	Payment Number	Principle payment PP_t	Interest Payment IP_t	Total Payment $TP_t = IP_t + PP_t$	Unspent Funds UF_t	Return on Investment
Jan	1	$63,241.18	$146,100.07	209,341	$146,100.07	$487.00
Feb	2	$63,557.39	$145,783.86	209,341	$145,783.86	$485.95
Mar	3	$63,875.18	$145,466.07	209,341	$145,466.07	$484.89
Apr	4	$64,194.55	$145,146.70	209,341	$145,146.70	$483.82
May	5	$64,515.52	$144,825.72	209,341	$144,825.72	$482.75
Jun	6	$64,838.10	$144,503.15	209,341	$144,503.15	$481.68
Jul	7	$65,162.29	$144,178.96	209,341	$144,178.96	$480.60
Aug	8	$65,488.10	$143,853.14	209,341	$143,853.14	$479.51
Sep	9	$65,815.55	$143,525.70	209,341	$143,525.70	$478.42
Oct	10	$66,144.62	$143,196.63	209,341	$143,196.63	$477.32
Nov	11	$66,475.35	$142,865.90	209,341	$142,865.90	$476.22
Dec	12	$66,807.72	$142,533.53	209,341	$142,533.53	$475.11
Total		$780,115.56	$1,731,979.42	2,512,095		$5,773.26

Capital Cost 30,946,219.15

141.45

Impact of San Felipe Springs on the Rio Grande

for the

Rio Grande Regional Water Authority

LBG-GUYTON ASSOCIATES

Professional Groundwater and Environmental Engineering Services

A Division of Leggette, Brashears & Graham, Inc.

Photograph on cover from
http://www.edwardsaquifer.net/sanfelip.html
By Gregg Eckhardt

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(at end of report)

Executive Summary

At the request of NRS Consulting Engineers on behalf of the Rio Grande Regional Water Authority, LBG-Guyton Associates has performed a preliminary study to evaluate San Felipe Springs in Val Verde County, Texas and their impact on flow downstream to the Rio Grande. An evaluation of the general hydrology, information on current and past flow conditions of San Felipe Springs and potential impact to inflows into the Rio Grande was made.

The City of Del Rio depends on the San Felipe Springs for their water supply. Del Rio has a surface water right to 11,416 acre-feet/year (ac-ft/yr), which is taken from the spring lake of the East Spring. For the West San Felipe Spring, pumps are installed into caverns that feed directly into the spring lake. Historically, the water produced from the West San Felipe Spring has been considered groundwater by the State of Texas because the pumps are installed into a cavern prior to becoming surface water. In recent years, the City's usage has been about 2.6 billion gallons per year or about 8,100 ac-ft/yr, which is distributed to both the City and Laughlin Air Force Base (AFB).

The City of Del Rio has recently constructed a microfiltration plant with a maximum capacity of about 18.2 million gallons per day. If the treatment plant is operated continuously, the maximum capacity is about 20,000 ac-ft/yr. Average discharge from San Felipe Springs is about 238 ac-ft/day and at full capacity the microfiltration plant can treat about 23 percent of that total springflow.

Downstream from the Springs prior to the confluence of the Rio Grande, water has historically been removed from San Felipe Creek for irrigation. San Felipe Manufacturing and Irrigation Company has a surface water right to remove up to 5,012 ac-ft/yr. Recent irrigation usage has only been a small portion of the total permitted amount, about 1,500 ac-ft/yr.

In recent years, the City of Del Rio has received funding to repair old infrastructure, which has greatly reduced their water losses. As a result, annual usage has declined by about 2 billion gallons or about 6,100 ac-ft/yr. Anticipted growth in Val Verde County over the next 50 years is to add about 5,000 ac-ft/yr to the existing demand of about 21,000 acre-feet of water per year. As a result, the additional demand over the next 50 years is anticipated to be less than the historic water usage prior to the new conservation efforts.

Historically, San Felipe Springs has accounted for a relatively small overall contribution of about 8 percent of the total volume of water in the Rio Grande near Del Rio. Discharge from San Felipe Springs may be impacted by increased groundwater production in areas that recharge the Springs. The impact of increased groundwater withdrawal from new wells to springflow is hard to predict but is dependent on the proximity of the withdrawal location to the Springs. If new wells are at or near the Springs, then the withdrawal ratio from the aquifer will be near one to one compared to springflow. If any new wells or addional pumpage are located some distance away from the Springs, then the withdrawal ratio will be less than one to one comparing quantities of new pumpage to lost springflow and available water to San Felipe Creek.

Introduction

At the request of NRS Consulting Engineers on behalf of the Rio Grande Regional Water Authority, LBG-Guyton Associates performed a "desktop" study to evaluate the San Felipe Springs system and the impact of groundwater withdrawals on flow to the Rio Grande. Water from San Felipe Springs eventually makes its way to the Rio Grande, as it passes from the Plateau Water Planning Region to the Rio Grande Water Planning Region (Figure 1). Currently, groundwater models have not been constructed and calibrated that accurately represent the groundwater system in this area and therefore were not considered in this study. This report includes evaluating hydrology, available information on current and past flow conditions of the Springs and potential impact to the Rio Grande inflows due to groundwater withdrawal from the San Felipe Springs area.

Most water that falls as rain either runs off into streams and lakes, evaporates or transpires before the water can percolate downward into an aquifer. Net lake evaporation is about 60 inches in western Val Verde County. Only a very small percentage of total rainfall ever enters an aquifer as recharge. The combination of high temperatures, high potential evapotranspiration and intermittent rainfall totals in the Del Rio area combine to produce a semiarid climate with drought conditions during all or parts of some years (Bomar, 1995). The rainfall in Val Verde County decreases from east to west, from about 22 inches per year in the northeastern end of the county to about 12 inches per year in the western part of the county near Del Rio. Most of the rainfall occurs as thunderstorms with the highest amounts falling in September and May (averaging up to 2.5 inches per month) and the driest winter months averaging a little over 0.5 inches per month (top graph in Figure 2). The average annual rainfall over the period of record (1951 - 2008) at the Del Rio International Airport is 18 inches and has ranged from less than 10 inches to 33.2 inches in 1969 (bottom graph in Figure 2). Generally, the drought during the mid-1950s is considered the most severe drought of record.

San Felipe Springs

San Felipe Springs is one of 48 springs in Val Verde County identified by Brune (1981) and is considered the fourth largest spring in Texas. San Felipe Springs is actually a combination of about 10 individual springs emanating from the Edwards limestone that form the headwaters of San Felipe Creek, which is a tributary to the Rio Grande (Figure 1). The recharge area for San Felipe Springs is not precisely known but is surmised to be a large area extending into northern Val Verde, Kinney and Edwards Counties (Reeves and Small, 1973). Long periods of below-normal rainfall lead to reduced recharge and to lower water levels in the aquifer. As aquifer levels fall, the volume of water discharging from San Felipe Springs into San Felipe Creek decrease.

San Felipe Springs has never ceased flowing through recorded history. The very location for the City of Del Rio was originally placed in proximity to this historic pristine water source. Spring discharge at San Felipe Springs (US Geological Survey Gage 08-4528.00), which has been maintained by the International Boundary and Water Commission (IBWC), is plotted with monthly rainfall in Figure 3. A 3-month running average of rainfall is also plotted in Figure 3 to show the correlation between precipitation trends and springflow. The reported value for San Felipe springflow includes the gaged flow downstream in San Felipe Creek, plus the City of Del Rio's withdrawals and an amount of water withdrawn for an irrigation canal located upstream of the gaged location.

For the period of record since 1961, low flow at San Felipe Springs occurred during 1963 at about 2,000 ac-ft/ month (Figure 3). An acre-foot of water equals 325,851 gallons. The yearly total flow for 1963 was 36,580 ac-ft or a little more than an average of 50 cubic feet per second (cfs). Miscellaneous measurements by the USGS during the drought of the 1950s indicate an instantaneous low flow of about 25 to 30 cfs for San Felipe Springs (Reeves and Small, 1973). Since Lake Amistad was filled in 1968, average discharge from San Felipe Springs has increased and has averaged 7,167 ac-ft/month. The lowest flow after the Lake was filled occurred in 1996 at a little less than 4,000 ac-ft/month (Figure 3).

City of Del Rio Use

Two of the 10 springs that compose San Felipe Springs, referred to as the East Spring and West Spring, provide all the public water supply currently used by the City of Del Rio and Laughlin AFB. Pumps are installed in the San Felipe East Spring lake and into a cave that feeds into the San Felipe West Spring lake. Spring water is pumped through a microfiltration plant, treated with chlorine and then supplied to the City and Base.

The City of Del Rio has a water right authorizing it to divert up to 11,416 acre-feet per year (ac-ft/yr) from the surface-water portion of the Springs for municipal use. The City of Del Rio reports their usage to the State separately as surface water and groundwater. The water withdrawn from wells installed in the cave near the spring outlet at the West Spring is technically considered groundwater.

Monthly average and annual historic usage are shown in Figure 4. Much of the annual variation seen between surface water and groundwater usage on the bottom graph of Figure 4 is believed to be reporting inconsistencies by the City of Del Rio to the State. The monthly usage for groundwater peaks in July at a little more than 200 million gallons per month (over 600 ac-ft/month). The reported surface water use peaks in August at almost 300 million gallons per month (over 900 ac-ft/month) (top graph in Figure 4). The general trend in the annual usage shown in the bottom graph of Figure 4 is upward from a low of just over 1 billion gallons per year (over 3,000 ac-ft/yr) to a high of over 6 billion gallons per year (over 18,400 ac-ft/yr). In recent years, the City of Del Rio has received funding to repair old water lines and storage tanks and has greatly reduced the water losses in the water system. This is likely the cause for the recent decrease of about 2 billion gallons (6,100 ac-ft/yr) in annual usage down to the reported 2.6 billion gallons (about 8,100 ac-ft/yr) in the year 2007.

Maximum capacity of the City's microfiltration plant is 18.2 million gallons per day (55.8 ac-ft/day), which if operated at full capacity year round would give about 20,000 ac-ft/yr. San Felipe Springs averages about 238 ac-ft/day. At full capacity, Del Rio can extract and treat about 23 percent of the average daily flow from the Springs.

Irrigation and Other Surface Water Gaging

Irrigation water is also removed from San Felipe Creek downstream of the Springs prior to its confluence with the Rio Grande. Figure 5 is the irrigation survey for the year 2000 and shows that most of the irrigation in Val Verde County occurs downstream of San Felipe Springs. The historic estimate of irrigation in Val Verde County has ranged from 1,350 ac-ft/year to about 2,400 ac-ft/yr and is shown with the irrigated acreage in the graph of Figure 6. San Felipe Manufacturing and Irrigation Company has a water right authorizing it to divert 4,962 ac-ft/yr for irrigation use and 50 ac-ft/yr for industrial use from San Felipe Creek. The total authorized surface water amount withdrawn from San Felipe Creek is 16,428 ac-ft/yr with the other irrigation and industrial permitted uses; however, this does not include water that is considered groundwater that is removed from near the Springs by the City of Del Rio.

Several gaging stations with historical data are located along the Rio Grande and are shown on Figure 1. A graph showing the gaged stream discharge at these stations is given in Figure 7. The following table summarizes the range and average flow in cfs since 1961 at each station:

Station	**Rio Grande below Amistad Dam**	**Rio Grande at Del Rio and Acuna**	**San Felipe Springs**	**San Felipe Creek**	**Maverick Canal Diversion near Mile 13**	**Rio Grande at Jimenez and Quemado**	**Rio Grande at Eagle Pass**
Maximum	61,094	113,713	188	16,386	1,780	3,528	134,549
Minimum	42	3	52	7	0	3	173
Mean	2,215	1,583	124	108	1,200	1,002	2,742

All values in cubic feet per second

Four of the the above listed gaging sites are located on the Rio Grande staggered from just below Lake Amistad downstream to Eagle Pass. In general, flow increases downstream from Lake Amistad to Eagle Pass, except for the Rio Grande at Jimenez/Quemado (US Geological Survey Gage 08-4557.00). The Maverick Canal gaging station (US Geological Survey Gage 08-4539.00 seen on Figure 1) measures water withdrawn from the Rio Grande for hydro-electric generation and irrigation use and results in decreased flows in the Rio Grande at that point. The other two gaging stations are for San Felipe Springs (US Geological Survey

Gage 08-4528.00) and San Felipe Creek (US Geological Survey Gage 08-4530.00), which contribute flow into the Rio Grande downstream of the Del Rio gaging station (US Geological Survey Gage 08-4518.00 seen on Figure 1).

As mentioned above, the official San Felipe springflow discharge data includes water taken out by the City of Del Rio and for one irrigation canal. The location of the gaging station for San Felipe Creek is downstream of San Felipe Springs near its confluence with the Rio Grande (Figure 1). The baseflow of the Creek is generally less than the reported flow for San Felipe Springs (Figure 8). The Creek flow is affected not only by withdrawals by the City of Del Rio and for irrigation but by the storm water runoff that results in extreme high stream flow spikes (Figure 8). During high flow events on the Rio Grande, the flow from San Felipe Creek contributes a relatively small portion, sometimes less than 0.1 percent, of the total flow in the Rio Grande near Del Rio. However, when the flow in the Rio Grande is low the percent contribution from San Felipe Springs increases and may constitute a majority of the baseflow to the River. For the period of record since 1961, the composite volume of water contributed from San Felipe Springs is about 8 percent of the total cumulative volume of water in the Rio Grande at Del Rio.

Future Projections

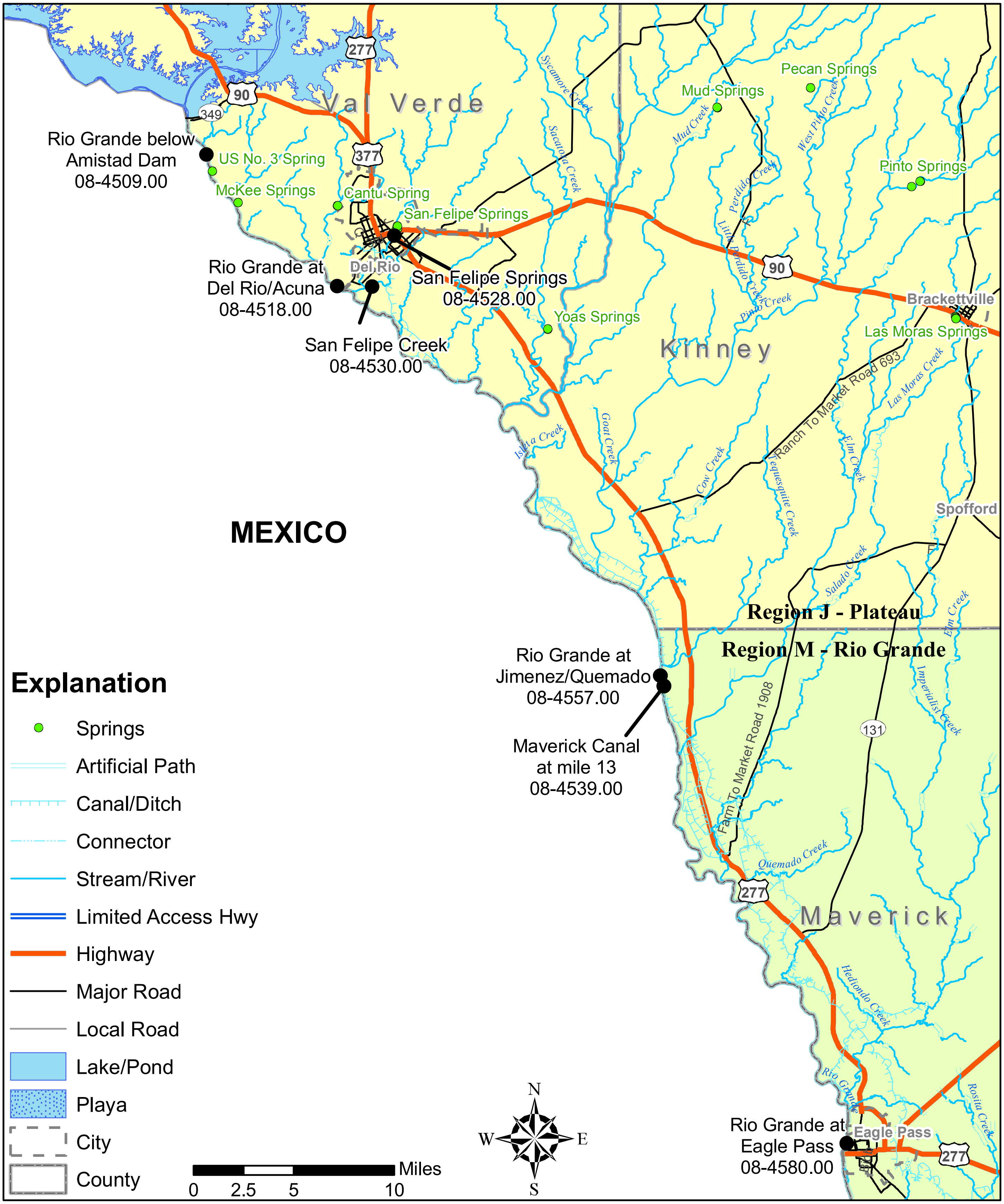
According to the State Data Center and U.S. Census Bureau's census, population in Val Verde County has been on a steady incline throughout history (top graph in Figure 9). Projections of regional population (blue bars on the top graph in Figure 9) and water demand (bottom graph in Figure 9) were developed in cooperation with the Texas Water Development Board, other state agencies and the 2006 Plateau Region Water Plan. In general, the population of Laughlin AFB has been fairly constant and is currently projected to remain that way. However, depending on future military circumstances, the size of the Base could grow more than is currently projected.

Based on data from the Plateau Regional Water Planning Group, demand for water in Val Verde County is projected to increase about 5,000 ac-ft/decade from a little less than 21,000 ac-ft/yr in 2010 to about 26,000 ac-ft/yr by the year 2060 (bottom graph in Figure 9). This amount does not consider any possible groundwater development and transport out of the County to other destinations. Since surface water in the Rio Grande Basin is largely allocated, much of the additional water produced in the County is likely to come from groundwater. The City of Del Rio has three wells that can produce water north of town but the City is not currently utilizing any of those wells.

Conclusions

Historically, the San Felipe Springs system has accounted for a relatively small overall contribution (8 percent) of the total volume of water to the Rio Grande near Del Rio. Water withdrawn from the Springs by the City of Del Rio has declined in recent years as a result of improvements in their infrastructure. Projections for future use in the next 50 years are not anticipated to be any greater than the historic usage prior to the infrastructure improvements. Discharge from San Felipe Springs can be impacted by increased groundwater production in areas that recharge the Springs. The impact of increased groundwater production from wells to decreased springflow is hard to predict but is dependent on the proximity of the pumping location to the Springs. If new wells are at or near the Springs, then the withdrawal ratio from the aquifer will be near one to one in the amount decreased from springflow. If new wells are located some distance away from the Springs, then the withdrawal ratio will be less than one to one comparing groundwater pumpage to decreased springflow. In order to track future impacts to springflow, the location and amount of groundwater produced needs to be recorded and measurements of accurate spring and creek discharge need to be continued.

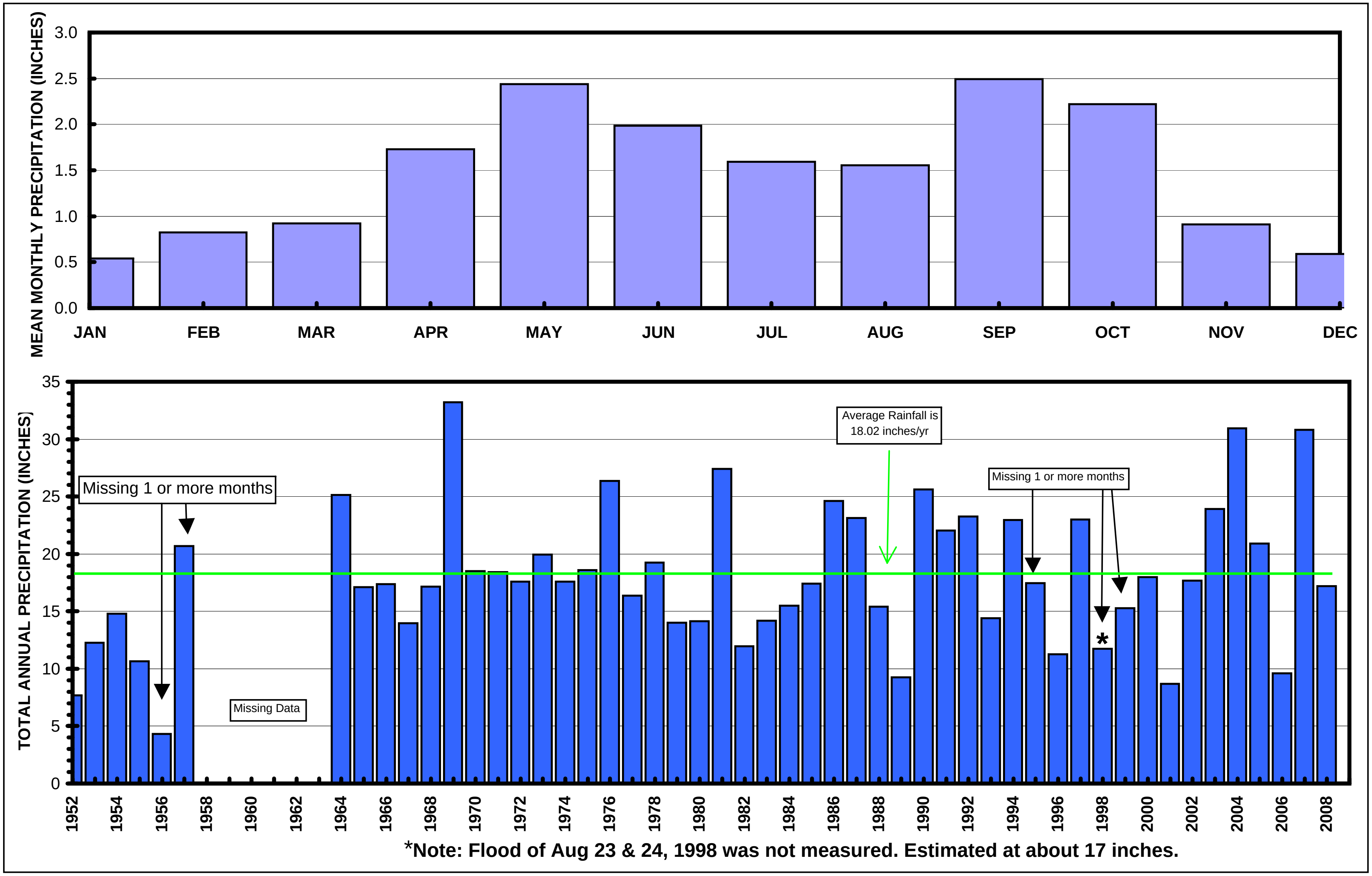
FIGURES



SITE MAP SHOWING STREAM GAGING STATIONS FROM AMISTAD TO EAGLE PASS

LBG-GUYTON ASSOCIATES

FIGURE 1

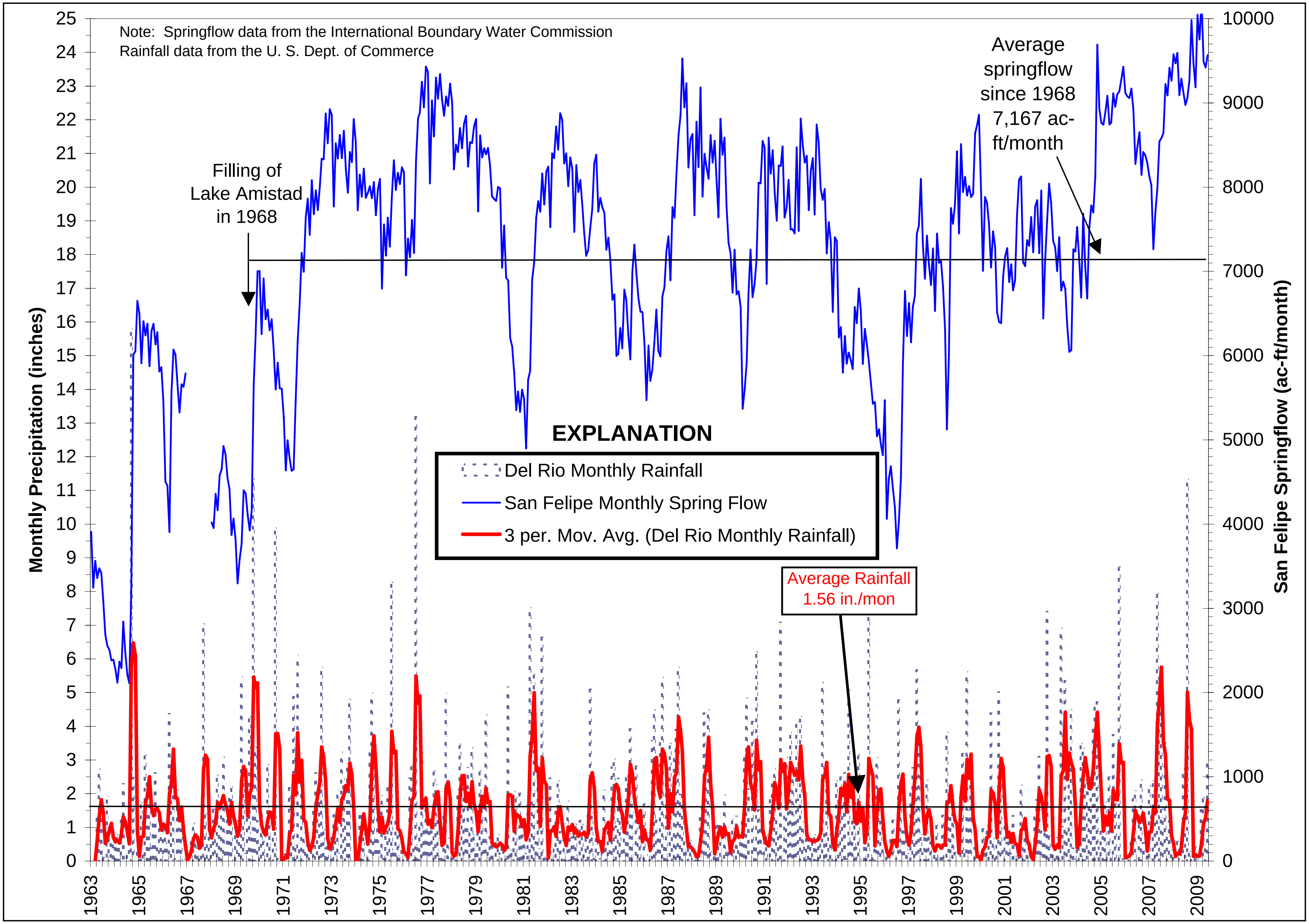


Note: Rainfall Data from the U.S. Department of Commerce - NOAA

MEAN MONTHLY AND HISTORIC TOTAL ANNUAL PRECIPITATION AT DEL RIO INTERNATIONAL AIRPORT, VAL VERDE COUNTY, TEXAS 1951 - 2008

LBG-GUYTON ASSOCIATES

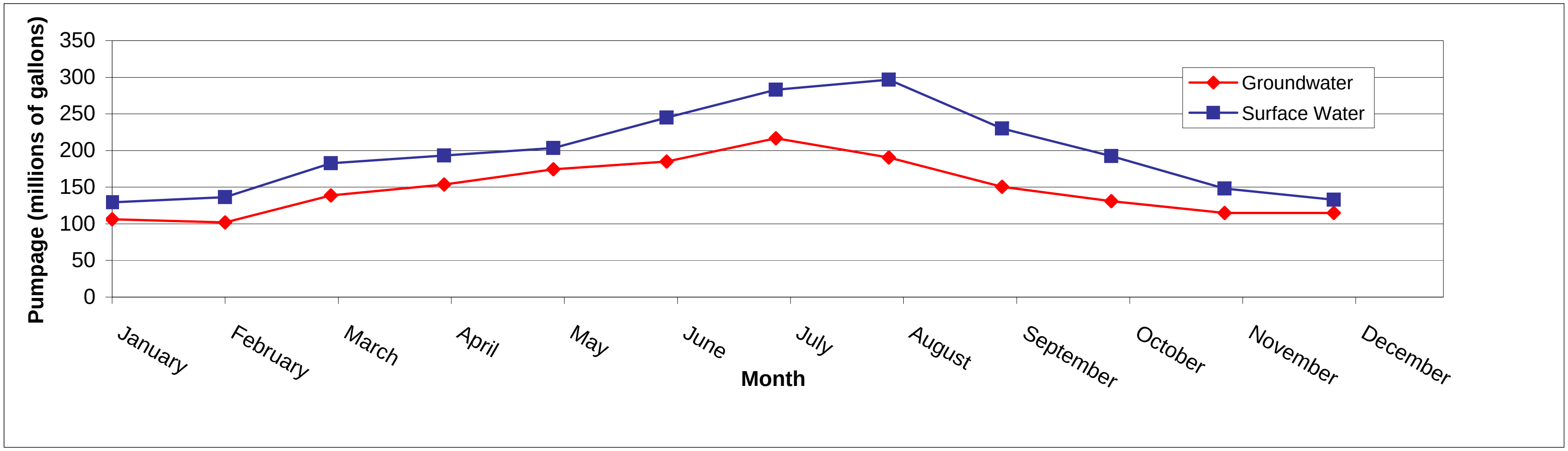
FIGURE 2

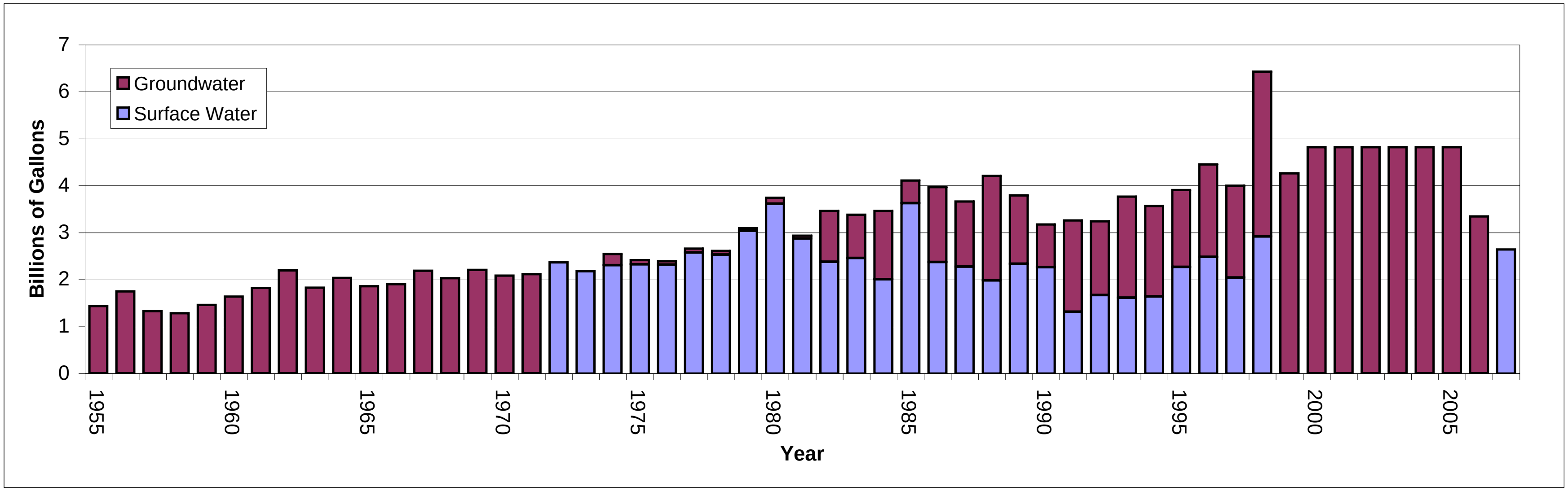


MONTHLY RAINFALL AT DEL RIO AND SAN FELIPE SPRINGFLOW

LBG-GUYTON ASSOCIATES

FIGURE 3

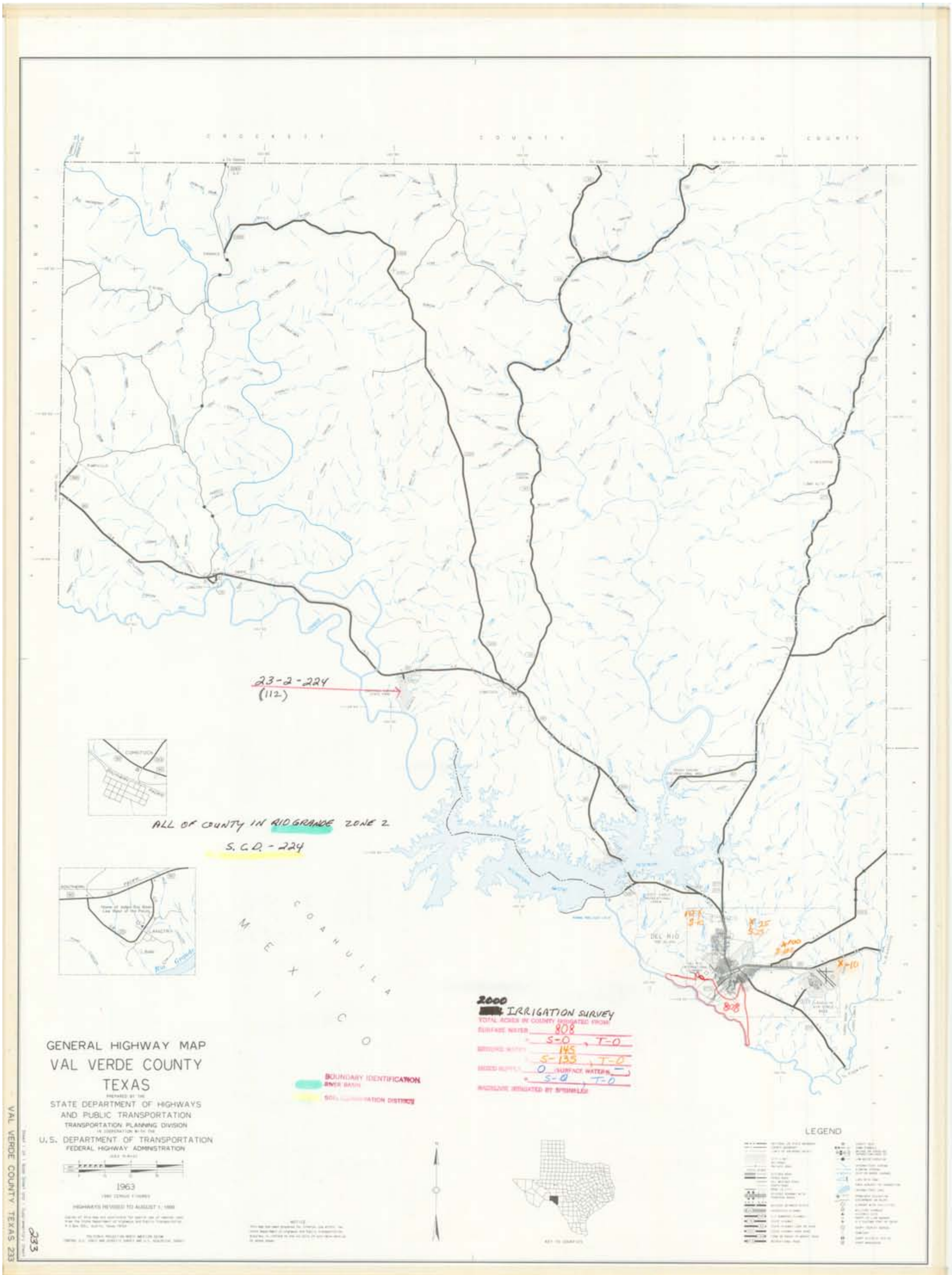




MEAN MONTHLY AND HISTORIC TOTAL WATER USE BY THE CITY OF DEL RIO, VAL VERDE COUNTY, TEXAS

LBG-GUYTON ASSOCIATES

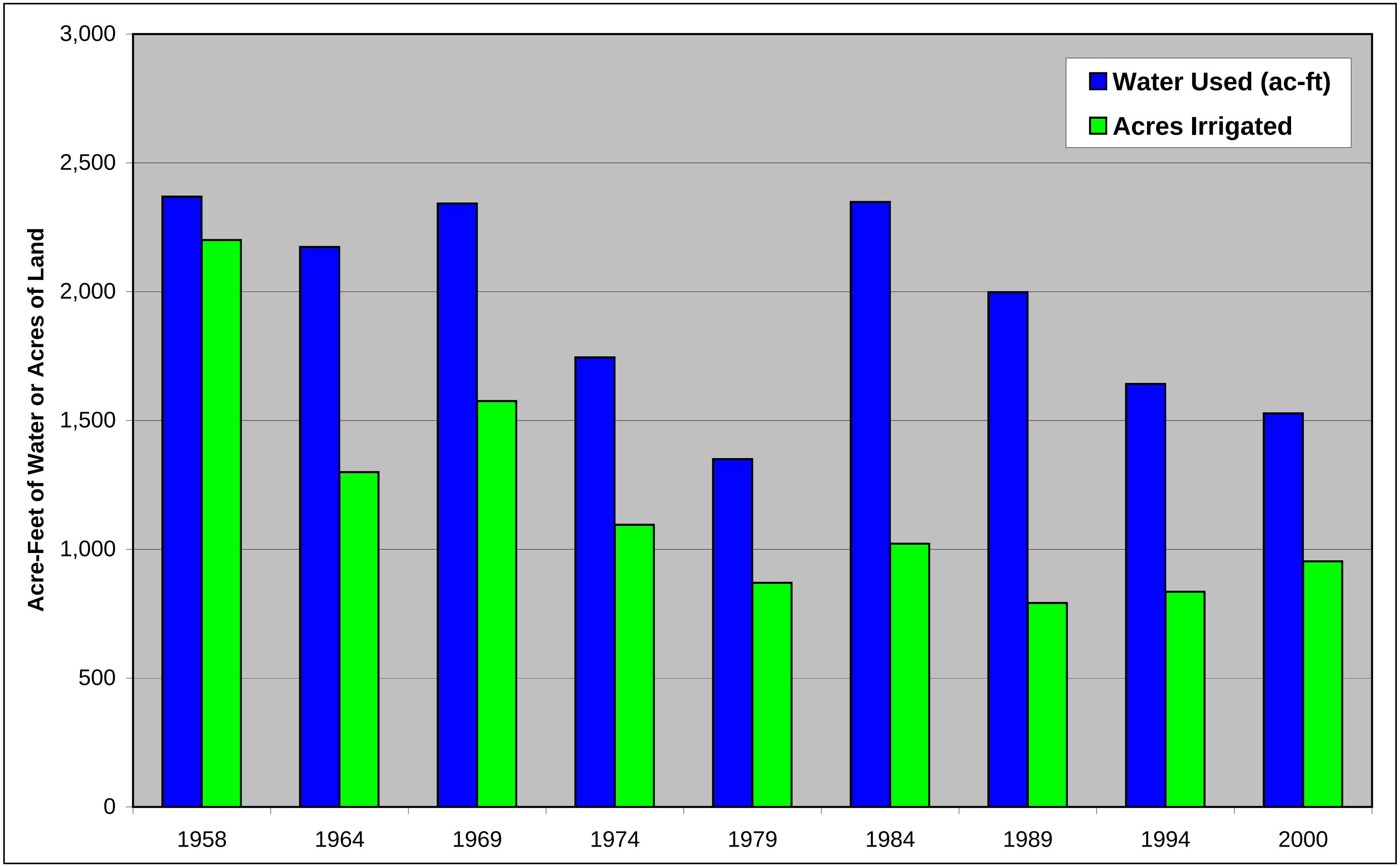
FIGURE 4



LBG-GUYTON ASSOCIATES

VAL VERDE COUNTY IRRIGATION SURVEY

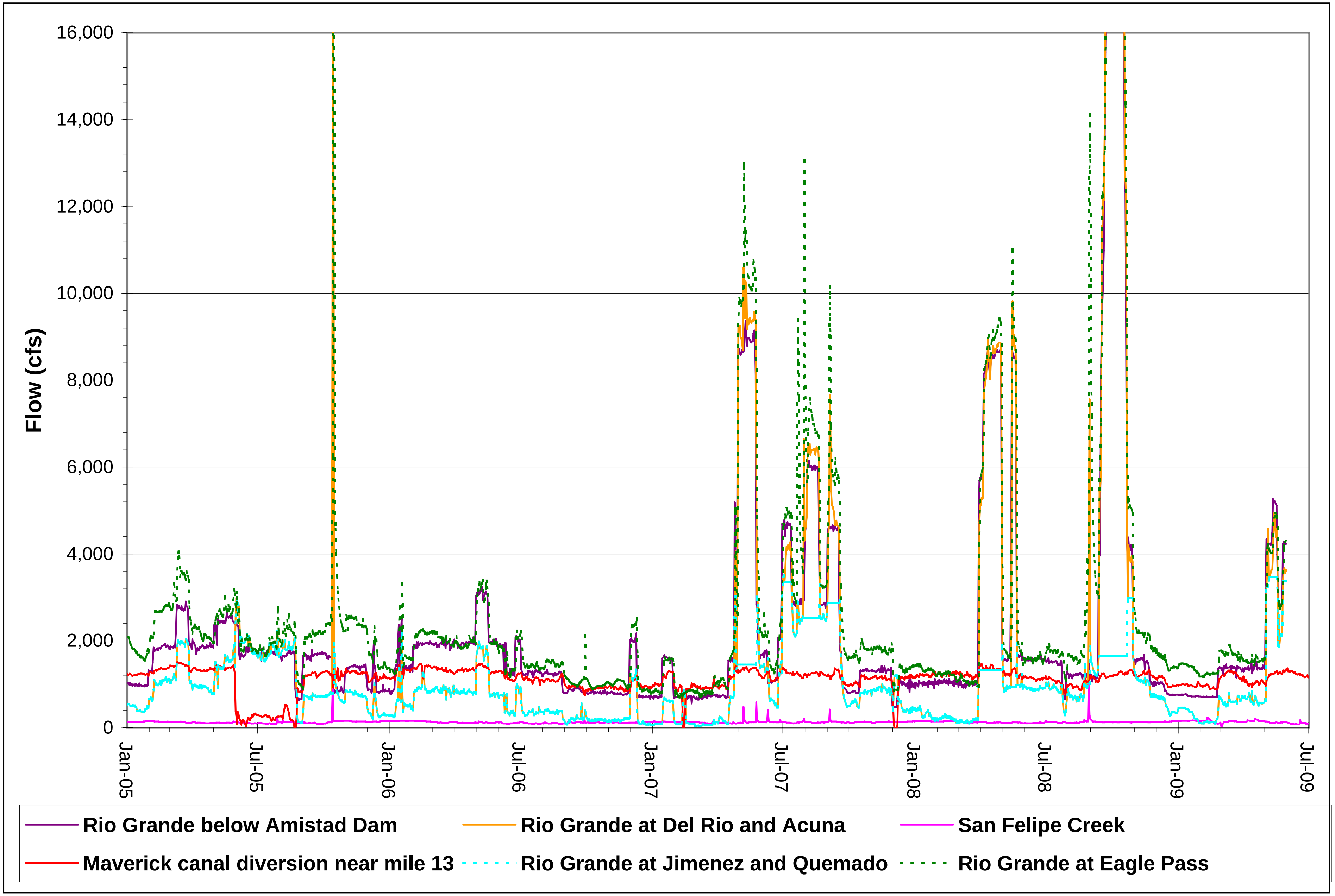
FIGURE 5



HISTORIC IRRIGATION IN VAL VERDE COUNTY

LBG-GUYTON ASSOCIATES

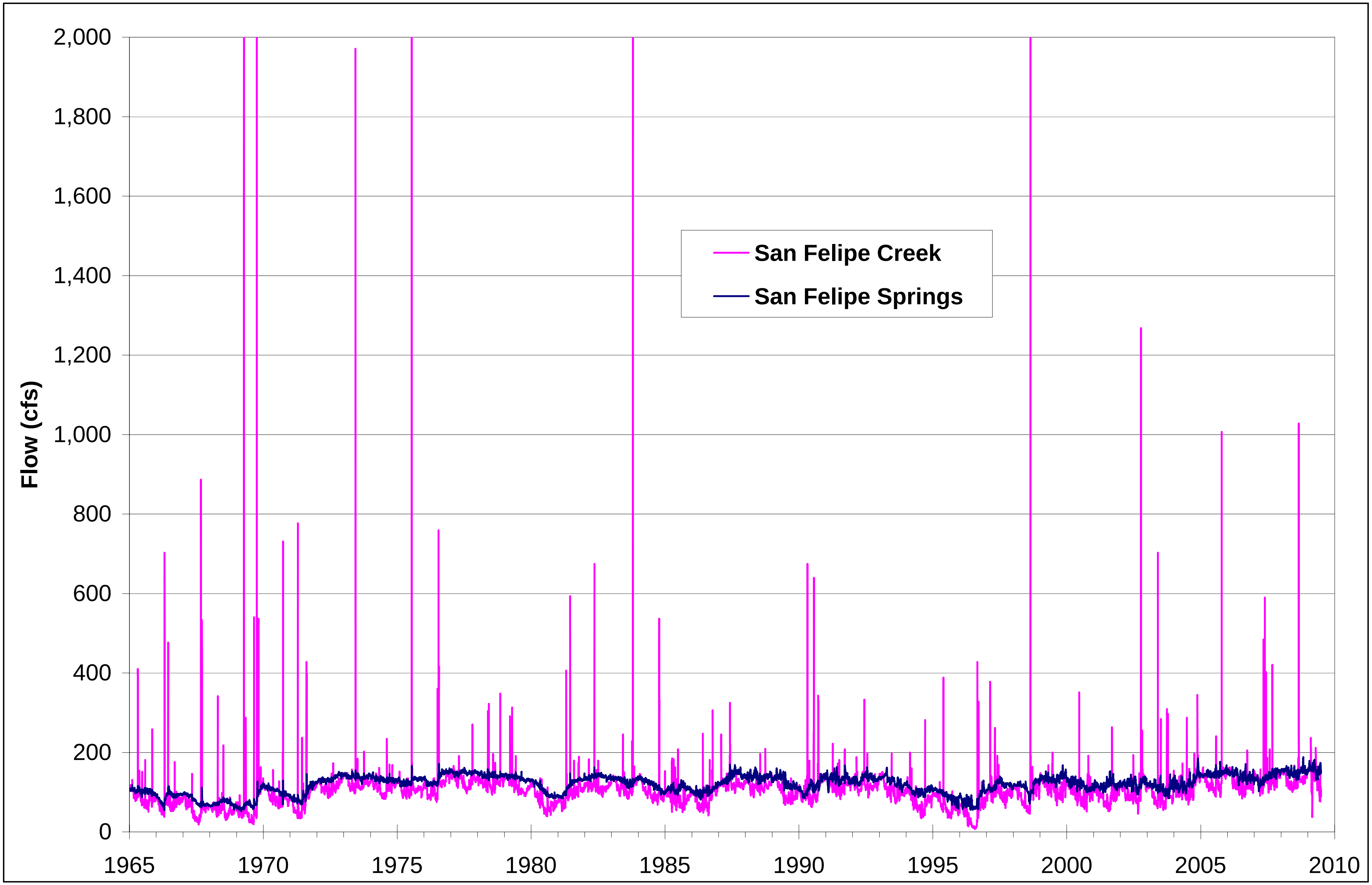
FIGURE 6



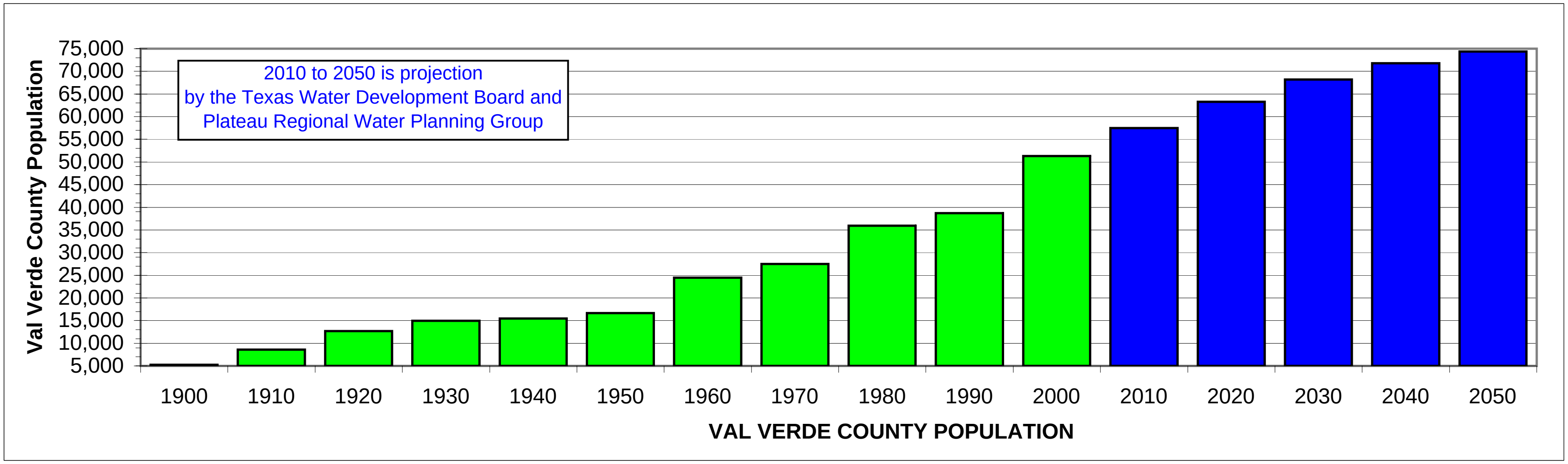
LBG-GUYTON ASSOCIATES

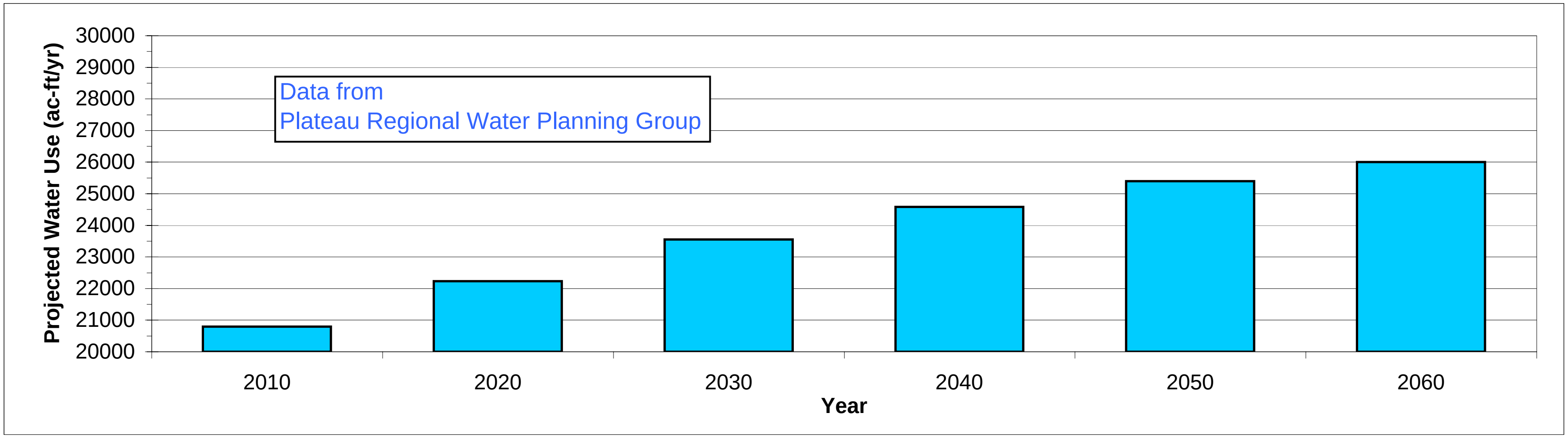
FLOW HYDROGRAPH OF RIO GRANDE AND OTHER RELEVANT SURFACE WATER FROM 2005-2009

FIGURE 7



HYDROGRAPH OF FLOW FOR SAN FELIPE SPRINGS AND CREEK





HISTORIC AND PROJECTED POPULATION AND WATER USE FOR VAL VERDE COUNTY, TEXAS

LBG-GUYTON ASSOCIATES

FIGURE 9

TEXAS
WATER
DEVELOPMENT
BOARD

P.O. Box 13231,
Capitol Station
Austin, TX
78711-3231

Phone: 512.463.7847
FAX: 512.475.2053

URL Address:
http://www.twdb.state.tx.us

Email Address:
info@twdb.state.tx.us

Texas Natural Resources Information System (TNRIS)
http://www.tnris.state.tx.us

Borderlands Information Center (BIC)
http://www.bic.state.tx.us

Water Information Integration and Dissemination (TWDB WIID System)
http://wiid.twdb.state.tx.us/

AMENDING AN APPROVED REGIONAL WATER PLAN

BACKGROUND

Every five years, the 16 regional water planning groups (RWPGs) must develop and adopt regional water plans, which are submitted to the Texas Water Development Board (TWDB) for approval. The TWDB then compiles the regional water plans into a state water plan. During the five-year span between regular adoption of regional water plans, there may be occasions to amend regional water plans to secure long-term water supplies.

HOW IS AN AMENDMENT TO A REGIONAL WATER PLAN INITIATED?

A RWPG may initiate an amendment on its own, or a political subdivision of the State of Texas in the regional water planning area may request an amendment from the RWPG based on changed conditions or new information.[1] A RWPG uses the following process to review amendment requests:

- The RWPG must formally consider the request within 180 days after its submittal.
- The RWPG may, at its discretion, accept or reject the proposed amendment.
- The political subdivision may petition the TWDB Executive Administrator for agency review if the political subdivision is not satisfied with the RWPG's decision.[2]
  - A. The Executive Administrator may request the RWPG to make a revision.
  - B. If the revision is not made within 90 days, the matter is presented to the TWDB, which can order a revision to the regional water plan and state water plan based on changed conditions or new information.

WHAT ARE THE WAYS THAT A REGIONAL WATER PLAN MAY BE MODIFIED?

Revisions to Population or Water Demand Projections, which may be requested from the TWDB whenever current projections are no longer reasonable due to changed conditions or the availability of new information.[3]

The process requires the following:

- A RWPG must submit a revision request, usually based on a request from a political subdivision, to the TWDB.
- The RWPG must provide at a least 14-day notice for a meeting and make the proposed population and/or water demand projection

revisions available for public inspection prior to the meeting.[4]

- The RWPG must accept oral and written public comments at the meeting in which the request is considered and written comments for 14 days following the meeting.
- The RWPG submits the revision request to the TWDB, including a summary of all comments received by the RWPG at the meeting and during the 14-day comment period.
- The TWDB consults with other state agencies and, within 45 days of receipt of a revision request from a RWPG, the Executive Administrator will respond to the request.
- All requested revisions will be presented for consideration of Board approval at the next scheduled TWDB meeting. TWDB staff will recommend to the Board a consensus recommendation from the TWDB, the Texas Department of Agriculture, Texas Commission on Environmental Quality, and Texas Parks and Wildlife Department.

Substitutions of water management strategies that have already been fully evaluated and are explicitly included as identified "alternative" water management strategies in adopted regional water plans if [5]

– the water management strategy originally recommended is no longer recommended, and
– the proposed substitution does not result in a water management strategy that is in excess of 125 percent of the recognized needs of the water user group for which the substituted strategy is recommended unless good cause can be demonstrated by the RWPG.

The process requires the following:

- A political subdivision requests the RWPG to make a substitution.
- The RWPG considers the substitution request as an action item on an agenda at a regular public RWPG meeting.[6]
- Substitution materials are submitted to the TWDB for Executive Administrator consideration.[7]
- The Executive Administrator approves the substitution if in accordance with 31 TAC § 357.7(a)(7)(H).
- The RWPG adopts the substitution at a regular public RWPG meeting and submits evidence of adoption to the TWDB.[8]

Minor amendments to incorporate changes that do not:

– result in over allocation of an existing or planned source of water;
– relate to a new reservoir;
– have a significant effect on instream flows, environmental flows, or freshwater flows to bays and estuaries;
– have a significant substantive impact on water planning or previously adopted management strategies; or,
– delete or change any legal requirements of a plan.[9]

The process requires the following:

- A political subdivision requests the RWPG to make an amendment.
- The RWPG considers the request and takes action to pursue the amendment at a regular public RWPG meeting.
- Amendment materials are prepared in accordance with TWDB rules and guidance and a request for a "minor amendment determination" is submitted to the TWDB's Executive Administrator.

- The Executive Administrator reviews the request and responds within 30 days.
- If the Executive Administrator determines that it is a "minor amendment," the RWPG considers adopting the amendment at a regular public meeting with an opportunity for public input. This meeting requires at least a 14-day notice.[10] The RWPG considers public comments and may adopt the amendment at the meeting.[11]
- The RWPG submits the adopted minor amendment materials, including a summary of public comments, to the TWDB for approval.
- The TWDB reviews the adopted minor amendment and, if acceptable, approves it at its next regular Board meeting.
- The TWDB amends the state water plan to incorporate the minor amendment.

Major amendments to incorporate changes that cannot be addressed through a minor amendment.[12]
The process requires the following:

- A political subdivision requests the RWPG to make an amendment.
- The RWPG considers the request and takes action to pursue the amendment at a regular public RWPG meeting.
- Amendment materials are prepared in accordance with TWDB rules and guidance for consideration at a public hearing.
- The RWPG holds a public hearing on the proposed amendment.[13] This requires 30 days between the mailed and published notice of the hearing and the hearing date and a 30-day comment period following the hearing.
- The RWPG considers all public comments received and may adopt the regional water plan amendment at a regular RWPG meeting[14] after the 30-day comment period.[15]
- The RWPG submits the adopted amendment materials, including a summary of public comments, to the TWDB for approval.[16]
- The TWDB reviews the adopted amendment and considers approving the adopted regional water plan amendment.
- The TWDB then amends the state water plan, which requires a 30-day public notice for the hearing on the proposed state water plan amendment prior to its adoption.

WHO PAYS FOR AN AMENDMENT?

The RWPG may ask the political subdivision requesting the amendment to pay for study costs related to the request. Limited TWDB funds may be available to pay for plan amendments. Unsolicited proposals requesting TWDB funding for an amendment may be submitted at any time using the standard grant application instruction sheet. Proposals must include a scope of work, task items, and expense budgets for the work to be performed. Allocation of funds requires Board approval and is variable based on the extent of the scope of work presented with the request and the availability of funds.

WHY MIGHT A REGIONAL WATER PLAN NEED TO BE AMENDED?

If a project sponsor seeks a) funding from the TWDB for a water supply project; or b) a water rights permit from the Texas Commission on Environmental Quality, the proposed project must be found to be "consistent" with the approved regional water plan and state water plan.

If the proposed project is not already "consistent" and the sponsor cannot wait to incorporate the proposed project into the next adopted regional water plan, the existing regional water plan must be amended, or a waiver of statutory requirements regarding consistency with such plans must be obtained from the TWDB and/or Texas Commission on Environmental Quality.[17]

STATUTE AND RULES

- Title 2, Chapter 16 of the Water Code: http://tlo2.tlc.state.tx.us/statutes/docs/WA/content/htm/wa.002.00.000016.00.htm#16.053.00
- Chapter 357, Part 10, Title 31 of the Texas Administrative Code: http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=10&ch=357&rl=Y
- For more information on regional water planning and related guidance, please visit the following Web site: http://www.twdb.state.tx.us/wrpi/rwp/rwp.htm

Note: This guidance document does not cover all procedural and substantive requirements applicable to water plan amendments. For this reason, this document should not be used as a substitute for the regulations as written. In case of doubt, consult the statutes in Chapter 16 of the Texas Water Code and Title 31, Chapter 357 of the Texas Administrative Code. Regional water planning groups or political subdivisions with legal questions regarding changes to the regional water plans should consult with their own attorneys or the Texas Attorney General Office.

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1 Per 31 TAC § 357.11(f)(g). Any amendment proposed must meet rules and guidelines for development of a regional water plan (RWP).
2 The petition must be provided to the RWPG and must include: the changed condition or new information that affects the approved RWP; the specific sections and provisions of the approved RWP that are affected by the changed condition or new information; the efforts made with the RWPG to obtain an amendment; and the proposed amendment to the approved RWP [31 TAC § 357.11(g)(1)].
3 Per 31 TAC §357.5(d)(2).
4 Per 31 TAC §357.5(d)(2).
5 31 TAC. § 357.7(a)(7)(H).
6 Posted under the Texas Open Meetings Act; See also, 31 TAC § 357.12.
7 Per criteria under 31 TAC Ch. §357.7(a)(7)(H).
8 Posted under the Texas Open Meetings Act.
9 Per 31 TAC Ch. §357.16.
10 Per 31 TAC §357.16(d), §357.12(a)(c)(d) and posted under the Texas Open Meetings Act.
11 Amendment adoption must include response to public comment, and otherwise comply with TWDB technical guidelines.
12 Per 31 TAC §357.11(f).
13 Per 31 TAC §357.11(f); §357.12(a)(4)-(6); §357.12(a)(4)(5)(6)(b)(c)(d).
14 Posted under the Texas Open Meetings Act; See also, 31 TAC § 357.12.
15 Amendment adoption must include response to public comment, and otherwise comply with TWDB technical guidelines.
16 Amendments to an approved RWP shall include a technical report and data in accordance with TWDB specifications, executive summary, and summaries of all written and oral comments received with a response. Data must be transferred to TWDB (31 TAC § 357.10).
17 Per 31 TAC §357.13(c).

Exhibit C

General Guidelines for Regional Water Plan Development (2007-2011)

The Texas Water Development Board

September 8, 2008

Contents

Background and Purpose

The third round of regional and state water planning as defined by Senate Bill 1 of the 75th Texas Legislature commenced in 2007 and will extend through 2012. Since the third round of planning takes place during an "off-census cycle," regional water planning groups were in favor of refining the process to allow planning groups greater flexibility in determining the focus of their plans. In addition, both the planning groups and the Texas Water Development Board (TWDB) determined that the current planning cycle would not require complete revisions of regional water plans due to the lack of new population data from the U.S. Census Bureau. In general, regions will focus on specific areas of water demand and water supply availability; evaluations of new water management strategies in response to changed conditions; environmental studies or work to further the implementation of water management strategies recommended in previous plans, reevaluations of population and water demand projections only under the presence of changed conditions; updating the costs of water management strategies; interregional coordination; infrastructure financing surveys; and administrative and public participation activities.

The following document summarizes guidelines for developing and/or reevaluating regional water plans for the current planning cycle. Provisions of Title 31 of the Texas Administrative Code (TAC) Chapter 357 serve as the foundation for information in this document. Other referenced sources throughout this document provide additional guidance and clarification including the TWDB document entitled "*Guidelines for Regional Water Planning Data Deliverables*" available at the TWDB's website, which contains important supplementary information regarding estimating and reporting water supply availability and other data. Any future revisions to 31 TAC 357 adopted by the TWDB may result in changes to these planning guidelines.

Included in this document are sections covering the following tasks as specified in statute and agency rules:

1) planning area description [31 TAC §357.7(a)(1)];

2) population and water demand projections [31 TAC §357.7(a)(2)];

3) water supply analysis [31 TAC §357.7(a)(3)];

4) identification, evaluation, and selection of water management strategies based on needs [31 TAC §357.7(a)(4-9)]

5) impacts of water management strategies on key water quality parameters of the state [31 TAC §357.7(a)(12)], and impacts of voluntary redistributions of water [31 TAC §357.7(a)(8)(G)];

6) consolidated water conservation and drought management strategy recommendations [31 TAC §357.7(a)(11) and 31 TAC §357.7(a)(7)];

7) description of how regional water plans are consistent with the long-term protection of the state's water, agricultural and natural resources [31 TAC §357.7(a)(13) and §357.14(2)(C)];

8) unique stream segments, reservoir sites, and legislative recommendations [31 TAC §357.7 (a)(10); 31 TAC §357.8; 31 TAC §357.9];

9) reporting of water infrastructure financing mechanisms [31 TAC §357.7(a)(14)];

10) adoption of regional water plans and public participation [31 TAC §357.11-12]; and

11) data reporting requirements and written reports deliverable to the TWDB [31 TAC §357.10].

1.0 Planning Area Description

For the third round of planning, Task 1 is a relatively limited effort to update planning area descriptions reported in the 2006 regional water plans. Planning groups should document substantial changes in any of the following areas:

- wholesale water providers, current water use, and identified water quality problems;
- sources of groundwater and surface water including major springs that are important for water supplies or natural resource protection;
- socioeconomic aspects including information on population, major water demand centers, agricultural and natural resources, and primary economic activities including businesses highly dependent on water resources;
- assessment of current preparations for drought within a regional water planning area;
- summaries of existing regional water plans, recommendations in state water plans, and local water plans;
- identified threats to agricultural and natural resources resulting from water quantity or quality problems related to water supply; and
- information compiled by the TWDB from water loss audits performed by retail public utilities pursuant to [31 TAC §358.6].

2.0 Population and Water Demand Projections

Population and water demand projections from the 2007 state water plan will serve as estimates for the current round of planning; however, the TWDB will consider requests for changes to population and water demand projections if conditions have changed. Entities wishing to revise projections should address their requests through their respective planning group. If the planning group concurs, it will submit requests to the executive administrator of the TWDB. Requests for revisions should be accompanied by supporting data, analyses, and documentation. TWDB staff will coordinate reviews of each request with the Texas Commission on Environmental Quality, the Texas Parks and Wildlife Department, and the Texas Department of Agriculture.

Population Projections

To ensure consistency and to maintain public credibility in population projections, population estimates published by the Texas State Data Center will be the primary source of reference for any revision requests, unless planning groups can provide alternate published sources based on a similarly rigorous methodology. In regions where estimates from the Texas State Data Center show that current population growth on a regional level is falling significantly short of growth projected in the 2007 state water plan, some localized adjustments and redistribution of projected populations may be appropriate, but increases to regional totals may not be justifiable.

Some examples of changes to sub-county populations (i.e., cities, utilities, or rural areas) projections that may be justifiable include:

- population estimates of the Texas State Data Center, or other credible sources, are greater than projected populations used in the 2007 state water plan for the year 2010;
- population growth rates for a sub-county area as tabulated by the Texas State Data Center over the most recent five years is substantially greater than growth rates reported by the U.S. Census Bureau between 1990 and 2000;
- cities have annexed additional land since the 2000 Census; or
- water utilities have expanded their service areas since last updated by the Texas Commission on Environmental Quality.

Water Demand Projections

Municipal water demands will be adjusted for water user groups with revised population projections. Similarly, if acceptable data sources indicate that a measured gallons per capita per day from years prior to 2000 is more representative of drought of record conditions, the TWDB will consider formal requests for revisions. Entities may also request changes to water demand projections for other water user groups, including irrigation, livestock, and manufacturing, assuming they provide verifiable supporting data and documentation to their respective planning group and the TWDB. The TWDB is currently engaged in a study with the Bureau of Economic Geology at the University of Texas at Austin to revise and/or verify steam-electric water demands for each planning region. Results of this study should be available by September of 2008; at which time, the TWDB will disseminate results to each planning group for review and comment.

3.0 Existing Water Supplies

Planning groups will reevaluate "existing" water supplies for entities including water user groups and wholesale water providers as defined in statute and administrative rules [31 TAC §357.7(a)(3).[1] An existing water supply is the volume of water available to water user groups and

[1] In addition to material regarding water supplies in this document, planning groups should refer to the TWDB's "*Guidelines for Regional Water Planning Data Deliverables*" for additional information for estimating existing water supplies.

wholesale water providers under drought of record conditions taking into account any physical constraints such as transmission or treatment facilities that would limit supplies *and* any legal or policy constraints. An existing supply must be connected, meaning that it currently has infrastructure for conveying water to water users or it is anticipated that it will be accessible and connected by the conclusion of the current planning cycle. An example of supplies that are "non-connected" would include lakes without connecting pipelines. Evaluations should consider surface water and groundwater data from the 2007 state water plan and 2006 regional water plans, data regarding existing water rights, contracts and option agreements, and/or other planning and water supply studies. Water supplies from contracted agreements should be based on the terms of a contract, which may be assumed to renew upon a contract's termination date if contract holders contemplate renewals or extensions. The amount of water available from existing supplies in future decades assumes that current infrastructure for existing water supplies does not change through time. In addition to reporting existing water supply volumes, planning groups must also identify all water sources in a planning region even if such sources are not connected, but are potentially available for use in the future (see the "*Guidelines for Regional Water Planning Data Deliverables*" for further information).

The current infrastructure associated with existing supplies - excluding internal water distribution systems – should be researched to determine how much water a system can transport, pump, and distribute.

Sources for existing water supplies may include surface waters such as reservoirs and rivers, groundwater, water reuse, and/or a combination of several different sources.

3.1 Surface Water

Planning groups should analyze existing surface water supplies based on firm yield for both reservoirs and surface water diversions. For reservoirs, firm yield is the maximum amount of water a reservoir can provide in a given year during drought of record conditions using reasonable sedimentation rates, and under the assumption that senior water rights holders have their full allotments of water. Planning groups may analyze existing water supplies from reservoirs on operational procedures other than firm yield and may use other methods of determining existing supplies in addition to firm yield with written approval from the TWDB's executive administrator. However*, existing water supply data submitted to the TWDB for incorporation into the state water plan must include firm yield*. Unless the TWDB's executive administrator has approved other models, planning groups should use "Run 3" of Water Availability Models maintained by the Texas Commission on Environmental Quality to estimate firm yields for surface water supplies. The TWDB's executive administrator must approve any modifications to data files used in Water Availability Models for permitted return flows and changed conditions.

When using Water Availability Models for firm yield analyses, the TWDB recommends using an "adding-in" approach where each water right is added into the model one by one beginning with the most senior right. After a water right is added into the model, simulated water supply shortages are evaluated. If a supply shortage exists, the diversion amount of the newly added water right should be reduced until the supply shortage disappears. The next right is added in only when all senior rights have their maximum diversions without supply shortages (capped by their permitted amounts). The process terminates when no further diversions can be added in.

If all water rights have been fully satisfied and a given reservoir still has surplus supply, a hypothetical junior water right should be added, using a uniform monthly distribution that reduces the supply source to zero. The firm yield is the sum of model specified diversions, including extended diversions, of added-in water rights. If applicable, environmental flow requirements including bay and estuary and instream flow requirements should be fully satisfied when modeling “add-in” water rights.

When simulating firm yields for reservoirs, the following criteria must be met if applicable:

1. inflows to reservoirs are the remainder of naturalized stream flows after upstream senior water rights are met;

2. downstream senior water rights must be met; however, this does not require releases of water from a reservoir unless specifically stated in existing water rights;

3. bay and estuary and instream flow requirements should be fully satisfied if permits authorizing a reservoir include such requirements, or if a simulation is for a new water right or proposed diversion;

4. minimum allowable reservoir levels are the top of dead storage;

5. maximum allowable reservoir levels are the top of water supply storage volume for reservoirs with existing water rights, and special conditions of water rights should be honored (this may result in a different minimum and/or maximum allowable reservoir level);

6. evaporative losses are based on evaporation rate data that best coincide with the period of record and time steps for inflows;

7. annual water supply demands are constant values in all years, and the distribution of annual demands within a given year are constant in all years and should consider the different types of water use expected; and

8. time steps should not exceed one month.

Planning groups may modify input data sets for Water Availability Models to reflect return flows specified in water rights permits and other changed conditions; however, planning groups must provide documentation to the TWDB justifying such changes.

For surface water diversions, planning groups should use “firm diversions,” which are the maximum annual diversions in a given year assuming drought of record conditions using reasonable diversion distribution patterns and assuming that senior water rights are met. These amounts should not exceed the infrastructure’s diversion capacity and permit amounts. As is the case with reservoirs, planning groups should use Water Availability Models (Run 3) for surface water diversions unless the TWDB approves other methods. In addition, the TWDB suggests using the same “adding-in” approach for water rights. Firm diversions are the sum of model specified diversions, including extended diversions, of all “added-in” water rights. Parameters of Water Availability Models should not be altered, and environmental flow requirements, if applicable, should be fully satisfied when modeling hypothetical “added-in” water rights.

If relevant, when simulating firm diversions the following criteria must be met:

1. inflows to diversion sites are the remainder of naturalized stream flows assuming upstream and downstream senior water rights are met (during times of drought it is possible that senior water rights will be withdrawn to legal limits either for use, sale, and/or transfer; nevertheless, if planning groups can provide documentation to the TWDB showing a lower demand than legal maximums, they can modify inputs accordingly);

2. bay and estuary and instream flow requirements should be fully satisfied if permits authorizing diversions include such requirements, or if a simulation is for a new water right or proposed diversion;

3. annual diversion amounts are constant values in all years, and the distribution of diversions within a given year are constant and consider the different types of water use expected; and

4. time steps should not exceed one month.

For run-of-river diversions, drought periods begin with unappropriated flows in rivers declining significantly from their normal levels, or above and before their full recovery to normal levels or greater. The drought of record is a period that includes record minimum river channel unappropriated monthly flow rates and begins and ends with unappropriated flows at or above normal levels.

For surface waters bordering neighboring states or countries, planning groups should analyze and report available water supplies taking into account existing legal agreements; and for surface water withdrawals that do not require permits, such as domestic and livestock uses, estimate water available under drought of record conditions based on available information.

Each planning group should also provide both a list of water rights associated with existing surface water supplies and the association between these water rights, the sources and the water user groups, and the associated water volumes. All water used by a water user group must be attributed to one or more existing water supplies and all surface water supplies must be associated with applicable water rights. When water rights are consolidated into one existing surface water supply per basin, a water right included in the consolidation should not also be listed as a right for another existing water supply source. Water rights cannot be counted more than once as a source for an existing supply.

Existing supplies from run-of-river diversions are based on the diversion point or on an aggregate of diversions. List the county-basin of the source diversion point. Run-of-river diversions can be aggregated into a combined run-of-river diversion source type if the aggregated water rights are individually less than 10,000 acre-feet for irrigation or individually less than 1,000 acre-feet for other use categories. Do not list water rights within aggregated run-of-river diversion source types individually. List run-of-river diversions as individual water rights for irrigation permits equal to or greater than 10,000 acre-feet. For all other water uses list the individual water rights if the permit is equal to or greater than 1,000 acre-feet. All other run-of-river diversions may be listed as individual water rights.

For unpermitted supplies, list the source as the sum of unpermitted surface water in the county-basin. Unpermitted supplies may be listed individually as well.

3.2 Groundwater

For groundwater supplies, planning groups should calculate the greatest annual amount of water available from an aquifer without violating the most restrictive physical and/or regulatory conditions limiting withdrawals under drought of record conditions. Regulatory conditions refer to limits on water withdrawals imposed by groundwater conservation districts. When estimating groundwater supplies, planning groups should use TWDB Groundwater Availability Models if available unless better site specific information is accessible. As is the case with surface water supplies, planning groups should document and justify other methods used. If groundwater districts within a groundwater management area have determined the desired future condition for their aquifers, and the TWDB has translated desired future conditions into an estimated managed available groundwater as of January 1, 2008; then planning groups must use these estimates as the basis for existing groundwater supplies.

3.3 Systems

Water supplies can be categorized as systems if they meet one or more of the following criteria: 1) a source includes groundwater and surface water; 2) several reservoirs operate together, but supplies from a specific reservoir cannot be tracked directly to an end user; and/or 3) two or more reservoirs operate as a system resulting in a system gain in firm yield. System gain is the amount of water a system creates that would otherwise be unavailable if the reservoirs were operated independently. For multi-reservoir systems, the minimum system gain during drought of record conditions can be considered additional water available. Total existing water from a system should not exceed the sum of the firm yields of individual reservoirs in a system. Planning groups must adequately describe methods used to calculate system gains. Where special conditions exist, such as in the Rio Grande Project, planning groups may base existing water supplies on operational procedures rather than firm yield. Planning groups must adequately describe special conditions other than the Rio Grande Project in submitted scopes of work. For interstate and international reservoirs, planning groups should report water amounts available to Texas according to existing legal agreements.

3.4 Reuse

Planning groups will quantify existing water supplies from reuse as either direct or indirect. Indirect reuse is process water that reenters rivers or stream systems and is diverted and used again downstream. For indirect reuse, planning groups will use currently permitted reuse projects with infrastructure in place needed to divert and use water in accordance with permits issued by the Texas Commission on Environmental Quality. Potential sources for indirect reuse in the future will require new permits and additional infrastructure. As such, planning groups should consider these as water management strategies, and should explain methods used to estimate the amount of water that such strategies would generate in the future.

Direct reuse is process water recirculated within a given system. For direct reuse, planning groups should use the amount of water from direct reuse sources that they expect will be available during drought of record conditions from currently installed wastewater reclamation infrastructure. These amounts should not exceed the amounts of water available to utilities generating the wastewater. Planning groups should treat potential future sources of direct reuse as water management strategies, and should provide adequate justification to explain methods for estimating the amount of reused water available from such sources.

4.0 Water Management Strategies

Planning groups will reevaluate water management strategies identified in 2006 regional water plans for each water user group and wholesale water provider as defined in statute and administrative rules where future water supply needs exist [31 TAC §357.7 (a) 4-5]. A need for water is present when existing water supplies are less than projected water demands. In addition, each group may recommend new management strategies due to changed physical or socioeconomic conditions. Existing water rights, water contracts, and option agreements should be protected, although amendments to these may be recommended realizing that consent of owners would be needed for implementation.

Planning groups will reevaluate and/or evaluate new and existing water management strategies based on criteria specified in [31 TAC §357.7(a) 7-9, 12] including water quantities generated by strategies, the reliability of strategies, financial costs, and environmental impacts.

For all strategies identified in 2006 regional water plans, planning groups must update financial costs. For remaining criteria, each planning group will determine if physical and/or socioeconomic conditions have changed enough to warrant a reassessment. For any new strategy recommended, all evaluation criteria must be met.

4.1Quantity, Reliability and Financial Costs

4.1.1 Quantity and Reliability

Water quantities produced by recommended surface water management strategies will be based on firm yield as defined in Section 3.1; and water quantities generated by groundwater should be based on groundwater availability as defined in Section 3.2.

4.1.2 Financial Costs

Cost evaluations for new and existing water management strategies will include capital costs, debt service, and annual operating and maintenance expenses over the planning horizon. Reported costs will only include expenses associated with infrastructure needed to convey water from sources and treat water for end user requirements; however, reported costs should not include expenses associated with internal distribution networks outside of treatment plants and major transmission facilities. Planning groups must report capital costs and average annual operation and maintenance costs as separate items in the Regional Water Planning Data Web Interface (see the TWDB's "*Guidelines for Regional Water Planning Data Deliverables*" for further information).

Capital Costs

Capital costs consist of construction funds and other capital outlays including, but not limited to, costs for engineering, contingencies, financial, legal, administration, environmental permitting and mitigation, land, and interest during construction. Construction costs, if applicable, should include expenses for the following types of infrastructure:

- pump stations,
- pipelines,
- water intakes,
- water treatment and storage facilities,
- well fields;
- relocation of existing infrastructure such as roads and utilities; and
- any other significant construction costs identified by each planning group.

Interest during construction is based on total project costs drawn down at a constant rate per month during a construction period. Interest is the total interest accrued at the end of a construction period using a 6.0 percent annual interest rate less a 4.0 percent rate of return on investment of unspent funds. Each planning group should adjust construction cost estimates for existing water management strategies based on the September 2008 price indices for commodities such as cement and steel as reported in the "*Engineering News Record (ENR) Construction Cost Index*."

If applicable, other capital costs include:

- engineering and feasibility studies including those for permitting and mitigation, legal assistance, financing, bond counsel, and contingencies (engineering, contingencies, financial, and legal services should be lumped together and estimated as 30 percent of total construction costs for pipeline projects and 35 percent for other facilities unless more detailed project and/or site specific information is available);

- land and easements costs (easement costs for pipelines should include a permanent easement plus a temporary construction easement as well as rights to enter easements for maintenance); and

- purchases of water rights.

Debt Service

For water management strategies other than reservoirs the length of debt service is 20 years unless otherwise justified. For reservoirs, the period is 40 years. Level debt service applies to all projects, and the annual interest rate for project financing is 6.0 percent. Terms of debt service will be reported in the TWDB's Regional Water Planning Data Interface.

Annual Operating and Maintenance Costs

Operations and maintenance costs should be based on the quantity of water supplied. Unless project specific data are accessible, planning groups will calculate annual operating and maintenance costs as 1.0 percent of total estimated construction cost for pipelines, 2.5 percent of estimated construction costs for pump stations, and 1.5 percent of estimated construction costs for dams. Costs include labor and materials required to maintain projects such as regular repair and/or replacement of equipment. Power costs are calculated on an annual basis using calculated horsepower input and a power purchase cost of $0.09 per kilowatt hour; however, each planning group may adjust this figure based on local and regional conditions if they specify and document their reasons. Planning groups should include costs of water if water management strategies involve purchases of raw or treated water on an annual basis (e.g. leases of water rights).

4.2 Environmental Impacts

Planning groups will evaluate and provide a quantitative reporting of how water management strategies could affect environmental and cultural resources including impacts to environmental water needs, wildlife habitats, cultural resources, and the effects of upstream development on the bays, estuaries, and arms of the Gulf of Mexico. Planning groups are free to develop and document an overall methodology for evaluating impacts; however, for environmental flows, planning groups should use site specific studies when available. If such studies are not available, then planning groups should use the 1997 "*Consensus Criteria for Environmental Flow Needs*" for strategies involving surface water development and those requiring permits from the Texas Commission on Environmental Quality. These criteria were developed through extensive collaboration among scientists and engineers from the state's natural resource agencies including TWDB, the Texas Parks and Wildlife Department, and the Texas Commission on Environmental Quality, as well as academic professionals, engineering consultants, and informed members of the public. More specifically, the criteria are multi-stage rules for environmentally safe operation of impoundments and diversions during above normal flow conditions, below normal flow conditions, and during drought of record conditions. Documentation describing the methodology and its application is available at the TWDB's website: http://www.twdb.state.tx.us/RWPG/twdb-docs/env-criteria.htm.

4.3 Alternative Water Management Strategies

A complete list of evaluated alternative water management strategies will be included in a single table within regional water plans along with each strategy's name, an expected implementation date, the total yield of Water Management Strategy[2] on a decadal basis and the capital costs of the water management strategy. All alternative water management strategies must be evaluated based on criteria specified in [31 TAC §357.7(a)(7-9, 12)].

Planning groups may substitute an evaluated alternative water management strategy for a strategy previously recommended, if the previously recommended strategy is no longer feasible. Proposed alternatives should not result in water supplies that exceed 125 percent of identified water needs for a given water user group for which an alternative is recommended taking into

[2] See *Guidelines for Regional Water Planning Data Deliverables*

account other strategies already recommended for the same water user group. Planning groups must submit proposed alternative strategies to the TWDB for approval by the executive administrator. If a planning group can demonstrate that there is good cause for a requested alternative to exceed the 125 percent limit, then the executive administrator may issue a written waiver, [31 TAC §357.7(a)(7)(H)].

5.0 Impacts of Water Management Strategies on Key Water Quality Parameters in the State and Impacts of Moving Water from Agricultural and Rural Areas

Each planning group must describe how implementing recommended and alternative water management strategies could affect water quality in Texas. Planning groups should base water quality impacts on parameters important to water uses in each region. Planning groups will also discuss how water management strategies could affect: 1) agricultural resources including analyses of third-party impacts of moving water from rural and agricultural areas; 2) water resources of the state including groundwater and surface water interrelationships; and 3) other factors deemed relevant by planning groups such as recreational impacts. Furthermore, planning groups should consider statutory provisions regarding interbasin transfers of surface water [TWC §11.085]. At minimum, considerations should include a summation of water needs in basins of origin and receiving basins based on water needs in approved regional plans.

6.0 Water Conservation and Drought Management Recommendations

When evaluating and recommending water management strategies, each planning group will consider “active” water conservation as potentially feasible water management strategies for water user groups for which [TWC §11.1271] applies and must consider active water conservation strategies for water user groups with needs. Active water conservation strategies are those that conserve water over and beyond what would happen anyway as result of “passive” water conservation measures that stem from federal and state legislation requiring more efficient plumbing fixtures in new building construction. If a planning group does not adopt active water conservation strategies to meet needs, they must document their reasons. In addition, planning groups should include active water conservation strategies for water user groups or wholesale water providers that will obtain water from new interbasin transfers.

Planning groups must also consider drought management strategies for identified water needs, and whenever applicable, drought management strategies should be consistent with guidance provided by the Texas Commission on Environmental Quality [TWC §11.1272]. Drought management strategies decrease short-term peak water requirements. Strategies for drought management are similar to those for water conservation, although there are some basic differences. For example, water conservation and drought management strategies differ in their longevity. Water conservation strategies are generally implemented on a permanent basis, whereas drought management practices are implemented during times of severe drought or other emergencies that can limit water supplies. If a planning group does not select drought management as a water management strategy, they must document the reason.

7.0 Descriptions of how Regional Water Plans are Consistent with the Long-term Protection of the State's Water, Agricultural, and Natural Resources

Planning groups should describe how regional water plans are consistent with the long-term protection of Texas' water, agricultural, and natural resources including the requirement that planning analyses and recommendations honor all existing water rights and contracts. Although much of the analysis pertaining to this requirement will be developed for other tasks, including tasks associated with estimating the environmental and water quality impacts of water management strategies, planning groups are encouraged to identify the specific resources important to their planning areas and describe how these resources are protected through the regional water planning process.

8.0 Unique Stream Segments and Reservoir Sites and Other Legislative Recommendations

8.1 Unique Stream Segments

Planning groups may recommend all or parts of river and stream segments in their respective regions as having "unique ecological values". To recommend a designation, planning groups must justify it based on the following criteria:

- biological function measured as stream segments displaying significant habitat value including both quantity and quality considering degrees of biodiversity, age, and uniqueness including terrestrial, wetland, aquatic, or estuarine habitats;

- hydrologic function measured as stream segments fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;

- riparian conservation areas measured as stream segments fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments fringed by other areas managed for conservation purposes under governmentally approved conservation plans;

- high water quality, exceptional aquatic life, high aesthetic value and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; or

- threatened or endangered species and unique communities defined as sites along streams where water development projects would have significant detrimental effects on state or federally listed threatened and endangered species, and sites along streams significant due to the presence of unique, exemplary, or unusually extensive natural communities.

Planning groups seeking a designation should forward a recommendation package to the Texas Parks and Wildlife Department, who will in turn provide a written evaluation of the proposal within 30 days. Packages should contain a description of a site's location along with maps, photographs, and documentation with supporting literature and data that characterizes a site's unique ecological value. Adopted regional water plans should include, if available, the Texas Parks and Wildlife Department's written evaluation.

If the Texas Legislature designates a stream or river segment as unique; or if a planning group recommends that a stream or river segment be classified as unique, each planning group must quantitatively assess how recommended water management strategies in a regional plan would affect flows deemed important (by planning groups) to the stream or river segment in question. Furthermore, assessments should describe how a regional plan would affect the unique features cited by a region as the impetus for a legislative designation.

8.2 Unique Reservoir Sites

Planning groups may recommend sites for reservoir construction that have "unique value" by including a description of the site, reasons for the unique designation and expected beneficiaries of water supplies developed at a given site. The following criteria should be used to determine if a site is unique:

- site specific reservoir development is recommended as a specific water management strategy or as an alternative long-term scenario in an adopted regional water plan; or
- factors such as location, hydrologic, geologic, topographic, water availability, water quality, environmental, cultural, and current development characteristics make a site uniquely suited for either reservoir development to provide water supply for the current planning period; or where it might reasonably be needed to meet water needs beyond the 50-year planning period.

8.3 Other Legislative Recommendations

Planning groups may compile regulatory, administrative, or legislative recommendations that will facilitate the orderly development, management, and conservation of water resources in Texas, and will help the state prepare for and respond to droughts. In addition, they may develop information regarding the potential impacts of recommendations enacted into law once proposed changes are in effect.

9.0 Reporting of Financing Mechanisms for Water Management Strategies

Planning groups will assess how local governments, regional authorities, and other political subdivisions would finance the implementation of water management strategies via a formal survey administered by TWDB and executed by each planning group. TWDB will develop a survey instrument and methodology. Each planning group will conduct a survey and report findings to TWDB. TWDB will provide additional instructions and documentation describing the survey methodology and formats for reporting resultant data.

10.0 Adoption of Plan and Public Participation

Planning groups will adopt regional water plans and allow for public participation in the plan adoption process in accordance with administrative rules and statute and allow for public participation.

11.0 Deliverables

11.1 Written Reports

Planning groups will update the contents of 2006 regional water plans with new information and analyses conducted as part of the current planning cycle. As was the case for the last planning cycle, initially prepared and adopted regional water plans or amendments to approved regional water plans should include a technical report containing chapters describing each task summarized in this document; an executive summary documenting key findings and recommendations that does not exceed 30 pages.The 2011 regional water plan should also include a minimum of a one-page summary of each of the region-specific studies performed during phase I of this third round of regional water planning that describes the region-specific study, results, and whether and/or how each region-specific study was incorporated into the regional water plan. Appendices deemed appropriate by planning groups may also be included.

In addition, each regional water plan must include in its chapter describing water management strategies (Task 4): a list of all potentially feasible water management strategies; and, a single table listing all recommended water management strategies including the strategy names, implementation dates, total yield of Water Management Strategy[3] by decade, total capital costs, and the estimated unit water costs in both the first and last planning decades of implementation, correlated to DB12 as closely as possible. This table of recommended water management strategies will contain the same information fields that are presented in Appendix 2.1 of the 2007 State Water Plan. Similarly, each regional water plan must report in the same chapter all alternative water management strategies (as described in Section 4.3 of this document) considered for substitution listing the same criteria. Other documentation should include: 1) model water conservation plans pursuant to [TWC §11.1271]; 2) model drought contingency plans pursuant to [TWC §11.1272]; and 3) summaries of written and oral comments from the public during the plan adoption process with responses by planning groups explaining how plans were revised or why changes were not warranted.

11.2 Regional Water Planning Data Reporting

Planning groups must submit data generated or updated during the current round of planning to TWDB in accordance with TWDB specifications *prior to* submitting initially

[3] See *Guidelines for Regional Water Planning Data Deliverables*

prepared regional water plans. Data must be entered through the TWDB's Regional Water Planning Data Web Interface at http://www.twdb.state.tx.us/apps/db12. Specifications regarding data requirements, format, calculation, and composition are available on TWDB's website.

ATTACHMENT A

TWDB Comments on Initially Prepared 2011 Region M Regional Water Plan

LEVEL 1. Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

General Comment

1. Pages in the hard copies of the initially prepared plan do not match the pages in the electronic version of the initially prepared plan (e.g. page 4-26 in the hard copy corresponds to page 4-21 in the electronic version). Please ensure that all the final hard copies and electronic copies of the plan are identical.
    - *Final copies and electronic copies are now identical*

2. Please include a Table of Contents at the front of the plan that covers the entire plan contents including appendices.
    - *Table of contents has been included in final plan*

3. In accordance with the outcome of Region-Specific Study No. 2, please revise throughout plan all references to each irrigation district to consistently and accurately reflect their TWDB-approved designations (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010) either as a) wholesale water providers or b) as a subset of the water demands indirectly covered by various county irrigation water user groups. Please clarify in the plan that no irrigation districts are designated as stand-alone irrigation 'water user groups' and that, because of non-synchronous boundaries, no irrigation district water demand projection aligns with any designated county irrigation water user group water demand projection.
    - *This has been finalized throughout the plan and a copy of Special Study 2 is in the Appendix.*

Executive Summary

4. Please provide an Executive Summary in the plan. *[Title 31 Texas Administrative Code (TAC) §357.10(a)(2); Contract Exhibit "C" Section 11.1]*
    - *Posted on website and in Spanish*

Chapter 1

5. Please include one-page summaries of the region-specific studies performed during phase I of this third round of planning including a description of whether and/or how each region-specific study was incorporated into the regional water plan. *[Contract Exhibit "C" Section 11.1]*

The one-page summaries have been included along with a general introduction to all three summaries. They can be seen under section 1.5.4 and subsections 1.5.4.1, 1.5.4.2, and 1.5.4.3 in the Final Plan.

6. Page 1-48, Table 1.6: Table 1.6 only includes an apparent listing of Water User Groups that includes some Wholesale Water Providers. Table 1.6 does not label Wholesale Water Providers anywhere as a distinct group. Please provide in the plan the accurate and complete listing of TWDB-approved wholesale water providers (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010). *[31 TAC §357.7(a)(1)(A)]*
   - ***A table listing Wholesale Water Providers has been added. It is listed as table 1.6 and on page 1-50 with accordance to Special Study No. 2.***

7. Page 1-48, Table 1.6: Table 1.6 includes does not label Water User Groups as a distinct group. Please provide in the plan the accurate and complete listing of water user groups. *[31 TAC §357.7(a)(1)(A)]*
   - ***A table listing Water User Groups has been added. It is listed as table 1.6 and is displayed on page 1-50. It is a listing of Irrigation Districts as subsets of the Irrigation WUGs and is in accordance with Special Study No. 2.***

8. Page 1-48, footnote 12: Please provide in the plan the correct reference to the results from the Region-Specific Study no. 2, amendment no. 1 that individual irrigation districts are *not* classified as water user groups but rather may be addressed as subset of any associated county irrigation water user group(s) (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010). *[Contract Exhibits "C" and "D"]*
   - ***The correct reference has been provided and it can be seen below. The footnote refers to Table 1.6 which is displayed on page 1-50 in Final Plan.***
     Individual irrigation districts are not classified as water user groups but rather are addressed as subset of the associated county irrigation water user group (per Amendment no. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010.)

9. Page 1-49, paragraph 1: Please provide in the plan the appropriate separate and distinct definitions of a water user group and of a wholesale water provider. *[31 TAC* §357.2*]*
   - ***The appropriate definitions of water user groups and wholesale water providers have been added to Chapter 1 and are distinctively defined. These definitions can be found on page 1-50 and continues onto page 1-51.***

10. Pages 1-62, 3-44 (paragraph 1); Section 8.3.1, page 8-11, second bullet: Please incorporate relevant information into the plan from the Phase One,

Region-Specific Study No. 1 regarding the water accounting issues at Ft. Quitman. *[Contract Exhibit "C" Section 11.1]*

- ***Relevant information has been included regarding the water accounting at Ft. Quitman and is listed in section 1.13. For reference, the initial section is displayed below followed by the revised section. Additionally, a footnote listed as number 13 has been added to the title it states that :*** Information on Water Accounting at Fort Quitman came from "Special Study No. 1: Evaluation of Alternate Water Supply Management Strategies Regarding the Use and Classification of Existing Water Rights on the Lower and Middle Rio Grande."

<u>Chapter 2</u>

11. Please present in the plan TWDB-approved population and water demand projections for categories of use for wholesale water providers considering counties and river basins, including information on contractual obligations and demands. *[31 TAC §357.7(a)(2)(B)]*
    - ***A table listing water demand projections, and contractual obligations for Wholesale Water Providers has been inserted Chapter 2 in Attachment 2-1 in Table 2.21 on page 2-21.***

12. Page 2-5, Table 2.2: Please provide in the plan a breakdown of population by cities with populations greater than 500 people and by retail public utilities. *[31 TAC §357.7(a)(2)(A)]*
    - ***A table listing populations by cities and Water User Groups have been inserted Chapter 2 in Attachment 2-1 on pages 2-6 through 2-9.***

13. Page 2-5, Table 2.3 (and Attachment 2-1): Please provide in the plan water user group population projections that are broken out by both county and river basin. *[31 TAC §357.7(a)(2)(A)(iv)]* (Upon request, this data can be provided in the required format by TWDB.)
    - ***Eight tables that show Water User Group population projections with respect to county and river basin have been included in Chapter 2. These tables show the aforementioned information and are broken out into Cameron, Hidalgo, Jim Hogg, Maverick, Starr, Webb, Willacy, and Zapata County. They are listed as Tables 2.3 through 2.10 and can be found on pages 2-6 through 2-9.***

14. Page 2-8, Table 2.4; page 2-22, Attachment 2-1 first table; and pages 2-24 to 2-27, Attachment 2-1 table: All municipal water demand projections presented appear to be <u>total</u> water demands. Please provide in the plan the appropriate TWDB-approved <u>*net*</u> water demand

projections for all municipal water use categories broken out by both county and river basin. *[31 TAC §357.5(d)(1) and (2)]*

- ***All total water demands have been changed to net water demands in all the tables mentioned above. Also, all tables were expanded and, now, list counties and river basins. The finalized tables can be found on pages 2-12 and in Attachment 2-1***

15. Page 2-14, Table 2.9: Plan text refers to the TWDB-approved total irrigation water demand of 981,749 in 2060. Table 2.9 shows total 2060 irrigation water demands of 1,274,020 acft/yr for 2060. Please reconcile numbers throughout plan in accordance with TWDB-approved irrigation water demand projections.
    - ***Irrigation totals have been changed from their previous demands to the TWDB approved irrigation demands. These figures can be seen on pages 2-2 and 2-16 in the final plan.***

16. Page 2-11, Figure 2.8: Plan text refers to the TWDB-approved total irrigation water demand of 981,749 acft/yr in 2060 per Figure 2.8. Figure 2.8 does not show 981,749 acft/yr for 2060 but rather 1,274,020 acft/yr. Please reconcile numbers throughout plan in accordance with TWDB-approved irrigation demand projections.
    - ***Irrigation demand projections have been changed in accordance with TWDB approved total irrigation water demands. This can be found in the revised Figure 2-8 on page 2-16.***

17. Pages 2-12 and 2-13; Tables 2.6, 2.7, and 2.8; and Attachment 2-1, page 2-24: Please provide in the plan TWDB-approved irrigation water demands that are broken out by both county and river basin. *[31 TAC §357.7(a)(2)(A)(iv)]* (Upon request, this data can be provided in the required format by TWDB.)
    - ***The three aforementioned tables are derived from Special Study No. 2 and are now broken out into both county and river basin. These can be found in Table 2.14, Table 2.15, and Table 2.16 on pages 2-17 through 2-19.***

18. Page 2-13: Please provide in the plan water demand projections and population projections broken out for the newly added irrigation district Jim Hogg WCID2 and Union WSC. *[Contract Exhibit "A" Task 2.3]*
    - ***The requested information will not be included in Final Plan.***

19. Page 2-20: Please provide in the plan water demand projections for potential ethanol production plants and on a county-by-county basis. *[Contract Exhibit "A" Task 2.5]*
    - ***Study was conducted on the respective matter and did not yield any suitable or feasible potential ethanol plants in Region M.***

Needless to say, water demand projections for potential ethanol production plants were not incorporated into the plan. However, additional information was added to the respective matter from comments from Texas A&M professor Ron Lacewell.

20. Attachment 2-1, pages 2-24 and 2-25: Municipal water demands for Cameron County do not appear to be summed correctly (e.g. 90,566 acft/yr for 2010 county total; sum is actually 88,676 acft/yr); and do not appear to match Cameron County demands listed in Table 2.4, page 2-8 (e.g. 89,555 acft/yr for 2010). Please revise to reflect TWDB-approved demand projections for Cameron County municipal totals (e.g. 88,690 acft/yr for 2010) as required. *[31 TAC §357.7(a)(2)(A)(iv)]*
    - ***The requested changes were made and the revised tables are included in Chapter 2. Attachment 2-1 has been corrected and can now be seen on page 2-37.***

21. Attachment 2-1, page 2-26: Attachment 2-1 does not include Jim Hogg County municipal water demand projections. Please include in the plan Attachment 2-1 table municipal water user group water demand projections for Jim Hogg County. *[31 TAC §357.7(a)(2)(A)(iv)]*
    - ***Jim Hogg County municipal water demand projections have been added into the attachment. The respective table can be seen on page 2-39.***

<u>Chapter 3</u>

22. Based on the data in the online planning database, Amistad-Falcon Reservoir appears to be over allocated by 5,111 acft/yr in 2010 and 139,798 acft/yr in 2060. Please revise the plan to acknowledge the volume by which Amistad-Falcon Reservoir is over allocated in each planning decade and to show, quantitatively, how this total over allocation will be resolved in each decade between water user categories in practice (e.g. by voluntary redistribution between municipal and irrigation users). This reallocation may be shown quantified at an aggregate level for irrigation users only. Or, alternatively, revise the plan and online planning database to remove this water source over allocation. *[31 TAC §357.7(a)(3)(A)]*
    - ***Graphs and tables showing overallocation of Amistad-Falcon water have been inserted into Chapter 4 in Table 4.21, which can be found under 4.3.1.1.***

23. The plan does not clearly present or account for the volume of reallocations of existing water supplies that provide the water source for significant recommended municipal water management strategies in the plan. Reallocations of existing water supplies for recommended water management strategies do not appear to be accounted for against the

current water users as either upfront reductions to their existing supplies or as 'negative' water management strategies (i.e. reallocations of existing water supply away from a water user group category during plan implementation). Either approach will increase identified water needs unless sufficient surplus supplies are available to reallocate. Please revise the plan to clearly quantify and present these anticipated water supply reallocations, for each water source, by decade, and by water use category. For each water source (e.g. Amistad-Falcon Reservoir), the reallocations of supplies away from existing water users may be shown as an aggregate volume for irrigation water users but should be broken out for each individual municipal water user group. The information presented should clearly account for all water reallocations (away from and/or to water users) by decade. *[31 TAC §357.7(a)(3)(A)]*

- ***Information was inserted into Chapter 4 pertaining to reallocations of Amistad-Falcon water once WMS were implemented. This information can be found in Figure 4.10 and Table 4.22.***

24. Please include one-page summaries of the region-specific studies performed during phase I of this third round of planning including a description of whether and/or how each region-specific study was incorporated into the regional water plan. *[Contract Exhibits "A" Task 3.1 and "C" Section 11]*
    - ***One-page summaries have been included into Chapter 3 along with a general introduction to all studies. They are located under section 3.8 and subsections 3.8.1, 3.8.2, and 3.8.3.***

25. Please provide in the plan revised water supply availability numbers due to the inclusion of a new source of water from the Hidalgo County Drainage District. *[Contract Exhibit "A" Task 3.2]*
    - ***This project has been moved under a new heading in chapter 4 "Strategies Considered but Not Fully Evaluated," which can be found in section 4.9.1 on page 4-106. This will not be a new source of water at this time until further evaluation is done.***

26. Please provide in the plan water supply projections associated with the implementation of the Falcon-Matamoros pipeline project. *[Contract Exhibit "A" Task 3.3]*
    - ***Text has been included into Chapter 3 section 3.10, stating there is no water supply availability information at this time.***

27. Please discuss in the plan any considerations of the management plans of the four confirmed Groundwater Conservation Districts (Brush Country, Kenedy County, Red Sands, and Starr County) located within Region M. *[31 TAC §357.5(k)(1)(D)]*

- ***A discussion mentioning these considerations has been included into the plan. There are brief discussions of each district including their location and any current activity they might be having at this time. It can be found under section 3.6.***

28. Page 3-3, Section 3.2.6: Please include the San Felipe Springs Report that is reference on page 3-36 in the plan in accordance with the placeholder statement.

- ***A one-page summary of the San Felipe Springs Report has been incorporated into Chapter 3 and the final full report is located in the appendix.***

29. Pages 3-60, 3-61, and 3-64; Tables 3.9, 3.10, and 3.11: Please provide groundwater availability volumes for each water use category as well as for each water user group by county and basin location. *[31 TAC §357.7(a)(3)(D); Contract Exhibit "C" Section 3.0]*

- ***The requested changes were made to the three tables and a new table that deals with projected groundwater from "Other Aquifer" was added. The three revised tables can be found on pages 3-67, 3-69, and 3-73. In Attachment 3-1 there can be found Groundwater Availability broken down by WUG into county and basin location.***

30. Pages 3-75 through 3-89, Section 3.7: Please provide in the plan surface water availability volumes broken out for each water use category as well as for each water user group by county and basin location. *[31 TAC §357.7(a)(3)(F)(i)-(iv);§357.7(a)(3)(G); Contract Exhibit "C" Section 3.0]*

- ***The requested information was incorporated into a table and was integrated into the report. It can be found in section 3.7.1. Also water availability volumes for each WUG are broken down into county and basin location.***

<u>Chapter 4</u>

31. The plan does not accurately present the volume of identified water needs (e.g. irrigation) that will occur either because of reallocations of existing water supplies to recommended water management strategies or because of the reallocating water supply between water user groups from Amistad-Falcon Reservoir. Depending upon how the plan addresses the over allocation of Amistad-Falcon Reservoir and how reallocations of existing water user group supplies are accounted for, please update and present identified water needs for each decade. For each water source (e.g. Amistad-Falcon Reservoir), the reallocations of supplies away from existing water users may be shown as an aggregate volume of water

need for irrigation water users but should be broken out and presented for each individual municipal water user group. *[31 TAC §357.7(a)(4)(A)]*

- ***The information above can has been inserted into the Final Plan in section 4.3.1.1.***

32. The plan does not present the volume of irrigation needs that would remain unmet in each decade after all recommended water management strategies are implemented. Based on the data in the plan and online planning database, and without resolving the over allocation of Amistad-Falcon Reservoir, it appears that unmet irrigation water needs could exceed 279,000 acft/yr in 2010 and 85,000 acft/yr in 2060. If the over allocation of Amistad-Falcon reservoir is resolved through the reallocation of water supply from irrigation to municipal use, the unmet irrigation needs would exceed 225,000 acft/yr in 2060. Please revise the plan to quantify and present all unmet water needs, by decade and by water use category and explain why the needs could not be met. Unmet irrigation needs may be presented as an aggregate volume for irrigation water users, by decade. *[31 TAC §357.7(a)(5)(C)(i)]*

- ***Table. 4.23 shows unmet water needs for irrigation when reallocating water from irrigation to municipal use, due to implementation of WMS. This can be found under section 4.3.1.2***

33. Please quantitatively report third party social and economic impacts from voluntary redistributions of water from rural and agricultural areas. *[31 TAC §357.7(a)(8)(G)]*

- ***This information has been inserted into Chapter 4 and can be found in section 4.3.1.3.***

34. Capital costs were not prepared in accordance with Exhibit "C" guidelines (e.g. annual costs were summed to estimate capital costs). Please revise capital costs to comply with required costing methodology requirements (including those for Section 4.8) *[31 TAC §357.7(a)(8)(A)(i); §357.7(a)(9); Contract Exhibits "A" Section 4.1 and "C" Section 4.1.2]*

- ***The requested changes have been made; capital costs have been fixed based on Exhibit "c" guidelines and corrected. These changes are manifested throughout Chapter 4 and in the Database. The methodology of the capital costs were approved by TWDB.***

35. Provide a list of potentially feasible water management strategies that were considered and evaluated by the planning group. *[Contract Exhibit "C" Section 11.1]*

- ***A list of WMS that have been evaluated has been inserted into the report. The respective list can be found under section 4.3.***

36. Please include table summarizing all recommended water management strategies with associated water supplies presented by decade and capital costs. *[Contract Exhibit "C" Sections 4.3, 11.1]*
    - ***A summary table has been included with updated water supplies and their associated capital costs into Chapter 4. It is listed as Table 4.19.***

37. Please include a table listing alternative strategies with associated water supplies presented by decade and capital costs, if alternative water management strategies were included by the planning group. *[Contract Exhibit "C" Sections 4.3, 11.1]*
    - ***A list of alternative strategies has been incorporated into the plan; this list is presumably the same as the recommended WMS. It can be found under section 4.10.***

38. Please provide in the plan the technical evaluation of the new water management strategy referred to as the Hidalgo Water Supply project, including strategy description, water supply yields and implementation schedule, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.3.d]*
    - ***This project will have no technical evaluation, it was rearranged accordingly in the plan; it is under the "Strategies Considered but Not Fully Evaluated" section because there was no firm outcome of the evaluation.***

39. Please describe in the plan the development of alternative strategies for entities whose recommended water management strategies may become infeasible; including invasion of aquatic weeds and treaty noncompliance for Mexico's water deliveries to the United States. *[31 TAC §357.7(a)(7)(H); Contract Exhibit "A" Task 4.5]*
    - ***The requested information can be found in Chapter 4 under section 4.10. A paragraph has been inserted describing an alternative strategy along with how to and why an entity would want to implement an alternative strategy. This information can be located in Chapter 4 in section 4.10 on page 4-112. The strategies listed are presumably the same as the recommended WMS.***

40. Please include information on how the plan explored opportunities and benefits of regional water supply facilities or providing for regional management of water facilities. *[31 TAC §357.5(e)(6)]*
    - ***The requested information has been incorporated into the report in section 4.1 beginning on page 4-9. This section refers to the benefits of bringing presentations by entities to the board members and also it is describing the new explored water supply facilities in the region.***

41. Please present in the plan for each identified water user group with a need the water management strategy and associated water supply volumes that were identified to meet each need or identify if the need is recommended to be unmet. *[31 TAC §357.7(a)(5) and §357.7(a)(8)]*
    - ***The requested information has been referenced in Chapter 4 as Attachment 4-1.***

42. Pages 4-14 and 4-15: The irrigation surplus/needs totals do not match between Tables 4.13 (e.g. 2010 total need is 410,637 acft/yr) and 4.14 (e.g. 2010 total need is 518,560 acft/yr). Please reconcile numbers as appropriate in plan in accordance with TWDB-approved irrigation demand projections.
    - ***Table 4.13 has been updated and changed to match the total irrigation surplus/needs and is shown on page 4-22. The respective footnote has been added to Table 4.14 and references Special Study No. 2.***
    -

43. Page 4-15, Table 4.14: Please provide in the plan irrigation district surplus/deficits broken out by county and river basin. *[31 TAC §357.7(a)(4)(A)(iv)]*
    - ***The table was revised and now includes county and river basin information, with reference to Special Study No. 2. This table has been inserted into Chapter 4 and can be found in section 4.2.3.***
    -

44. Page 4-25, Table 4-19, row 2: Please provide in the plan the technical evaluation of the new water management strategy regarding transfer of reservoir storage from one user to another based on need, including strategy description, water supply yield, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.3.c]*

This comment refers to the WMS Banco Morales Reservoir, which can be found under section 4.5.8.4. The existing WMS "Reallocation of Storage in the Amistad-Falcon Reservoir System" is now under section "Water Management Strategies Not Reevaluated from the Previous Plan and Not Recommended" and can be found under section 4.8.8.

45. Pages 4-48 and 4-49; Table 4.30, 4.31, 4.32: Please describe in the plan how advanced water conservation practices were considered for each of the water user groups with identified water needs and provide the specific conservation practices that were identified for each water user group with an identified water need. If evaluated, please present the associated conservation water management strategy supplies and costs by each water user group with identified needs. In addition, language in this section should be updated to reflect the current time frame (for example,

by revision of the sentence stating that "However, the DOE's mandate does not take effect until 2007.") *[31 TAC §357.7(a)(7)(A); §357.14(2)(B)]*

- ***The requested information has been incorporated into the plan under section 4.5.4.2. This information was based on population projections for each WUG.***

46. Pages 4-75 through 4-94: Please clarify whether water management strategies listed in Section 4.8 are recommended and revise plan accordingly. *[31 TAC §357.7(a)(8)]*
    - ***This section has been revised accordingly; the respective strategies were not reevaluated from the previous plan and, thus, are not recommended.***

47. Page 4-118, Section 4.11: Please provide in the plan the technical evaluation of the new water management strategy(s) for meeting the needs of Ethanol Production Plants, including strategy description, water supply yields, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.6]*
    - ***Ethanol Production Plants was a recommended WMS; a study was conducted on the respective matter and did not yield any suitable or feasible potential ethanol plants in Region M. Therefore, the respective subject was moved and is now under the section "Strategies Considered but Not Fully Evaluated." This can be found in section 4.9.3.***

Chapter 5

48. Page 5-4: Plan does not clearly present the volume of water that would be shifted from agricultural areas (e.g. for irrigation) to municipal use and does not quantitatively report the associated impacts to agricultural resources. Please quantify the volume of water that the plan allocates from irrigation use to municipal use during a drought of record and quantify the impacts (e.g. acreage of irrigated agriculture) to agricultural resources. *[31 TAC §357.7(a)(8)(A)(iii)]*
    - ***This information was incorporated into Chapter 5 and can be found under section 5.2. A table summarizing the volume of water allocated from irrigation to municipal has been inserted and found in table 5-3.***

Chapter 6

49. Please include a summary of information regarding water loss audits specific to Region M. *[TAC 31§ 357.7 (a)(1)(M)]*
    - ***A comprehensive summary has been included on water loss audits specific to Region M. It can be found under the section 6.5.1 on page***

6-7. Information was obtained from the Texas Water Loss Audit Report.

Chapter 7

50. Please explain how the region considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder pursuant to Texas Water Code §11.139. *[31 TAC §357.5(i)]*
    - ***The requested information was incorporated into the report in the form of a paragraph and can be found in section 7.1.1 on page 7-2. Information was received on this matter from the TCEQ website on operating reserve.***

51. Page 7-2, Section 7.2, first paragraph: Plan statement that "In the long run, total water savings associated with both strategies would allow irrigators to offset water supply deficits." appears incorrect based on the data in the plan and online planning database, which currently shows 85,000 acft/yr of unmet water needs in 2060; after implementing all recommended water management strategies. Please revise statement as appropriate.
    - ***The requested changes were made and are now incorporated into the report. The sentence mentioned above was revised accordingly and can be found in section 7.2 and on page 7-2.***

52. Page 7-2, paragraph 3: It appears in the text that the 2020 or 2030 decade "…irrigation water supply deficit of over 410,000ac-ft/yr…to 210,000ac-ft/yr by 2060" does not match the referenced irrigation supply/deficit summary table on the 1st page of the unlabeled appendix (-657,117 acft/yr in 2020; -592,920 acft/yr in 2030; -553,468 acft/yr in 2060). Please reconcile volumes throughout plan as appropriate.
    - ***The requested numbers have been reconciled throughout the plan and can be seen on page 7-2.***
53. Page 7-2, paragraph 3: Text states that the "conveyance system improvements could yield savings of 243,000ac-ft" does not match the referenced summary table on the first page of the unlabeled appendix (conveyance system conservation yield = 218,783 acft/yr). Please reconcile volumes throughout plan as appropriate.
    - ***These figures have now been changed in the plan. The updated change can be found on page 7-2.***

LEVEL 2. Comments and suggestions that might be considered to clarify or enhance the plan.

General

1. Please consider providing titles and identification numbers for all tables, figures, appendices, and attachments in the plan.
   - ***Titles have been inserted into all appropriate places.***

2. Please consider updating the information throughout the plan to reflect information associated with the current third round of regional planning. (examples: page 1-3, paragraph 1; page 1-39, paragraph 1; page 1-49, paragraphs 1 and 3; page 8-7, paragraph 4; etc.)
   - ***Information on third round planning has been inserted into the plan.***

Chapter 3

3. Section 3.6, pages 53-64; Tables 3.9, 3.10 and 3.11: Please consider indicating which TWDB-run Groundwater Availability Model Reports, if any, were used to develop the projected tabular groundwater availability values. Also, please consider noting that the Carrizo-Wilcox Aquifer GAM has been superseded by the Queen City/Sparta GAM, which includes the Carrizo-Wilcox Aquifer.
   - ***Information on this matter was not inserted into the plan***

Chapter 7

4. Page 7-2, paragraph 1; and throughout (other examples - page 4-32, paragraph 3; page 4-72, paragraph 2): Please consider clarifying the 2-to-1 ratio is the conversion ratio is for *Class A* irrigation water rights to DMI water use and that the *Class B* irrigation rights require a 2.5:1 conversion ratio.
   - ***This information has been revised throughout the plan***

Appendix

5. Please divide the generic "appendix" at the end of the plan as discrete individual appendices based on specific content and relevance to plan chapters and identify and label appendices content appropriately. Please reference appendices appropriately in the plan text and table of contents.
   - ***Numbering systems for the appendices were included into the plan.***

Board Member Comments

Chapter 4: Identification, Evaluation, and Selection of Water Management Strategies Based On Needs

1. Develop a new Water Management Strategy "Improving Water Distribution". Include Elsa Elevated Storage Tank and Improving Water Distribution in that category
- ***This was included in Chapter 4 under section 4.5.9.***

2. Include table in Chapter 4 showing cost summary information for Water Management Strategies.
- ***A table summarizing cost information is in Table. 4.19.***

3. Develop new Water Management Strategy "Dams, Weirs, and Storage". Include Brownsville Weir, Laredo Low Water Weir, Resaca Restoration, and Banco Morales Reservoir.
- ***A new section WMS has been inserted into the plan under section 4.5.8.***

4. Develop new component of "Dams, Weirs, and Storage" and include Resaca Restoration and Banco Morales Reservoir.
- ***A new section WMS has been inserted into the plan under section 4.5.8.***
-

5. Prepare a document describing the minimum amount of information required to include in a new WMS. Document should be placed as an attachment in Chapter 4.
   - ***This information can be seen in Chapter 4 under Attachment 4-2.***

6. Add list of projects in the Region and list in Chapter 4
- ***This can be found in Chapter 4 on page 4-135.***

7. 4.5.7.1-Take out "flow otherwise"
- ***This comment has been incorporated into the plan under section 4.5.7.1.***

Chapter 8: Unique Stream Segments/Reservoir Sites/Legislative Recommendations

1. Section 8.3.1. Give examples of what unique circumstances are (i.e. high population, Mexico Treaty, lowest rainfall)
- ***More examples of unique circumstances were incorporated into Section 8.3.1.***

2. Section 8.3.1. Add an additional bullet under state issues reading: "The region is projecting a shortage in water supply in the coming future. There

are limitations for funding, but to overcome this we need more state assistance."

- ***An additional bullet has been incorporated into the plan. It is now listed under bullet number 2 under State Issues.***

3. 8.2.2. Change Webb County Low Water Dam to Laredo Low Water Weir
   - ***This change has been made and is found under section 8.2.2.***

4. 8.3 Assign numbers to legislative recommendation instead of bullets
   - ***Numbers have been assigned to Legislative Issues in Chapter 8.***

5. Last bullet should be first bullet and highlighted under State Recommendations
   - ***This bullet has been highlighted in the plan and is now listed under number 1.***

6. Page 8-10 Under Recommendations on Nation, 1st bullet, change "should be" with "will be"
   - ***This change has been incorporated on Page 8-10, it is now "will be."***

7. Page 8-10 last bullet, remove "currently underway" and replace it with "authorized"
   - ***The last bullet which is now number 11, has been changed from "currently underway" to "authorized".***

8. 8.3 Change title to "Regulation, Administration, or Legislation Issues"
   - ***The title has been changed to "Regulation, Administration, or Legislation Issues"***

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Ecological Services - LRGV SubOffice
Phone: (956) 784-7560 Fax: (956) 787-8338
Rt. 2 Box 202-A
Alamo, TX 78516
June 28, 2010

Mr. Kenneth N. Jones
Executive Director, LRGVDC
311 N. 15th Street
McAllen, Texas 78501-4705

Consultation No. 21410-2010-TA-0406

Dear Mr. Jones:

This responds to your Rio Grande Regional Water Planning Group Draft Water Management Plan for Region M. The regional water plans are to be based on an assessment of future water demands and currently available water supply and are to include specific recommendations for meeting identified water needs through 2060. The plans may also include recommendations regarding strategies for meeting long-term (2040-2060) needs, as well as recommendations regarding legislative designation of ecologically unique rivers and streams, reservoir sites, and policy issues. The regional water plans and the state water plan are to be updated every five years. This is the third round of regional water planning.

General comments:

There is no discussion of climate change or sea level rising and how that can have a negative impact on our water resources and increase of salinity in the Rio Grande River and other freshwater sources.

Any open canals that could be closed and be replaced with a pipeline will reduce water availability to local wildlife, loss of habitat, and have a negative impact on ecotourism.

When canals are mowed to allow more water flow, one side of the canal should at least be left with vegetation to provide a wildlife travel corridor, so wildlife can still move along the water canals.

Specific Comments:

Chapter 1

On page 1-19, 1.1.3.2 Lower Lower Laguna Madre, first paragraph, fourth sentence should read: The Arroyo Colorado and **Rio Grande** provides most of the freshwater inflow to the bay with other drainage canals and floodways having smaller contributions.

1.14 Protected Areas should add: Estero Llano Grande and Resaca de la Palma State Parks should be added at the end of the first paragraph.

1.14 Protected Areas, second paragraph, first sentence should read: Nine local communities, USFWS, and Texas Parks and Wildlife Department (TPWD) have recently developed and completed the final stages of the World Birding Center committing $20-25 million to the project.

On Page 1-22, 1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor, first paragraph, third sentence should read: It currently includes **115** individual tracts totaling over **91,000** acres.

1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor, first paragraph, fourth sentence should read: The completed refuge is projected to total **132,500** acres in fee and conservation easements.

On Page 1-25, 1.2.3 Economic Activities, eighth paragraph, second sentence should read: The economic impact by bird watchers in the Rio Grande Valley is estimated to be approximately $125 million dollars per year (Source: **McAllen Chamber of Commerce**).

On Page 1-42, 1.6.1 Quantity, third paragraph, first sentence should read: Another threat to agriculture and natural resources of the region is the impact of ongoing and projected urbanization on currently undeveloped areas, **and the loss of water availability for wildlife.**

On Page 1-45, 1.6.2 Water Quality, add paragraph: Water quality can also be improved by increasing the width of riparian vegetation along rivers (like the Rio Grande and Arroyo Colorado) and streams to minimize urban and agriculture runoff impacts from contaminated water especially agriculture fields next to rivers or drainages with little to no vegetative buffer along the riparian area.

Chapter 4

On Page 4-50, 4.5.4 Advanced Water Conservation, 4.5.4.1 Strategy Description, first paragraph, last sentence should include: irrigate lawns during evening hours throughout the municipalities for water conservation.

On Page 4-58, 4.5.5 Sea Water Desalination, 4.5.5.4 Environmental Impacts, first paragraph, add to end of sentence: and the brine concentrate should be piped out several miles out into the gulf, or directionally drilled.

We appreciate the opportunity to provide pre-planning information and look forward to providing any further assistance.

If we can be of further assistance, please contact Ernesto Reyes at the above letterhead and telephone number.

Sincerely,

Ernesto Reyes Jr.
Senior Fish & Wildlife Biologist
For
Allan M. Strand
Field Supervisor

cc:
Field Supervisor, U.S. Fish and Wildlife Service, Corpus Christi, TX

Response to Comments from the United States Department of the Interior

General Comments:

There is no discussion of climate change or sea level rising and how that can have a negative impact on our water resources and increase of salinity in the Rio Grande River and other freshwater sources.

- *The board members did not want to incorporate this comment into the plan.*

Any open canals that could be closed and be replaced with a pipeline will reduce water availability to local wildlife, loss of habitat, and have a negative impact on ecotourism.

- *The board members voted on not incorporating this comment into the plan.*

When canals are mowed to allow more water flow, one side of the canal should at least be left with vegetation to provide a wildlife travel corridor, so wildlife can still move along the water canals.

- *The board members did not want to incorporate this comment into the plan.*

Chapter 1

On page 1-19, 1.1.3.2 Lower Laguna Madre, first paragraph, fourth sentence should read: The Arroyo Colorado and Rio Grande provides most of the freshwater inflow to the bay with other drainage canals and floodways having smaller contributions.

• *Rio Grande was added into this sentence and was incorporated into Chapter 1 on page 1-19, first paragraph, fourth sentence.*

1.1.4 Protected Areas should add: Estero Llano Grande and Resaca de la Palms State Parks should be added at the end of the first paragraph.

• *Estero Llano Grande and Resaca de la Palms State parks was added to section 1.1.4 Protected areas*

1.1.4 Protected Areas, second paragraph, first sentence should read: Nine local communities, **USFWS**, and Texas Parks and Wildlife Department (TPWD) have recently developed and completed the final stages of the World Birding Center committing $20-25 million to the project.

• *This sentence has been revised and inserted into section 1.1.4 Protected Areas, second paragraph, first sentence.*

On Page 1-22, 1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corrido, first paragraph, third sentence should read: It currently includes 115 individual tracts totaling over 91,000 acres.

• *This sentence has been revised and can be found on page 1-22, in section 1.1.4.1 Lower Rio Grande Valley National Wildlife refuge and Wildlife Corrido, in the first paragraph, third sentence.*

1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor, first paragraph, fourth sentence should read: The completed refuge is projected to total 132,500 acres in fee and conservation easements.
• *This revised sentence can be found in section 1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor, in the first paragraph, fourth sentence.*

On Page 1-25, 1.2.3 Economic Activities, eighth paragraph, second sentence should read: The economic impact by bird watchers in the Rio Grande Valley is estimated to be approximately $125 million dollars per year (Source: McAllen Chamber of Commerce).
• *This revised sentence can be found in section 1.1.4.1 Lower Rio Grande Valley National Wildlife Refuge and Wildlife Corridor, in the first paragraph, fourth sentence.*

On Page 1-42, 1.6.1 Quantity, third paragraph, first sentence should read: Another threat to agriculture and natural resources of the region is the impact of ongoing and projected urbanization on currently undeveloped areas, and the loss of water availability for wildlife.
• *This revised sentence can be found on page 1-42, 1.6.1 Quantity, third paragraph, first sentence.*

On Page 1-45, 1.6.2 Water Quality, add paragraph: Water quality can also be improved by increasing the width of riparian vegetation along rivers (like the Rio Grande and Arroyo Colorado) and streams to minimize urban and agriculture runoff impacts from contaminated water especially agriculture fields next to rivers or drainages with little to no vegetative buffer along the riparian area.
• *The addition of this new paragraph can be found on page 1-45 under section 1.6.2 Water Quality.*

<u>Chapter 4</u>

On Page 4-50, 4.5.4 Advanced Water Conservation, 4.5.4.1 Strategy Description, first paragraph, last sentence should include: irrigation lawns during evening hours throughout the municipalities for water conservation.
• *The above comment was added to the sentence under Advanced Water Conservation, under the Strategy Description section, in first paragraph, last sentence.*

On Page 4-58, 4.5.5 Seawater Desalination, 4.5.5.4 Environmental Impacts, first paragraph, add to end of sentence: and the brine concentrate should be piped out several miles out into the gulf, or directionally drilled.

• *The above comment was added to the sentence in section named Seawater Desalination, under Environmental Impacts, in the first paragraph, last sentence.*

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June 21, 2010

Mr. Ken Jones
Lower Rio Grande Valley Development Council
311 N. 15th Street
McAllen, Texas 78501 4705

Re: 2010 Region M Initially Prepared Plan

Dear Mr. Jones:

Thank you for the opportunity to review and comment on the 2010 Initially Prepared Regional Water Plan (IPP) for the Lower Rio Grande Region M. Texas Parks and Wildlife (TPW) acknowledges the time, money and effort required to produce the regional water plan as mandated by Senate Bill 1 of the 75th Legislature. A number of positive steps have been taken since the first planning cycle to advance the issue of environmental protection. For example, the regional water planning groups are required by TAC §357.7(a)(8)(A), to perform a "quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico" when evaluating water management strategies (WMS). Quantification of environmental impacts is a critical step in planning for our state's future water needs while also protecting environmental resources.

TPW staff has reviewed the IPP with a focus on the following questions:

- Does the plan include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the plan include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the plan discuss how these threats will be addressed?
- Does the plan describe how it is consistent with long-term protection of natural resources?
- Does the plan include water conservation as a water management strategy? Reuse?
- Does the plan recommend any stream segments be nominated as ecologically unique?
- If the plan includes strategies identified in the 2006 regional water plan, does it address concerns raised by TPWD at that time?

In general, the 2010 Region M IPP is a well-written document that acknowledges the importance of environmental flow needs of the Rio Grande. However, TPWD believes that more quantitative analysis rather than narrative description is needed for the environmental impacts associated with each water

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.state.tx.us

description is needed for the environmental impacts associated with each water management strategy.

The Region M IPP includes conservation and reuse for meeting future municipal, industrial and agricultural water needs. While reuse of potable and non-potable water is thoroughly discussed, potential adverse effects of higher rates of reuse on effluent dependent streams, in particular the Arroyo Colorado should be acknowledged. TPWD encourages exploring the potential for additional conservation through implementation of additional Water Conservation Implementation Task Force Best Management Practices.

The plan does not recommend nomination of any stream segments as ecologically unique. As indicated in Table 8.1, TPWD has identified several stream segments in the region that meet at least one of the criteria for classification as ecologically unique should the regional planning group decide to pursue nomination of an ecologically significant stream in the future. These segments include portions of the tidal segment of the Arroyo Colorado, Las Moras Creek, and the Lower Rio Grande.

TPWD appreciates the efforts to quantitatively assess the inflow needs to the Lower Laguna Madre Estuary. Chapter 8 of the 2006 Regional Water Plan stated "Environmental flows in the Rio Grande could be included as a separate WUG in the next round of regional planning to ensure minimums would be met in a manner consistent with all other WUGs." This sentence is repeated in Chapter 8 of the IPP. TPWD believes that this idea has significant merit and encourages Region M to explicitly consider this option in the next planning cycle. Since surface flows are quite limited in Region M, environmental stream flows are of considerable importance.

Thank you for your consideration of these comments. TPWD looks forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 389-8715 if you have any questions or comments.

Sincerely,

Ross Melinchuk,
Deputy Executive Director, Natural Resources

RM:CL:ch

Texas Parks and Wildlife
Response to General Comments

No specific comments were made from TPWD and therefore not incorporated into the plan.

June 28, 2010

Mr. Glenn Jarvis
Chairman, Rio Grande Regional
Water Planning Group
1801 South 2nd Street, Suite 550
McAllen, TX 78503

Mr. Ken Jones
Executive Director, Lower Rio Grande Valley
Developmental Council
311 North 15th Street
McAllen, TX 78501

Re: Texas Water Development Board Comments for the Rio Grande Regional Water Planning Group (Region M) Initially Prepared Plan, Contract No. 0904830872

Dear Mr. Jarvis and Mr. Jones:

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted by March 1, 2010 on behalf of the Region M Regional Water Planning Group. The attached comments (Attachments A and B) follow this format:

- Level 1: Comments, questions, and online planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and
- Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional plan.

The TWDB's statutory requirement for review of potential interregional conflicts under Title 31, Texas Administrative Code (TAC) §357.14 will not be completed until submittal and review of adopted regional water plans.

Title 31, TAC, §357.11(b) requires the regional water planning group to consider timely agency and public comment. Section 357.10(a)(3) of the TAC requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted.

Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan.

If you have any questions, please do not hesitate to contact Ms. Connie Townsend of my staff at (512) 463-8290.

Sincerely,

Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Attachments (3)

c w/att: Mr. Jake White, NRS Consulting Engineers, Inc.

ATTACHMENT A

TWDB Comments on Initially Prepared 2011 Region M Regional Water Plan

LEVEL 1. Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

General Comment

1. Pages in the hard copies of the initially prepared plan do not match the pages in the electronic version of the initially prepared plan (e.g. page 4-26 in the hard copy corresponds to page 4-21 in the electronic version). Please ensure that all the final hard copies and electronic copies of the plan are identical.

2. Please include a Table of Contents at the front of the plan that covers the entire plan contents including appendices.

3. In accordance with the outcome of Region-Specific Study No. 2, please revise throughout plan all references to each irrigation district to consistently and accurately reflect their TWDB-approved designations (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010) either as a) wholesale water providers or b) as a subset of the water demands indirectly covered by various county irrigation water user groups. Please clarify in the plan that no irrigation districts are designated as stand-alone irrigation 'water user groups' and that, because of non-synchronous boundaries, no irrigation district water demand projection aligns with any designated county irrigation water user group water demand projection.

Executive Summary

4. Please provide an Executive Summary in the plan. *[Title 31 Texas Administrative Code (TAC) §357.10(a)(2); Contract Exhibit "C" Section 11.1]*

Chapter 1

5. Please include one-page summaries of the region-specific studies performed during phase I of this third round of planning including a description of whether and/or how each region-specific study was incorporated into the regional water plan. *[Contract Exhibit "C" Section 11.1]*

6. Page 1-48, Table 1.6: Table 1.6 only includes an apparent listing of Water User Groups that includes some Wholesale Water Providers. Table 1.6 does not label Wholesale Water Providers anywhere as a distinct group. Please provide in the plan the accurate and complete listing of TWDB-approved wholesale water providers (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010). *[31 TAC §357.7(a)(1)(A)]*

7. Page 1-48, Table 1.6: Table 1.6 includes does not label Water User Groups as a distinct group. Please provide in the plan the accurate and complete listing of water user groups. *[31 TAC §357.7(a)(1)(A)]*

8. Page 1-48, footnote 12: Please provide in the plan the correct reference to the results from the Region-Specific Study no. 2, amendment no. 1 that individual irrigation districts are *not* classified as water user groups but rather may be addressed as subset of any associated county irrigation water user group(s) (per Amendment No. 1 to Final Study No. 2 as approved by TWDB on April 5, 2010). *[Contract Exhibits "C" and "D"]*

9. Page 1-49, paragraph 1: Please provide in the plan the appropriate separate and distinct definitions of a water user group and of a wholesale water provider. *[31 TAC §357.2]*

10. Pages 1-62, 3-44 (paragraph 1); Section 8.3.1, page 8-11, second bullet: Please incorporate relevant information into the plan from the Phase One, Region-Specific Study No. 1 regarding the water accounting issues at Ft. Quitman. *[Contract Exhibit "C" Section 11.1]*

Chapter 2

11. Please present in the plan TWDB-approved population and water demand projections for categories of use for wholesale water providers considering counties and river basins, including information on contractual obligations and demands. *[31 TAC §357.7(a)(2)(B)]*

12. Page 2-5, Table 2.2: Please provide in the plan a breakdown of population by cities with populations greater than 500 people and by retail public utilities. *[31 TAC §357.7(a)(2)(A)]*

13. Page 2-5, Table 2.3 (and Attachment 2-1): Please provide in the plan water user group population projections that are broken out by both county and river basin. *[31 TAC §357.7(a)(2)(A)(iv)]* (Upon request, this data can be provided in the required format by TWDB.)

14. Page 2-8, Table 2.4; page 2-22, Attachment 2-1 first table; and pages 2-24 to 2-27, Attachment 2-1 table: All municipal water demand projections presented appear to be total water demands. Please provide in the plan the appropriate TWDB-approved *net* water demand projections for all municipal water use categories broken out by both county and river basin. *[31 TAC §357.5(d)(1) and (2)]*

15. Page 2-11, Table 2.9: Plan text refers to the TWDB-approved total irrigation water demand of 981,749 in 2060. Table 2.9 shows total 2060 irrigation water demands of 1,274,020 acft/yr for 2060. Please reconcile numbers throughout plan in accordance with TWDB-approved irrigation water demand projections.

16. Page 2-11, Figure 2.8: Plan text refers to the TWDB-approved total irrigation water demand of 981,749 acft/yr in 2060 per Figure 2.8. Figure 2.8 does not show 981,749 acft/yr for 2060 but rather 1,274,020 acft/yr. Please reconcile numbers throughout plan in accordance with TWDB-approved irrigation demand projections.

17. Pages 2-12 and 2-13; Tables 2.6, 2.7, and 2.8; and Attachment 2-1, page 2-24: Please provide in the plan TWDB-approved irrigation water demands that are broken out by both county and river basin. *[31 TAC §357.7(a)(2)(A)(iv)]* (Upon request, this data can be provided in the required format by TWDB.)

18. Page 2-13: Please provide in the plan water demand projections and population projections broken out for the newly added irrigation district Jim Hogg WCID2 and Union WSC. *[Contract Exhibit "A" Task 2.3]*

19. Page 2-20: Please provide in the plan water demand projections for potential ethanol production plants and on a county-by-county basis. *[Contract Exhibit "A" Task 2.5]*

20. Attachment 2-1, pages 2-24 and 2-25: Municipal water demands for Cameron County do not appear to be summed correctly (e.g. 90,566 acft/yr for 2010 county total; sum is actually 88,676 acft/yr); and do not appear to match Cameron County demands listed in Table 2.4, page 2-8 (e.g. 89,555 acft/yr for 2010). Please revise to reflect TWDB-approved demand projections for Cameron County municipal totals (e.g. 88,690 acft/yr for 2010) as required. *[31 TAC §357.7(a)(2)(A)(iv)]*

21. Attachment 2-1, page 2-26: Attachment 2-1 does not include Jim Hogg County municipal water demand projections. Please include in the plan Attachment 2-1 table municipal water user group water demand projections for Jim Hogg County. *[31 TAC §357.7(a)(2)(A)(iv)]*

<u>Chapter 3</u>

22. Based on the data in the online planning database, Amistad-Falcon Reservoir appears to be over allocated by 5,111 acft/yr in 2010 and 139,798 acft/yr in 2060. Please revise the plan to acknowledge the volume by which Amistad-Falcon Reservoir is over allocated in each planning decade and to show, quantitatively, how this total over allocation will be resolved in each decade between water user categories in practice (e.g. by voluntary redistribution between municipal and irrigation users). This reallocation may be shown quantified at an aggregate level for irrigation users only. Or, alternatively, revise the plan and online planning database to remove this water source over allocation. *[31 TAC §357.7(a)(3)(A)]*

23. The plan does not clearly present or account for the volume of reallocations of existing water supplies that provide the water source for significant recommended municipal water management strategies in the plan. Reallocations of existing water supplies for recommended water management strategies do not appear to be accounted for against the current water users as either upfront reductions to their existing supplies or as 'negative' water management strategies (i.e. reallocations of existing water supply away from a water user group category during plan implementation). Either approach will increase identified water needs unless sufficient surplus supplies are available to reallocate. Please revise the plan to clearly quantify and present these anticipated water supply reallocations, for each water source, by decade, and by water use category. For each water source (e.g. Amistad-Falcon Reservoir), the reallocations of supplies away from existing water users may be shown as an aggregate volume for irrigation water users but should be broken out for each individual municipal water user group. The information presented should clearly account for all water reallocations (away from and/or to water users) by decade. *[31 TAC §357.7(a)(3)(A)]*

24. Please include one-page summaries of the region-specific studies performed during phase I of this third round of planning including a description of whether and/or how each region-specific study was incorporated into the regional water plan. *[Contract Exhibits "A" Task 3.1 and "C" Section 11]*

25. Please provide in the plan revised water supply availability numbers due to the inclusion of a new source of water from the Hidalgo County Drainage District. *[Contract Exhibit "A" Task 3.2]*

26. Please provide in the plan water supply projections associated with the implementation of the Falcon-Matamoras pipeline project. *[Contract Exhibit "A" Task 3.3]*

27. Please discuss in the plan any considerations of the management plans of the four confirmed Groundwater Conservation Districts (Brush Country, Kenedy County, Red Sands, and Starr County) located within Region M. *[31 TAC §357.5(k)(1)(D)]*

28. Page 3-36, Section 3.2.6: Please include the San Felipe Springs Report that is referenced on page 3-36 in the plan in accordance with the placeholder statement.

29. Pages 3-60, 3-61, and 3-64; Tables 3.9, 3.10, and 3.11: Please provide groundwater availability volumes for each water use category as well as for each water user group by county and basin location. *[31 TAC §357.7(a)(3)(D); Contract Exhibit "C" Section 3.0]*

30. Pages 3-75 through 3-89, Section 3.7: Please provide in the plan surface water availability volumes broken out for each water use category as well as for each water user group by county and basin location. *[31 TAC §357.7(a)(3)(F)(i)-(iv);§357.7(a)(3)(G); Contract Exhibit "C" Section 3.0]*

<u>Chapter 4</u>

31. The plan does not accurately present the volume of identified water needs (e.g. irrigation) that will occur either because of reallocations of existing water supplies to recommended water management strategies or because of the reallocating water supply between water user groups from Amistad-Falcon Reservoir. Depending upon how the plan addresses the over allocation of Amistad-Falcon Reservoir and how reallocations of existing water user group supplies are accounted for, please update and present identified water needs for each decade. For each water source (e.g. Amistad-Falcon Reservoir), the reallocations of supplies away from existing water users may be shown as an aggregate volume of water need for irrigation water users but should be broken out and presented for each individual municipal water user group. *[31 TAC §357.7(a)(4)(A)]*

32. The plan does not present the volume of irrigation needs that would remain unmet in each decade after all recommended water management strategies are implemented. Based on the data in the plan and online planning database, and without resolving the over allocation of Amistad-Falcon Reservoir, it appears that unmet irrigation water needs could exceed 279,000 acft/yr in 2010 and 85,000 acft/yr in 2060. If the over allocation of Amistad-Falcon reservoir is resolved through the reallocation of water supply from irrigation to municipal use, the unmet irrigation needs would exceed 225,000 acft/yr in 2060. Please revise the plan to quantify and present all unmet water needs, by decade and by water use category and explain why the needs could not be met. Unmet irrigation needs may be presented as an aggregate volume for irrigation water users, by decade. *[31 TAC §357.7(a)(5)(C)(i)]*

33. Please quantitatively report third party social and economic impacts from voluntary redistributions of water from rural and agricultural areas. *[31 TAC §357.7(a)(8)(G)]*

34. Capital costs were not prepared in accordance with Exhibit "C" guidelines (e.g. annual costs were summed to estimate capital costs). Please revise capital costs to comply with required costing methodology requirements (including those for Section 4.8) *[31 TAC §357.7(a)(8)(A)(i); §357.7(a)(9); Contract Exhibits "A" Section 4.1 and "C" Section 4.1.2]*

35. Provide a list of potentially feasible water management strategies that were considered and evaluated by the planning group. *[Contract Exhibit "C" Section 11.1]*

36. Please include table summarizing all recommended water management strategies with associated water supplies presented by decade and capital costs. *[Contract Exhibit "C" Sections 4.3, 11.1]*

37. Please include a table listing alternative strategies with associated water supplies presented by decade and capital costs, if alternative water management strategies were included by the planning group. *[Contract Exhibit "C" Sections 4.3, 11.1]*

38. Please provide in the plan the technical evaluation of the new water management strategy referred to as the Hidalgo Water Supply project, including strategy description, water supply yields and implementation schedule, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.3.d]*

39. Please describe in the plan the development of alternative strategies for entities whose recommended water management strategies may become infeasible; including invasion of aquatic weeds and treaty noncompliance for Mexico's water deliveries to the United States. *[31 TAC §357.7(a)(7)(H); Contract Exhibit "A" Task 4.5]*

40. Please include information on how the plan explored opportunities and benefits of regional water supply facilities or providing for regional management of water facilities. *[31 TAC §357.5(e)(6)]*

41. Please present in the plan for each identified water user group with a need the water management strategy and associated water supply volumes that were identified to meet each need or identify if the need is recommended to be unmet. *[31 TAC §357.7(a)(5) and §357.7(a)(8)]*

42. Pages 4-14 and 4-15: The irrigation surplus/needs totals do not match between Tables 4.13 (e.g. 2010 total need is 410,637 acft/yr) and 4.14 (e.g. 2010 total need is 518,560 acft/yr). Please reconcile numbers as appropriate in plan in accordance with TWDB-approved irrigation demand projections.

43. Page 4-15, Table 4.14: Please provide in the plan irrigation district surplus/deficits broken out by county and river basin. *[31 TAC §357.7(a)(4)(A)(iv)]*

44. Page 4-25, Table 4-19, row 2: Please provide in the plan the technical evaluation of the new water management strategy regarding transfer of reservoir storage from one user to another based on need, including strategy description, water supply yield, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.3.c]*

45. Pages 4-48 and 4-49; Table 4.30, 4.31, 4.32: Please describe in the plan how advanced water conservation practices were considered for each of the water user groups with identified water needs and provide the specific conservation practices that were identified for each water user group with an identified water need. If evaluated, please present the associated conservation water management strategy supplies and costs by each water user group with identified needs. In addition, language in this section should be updated to reflect the current time frame (for example, by revision of the sentence stating that "However, the DOE's mandate does not take effect until 2007.") *[31 TAC §357.7(a)(7)(A); §357.14(2)(B)]*

46. Pages 4-75 through 4-94: Please clarify whether water management strategies listed in Section 4.8 are recommended and revise plan accordingly. *[31 TAC §357.7(a)(8)]*

47. Page 4-118, Section 4.11: Please provide in the plan the technical evaluation of the new water management strategy(s) for meeting the needs of Ethanol Production Plants, including strategy description, water supply yields, cost, environmental impact, implementation issues, and recommendations. *[Contract Exhibit "A" Task 4.6]*

Chapter 5

48. Page 5-4: Plan does not clearly present the volume of water that would be shifted from agricultural areas (e.g. for irrigation) to municipal use and does not quantitatively report the associated impacts to agricultural resources. Please quantify the volume of water that the plan allocates from irrigation use to municipal use during a drought of record and quantify the impacts (e.g. acreage of irrigated agriculture) to agricultural resources. *[31 TAC §357.7(a)(8)(A)(iii)]*

Chapter 6

49. Please include a summary of information regarding water loss audits specific to Region M. *[TAC 31§ 357.7 (a)(1)(M)]*

Chapter 7

50. Please explain how the region considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder pursuant to Texas Water Code §11.139. *[31 TAC §357.5(i)]*

51. Page 7-2, Section 7.2, first paragraph: Plan statement that "In the long run, total water savings associated with both strategies would allow irrigators to offset water supply deficits." appears incorrect based on the data in the plan and online planning database, which currently shows 85,000 acft/yr of unmet water needs in 2060; after implementing all recommended water management strategies. Please revise statement as appropriate.

52. Page 7-2, paragraph 3: It appears in the text that the 2020 or 2030 decade "...irrigation water supply deficit of over 410,000ac-ft/yr...to 210,000ac-ft/yr by 2060" does not match the referenced irrigation supply/deficit summary table on the 1st page of the unlabeled appendix (-657,117 acft/yr in 2020; -

592,920 acft/yr in 2030; -553,468 acft/yr in 2060). Please reconcile volumes throughout plan as appropriate.

53. Page 7-2, paragraph 3: Text states that the "conveyance system improvements could yield savings of 243,000ac-ft" does not match the referenced summary table on the first page of the unlabeled appendix (conveyance system conservation yield = 218,783 acft/yr). Please reconcile volumes throughout plan as appropriate.

Appendix

54. Unlabeled Appendix, *Decision Documents for Municipal Water Users* (unnumbered pages): one page appears to be printed from the previous plan's online database (DB07) instead of the current online database (DB12). Please revise. *[Contract Exhibit "D"]*

55. Unlabeled Appendix, *Decision Documents for Municipal Water Users* (unnumbered pages): It appears that the individual municipal water demand analysis pages have numerous errors and do not match the plan Attachment 2-1, Table 2.4 (page 2-8), or the TWDB-approved demands. For example, the City of Brownsville 2010 water demand: TWDB-approved amount 45,312 acft/yr; decision document amount 44,338 acft/yr; Attachment 2-1 amount 45,312 acft/yr). Please revise the plan as appropriate.

56. *(Attachment B)* Comments on the online planning database (i.e. DB12) are herein being provided in spreadsheet format. These Level 1 comments are based on a direct comparison of the online planning database against the Initially Prepared Regional Water Plan document as submitted. The table only includes numbers that do not reconcile between the plan (left side of spreadsheet) and online database (right side of spreadsheet). An electronic version of this spreadsheet will be provided upon request.

57. *(Attachment C)* Based on the information provided to date by the regional water planning groups, TWDB has also attached a summary, in spreadsheet format, of apparent water source over allocations and apparent unmet water needs that were identified during the review of the online planning database and Initially Prepared Regional Water Plan. *[Additional TWDB comments regarding the general conformance of the online planning database (DB12) format and content to the Guidelines for Regional Water Planning Data Deliverables (Contract Exhibit D) are being provided by TWDB staff under separate cover as 'Exception Reports']*

LEVEL 2. Comments and suggestions that might be considered to clarify or enhance the plan.

General

1. Please consider providing titles and identification numbers for all tables, figures, appendices, and attachments in the plan.

2. Please consider updating the information throughout the plan to reflect information associated with the current third round of regional planning. (examples: page 1-3, paragraph 1; page 1-39, paragraph 1; page 1-49, paragraphs 1 and 3; page 8-7, paragraph 4; etc.)

Chapter 3

3. Section 3.6, pages 53-64; Tables 3.9, 3.10 and 3.11: Please consider indicating which TWDB-run Groundwater Availability Model Reports, if any, were used to develop the projected tabular groundwater availability values. Also, please consider noting that the Carrizo-Wilcox Aquifer GAM has been superseded by the Queen City/Sparta GAM, which includes the Carrizo-Wilcox Aquifer.

Chapter 7

4. Page 7-2, paragraph 1; and throughout (other examples - page 4-32, paragraph 3; page 4-72, paragraph 2): Please consider clarifying the 2-to-1 ratio is the conversion ratio is for *Class A* irrigation water rights to DMI water use and that the *Class B* irrigation rights require a 2.5:1 conversion ratio.

Appendix

5. Please divide the generic "appendix" at the end of the plan as discrete individual appendices based on specific content and relevance to plan chapters and identify and label appendices content appropriately. Please reference appendices appropriately in the plan text and table of contents.

REGION M

Region IPP	Item	IPP document reference[A]: Page number[A]	IPP document reference[A]: Table number	Non-matching numbers — IPP document number: non-decadal number	2010	2020	2030	2040	2050	2060	Online Planning Database (DB12) number: non-decadal number	2010	2020	2030	2040	2050	2060
M	Cameron Co. Irrigation Demands	2-12	2.6		601,253	548,279	554,827	496,408	496,408	496,408		367,404	347,771	325,144	325,144	325,144	325,144
M	Hidalgo Co. Irrigation Demands	2-13	2.7		697,522	611,747	540,501	540,501	540,501	540,501		574,988	519,368	449,081	449,081	449,081	449,081
M	Willacy Co. Irrigation Demands	2-13	2.8		94,102	94,811	94,902	94,902	94,902	94,902		59,191	60,203	60,623	60,623	60,623	60,623
M	Cameron Co. Irrigation Demands	2-14	2.9		601,253	548,279	554,827	496,408	496,408	496,408		367,404	347,771	325,144	325,144	325,144	325,144
M	Hidalgo Co. Irrigation Demands	2-14	2.9		697,522	611,747	540,501	540,501	540,501	540,501		574,988	519,368	449,081	449,081	449,081	449,081
M	Willacy Co. Irrigation Demands	2-14	2.9		94,102	94,811	94,902	94,902	94,902	94,902		59,191	60,203	60,623	60,623	60,623	60,623
M	Cameron Co. Irrigation Demands	NA	appendix 'decision docs' - have no page #s or tbl #s		601,253	548,279	554,827	496,408	496,408	496,408		367,404	347,771	325,144	325,144	325,144	325,144
M	Hidalgo Co. Irrigation Demands	NA			697,522	611,747	540,501	540,501	540,501	540,501		574,988	519,368	449,081	449,081	449,081	449,081
M	Willacy Co. Irrigation Demands	NA			94,102	94,811	94,902	94,902	94,902	94,902		59,191	60,203	60,623	60,623	60,623	60,623
M	Cameron 'County-Other' Irrigation Demands	NA			47,343	58,946	121,875	63,456	63,456	63,456		NA	NA	NA	NA	NA	NA
M	Hidalgo 'County-Other' Irrigation Demands	NA			-	7,896	16,032	16,032	16,032	16,032		NA	NA	NA	NA	NA	NA
M	Willacy 'County-Other' Irrigation Demands	NA			18,890	20,251	21,251	21,251	21,251	21,251		NA	NA	NA	NA	NA	NA
M	Firm Yield of Amistad-Falcon U.S.	3-51	3.8		1,087,449	1,067,310	1,056,719	1,048,965	1,041,627	1,034,592		1,011,976	1,004,976	998,476	991,976	985,476	979,476
M	Gulf Coast Aquifer Availability Cameron County	3-60	3.9		104,000	104,000	104,000	104,000	104,000	104,000		104,700	104,700	104,700	104,700	104,700	104,700
M	Gulf Coast Aquifer Availability Hidalgo County	3-60	3.9		52,500	52,500	52,500	52,500	52,500	52,500		52,530	52,530	52,530	52,530	52,530	52,530
M	Gulf Coast Aquifer Availability Willacy County	3-60	3.9		90,100	90,100	90,100	90,100	90,100	90,100		90,140	90,140	90,140	90,140	90,140	90,140
M	Gulf Coast Aquifer Availability Zapata County	3-60	3.9		250	250	250	250	250	250		500	500	500	500	500	500
M	Carrizo Aquifer Availability Maverick County	3-61	3.10		2,050	2,050	2,050	2,050	2,050	2,050		2,066	2,066	2,066	2,066	2,066	2,066
M	Carrizo Aquifer Availability Webb County	3-61	3.10		17,100	17,100	17,100	17,100	17,100	17,100		17,176	17,176	17,176	17,176	17,176	17,176
M	Other Aquifer Availability Hidalgo County	Ch.3			NA	NA	NA	NA	NA	NA		10,000	10,000	10,000	10,000	10,000	10,000
M	Other Aquifer Availability Maverick County	Ch.3			NA	NA	NA	NA	NA	NA		10,000	10,000	10,000	10,000	10,000	10,000
M	Other Aquifer Availability Starr County	Ch.3			NA	NA	NA	NA	NA	NA		10,000	10,000	10,000	10,000	10,000	10,000
M	Other Aquifer Availability Webb County	Ch.3			NA	NA	NA	NA	NA	NA		10,000	10,000	10,000	10,000	10,000	10,000
M	Other Aquifer Availability Zapata County	Ch.3			NA	NA	NA	NA	NA	NA		10,000	10,000	10,000	10,000	10,000	10,000
M	Firm Yield Amistad-Falcon Irrigation Cameron County	3-75	3.12				218,283	216,223	214,165					218,282	216,224	214,164	
M	Firm Yield Amistad-Falcon Irrigation Hidalgo County	3-75	3.12				353,510							353,511			
M	Firm Yield Amistad-Falcon Irrigation Starr County	3-75	3.12		15,772							15,773					
M	Firm Yield Amistad-Falcon Irrigation Total	3-75	3.12		701,261			681,296	674,808			701,262			681,297	674,807	
M	Firm Yield Amistad-Falcon Mining Hidalgo County	3-75	3.12		205				197	196		206				198	195
M	Firm Yield Amistad-Falcon Mining Webb County	3-75	3.12			640	634	628	622	616			641	635	629	623	617
M	Firm Yield Amistad-Falcon Mining Total	3-75	3.12		1,045	1,035	1,025	1,016	1,006			1,046	1,036	1,026	1,017	1,008	
M	Available Reservoir Yield for Irrigation and Mining	3-75	3.12		702,306	695,308	688,810	682,312	675,814	669,815		702,308	695,309	688,811	682,314	675,815	669,813
M	Irrigation Reuse Hidalgo County	3-78	table	4,042								8,576	8,576	8,576	8,576	8,576	8,576
M	Irrigation Reuse Total	3-78	table	5,647								9,935	9,935	9,935	9,935	9,935	9,935
M	Irrigation Supply Surface Water Reuse	3-81	3.13		5,647	5,647	5,647	5,647	5,647	5,647		9,935	9,935	9,935	9,935	9,935	9,935
M	Irrigation Supply Other Aquifer	3-81	3.13		10,319	10,319	10,319	10,319	10,319	10,319		10,320	10,320	10,320	10,320	10,320	10,320
M	Irrigation Supply Rio Grande Run of River	3-81	3.13		NA	NA	NA	NA	NA	NA		394	394	394	394	394	394
M	Irrigation Supply Rio Grande Tributarites	3-81	3.13		510	510	510	510	510	510		NA	NA	NA	NA	NA	NA
M	Irrigation Supply Total	3-81	3.13		752,995	746,006	739,518	733,030	726,541	720,552		757,168	750,179	743,691	737,203	730,713	724,724
M	Livestock Supply Carrizo-Wilcox Aquifer	3-81	3.13		1,019	1,019	1,019	1,019	1,019	1,019		1,020	1,020	1,020	1,020	1,020	1,020
M	Livestock Supply Gulf Coast Aquifer	3-81	3.13		3,817	3,817	3,817	3,817	3,817	3,817		3,818	3,818	3,818	3,818	3,818	3,818
M	Livestock Supply Total	3-81	3.13		5,816	5,816	5,816	5,816	5,816	5,816		5,817	5,817	5,817	5,817	5,817	5,817
M	Mining Supply Amistad Falcon	3-81	3.13							996							995
M	Mining Supply Carrizo-Wilcox	3-81	3.13		598	595	596	597		597		597	596	597	598		598
M	Mining Supply Gulf Coast	3-81	3.13			3,123							3,122				
M	Mining Supply Other Aquifer	3-81	3.13			332		338		344			334		337		343
M	Mining Supply Total	3-81	3.13			5,087	5,168	5,248		5,398			5,088	5,169	5,249		5,396
M	Munufacturing Supply Amistad-Falcon	3-80	3.13		3,373	3,373	3,373	3,373	3,373	3,373		3,374	3,374	3,374	3,374	3,374	3,374
M	Munufacturing Supply Total	3-80	3.13		6,549	6,552	6,555	6,558	6,560	6,563		6,550	6,553	6,556	6,559	6,561	6,564
M	Municipal Supply Amistad-Falcon	3-80	3.13		295,839	295,598	295,903	296,077	295,852	295,739		294,429	294,931	295,459	295,822	295,757	295,775
M	Municipal Supply Carrizo Wilcox Aquifer	3-80	3.13			1,191	1,192	1,192					1,190	1,191	1,193		
M	Municipal Supply Gulf Coast Aquifer	3-80	3.13		22,783	22,549	22,306	22,043	21,751	21,461		23,147	22,915	22,673	22,409	22,117	21,829
M	Municipal Supply Other Aquifer	3-80	3.13		2,157	2,157	2,157	2,157	2,157	2,157		2,083	2,083	2,083	2,083	2,083	2,083
M	Municipal Supply Direct Reuse	3-80	3.13		-	-	-	-	-	-		7,462	7,462	7,462	7,462	7,462	7,462
M	Municipal Supply Total	3-80	3.13		321,969	321,495	321,559	321,470	320,953	320,551		328,311	328,581	328,868	328,969	328,612	328,343
M	Available Supplies Total	3-81	3.13		1,108,486	1,101,172	1,094,832	1,088,338	1,081,415	1,075,096		1,119,003	1,112,434	1,106,317	1,100,013	1,093,248	1,087,060
M	Municipal Needs	4-4	4.1		23,936	61,064	113,978	174,120	245,148	321,248		26,786	67,336	119,976	181,351	255,177	333,568
M	Irrigation Needs	4-4	4.1		410,637	336,224	242,442	248,903	255,366	261,330		407,522	333,246	239,408	245,896	252,386	258,375
M	Livestock Needs	4-4	4.1		1	1	1	1	1	1		-	-	-	-	-	-
M	Total Needs	4-4	4.1		436,494	401,623	363,542	433,451	515,457	603,484		436,229	404,917	366,506	437,675	522,506	612,849
M	Southmost Regional Water Authority Needs	4-5	4.3		(11,844)	(11,844)	(11,844)	(11,844)	(11,844)	(11,844)		(6,888)	(6,888)	(6,888)	(6,888)	(6,888)	(6,888)

REGION M

Non-matching numbers

		IPP document reference [A]:		IPP document number							Online Planning Database (DB12) number						
Region IPP	Item	Page number [A]	Table number	non-decadal number	2010	2020	2030	2040	2050	2060	non-decadal number	2010	2020	2030	2040	2050	2060
M	North Alamo WSC Needs	4-5	4.3					(2,450)	(7,465)	(12,565)					-	-	-
M	Brownsville Irrigation and Drainage District Needs	4-5	4.3		-	-	-	-	-	-		(34)	(34)	(34)	(34)	(34)	(34)
M	Brownsville (Nueces-Rio Grande) Needs	4-7	4.4		(7,131)	(14,959)	(22,619)	(31,044)	(39,338)	(47,857)		(8,103)	(16,828)	(25,645)	(34,844)	(43,994)	(53,028)
M	Brownsville (Rio Grande) Needs	4-7	4.4		(121)	(177)	(234)	(300)	(364)	(431)		(123)	(191)	(259)	(331)	(401)	(471)
M	Harlingen Needs	4-7	4.4						178	(1,346)						(1,377)	(3,041)
M	Los Fresnos	4-7	4.4				(206)	(474)	(740)	(997)				(145)	(388)	(643)	(886)
M	Military Highway WSC (Nueces-Rio Grande) Needs	4-7	4.4			(239)	(799)	(1,437)	(2,117)	(2,817)			-	-	(46)	(481)	(929)
M	Military Highway WSC (Rio Grande) Needs	4-7	4.4			(11)	(5)	(1)	(7)	(13)			-	-	(1)	(7)	(13)
M	Palm Valley Needs	4-7	4.4		(73)	(62)	(49)	(35)	(27)	(23)		(81)	(76)	(69)	(62)	(58)	(56)
M	Primera Needs	4-7	4.4		(186)	(289)	(389)	(505)	(618)	(740)		(209)	(332)	(456)	(589)	(721)	(855)
M	Valley MUD 2 (Nueces-Rio Grande) Needs	4-7	4.4			(387)	(422)	(457)	(494)	(532)			-	(81)	(187)	(298)	(407)
M	Cameron County-Other (Rio Grande) Needs	4-7	4.4		(8)	(9)	(12)	(13)	(15)	(17)		-	-	-	-	-	-
M	Cameron County Sum of Deficits (Municipal)	4-7	4.4		(10,486)	(20,697)	(31,578)	(43,925)	(56,725)	(70,540)		(11,487)	(21,989)	(33,497)	(46,108)	(60,987)	(76,799)
M	Alton Needs	4-8	4.5				-	-	-	-				(2,446)	(3,419)	(4,482)	(5,602)
M	Donna Needs	4-8	4.5							-							(103)
M	Edcouch Needs	4-8	4.5		(108)	(145)	(190)	(246)	(317)	(401)		(129)	(188)	(255)	(332)	(420)	(516)
M	Edinburg Needs	4-8	4.5				(242)	(2,555)	(5,590)	(8,700)				-	(1,805)	(5,151)	(8,580)
M	Hidalgo Needs (Nueces-Rio Grande)	4-8	4.5				(83)	(520)	(1,028)	(1,545)				(219)	(685)	(1,206)	(1,740)
M	Hidalgo Needs (Rio Grande)	4-8	4.5		41	64	27	67	92	114		(2)	(18)	(20)	(27)	(49)	(71)
M	La Joya Needs (Nueces-Rio Grande)	4-8	4.5			193	115	130	123	105			(5)	(59)	(120)	(189)	(265)
M	La Joya Needs (Rio Grande)	4-8	4.5		(113)	(157)	(130)	(205)	(273)	(348)		-	(2)	(25)	(51)	(80)	(113)
M	McAllen Needs (Nueces-Rio Grande)	4-8	4.5			(1,139)	(6,463)	(12,017)	(18,411)	(25,447)			(2,501)	(8,474)	(14,830)	(21,932)	(29,453)
M	McAllen Needs (Rio Grande)	4-8	4.5			-	(1)	(2)	(3)	(4)			(1)	(1)	(2)	(3)	(4)
M	Mission Needs	4-8	4.5		(1,128)	(3,756)	(6,703)	(9,719)	(13,496)	(17,365)		(1,470)	(4,468)	(7,824)	(11,365)	(15,469)	(19,674)
M	Penitas	4-8	4.5					18	15	7					(1)	(7)	(16)
M	Pharr Needs	4-8	4.5			(1,085)	(3,126)	(5,446)	(7,904)	(10,675)			(1,754)	(4,152)	(6,799)	(9,649)	(12,695)
M	Weslaco Needs	4-8	4.5				(33)	(812)	(1,743)	(2,803)				-	-	(517)	(1,682)
M	Hidalgo Co. Sum of Deficits (Municipal) Needs	4-8	4.5		(3,016)	(13,256)	(30,619)	(56,101)	(89,289)	(108,673)		(3,268)	(15,912)	(37,125)	(64,017)	(99,496)	(137,156)
M	El Indio Needs	4-9	4.7		(1)	(1)						-	-				
M	Maverick County-Other (Rio Grande) Needs	4-9	4.7		(280)	(801)	(1,293)	(1,733)	(2,122)	(2,475)		(67)	(632)	(1,165)	(1,641)	(2,063)	(2,442)
M	Maverick Co. Sum of Deficits (Municipal) Needs	4-9	4.7		(281)	(802)	(1,293)	(1,733)	(2,122)	(2,475)		(67)	(632)	(1,165)	(1,641)	(2,063)	(2,442)
M	La Grulla Needs	4-10	4.8		(341)	(389)	(442)	(500)	(563)	(634)		(345)	(397)	(454)	(516)	(582)	(653)
M	Rio Grande City Needs	4-10	4.8		(425)	(627)	(892)	(1,117)	(1,409)	(1,733)		(483)	(755)	(1,066)	(1,361)	(1,692)	(2,034)
M	Roma Needs	4-10	4.8		(41)	(363)	(702)	(1,064)	(1,447)	(1,853)		(104)	(491)	(895)	(1,314)	(1,743)	(2,175)
M	Starr County-Other (Rio Grande) Needs	4-10	4.8		(5,161)	(6,540)	(7,961)	(9,424)				(4,688)	(6,195)	(7,746)	(9,332)		
M	Starr Co. Sum of Deficits (Municipal) Needs	4-10	4.8		(6,143)	(8,233)	(10,459)	(12,707)	(15,016)	(17,392)		(5,794)	(8,152)	(10,623)	(13,126)	(15,614)	(18,034)
M	San Perlita Needs	4-11	4.10					(1)							-		
M	Cameron Irrigation (Nueces-Rio Grande) Needs	4-14	4.13		(128,910)	(112,295)	(92,672)	(94,636)	(96,601)	(98,415)		(131,084)	(114,354)	(94,595)	(96,559)	(98,524)	(100,338)
M	Cameron Irrigation (Rio Grande) Needs	4-14	4.13		(6,412)	(5,612)	(4,668)	(4,762)	(4,857)	(4,944)		(4,238)	(3,553)	(2,745)	(2,839)	(2,934)	(3,021)
M	Hidalgo Irrigation (Nueces-Rio Grande) Needs	4-14	4.13		(197,048)	(144,012)	(75,704)	(79,012)	(82,320)	(85,374)		(179,009)	(127,739)	(61,663)	(64,971)	(68,279)	(71,333)
M	Hidalgo Irrigation (Rio Grande) Needs	4-14	4.13		(775)	(343)	212	185	158	133		(14,526)	(12,328)	(9,540)	(9,567)	(9,594)	(9,619)
M	Maverick Irrigation (Nueces) Needs	4-14	4.13		(3,506)	(3,208)	(2,867)	(2,867)	(2,867)	(2,867)		-	-	-	-	-	-
M	Maverick Irrigation (Rio Grande) Needs	4-14	4.13		(31,920)	(29,407)	(26,415)	(26,913)	(27,410)	(27,869)		(36,482)	(33,808)	(30,633)	(31,131)	(31,628)	(32,087)
M	Zapata Irrigation Needs	4-14	4.13		(2,378)	(2,085)	(1,805)	(1,842)	(1,879)	(1,913)		(2,494)	(2,201)	(1,921)	(1,958)	(1,995)	(2,029)
M	Irrigation Sum of Deficits	4-14	4.13		(410,637)	(336,224)	(242,442)	(248,903)	(255,366)	(261,330)		(407,522)	(333,246)	(239,408)	(245,896)	(252,386)	(258,375)
M	<u>Content of Entire Table</u>, with exception of Brownsville Weir WMS volume, does not match online planning db. <u>Example</u> is 'Advanced Water Conservation' annual cost. Check all entries.	4-21	4.17	19,009								2,851	5,987	11,489	15,838	21,346	27,411
M	<u>Content of Entire Table</u> does not match online planning db. <u>Example</u> is 'Cameron Co. Municipal Demand'. Check all entries.	4-22	4.18		89,555	106,553	123,873	141,599	159,379	176,749		88,690	104,850	121,342	138,190	155,290	172,211
M	<u>Content of Entire Table</u> does not match online planning db. <u>Example</u> is 'Water Rights Purchase Cameron'. Check all entries.	4-33	4.21	15,435							15,121						
M	<u>Content of Entire Table</u> does not match online planning db. <u>Example</u> is 'Non-potable reuse Cameron'. Check all entries.	4-38	4.25	600								846	1,780	2,173	2,562	2,949	3,755
M	Advanced Conservation 2060 Cameron Co.	4-49	4.32							3,731							4,810
M	Advanced Conservation volume 2060 Hidalgo Co.	4-49	4.32							10,281							17,373
M	Advanced Conservation volume 2060 Jim Hogg Co.	4-49	4.32							9							7

REGION M

Region IPP	Item	IPP document reference^A: Page number^A	Table number	Non-matching numbers — IPP document number: non-decadal number	2010	2020	2030	2040	2050	2060	Online Planning Database (DB12) number: non-decadal number	2010	2020	2030	2040	2050	2060
M	Advanced Conservation volume 2060 Starr Co.	4-49	4.32							595							810
M	Advanced Conservation volume 2060 Webb Co.	4-49	4.32							3,907							3,906
M	Advanced Conservation volume 2060 Willacy Co.	4-49	4.32							78							79
M	Total Cost (Capital) advanced conservation WMS	4-50	4th paragraph	6,377,376							5,833,452						
M	Total Cost (Capital) seawater desal WMS	4-54	last paragraph	6,000,000							1.70E+11						
M	Annual Cost seawater desal WMS	4-55	1st paragraph	1,500,000							6.57E+10						
M	Capital Cost seawater desal Brownsville	4-56	4.37	151,388,000							1.70E+11						
M	Annual Cost seawater desal Brownsville	4-56	4.37	11,776,000							6.57E+10						
M	Brackish GW volume 2060 Cameron Co.	4-60	4.39							24,753							25,069
M	Brackish GW volume 2060 Hidalgo Co.	4-60	4.39							21,792							23,066
M	Brackish GW volume 2060 Starr Co.	4-60	4.39							1,120							1,498
M	Brackish GW volume 2060 Willacy Co.	4-60	4.39							11,426							11,326
M	Brownsville Weir WMs cost	4-64	3rd paragraph	31,000,000							96,541,766						
M	Groundwater volume 2060 Cameron Co.	4-69	4.42							2,250							2,947
M	Groundwater volume 2060 Hidalgo Co.	4-69	4.42							7,774							9,147
M	Groundwater volume 2060 Jim Hogg Co.	4-69	4.42							73							65
M	Groundwater volume 2060 Webb Co.	4-69	4.42							15,539							7,918
M	Groundwater WMS cost	4-69	last paragraph	3,376,030							87,262,607						
M	Groundwater WMS annual cost	4-69	last paragraph	3,676,119							20,739,289						
M	Water yield purchase WMS	4-72	4.44	143,944							151,237						
M	Water yield urbanization WMS	4-72	4.44	15,245							16,406						
M	Water yield contract WMS	4-72	4.44	4,577							4,671						
M	Overall WMS yield	4-73	3rd paragraph	324,937								211,553	373,899	466,355	571,668	691,183	816,596
M	Non-potable reuse 2060 volume	4-73	3rd paragraph							30,841							45,459
M	Groundwater WMS yield	4-74	4.45	29,824								3,772	8,572	17,139	20,492	22,194	24,265
M	Advanced conservation WMS yield	4-74	4.45	19,009								2,851	5,987	11,489	15,838	21,346	27,411
M	Non-potable reuse WMS yield	4-74	4.45	30,841								2,417	9,444	12,378	19,216	28,888	45,459
M	Potable reuse WMS yield	4-74	4.45	1,120								1,120	1,120	1,120	1,120	1,300	1,540
M	Brownsville Weir WMS yield	4-74	4.45	20,643								20,643	20,643	20,643	20,643	20,643	23,643
M	Water right purchase WMS yield	4-74	4.45	143,944								9,611	19,461	41,602	70,944	110,913	151,237
M	Water right urbanization WMS yield	4-74	4.45	15,245								299	3,433	6,467	9,496	12,868	16,406
M	Water right contract WMS yield	4-74	4.45	4,577								312	738	1,665	2,352	3,198	4,671
M	Brackish gw desal WMS yield	4-74	4.45	69,832								42,715	48,978	52,660	58,823	71,047	76,051
M	Seawater desal WMS yield	4-74	4.45	7,902								125	125	143	6,049	6,421	7,902
M	Total WMS yield	4-74	4.45	342,937								211,553	373,899	466,355	571,668	691,183	816,596
M	Groundwater WMS yield	4-74	4.46	29,824								3,772	8,572	17,139	20,492	22,194	24,265
M	Advanced conservation WMS yield	4-74	4.46	19,009								2,851	5,987	11,489	15,838	21,346	27,411
M	Non-potable reuse WMS yield	4-74	4.46	30,841								2,417	9,444	12,378	19,216	28,888	45,459
M	Potable reuse WMS yield	4-75	4.46	1,120								1,120	1,120	1,120	1,120	1,300	1,540
M	Brownsville Weir WMS yield	4-75	4.46	20,643								20,643	20,643	20,643	20,643	20,643	23,643
M	Water right purchase WMS yield	4-75	4.46	143,944								9,611	19,461	41,602	70,944	110,913	151,237
M	Water right urbanization WMS yield	4-75	4.46	15,245								299	3,433	6,467	9,496	12,868	16,406
M	Water right contract WMS yield	4-75	4.46	4,577								312	738	1,665	2,352	3,198	4,671
M	Brackish gw desal WMS yield	4-75	4.46	69,832								42,715	48,978	52,660	58,823	71,047	76,051
M	Seawater desal WMS yield	4-75	4.46	7,902								125	125	143	6,049	6,421	7,902
M	Total WMS yield	4-75	4.46	342,937								211,553	373,899	466,355	571,668	691,183	816,596
M	Irrigation Conveyance Conservation yield Cameron Co.	4-101	4.48	77,447								27306	54613	57343	60074	62805	65535
M	Irrigation Conveyance Conservation yield Hidalgo Co.	4-101	4.48	162,785								49,566	99,132	104,089	109,045	114,002	118,959
M	Irrigation Conveyance Conservation yield Maverick Co.	4-101	4.48	16,147								10394	20781	21826	22866	23905	24944
M	Irrigation Conveyance Conservation yield Starr Co.	4-101	4.48	7,894								NA	NA	NA	NA	NA	NA
M	Irrigation Conveyance Conservation yield Willacy Co.	4-101	4.48	9,760								3894	7787	8177	8566	8955	9345
M	Irrigation Conveyance Conservation yield Total	4-101	4.48	274,033								91,160	182,313	191,435	200,551	209,667	218,783
M	Irrigation Conveyance Conservation yield Cameron Co.	4-102	4.50		10,324	20,655	30,979	41,302	51,634	61,958		27306	54613	57343	60074	62805	65535
M	Irrigation Conveyance Conservation yield Hidalgo Co.	4-102	4.50		21,699	43,415	65,114	89,813	108,529	130,228		49,566	99,132	104,089	109,045	114,002	118,959
M	Irrigation Conveyance Conservation yield Maverick Co.	4-102	4.50		2,152	4,306	6,459	8,611	10,765	12,918		10394	20781	21826	22866	23905	24944
M	Irrigation Conveyance Conservation yield Starr Co.	4-102	4.50		1,052	2,105	3,158	4,210	5,263	6,315		NA	NA	NA	NA	NA	NA

REGION M

Non-matching numbers

		IPP document reference [A]:		IPP document number							Online Planning Database (DB12) number						
Region IPP	Item	Page number [A]	Table number	non-decadal number	2010	2020	2030	2040	2050	2060	non-decadal number	2010	2020	2030	2040	2050	2060
M	Irrigation Conveyance Conservation yield Willacy Co.	4-102	4.50		1,301	2,603	3,904	5,205	6,507	7,808		3894	7787	8177	8566	8955	9345
M	Irrigation Conveyance Conservation yield Total	4-102	4.50		36,529	73,085	109,613	146,142	182,698	219,226		91,160	182,313	191,435	200,551	209,667	218,783
M	On-Farm Conservation yield Hidalgo Co.	4-105	4.54			45,597	67,819	90,436	113,079	135,711			43,416	65,114	86,815	108,529	130,229
M	On-Farm Conservation yield Maverick Co.	4-105			NA	NA	NA	NA	NA	NA		2,152	4,306	6,459	8,611	10,765	12,918
M	On-Farm Conservation yield Starr Co.	4-105			NA	NA	NA	NA	NA	NA		1,052	2,105	3,158	4,210	5,263	6,315
M	Conveyance yield Maverick Co. (Normal)	4-116	4.538			20,787							20,781				
M	Conveyance yield Total (Normal)	4-116	4.538			182,319							182,313				
M	Conveyance yield Hidalgo County	4-113	4.61			84,564	103,358	108,732	113,925	122,706			99,132	104,089	109,045	114,002	118,959
M	Sum of individual Cameron Co. Irrigation Districts and "Irrigation C-O" Conveyance volume vs. Irrigation Cameron Co.	NA	Appendix							70,459							65,535
M	Sum of individual Cameron Co. Irrigation Districts and "Irrigation C-O" On-Farm volume vs. Irrigation Cameron Co.	NA	Appendix							67,349							61,958
M	Sum of individual Hidalgo Co. Irrigation Districts and "Irrigation C-O" Conveyance volume vs. Irrigation Hidalgo Co.	NA	Appendix							126,769							118,959
M	Sum of individual Hidalgo Co. Irrigation Districts and "Irrigation C-O" On-Farm volume vs. Irrigation Hidalgo Co.	NA	Appendix							138,094							130,229
M	Brownsville Irrig. District - WMS volumes for On-Farm Conservation	NA	Appendix		838	1277	1151	1868	2334	2801		NA	NA	NA	NA	NA	NA
M	Brownsville Irrig. District - WMS volumes for Conveyance Conservation	NA	Appendix		2218	3378	2130	2717	2839	2962		NA	NA	NA	NA	NA	NA
M	Regional Irrigation Conveyance System Yield	Appendix	Region M Summary			182,319							182,313				
M	Regional Irrigation On-Farm Conservation Yield	Appendix	Region M Summary		36,529		109,613	146,142		219,226		36,528		109,614	146,144		219,228
M	Conveyance Yield Maverick Co.	Appendix	Irrigation: Maverick Co.			22,787							20,781				
M	On-Farm Yield Hidalgo Co.	Appendix	Irrigation: Hidalgo Co.			43,415		86,813		130,228			43,416		86,815		130,229
M	Steam Electric - Webb Co. GW WMS Yield	Appendix	Steam Electric: Webb Co.		-	-	-	-	91	256		NA	NA	NA	NA	NA	NA
M	Steam Electric - Webb Co. GW WMS Annual Cost	Appendix	Steam Electric: Webb Co.	110,773							NA						
M	Steam Electric - Cameron Co. Reuse WMS Annual Cost	Appendix	Steam Electric: Cameron Co.	186,954							209,918						
M	Steam Electric - Cameron Co. GW WMS Annual Cost	Appendix	Steam Electric: Cameron Co.	62,310							73,993						
M	Mfg - Cameron Co. GW WMS Yield	Appendix	Mfg: Cameron Co.		1,000	1,000	1,000	1,000	1,000	1,000		100	100	100	100	100	100
M	Mfg - Cameron Co. GW WMS Annual Cost	Appendix	Mfg: Cameron Co.	-							432,709						
M	Additional GW WMS Cameron Co.	Appendix	"Water supply and demand analysis municipal county breakdown"	2,388								1,070	2,225	2,380	2,543	2,668	2,803
M	Additional GW WMS yield, annual cost Webb C-O	Appendix	C-O Webb Co.	228,903	74	144	224	313	416	529	NA	NA	NA	NA	NA	NA	NA
M	Additional GW annual cost Starr Co.	Appendix	C-O Starr Co.	1,790,548							1,818,674						
M	Additional GW WMS volume Starr Co.	Appendix	C-O Starr Co.			3,270	2,981	3,712	4,022	4,138			3,195	2,869	3,557	3,826	3,890
M	Advanced Conservation WMS annual Cost Hidalgo Co.	Appendix	C-O Hidalgo Co.	80,256								13,711	31,336	56,024	81,814	108,947	136,491
M	Advanced Conservation WMS annual Cost Cameron Co.	Appendix	C-O Cameron Co.	16,476								10,676	25,414	41,683	59,046	77,753	96,732
M	Water Right Purchase WMS annual Cost Brownsville	Appendix	Brownsville	1,402,187								-	-	-	-	-	2.89.E+09
M	Advanced Conservation WMS annual Cost Brownsville	Appendix	Brownsville	97,302								14,246	29,338	44,935	60,477	76,019	121,742
M	Non-potable reuse WMS annual Cost Brownsville	Appendix	Brownsville	233,242								-	116,621,204	116,621,204	116,621,204	116,621,204	116,621,204
M	Brownsville Weir WMS annual Cost Brownsville	Appendix	Brownsville	12,074,988								1.11.E+11	1.11.E+11	1.11.E+11	1.11.E+11	2.23.E+11	2.27.E+11
M	Brackish GW WMS annual Cost Brownsville	Appendix	Brownsville	13,022,606								1.11.E+11	1.11.E+11	1.11.E+11	1.11.E+11	2.23.E+11	2.27.E+11

ATTACHMENT B : LEVEL 1 COMMENTS-INITIALLY PREPARED REGIONAL WATER PLAN VS. ONLINE PLANNING DATABASE REVIEW

REGION M

		IPP document reference [A]:		Non-matching numbers: IPP document number							Non-matching numbers: Online Planning Database (DB12) number						
Region IPP	Item	Page number [A]	Table number	non-decadal number	2010	2020	2030	2040	2050	2060	non-decadal number	2010	2020	2030	2040	2050	2060
M	Seawater desal WMS annual Cost Brownsville	Appendix	Brownsville	9,277,896								0.00.E+00	0.00.E+00	0.00.E+00	5.22.E+10	5.22.E+10	6.57.E+10
M	Water right purchase WMS volume Brownsville	Appendix	Brownsville		-	-	-	-	-	1,793		-	-	-	-	-	1,923
M	Advanced conservation WMS volume Brownsville	Appendix	Brownsville		301	581	870	1,160	1,451	1,728		253	521	798	1,074	1,350	2,162
M	Brackish GW WMS volume Brownsville	Appendix	Brownsville		8,401	8,401	8,401	8,401	16,802	16,802		8,414	8,417	8,420	8,424	16,828	17,129
M	Brownsville Weir WMS volume Brownsville	Appendix	Brownsville							20,643							23,643
M	Water Right Purchase WMS annual cost Harlingen	Appendix	Harlingen	39,102								-	-	-	-	58,653	97,754
M	Advanced Conservation WMS annual cost Harlingen	Appendix	Harlingen	26,915								3,829	7,940	12,107	13,514	31,871	44,654
M	Brackish GW WMS annual cost Harlingen	Appendix	Harlingen	1,489,671								-	19,377	19,377	19,377	454,187	1,490,446
M	Non-potable reuse WMS annual cost Harlingen	Appendix	Harlingen	23,324								-	-	-	-	69,973	93,297
M	Water Right Purchase WMS volume Harlingen	Appendix	Harlingen		-	-	-	-	50	50		-	-	-	-	75	125
M	Advanced Conservation WMS volume Harlingen	Appendix	Harlingen		86	163	242	322	402	478		68	141	215	290	691	968
M	Brackish GW WMS volume Harlingen	Appendix	Harlingen						388	1,922						586	1,923
M	Non-potable reuse WMS volume Harlingen	Appendix	Harlingen		-	-	-	-	50	50		-	-	-	-	25	25
M	Non-potable reuse WMS volume Laguna Madre	Appendix	Laguna Madre						50	50						25	25
M	Advanced Conservation WMS annual cost Laguna Vista	Appendix	Laguna Vista	1,847								225	450	676	901	1,126	1,351
M	Advanced Conservation WMS volume Laguna Vista	Appendix	Laguna Vista		7	12	17	23	28	33		4	8	12	16	20	24
M	Water Rights Contract WMS volume Military Hwy WSC	Appendix	Military Hwy WSC		-	-	15	34	56	78		-	-	10	20	40	60
M	Water Rights Purchase WMS volume Military Hwy WSC	Appendix	Military Hwy WSC		-	-	289	653	1,061	1,489		-	-	150	300	500	700
M	Advanced Conservation WMS volume Military Hwy WSC	Appendix	Military Hwy WSC		18	38	58	78	98	117		10	20	30	40	51	61
M	GW WMS volume Military Hwy WSC	Appendix	Military Hwy WSC		-	250	500	750	1,000	1,250		-	125	250	375	500	625
M	Advanced Conservation WMS annual cost Military Hwy WSC	Appendix	Military Hwy WSC	6,569								1,482	3,137	4,828	6,571	8,541	10,455
M	GW WMS annual cost Military Hwy WSC	Appendix	Military Hwy WSC	540,886								-	162,266	324,532	486,798	649,064	811,329
M	Water Right Purchase WMS annual cost Olmito WSC	Appendix	Olmito WSC	1,347,679								705,394	164,450	358,751	548,710	746,810	935,141
M	Water Right Contract WMS annual cost Primera	Appendix	Primera	30,953								-	8,539	21,347	32,021	43,762	45,363
M	Advanced Conservation WMS annual cost Primera	Appendix	Primera	6,476								3,210	4,955	6,025	7,714	8,278	8,447
M	Brackish GW WMS annual cost Primera	Appendix	Primera	77,506								39,528	54,254	73,631	86,032	96,108	87,582
M	GW WMS annual cost Primera	Appendix	Primera	55,387								30,290	38,944	51,925	68,368	68,368	72,695
M	Water Right Purchase WMS volume Primera	Appendix	Primera		31	63	95	129	219	339		31	68	95	123	211	339
M	Water Right Contract WMS volume Primera	Appendix	Primera		-	16	27	45	58	58		-	16	40	60	82	85
M	Advanced Conservation WMS volume Primera	Appendix	Primera		54	75	93	115	115	115		57	88	107	137	147	150
M	Brackish GW WMS volume Primera	Appendix	Primera		51	60	74	88	98	100		51	70	95	111	124	113
M	GW WMS volume Primera	Appendix	Primera		50	75	100	128	128	128		70	90	120	158	158	168
M	Water Right Purchase WMS annual cost Rio Hondo	Appendix	Rio Hondo	NA	NA	NA	NA	NA	NA	NA		156,407	156,407	156,407	156,407	156,407	156,407
M	Water Right Purchase WMS volume Valley MUD #2	Appendix	Valley MUD #2		-	113	160	209	263	316		-	268	269	269	269	269
M	Water Right Purchase WMS volume Alamo	Appendix	Alamo		-	90	180	271	361	451		-	100	200	277	381	471
M	Advanced Conservation WMS volume Alamo	Appendix	Alamo		9							25					
M	Brackish GW WMS volume Alamo	Appendix	Alamo		-	73	263	436	832	1,255		-	83	288	469	882	1,304
M	Non-potable reuse WMS volume Alamo	Appendix	Alamo		25	100	200					34	150	225			
M	Water Right Contract WMS annual cost Alamo	Appendix	Alamo	NA	NA	NA	NA	NA	NA	NA		-	2,668	5,337	7,472	10,140	12,808
M	Water Right Purchase WMS annual cost Alamo	Appendix	Alamo	352,697								-	78,203	156,407	216,623	297,955	368,338
M	Brackish GW WMS annual cost Alamo	Appendix	Alamo	972,704								-	64,330	222,443	363,504	683,605	1,010,682
M	Advanced Conservation WMS annual cost Alton	Appendix	Alton	11,251								3,313	4,633	137,734	192,524	252,381	315,449
M	Advanced Conservation WMS volume Alton	Appendix	Alton				109	137	168	200				2,446	3,419	4,482	5,602
M	Advanced Conservation WMS volume Donna	Appendix	Donna		23	42	63	86	111	137		15	32	51	72	95	118
M	Advanced Conservation WMS annual cost Donna	Appendix	Donna	7,725								845	1,802	2,872	4,054	5,349	6,645
M	Water Right Purchase WMS annual cost Edcouch	Appendix	Edcouch	234,610								50,832	92,280	136,856	192,380	233,828	281,532
M	Advanced Conservation WMS annual cost Edcouch	Appendix	Edcouch	5,687								3,660	3,942	4,561	4,786	6,814	8,784
M	Water Right Purchase WMS volume Edcouch	Appendix	Edcouch		50	150	200	250	300	350		65	118	175	246	299	360
M	Advanced Conservation WMS volume Edcouch	Appendix	Edcouch		58	45	40	46	67	101		65	70	81	86	121	156
M	Advanced Conservation WMS volume Elsa	Appendix	Elsa		5	9	12	16	20	25		2	5	7	10	14	17
M	GW WMS volume Hidalgo	Appendix	Hidalgo		110	250	350	450	550	650		112	253	354	454	555	656
M	GW WMS annual cost Hidalgo	Appendix	Hidalgo	281,260								95,196	216,354	302,896	389,438	475,979	562,521
M	Advanced Conservation WMS volume La Joya	Appendix	La Joya					28	37	45					49	62	73
M	Brackish GW WMS volume La Joya	Appendix	La Joya					100	100	100					120	120	120

REGION M

		IPP document reference[A]:		*Non-matching numbers* — IPP document number							Online Planning Database (DB12) number						
Region IPP	Item	Page number[A]	Table number	non-decadal number	2010	2020	2030	2040	2050	2060	non-decadal number	2010	2020	2030	2040	2050	2060
M	Advanced Conservation WMS annual cost La Joya	Appendix	La Joya	2,549								12,618	420	776	1,174	2,703	3,435
M	Brackish GW WMS annual cost La Joya	Appendix	La Joya	77,506								434,035	38,753	38,753	77,506	93,008	93,008
M	Water Right Contract WMS volume McAllen	Appendix	McAllen		-	-	120	215	280	380		-	-	225	329	393	432
M	Water Right Purchase WMS volume McAllen	Appendix	McAllen		-	-	727		5,320	7,220		-	1	999		5,721	7,345
M	Advanced Conservation WMS volume McAllen	Appendix	McAllen				595	825	1,077	1,335				625	850	1,177	1,423
M	Brackish GW WMS volume McAllen	Appendix	McAllen				5,600	5,600	7,841	7,841				6,139	6,600	8,121	8,821
M	GW WMS volume McAllen	Appendix	McAllen				352	588	875	1,450				487	619	945	1,543
M	Non-potable reuse WMS volume McAllen	Appendix	McAllen						5,287							5,578	
M	Water Right Contract WMS annual cost McAllen	Appendix	McAllen	202,798								-	-	120,078	175,581	209,736	230,550
M	Water Right Purchase WMS annual cost McAllen	Appendix	McAllen	5,646,283								-	-	781,252	3,194,608	4,473,233	5,744,038
M	Advanced Conservation WMSannual cost McAllen	Appendix	McAllen	75,160								10,763	21,494	35,194	47,864	66,277	80,129
M	Brackish GW WMS annual cost McAllen	Appendix	McAllen	6,077,267								2,604,211	2,604,211	4,758,111	5,115,415	6,294,285	6,836,829
M	GW WMS annual cost McAllen	Appendix	McAllen	627,427								-	-	210,729	267,847	408,910	667,669
M	Advanced Conservation WMSannual cost Mercedes	Appendix	Mercedes	4,237								394	788	1,295	2,083	2,421	2,984
M	Advanced Conservation WMS volume Mercedes	Appendix	Mercedes		16	26	37	49	62	75		7	14	23	32	43	53
M	Water Rights Urbanization WMS volume Mission	Appendix	Mission		198	2,200	4,240	6,200	8,900	11,660		299	2,633	4,901	7,236	10,014	12,118
M	Advanced Conservation WMS volume Mission	Appendix	Mission		170	319	503	666	862	1,063		260	437	598	789	987	1,675
M	Non-potable Reuse WMS volume Mission	Appendix	Mission		200	677	1,400	2,437	3,474	4,548		352	839	1,765	2,780	3,909	5,321
M	Water Rights Urbanization WMS annual cost Mission	Appendix	Mission	7,481,273								191,844	1,689,382	3,144,573	4,642,752	6,425,168	7,775,134
M	Advanced Conservation WMS annual cost Mission	Appendix	Mission	59,862								14,641	24,607	33,673	44,429	55,578	94,319
M	Non-potable Reuse WMS annual cost Mission	Appendix	Mission	2,121,572								164,203	391,381	823,346	1,296,828	1,823,489	2,482,166
M	Advanced conservation WMS annual cost N Alamo WSC	Appendix	N Alamo WSC	112,198								14,599	31,540	50,388	70,629	92,553	114,881
M	Brackish GW WMS annual cost N Alamo WSC	Appendix	N Alamo WSC	8,681,479								17,362,957	17,362,957	17,362,957	17,362,957	17,362,957	17,362,957
M	Advanced Conservation WMS volume Penitas	Appendix	Penitas						3	3						7	16
M	Advanced Conservation WMS annual cost Penitas	Appendix	Penitas	174								39	62	87	114	394	845
M	Water Rights Contract WMS annual cost Pharr	Appendix	Pharr	239,382								-	47,498	109,404	165,975	225,747	295,659
M	Water Rights Purchase WMS annual cost Pharr	Appendix	Pharr	6,784,925								-	545,860	1,937,880	3,691,981	5,541,491	6,956,190
M	Water Rights Urbanization WMS annual cost Pharr	Appendix	Pharr	834,104								-	256,647	491,480	595,422	684,607	1,285,162
M	Advanced Conservation WMS annual cost Pharr	Appendix	Pharr	49,586								8,038	20,666	26,916	33,167	44,935	53,100
M	GW WMS annual cost Pharr	Appendix	Pharr	43,270								43,271	64,906	75,724	86,542	97,359	108,177
M	Water Rights Contract WMS volume Pharr	Appendix	Pharr		-	70	104	208	331	449		-	89	205	311	423	554
M	Water Rights Purchase WMS volume Pharr	Appendix	Pharr		-	346	1,984	3,948	6,286	8,676		-	698	2,478	4,721	7,086	8,895
M	Water Rights Urbanization WMS volume Pharr	Appendix	Pharr		-	250	500	800	900	1,300		-	400	766	928	1,067	2,003
M	Advanced Conservation WMS volume Pharr	Appendix	Pharr		143	284	404	552	715	881		143	367	478	589	798	943
M	GW WMS volume Pharr	Appendix	Pharr		100	100	100	100	100	100		100	150	175	200	225	250
M	Water Rights Contract WMS volume Weslaco	Appendix	Weslaco							50							100
M	Water Rights Purchase WMS volume Weslaco	Appendix	Weslaco							50							100
M	Advanced Conservation WMS volume Weslaco	Appendix	Weslaco		44	82	124	169	323	683		44	82	124	217	643	798
M	Brackish GW WMS volume Weslaco	Appendix	Weslaco						100	100						250	350
M	GW WMS volume Weslaco	Appendix	Weslaco					-	200	800					100	429	899
M	Potable Reuse WMS volume Weslaco	Appendix	Weslaco						1,120	1,120						1,300	1,540
M	Water Rights Contract WMS annual cost Weslaco	Appendix	Weslaco	26,684								77,506	77,506	77,506	77,506	193,766	271,272
M	Water Rights Purchase WMS annual cost Weslaco	Appendix	Weslaco	39,102								-	-	-	-	-	78,203
M	Advanced Conservation WMS annual cost Weslaco	Appendix	Weslaco	38,459								2,467	4,590	6,962	12,219	36,207	44,935
M	Brackish GW WMS annual cost Weslaco	Appendix	Weslaco	77,506								77,506	77,506	77,506	77,506	193,766	271,272
M	GW WMS annual cost Weslaco	Appendix	Weslaco	346,166								-	-	-	43,271	185,632	389,005
M	Potable Reuse WMS annual cost Weslaco	Appendix	Weslaco	802,718								802,718	802,718	802,718	802,718	931,727	1,103,738
M	Advanced Conservation WMS volume Eagle Pass	Appendix	Eagle Pass		28	43	58	72	85	97		10	21	31	40	48	55
M	Advanced Conservation WMS annual cost Eagle Pass	Appendix	Eagle Pass	5,473								563	1,183	1,746	2,252	2,703	3,097
M	Water Right Contract WMS annual cost El Indo WSC	Appendix	El Indio	27								NA	NA	NA	NA	NA	NA
M	Water Right Contract WMS volume La Grulla WSC	Appendix	La Grulla		30	39	45	50	74	96		32	45	54	56	88	102
M	Water Right Purchase WMS volume La Grulla WSC	Appendix	La Grulla		241	250	255	260	279	299		243	252	259	270	279	304
M	Advanced Conservation WMS volume La Grulla WSC	Appendix	La Grulla						51							56	
M	GW WMS volume La Grulla WSC	Appendix	La Grulla							175							183
M	Water Right Contract WMSannual cost La Grulla WSC	Appendix	La Grulla	51,233								17,078	24,016	28,819	29,886	46,964	54,435
M	Water Right Purchase WMS annual cost La Grulla WSC	Appendix	La Grulla	233,828								190,034	197,073	202,547	211,149	218,187	237,738
M	GW WMS annual cost La Grulla WSC	Appendix	La Grulla	75,724								21,635	32,453	48,463	67,070	68,801	79,186
M	Water Right Purchase WMS annual cost Rio Grande City	Appendix	Rio Grande City	57,088								3,910	10,948	18,769	39,884	65,691	110,267

REGION M

Region IPP	Item	IPP document reference[A]: Page number[A]	Table number	Non-matching numbers — IPP document number: non-decadal number	2010	2020	2030	2040	2050	2060	Online Planning Database (DB12) number: non-decadal number	2010	2020	2030	2040	2050	2060
M	Advanced Conservation WMS annual cost Rio Grande City	Appendix	Rio Grande City	6,757								1,273	1,978	2,716	4,392	6,757	8,728
M	Brackish GW WMS annual cost Rio Grande City	Appendix	Rio Grande City	1,046,335								434,035	868,070	868,070	870,396	1,018,433	1,161,044
M	GW WMS annual cost Rio Grande City	Appendix	Rio Grande City	38,944								-	4,327	21,635	21,635	37,646	49,761
M	Non-potable reuse WMS annual cost Rio Grande City	Appendix	Rio Grande City	46,648								-	4,665	23,324	27,989	40,584	58,311
M	Water Right Purchase WMS volume Rio Grande City	Appendix	Rio Grande City					33	60	73					50	84	141
M	Advanced Conservation WMS volume Rio Grande City	Appendix	Rio Grande City					62	90	120					78	120	155
M	Brackish GW WMS volume Rio Grande City	Appendix	Rio Grande City					1120	1139	1350					1,123	1,314	1,498
M	GW WMS volume Rio Grande City	Appendix	Rio Grande City						50	90						87	115
M	Non-potable reuse WMS volume Rio Grande City	Appendix	Rio Grande City					50	70	100					60	87	125
M	Water Right Contract WMS annual cost Roma City	Appendix	Roma City	43,628								-	10,674	19,212	27,218	40,026	46,964
M	Water Right Purchase WMS annual cost Roma City	Appendix	Roma City	1,308,342								50,832	320,634	613,114	925,146	1,223,101	1,538,260
M	Advanced Conservation WMS annual cost Roma City	Appendix	Roma City	5,575								2,140	3,379	4,223	4,505	5,800	6,757
M	Water Right Contract WMS volume Roma City	Appendix	Roma City		0	11	28	46	64	82		-	20	36	51	75	88
M	Water Right Purchase WMS volume Roma City	Appendix	Roma City		12	305	618	952	1298	1673		65	410	784	1,183	1,564	1,967
M	Advanced Conservation WMS volume Roma City	Appendix	Roma City		29	47	56	66	86	99		39	61	75	80	104	120
M	Water Right Purchase WMS annual cost El Cenizo	Appendix	El Cenizo	1,154,516								-	1,574	10,033	19,346	30,100	41,467
M	Water Right Contract WMS annual cost Laredo	Appendix	Laredo	591,718								34,167	60,589	186,324	225,047	282,903	505,216
M	Brackish GW WMS annual cost Laredo	Appendix	Laredo	7,828,134								2,604,211	14,201,476	14,201,476	25,422,061	25,422,061	25,422,061
M	GW WMS annual cost Laredo	Appendix	Laredo	6,490,628								1,343,993	4,327,086	12,981,257	12,981,257	12,981,257	12,981,257
M	GW WMS volume Laredo	Appendix	Laredo		1,553	5,000	15,000	15,000	15,000	15,000		800	799	7,920	7,920	7,919	7,918
M	GW WMS annual cost Webb Co. Water Utility	Appendix	Webb Co. WU	4,327							NA	NA	NA	NA	NA	NA	NA
M	GW WMS volume Webb Co. Water Utility	Appendix	Webb Co. WU		0	0	0	10	10	10		NA	NA	NA	NA	NA	NA
M	Advanced Conservation WMS volume Lyford	Appendix	Lyford		3	4	5	6	7	8		1	2	3	3	4	4
M	Advanced Conservation WMS annual cost Lyford	Appendix	Lyford	459								56	113	169	169	225	225
M	Advanced Conservation WMS annual cost N Alamo WSC (Willacy)	Appendix	N Alamo WSC Willacy	2,683								14,599	31,540	50,388	70,629	92,553	114,881
M	Brackish GW WMS annual cost N Alamo WSC (Willacy)	Appendix	N Alamo WSC Willacy	8,681,479								17,362,957	17,362,957	17,362,957	17,362,957	17,362,957	17,362,957
M	Harlingen Water Works System Advanced Conservation WMS volume	Appendix	Harlingen		86	163	242	322	402	478		68	141	215	290	364	435
M	Harlingen Water Works System Brackish GW WMS volume	Appendix	Harlingen		0	25	25	25	388	1922		0	25	25	25	25	25
M	Section 7.2, irrigation water supply deficits	7-2	text			-410,000				-210,000		(407,522)	(333,246)	(239,408)	(245,896)	(252,386)	(258,375)
M	Potential water savings associated with on-farm improvements	7-2	text							274,000		36,528	73,085	109,614	146,144	182,698	219
M	Potential water savings associated with conveyance system improvements	7-2	text							243,000		91,160	182,313	191,435	200,551	209,667	218

NOTE A: Please verify/confirm page numbers in IPP.

Data reviews were based on both versions of IPP, however, the page numbers in the hard copy of IPP document do not always correspond to the pages in the electronic version of the IPP.

REGION M

POTENTIALLY OVER ALLOCATED SOURCES

Source Name	Source Region	Source County	Source Basin	Comments	Over allocated by WUG or WWP?	Interregional?
AMISTAD-FALCON LAKE/RESERVOIR SYSTEM	M	RESERVOIR	RIO GRANDE	Inadequate supplies available to cover all the transfers listed in the water management strategies.	WUG	No
DIRECT REUSE	M	HIDALGO	RIO GRANDE	Over allocated on the WUG side.	WUG	No
INDIRECT REUSE	M	CAMERON	NUECES RIO-GRANDE	After strategy implementation this source is over allocated.	WUG	No

WATER USER GROUPS WITH APPARENT UNMET NEEDS

WUG Name	WUG Region	WUG County	WUG Basin
COUNTY-OTHER	M	STARR	RIO GRANDE
COUNTY-OTHER	M	WEBB	RIO GRANDE
IRRIGATION	M	CAMERON	NUECES-RIO GRANDE
IRRIGATION	M	CAMERON	RIO GRANDE
IRRIGATION	M	HIDALGO	NUECES-RIO GRANDE
IRRIGATION	M	HIDALGO	RIO GRANDE
IRRIGATION	M	MAVERICK	RIO GRANDE
IRRIGATION	M	STARR	RIO GRANDE
IRRIGATION	M	WEBB	RIO GRANDE
IRRIGATION	M	WILLACY	NUECES-RIO GRANDE
IRRIGATION	M	ZAPATA	RIO GRANDE
LAREDO	M	WEBB	RIO GRANDE
STEAM ELECTRIC POWER	M	WEBB	RIO GRANDE